$7500 pd,
7-1-93
Recpt.#18086

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

AC 53-233851
PSD-FL-206

RECEIVED
JUL 08 1993
Division of Air
Resources Management

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: *Cogeneration Power Plant* [x] New[1] [ ] Existing[1]

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

COMPANY NAME: *Orange Cogeneration Limited Partnership* COUNTY: *Polk*

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) *Two GE LM6000 Combustion Turbines*

SOURCE LOCATION: Street *Clear Springs Road* City *Bartow*

UTM: East *418.75 km (Zone 17)* North *3083.0 km*

Latitude *27* ° *52* ' *15* "N Longitude *81* ° *49* ' *31* "W

APPLICANT NAME AND TITLE: *William R. Malenius, Director of Project Development*

APPLICANT ADDRESS: *3753 Howard Hughes Parkway, Suite 200, Las Vegas, NV 89109*

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of *Orange Cogeneration Limited Partnership*

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

*Attach letter of authorization

Signed:

William R. Malenius, Director of Project Development
Name and Title (Please Type)

Date: 6/24/93 Telephone No. *(714) 588-3767*

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 judgement, that

---

[1] See Florida Administration 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 Kennard F. Kosky

Kennard F. Kosky
Name (Please Type)

KBN Engineering and Applied Sciences, Inc.
Company Name (Please Type)

1034 N.W. 57th Street, Gainesville, FL 32605
Mailing Address (Please Type)

Florida Registration No. *14996* Date: 6/30/93 Telephone No. *(904) 331-9000*

SECTION II: GENERAL PROJECT INFORMATION

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

Construction and operation of a cogeneration facility. The power plant consists of two combustion turbines, associated heat recovery steam generators (HRSGs), one steam turbine generator, and an auxiliary fire-tube boiler. All combustion units will fire natural gas only. See Sections 1.0 and 2.0 in PSD Permit Application.

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

Start of Construction *12/01/93* Completion of Construction *12/31/95*

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

The cost of control is integral to the overall design of the project. Dry low-NO_x combustion technology will be used to reduce air pollutant emissions. See Section 4.0 in PSD Permit Application for estimated costs.

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

No previous DER permits.

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

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

1. Is this source in a non-attainment area for a particular pollutant?	*No*
a. If yes, has "offset" been applied?	
b. If yes, has "Lowest Achievable Emission Rate" been applied?	
c. If yes, list non-attainment pollutants.	
2. Does best available control technology (BACT) apply to this source? If yes, see Section VI.	*Yes*[a]
3. Does the State "Prevention of Significant Deterioration" (PSD) requirement apply to this source? If yes, see Sections VI and VII.	*Yes*[b]
4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source?	*Yes*[c]
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. *PSD permit application attached. Full responses can be found as follows:*

[a] *Section 4.0*
[b] *Section 3.0*
[c] *Section 4.0*

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

A. Raw Materials and Chemicals Used in your Process, if applicable: *Not applicable.*

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

B. Process Rate, if applicable: (See Section V, Item 1) *Not applicable.*

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 Tables 2-2 through 2-6 in PSD Application*

Name of Contaminant	Emission[1]		Allowed[2] Emission Rate per Rule 17-2 lbs/hr	Allowable[3] Emission lbs/hr	Potential[4] Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/hr	T/yr	
SO_2	*2.26 (WI)/2.15(DLN)*	*9.5 (WI)/9.0(DLN)*	*606 (WI)/575 (DLN)*	*606(WI)/575 (DLN)*	*2.26*	*9.5*	*See*
PM	*10 (WI/DLN)*	*43.8 (WI/DLM)*	*NA*	*NA*	*10*	*43.8*	*Figure 2-1*
NO_x	*75.7 (WI)/72.6(DLN)*	*318 (WI)/305(DLN)*	*326.4(WI)/322.8(DLN)*	*326.4(WI)/322.8(DLN)*	*75.7*	*318*	*in PSD*
CO	*57.0 (WI)/57.2(DLN)*	*235 (WI)/236(DLN)*	*NA*	*NA*	*57.2*	*236*	*Application*
VOC	*8.14 (WI)/8.17(DLN)*	*33.6 (WI)/33.8(DLN)*	*NA*	*NA*	*8.17*	*33.8*	

[1] See Section V, Item 2. *Maximum (lbs/hr) at 20° to 40°F; Actual (T/yr) at 59°F. Emissions based on the maximum rates from either using wet injection (WI) or dry low NO_x combustors (DLN) to control NO_x emissions to 25 ppmvd at 15% O_2. After 12/31/97, NO_x emissions will be limited to 15 ppmvd at 15% O_2 using DLN combustors.*

[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 *75 ppmvd NO_x corrected to 15% O_2 and heat rate at ISO conditions. FDER Rule 17-2.660; 40 CFR Part 60 Subpart GG.*

[3] Calculated from operating rate and applicable standard.

[4] Emission, if source operated with~~out~~ control (See Section V, Item 3).

D. Control Devices: (See Section V, Item 4) *See Section 4.0 in PSD application*

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
Natural Gas--CT	*0.7607 MMCF/hr (Wet injection, 59°F)*	*0.7925 MMCF/hr (Wet injection, 40°F)*	*749.7 (Wet injection, 40°F)*
	0.7212 MMCF/hr (Dry low NO$_x$, 59°F)	*0.7530 MMCF/hr (Dry low NO$_x$, 40°F)*	*712.3 (Dry low NO$_x$, 40°F)*

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

Fuel Analysis:

Percent Sulfur: *Natural gas--1 grain/100 CF;* Percent Ash: *<0.01% WGT*

Density: *Not applicable* lbs/gal Typical Percent Nitrogen: *0.03% WGT*

Heat Capacity: *Natural gas - 19,000 Btu/lb (LHV); 946 Btu/cf (LHV)* BTU/lb *Not applicable* BTU/gal

Other Fuel Contaminants (which may cause air pollution): *See Appendix A in PSD permit application*

F. If applicable, indicate the percent of fuel used for space heating. *Not applicable*

Annual Average ______ Maximum ______

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

Plant will be designed for zero wastewater discharge. Solid wastes will be disposed of in an approved manner.

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

Stack Height: *100* ft. Stack Diameter: *8.5* ft.

Gas Flow Rate: *294,841* ACFM *230,632* DSCFM Gas Exit Temperature: *215* °F.

Water Vapor Content: *6.1* % Velocity: *86.6* FPS

See Tables in Appendix A of PSD application. Data for natural gas at 40°F shown above (general maximum emission case) for combined cycle operation with dry low NO_x *combustors. See Table A-9. For data applicable for wet injection, see Table A-5.*

SECTION IV: INCINERATOR INFORMATION *Not Applicable*

Type of Waste	Type 0 (Plastics)	Type II (Rubbish)	Type III (Refuse)	Type IV (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		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: __________ ft. Stack Diameter: __________ 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 devices: [ ] 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)]
   Not Applicable
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.
   See Tables A-1 through A-12 in PSD application.
3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).
   See Tables A-1 through A-12 in PSD application.
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.)
   See Sections 2.0 and 4.0 in PSD application.
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).
   Manufacturers' expected performances form the basis of emission estimates (see Tables A-1 through A-12 in PSD application).
6. An 8 ½" 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.
   See Figure 2-1 in PSD application.
7. An 8 ½" 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 (Examples: Copy of relevant portion of USGS topographic map).
   See Figure 1-1 in PSD application.
8. An 8 ½" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.
   See Figure 2-1 in PSD application.

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

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. *Not Applicable*

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
NO_x - natural gas firing	*112.4 ppmvd (WI) / 115.9 ppmvd (DLN)*
	corrected to 15% O_2 and heat rate
SO_2	*0.8 percent sulfur content in fuel*

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

[*X*] Yes [ ] No

Contaminant	Rate or Concentration
See Section 4.0 in PSD application	

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

Contaminant	Rate or Concentration
See Sections 2.0 and 4.0 in PSD	
application	

D. Describe the existing control and treatment technology (if any). *Not applicable.*

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 in PSD application***

1.

a. Control Devices:

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 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:

F. Describe the control technology selected: *See Section 4.0 in PSD application*

1. Control Device:	2. Efficiency:[1]
3. Capital Cost:	4. Useful Life:
5. Operating Cost:	6. Energy:[2]
7. Maintenance Cost:	8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

---

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

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

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

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

See Sections 2.0 through 7.0 in PSD application

A. Company Monitored Data *See Section 5.0 in PSD application*

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

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 *See Section 6.1 in PSD application.*

1. ______ Year(s) of data from ______/____/______ to ______/____/______
month day year month day year

2. Surface data obtained from (location)______________________________

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

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

C. Computer Models Used *See Section 6.1 in PSD application.*

1. ______________________________ Modified? If yes, attach description.

2. ______________________________ 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 Section 6.1 in PSD application.*

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

E. Emission Data Used in Modeling *See Section 6.0 in PSD application.*

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. *See PSD application.*

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. *See Section 4.0 in PSD application.*

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. *See Section 4.0 in PSD application.*

$4500pd.
7-1-93
Recpt.# 180468

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

AC53-233852
PSD-FL-206

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: *Cogeneration Power Plant* [*X*] New[1] [ ] Existing[1]

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

COMPANY NAME: *Orange Cogeneration Limited Partnership* COUNTY: *Polk*

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) *Auxiliary Boiler*

SOURCE LOCATION: Street *Clear Springs Road* City *Bartow*

UTM: East *418.75 km (Zone 17)* North *3083.0 km*

Latitude *27* ° *52* ' *15* "N Longitude *81* ° *49* ' *31* "

APPLICANT NAME AND TITLE: *William R. Malenius, Director of Project Development*

APPLICANT ADDRESS: *3753 Howard Hughes Parkway, Suite 200, Las Vegas, NV 89109*

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of *Orange Cogeneration Limited Partnershi*

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

*Attach letter of authorization

Signed: Wm Malenius

Director of
William R. Malenius, Project Development
Name and Title (Please Type)

Date: 6/24/93 Telephone No. *(714) 588-3767*

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 judgement, that

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[1] See Florida Administration 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

Kennard F. Kosky
Name (Please Type)

KBN Engineering and Applied Sciences, Inc.
Company Name (Please Type)

1034 N.W. 57th Street, Gainesville, FL 32605
Mailing Address (Please Type)

Florida Registration No. *14996* Date: 6/3/93 Telephone No. *(904) 331-9000*

SECTION II: GENERAL PROJECT INFORMATION

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

Construction and operation of a cogeneration facility. The power plant consists of two combustion turbines, one steam turbine generator, associated heat recovery steam generators (HRSGs), and an auxiliary fire-tube boiler. All combustion units will fire natural gas only. See Sections 1.0 and 2.0 in PSD Permit Application.

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

Start of Construction *12/01/93* Completion of Construction *12/31/95*

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

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

No previous DER permits.

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

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

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

PSD permit application attached. Full responses can be found as follows:

[a] ***Section 4.0.***
[b] ***Section 3.0.***
[c] ***Section 4.0.***

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

A. Raw Materials and Chemicals Used in your Process, if applicable: *Not applicable*

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

B. Process Rate, if applicable: (See Section V, Item 1) *Not Applicable*

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 Table 2-5 in PSD application

Name of Contaminant	Emission[1]		Allowed[2] Emission Rate per Rule 17-2	Allowable[3] Emission lbs/hr	Potential[4] Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/hr	T/yr	
SO_2	*0.30*	*1.3*	*NA*	*NA*	*0.30*	*1.3*	*see*
PM	*1.0*	*4.4*	*NA*	*NA*	*1.0*	*4.4*	*Figure*
NO_x	*13.0*	*56.9*	*NA*	*NA*	*13.0*	*56.9*	*2-2 in*
CO	*10.0*	*43.8*	*NA*	*NA*	*10.0*	*43.8*	*PSD*
VOC	*4.3*	*18.8*	*NA*	*NA*	*4.3*	*18.8*	*App.*

[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 with~~out~~ control (See Section V, Item 3).

D. Control Devices: (See Section V, Item 4) *See Section 4.0 in PSD application*

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	
Natural gas	*0.105708 MMCF/hr*	*0.105708 MMCF/hr*	*100*

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

Fuel Analysis:

Percent Sulfur: *1 grain/100 CF* Percent Ash: *<0.01% WGT*

Density: *Not applicable* lbs/gal Typical Percent Nitrogen: *<0.03% WGT*

Heat Capacity: *19,000 Btu/lb (LHV)*
946 Btu/cf (LHV) BTU/lb *Not applicable* BTU/gal

Other Fuel Contaminants (which may cause air pollution): *See Appendix A in PSD permit application*

F. If applicable, indicate the percent of fuel used for space heating. *Not Applicable*

Annual Average ______ Maximum ______

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

Plant will be designed for zero wastewater discharge. Solid wastes will be disposed of in an approved manner.

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

Stack Height: *65* ft. Stack Diameter: *3.67* ft.

Gas Flow Rate: *29,731* ACFM *18,338* DSCFM Gas Exit Temperature: *305* °F.

Water Vapor Content: *approximately 10* % Velocity: *46.9* FPS

(See Table A-13 in PSD Application)

SECTION IV: INCINERATOR INFORMATION

Not Applicable

Type of Waste	Type O (Plastics)	Type II (Rubbish)	Type III (Refuse)	Type IV (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		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height: ____ ft. Stack Diameter: ____ 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 devices: [ ] 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)]
   Not applicable
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.
   See Section 2.0 in PSD application.
3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).
   See Section 2.0 in PSD application.
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.)
   See Section 4.0 in PSD application.
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).
   See Section 4.0 in PSD application.
6. An 8 ½" 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.
   See Figure 2-2 in PSD application.
7. An 8 ½" 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 (Examples: Copy of relevant portion of USGS topographic map).
   See Figure 1-1 in PSD application.
8. An 8 ½" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.
   See Figure 2-1 in PSD application.

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

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

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

☐ Yes ☒ No

Contaminant	Rate or Concentration

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

☒ Yes[a] ☐ No [a]*In general*

Contaminant	Rate or Concentration

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

Contaminant	Rate or Concentration
See Section 4.0 in PSD application	

D. Describe the existing control and treatment technology (if any). ***Not applicable.***

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 in PSD application.***

1.

a. Control Devices:

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 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:

F. Describe the control technology selected: ***See Section 4.0 in PSD application.***

1. Control Device:	2. Efficiency:[1]
3. Capital Cost:	4. Useful Life:
5. Operating Cost:	6. Energy:[2]
7. Maintenance Cost:	8. Manufacturer:

9. Other locations where employed on similar processes:

a. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

---

[1] Explain method of determining efficiency.

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

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

b. (1) Company:

(2) Mailing Address:

(3) City: (4) State:

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions:[1]

Contaminant	Rate or Concentration

(8) Process Rate:[1]

10. Reason for selection and description of systems:

---

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

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

See Sections 2.0 through 7.0 in PSD application

A. Company Monitored Data ***See Section 5.0 in PSD application***

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

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 *See Section 6.0 in PSD application*

1. ______ Year(s) of data from ________/____/______ to ________/____/______
month day year month day year

2. Surface data obtained from (location)________________________________

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

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

C. Computer Models Used *See Section 6.0 in PSD application*

1. ____________________________________ Modified? If yes, attach description.

2. ____________________________________ 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 Section 6.0 in PSD application*

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

E. Emission Data Used in Modeling *See Section 6.0 in PSD application*

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. *See PSD application*

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. *See Section 4.0 in PSD application*

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. *See Section 4.0 in PSD application*

DOCUMENTATION IN SUPPORT OF THE AIR CONSTRUCTION PERMIT APPLICATION

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1.0 INTRODUCTION

Orange Cogeneration Limited Partnership is proposing to construct and operate a nominal 99-megawatt (MW) cogeneration facility located in Polk County near Bartow, Florida (see Figure 1-1). The facility is referred to as the Orange Cogeneration Facility, which will be a combined cycle cogeneration power plant. The plant will provide low-pressure steam to the thermal host, Orange-Co of Florida, Inc. KBN Engineering and Applied Sciences, Inc. (KBN), has been contracted by Orange Cogeneration Limited Partnership to provide air permitting services and perform air quality impact assessments for the project.

The plant will consist of: 1) two advanced aircraft-derivative technology combustion turbine (CT) electric generating units, each with a heat recovery steam generator (HRSG); 2) one steam turbine generator (see Table 1-1); and 3) one auxiliary boiler. The plant will have a nominal electrical output of about 99 MW to the transmission system at average ambient conditions. The primary fuel for the CTs and auxiliary boiler is natural gas.

Nitrogen oxide (NO_x) emissions from the CT units will be controlled using dry low NO_x combustion technology. The CT units using this technology may become available when the plant becomes operational. However, for purposes of this analysis, it is assumed that NO_x emissions will be controlled using water injection for the first 15 months of plant operation.

Initially, the plant will operate with one CT in simple cycle mode, using water injection to control NO_x emissions. When the plant converts to combined cycle operation (i.e. addition of another CT, two HRSGs, steam turbine generator, and auxiliary boiler), NO_x emissions will be controlled, first using water injection and then using advanced dry low-NO_x combustors to limit NO_x emissions. Exhaust gas from the CTs will be routed to the HRSGs. The steam from the HRSGs will power a steam turbine to generate electrical power of no greater than 25 MW. When the plant is operating at partial load, an auxiliary boiler may provide supplemental steam to the

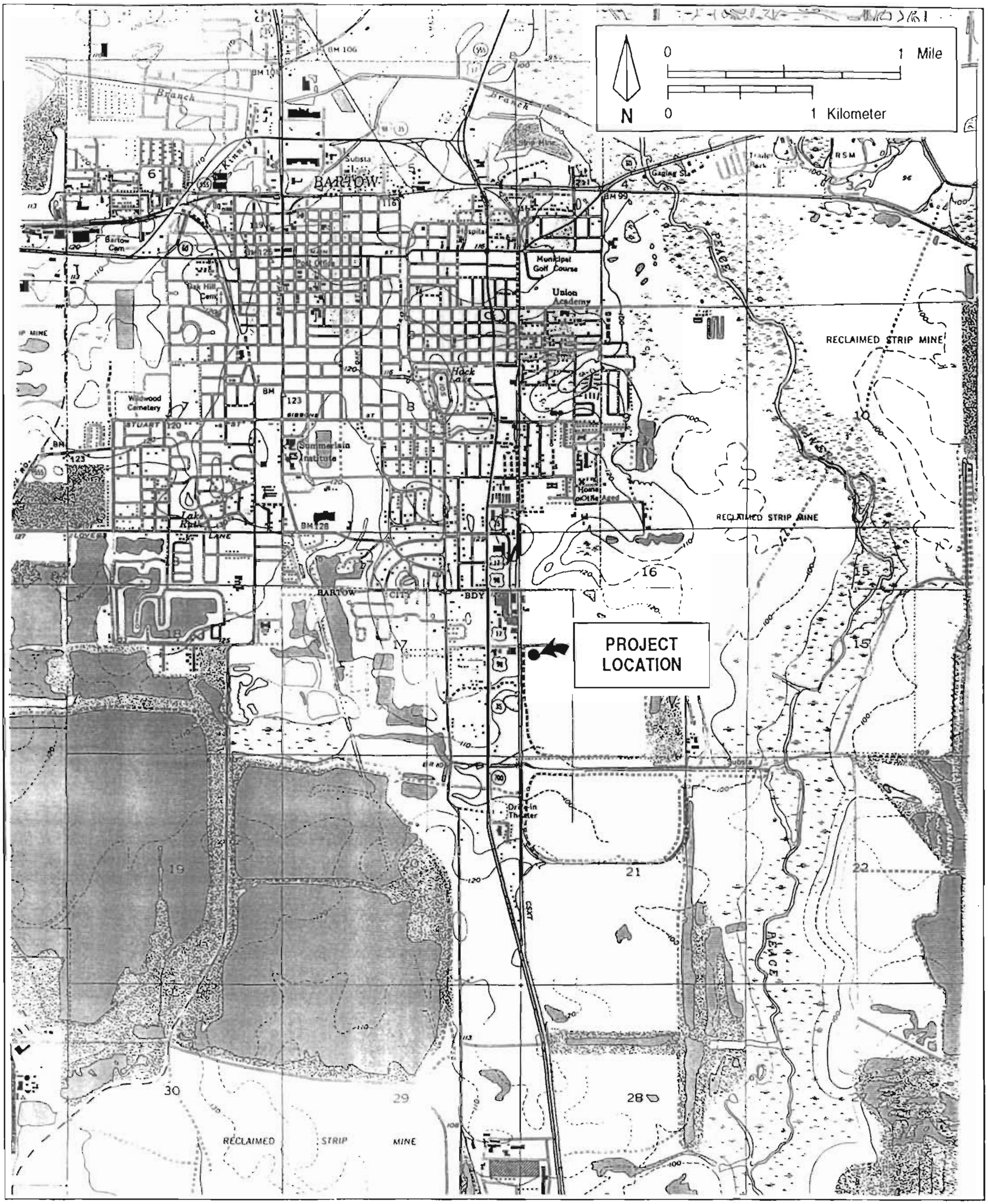


Figure 1-1 LOCATION OF PROPOSED COGENERATION FACILITY

SOURCE: USGS, 1986, 1987

Table 1-1. Characteristics of the Orange Cogeneration Facility

Characteristic	Data
Nominal Capacity	
Combustion Turbines[a]	78 MW
Steam Cycle	25 MW
Total	103 MW
Auxiliary Loads	4
Net Output	99 MW
Equipment Characteristics	
Type of CT	GE LM6000
Heat Input per Unit[a]	
- Water Injection	360 MMBtu/hr
- Dry Low NO_x	341 MMBtu/hr
Number of CTs	2
Number of HRSGs[b]	2
Number of Steam Turbines	1
Fuel	
Permanent Operation	Natural gas
Auxiliary Boiler	
Type	Fire-tube
Heat Input	100 MMBtu/hr
Fuel	Natural gas

Note: CT = combustion turbine.
GE = General Electric.
HRSG = heat recovery steam generator.
MMBtu/hr = million British thermal units per hour.

[a] Represents ISO conditions.
[b] HRSGs do not have supplemental firing.

thermal host. The auxiliary boiler is expected to have a maximum heat input of about 100 million British thermal units per hour (MMBtu/hr). Low-pressure steam will be exported to Orange-Co of Florida, Inc., located immediately to the northwest of Clear Springs Road and the CSX railroad, for process uses.

Operation of the cogeneration facility will result in the emission of air pollutants. Therefore, an air construction permit is required prior to beginning facility construction.

Because the proposed plant will be located in an attainment area for all criteria pollutants, the plant's emissions are subject to new source review (NSR) requirements as established by the Florida Department of Environmental Regulation (FDER) and the U.S. Environmental Protection Agency (EPA) under the Prevention of Significant Deterioration (PSD) regulations. The PSD review includes control technology review, source impact analysis, air quality analysis (monitoring), and additional impact analyses. This report supports the air construction permit application and constitutes a PSD permit application for approval with respect to the FDER and EPA PSD regulations.

The proposed plant will be a major new source because emissions of at least one regulated pollutant exceeds 250 tons per year (TPY). PSD review is required for these emissions and for any pollutant for which the net increase in emissions exceeds the PSD significant emission rates. The potential emissions from the proposed project will exceed the PSD significant emission rates for nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter (PM), particulate matter with an aerodynamic diameter of 10 micrometers (PM10), and volatile organic compounds (VOCs). Therefore, the project is subject to PSD review for these pollutants.

This report is presented in seven sections.

- Section 2.0 -- A general description of the proposed operation.

- Section 3.0 -- The air quality review requirements and applicability of the project to the PSD and nonattainment regulations.
- Section 4.0 -- The control technology review for the project applicable under the EPA's current (draft) top-down approach.
- Section 5.0 -- A discussion of the need for air quality monitoring data to satisfy the PSD preconstruction monitoring requirements.
- Section 6.0 -- The air source impact analysis approach.
- Section 7.0 -- The results of the air quality analyses and additional impact analyses associated with the project's impacts on vegetation, soils, and associated growth

2.0 PROJECT DESCRIPTION

The Orange Cogeneration Facility will consist of two CT electrical generating units equipped with HRSGs. The CTs will be advanced aircraft-derivative technology combustion turbines that will use advanced dry low-NO_x combustors to control NO_x emissions. During combined cycle operation, the CT combustion gases will exhaust through each HRSG and into its associated stack. There will be a bypass stack for simple cycle operation of one CT up to the first 11 months of operation.

NO_x emissions for CT units will be controlled using dry low-NO_x combustion technology. The CT units using this technology may become available when the plant becomes operational. However, for purposes of this analysis, it is assumed that NO_x emissions will be controlled using water injection for the first 15 months of plant operation.

Initially, the facility will consist of one CT operating in simple cycle mode, from September 30, 1994, to August 16, 1995. NO_x emissions will be limited to 25 parts per million, corrected to dry conditions by volume (ppmvd) and 15 percent oxygen (O_2), by using water injection. As early as June 16, 1995 but no later than August 16, 1995, an additional CT will be added, together with the associated HRSGs and steam turbine, to convert the facility to combined cycle operation. NO_x emissions will be limited to 25 ppmvd, corrected to 15 percent O_2, by using water injection or dry low NO_x combustion technology. Water injection technology will be used from June 16, 1995 to as late as December 31, 1995. Dry low NO_x combustion technology will be installed no later than December 31, 1995. By December 31, 1997, NO_x emissions will be limited to 15 ppmvd, corrected to 15 percent O_2, by using advanced dry low NO_x combustion technology. The proposed schedule of the facility's operation for simple and combined cycle modes is presented in Table 2-1.

At this time, the CT being considered for this project is the General Electric (GE) LM6000-PA. Operating and emission data are available for these turbines for an operating load of 100 percent and ambient

Table 2-1. Proposed Schedule of the Simple and Combined Cycle Operation for Orange Cogeneration Facility

Operating Mode	NO_x Control Technology	NO_x Emission Limit (ppmvd)[a]	Date of Operation	
			Start	End
Simple Cycle	Water injection	25	09/30/94	08/16/95[b]
Combined Cycle[c]	Water injection	25	06/16/95[d]	12/31/95
Combined Cycle	Dry low NO_x	25	12/31/95	12/31/97
Combined Cycle	Dry low NO_x	15	12/31/97	Future

[a] ppmvd corrected to 15 percent O_2.

[b] End date could be 06/16/95 if additional CT, HRSGs, and steam turbine are installed.

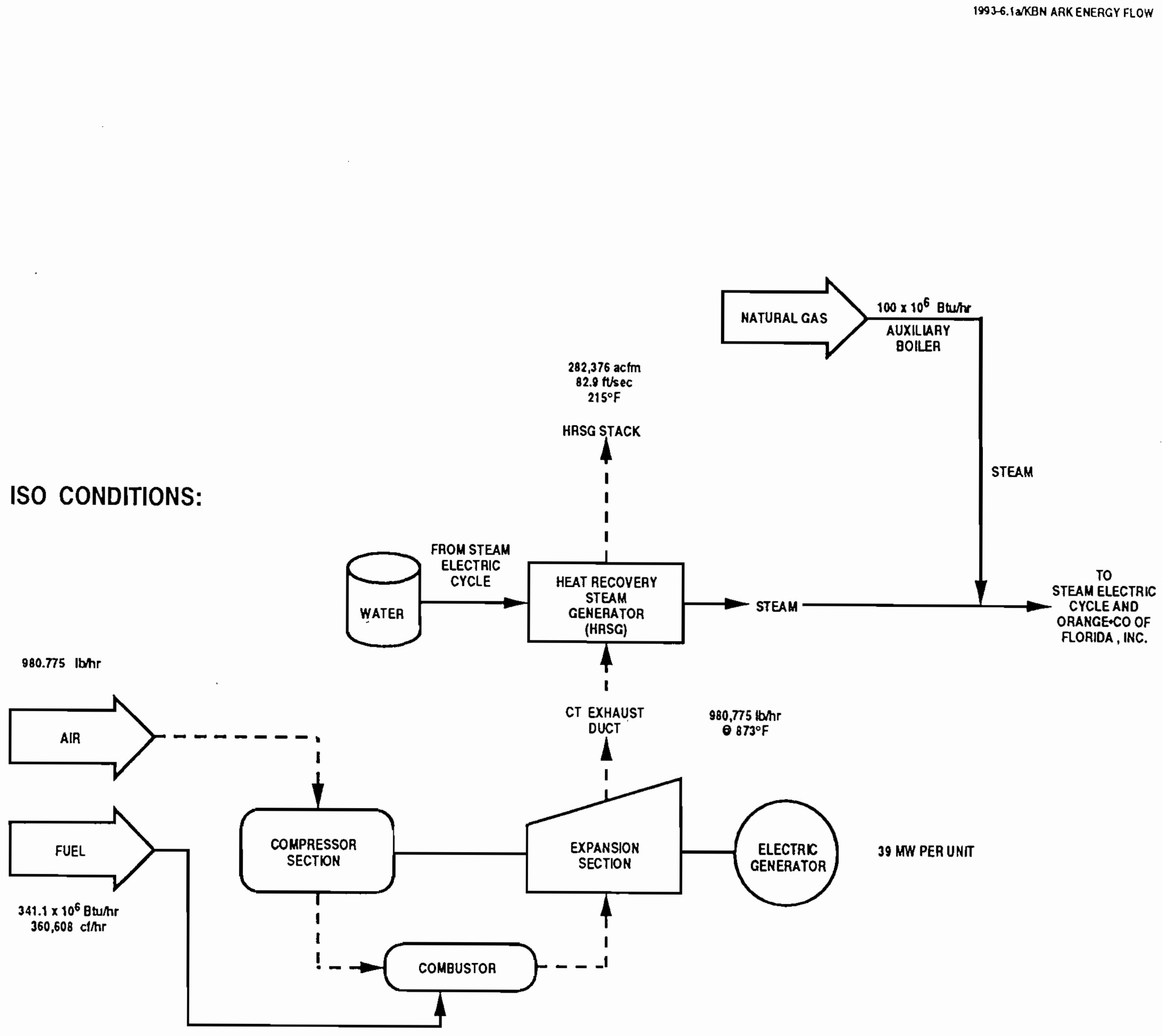
[c] Water injection technology is planned for initial combined cycle operation. Dry low NO_x technology could be available earlier than listed.

[d] Start date could be as late as 08/16/95.

temperatures ranging from 20 to 100°F. The CT/HRSG units and the auxiliary boiler will be fired with natural gas only and are assumed to operate for 8,760 hours in a year.

Each CT will have a nominal electrical output of about 39 MW and a maximum heat input of about 360 MMBtu/hr (water injection) and 341 MMBtu/hr (dry low NO_x) at 59 degrees Fahrenheit (°F) ambient conditions. The natural-gas-fired auxiliary boiler will have a maximum heat input of 100 MMBtu/hr. The steam from the HRSGs will power a steam turbine electrical generator with maximum output of about 25 MW. Low-pressure steam will be exported to Orange-Co of Florida, Inc. for process uses. Electrical power will be sold to the electric utility grid. A process flow diagram of the facility operating in combined cycle mode is presented in Figure 2-1.

Stack, operating, and emission data for each of the proposed combustion turbines are presented in Tables 2-2 through 2-4. Emission data for the auxiliary boiler are presented in Table 2-5. Detailed information on the combustion calculations for the fuel to be fired in the CT and auxiliary boiler is presented in Appendix A. A summary of total annual emissions from the CTs operation in simple and combined cycle modes and the auxiliary boiler is presented in Table 2-6. A plot plan of the facility is presented in Figure 2-2.



NOTE: 1. SEE TABLE A-9 FOR DESIGN INFORMATION AND STACK PARAMETERS.
2. FIGURE SHOWS FLOW DIAGRAM FOR ONE COMBUSTION TURBINE AND ONE HRSG.
3. PLANT WILL CONSIST OF TWO COMBUSTION TURBINES, EACH WITH A HRSG; ONE STEAM TURBINE GENERATOR; AND ONE AUXILIARY BOILER.

Figure 2-1 SIMPLIFIED FLOW DIAGRAM OF PROPOSED ORANGE COGENERATION POWER PLANT — DRY LOW NO_X COMBUSTOR, COMBINED CYCLE

Table 2-2. Stack, Operating, and Emission Data for the Proposed Combustion Turbine with Water Injection--Simple Cycle Operation

Parameter	Operating and Emission Data[a] for Ambient Temperatures (°F) at				
	20°F	40°F	59°F	80°F	100°F
<u>Stack Data (ft)</u>					
Height	60	60	60	60	60
Diameter	9.0	9.0	9.0	9.0	9.0
<u>Operating Data</u>					
Temperature (°F)	754	804	830	842	859
Velocity (ft/sec)	142.9	149.7	145.4	132.2	119.6
<u>Maximum Hourly Emission Data (lb/hr) Per Unit</u>[b]					
SO_2	1.07	1.13	1.09	0.95	0.82
PM	5.0	5.0	5.0	5.0	5.0
NO_x[c]	35.7	37.8	36.3	31.6	27.3
CO	28.5	28.4	26.8	24.1	21.3
VOC	4.07	4.05	3.83	3.44	3.04
Sulfuric Acid Mist	0.082	0.087	0.083	0.072	0.063
<u>Annual Potential Emission Data (TPY) Per Unit</u>[b]					
SO_2	NA	NA	4.76	NA	NA
PM	NA	NA	21.9	NA	NA
NO_x[c]	NA	NA	159.1	NA	NA
CO	NA	NA	117.5	NA	NA
VOC	NA	NA	16.8	NA	NA
Sulfuric Acid Mist	NA	NA	0.36	NA	NA

[a] Refer to Appendix A for detailed information. Annual emission data are based on the turbine firing natural gas for 8,760 hours. Tables A-1 through A-4 provide information on the simple cycle operation with wet injection.

[b] Other regulated pollutants are assumed to have negligible emissions. These pollutants include lead, reduced sulfur compounds, hydrogen sulfide, fluorides, beryllium, mercury, arsenic, asbestos, vinyl chloride, and radionuclides.

[c] Based on 25 ppm, corrected to 15 percent O_2 and dry conditions by volume.

Table 2-3. Stack, Operating, and Emission Data for the Proposed Combustion Turbine with Water Injection--Combined Cycle Operation

Parameter	Operating and Emission Data[a] for Ambient Temperatures (°F) at				
	20°F	40°F	59°F	80°F	100°F
Stack Data (ft)					
Height	100	100	100	100	100
Diameter	8.5	8.5	8.5	8.5	8.5
Operating Data					
Temperature (°F)	215	215	215	215	215
Velocity (ft/sec)	89.1	89.6	85.3	76.8	68.6
Maximum Hourly Emission Data (lb/hr)[b]/Per Unit					
SO_2	1.07	1.13	1.09	0.95	0.82
PM	5.0	5.0	5.0	5.0	5.0
NO_x[c]	35.7	37.8	36.3	31.6	27.3
CO	28.5	28.4	26.8	24.1	21.3
VOC	4.07	4.05	3.83	3.44	3.04
Sulfuric Acid Mist	0.082	0.087	0.083	0.072	0.063
Annual Potential Emission Data (TPY)[b]/Per Unit					
SO_2	NA	NA	4.76	NA	NA
PM	NA	NA	21.9	NA	NA
NO_x[c]	NA	NA	159.1	NA	NA
CO	NA	NA	117.5	NA	NA
VOC	NA	NA	16.8	NA	NA
Sulfuric Acid Mist	NA	NA	0.36	NA	NA

[a] Refer to Appendix A for detailed information. Annual emission data are based on the turbine firing natural gas for 8,760 hours. Tables A-5 through A-8 provide information on combined cycle operation with wet injection.

[b] Other regulated pollutants are assumed to have negligible emissions. These pollutants include lead, reduced sulfur compounds, hydrogen sulfide, fluorides, beryllium, mercury, arsenic, asbestos, vinyl chloride, and radionuclides.

[c] Based on 25 ppm, corrected to 15 percent O_2 and dry conditions by volume.

Table 2-4. Stack, Operating, and Emission Data for the Proposed Combustion Turbine with Dry Low NO_x Combustion Technology--Combined Cycle Operation

	Operating and Emission Data[a] for Ambient Temperatures (°F) at				
Parameter	20°F	40°F	59°F	80°F	100°F
Stack Data (ft)					
Height	100	100	100	100	100
Diameter	8.5	8.5	8.5	8.5	8.5
Operating Data					
Temperature (°F)	215	215	215	215	215
Velocity (ft/sec)	86.9	86.6	82.9	75.4	67.6
Maximum Hourly Emission Data (lb/hr) Per Unit[b]					
SO_2	1.03	1.08	1.03	0.91	0.79
PM	5.0	5.0	5.0	5.0	5.0
NO_x[c]	34.7	36.3	34.8	30.7	26.6
CO	28.6	28.4	27.0	24.3	21.5
VOC	4.09	4.05	3.86	3.47	3.06
Sulfuric Acid Mist	0.079	0.082	0.079	0.070	0.060
Annual Potential Emission Data (TPY) Per Unit[b]					
SO_2	NA	NA	4.51	NA	NA
PM	NA	NA	21.9	NA	NA
NO_x[c]	NA	NA	152.3	NA	NA
CO	NA	NA	118.2	NA	NA
VOC	NA	NA	16.9	NA	NA
Sulfuric Acid Mist	NA	NA	0.35	NA	NA

[a] Refer to Appendix A for detailed information. Annual emission data are based on the turbine firing natural gas for 8,760 hours. Tables A-9 through A-12 provide information on combined cycle operation with dry low NO_x.

[b] Other regulated pollutants are assumed to have negligible emissions. These pollutants include lead, reduced sulfur compounds, hydrogen sulfide, fluorides, beryllium, mercury, arsenic, asbestos, vinyl chloride, and radionuclides.

[c] Based on 25 ppm, corrected to 15 percent O_2 and dry conditions by volume.

Table 2-5. Stack, Operating, and Emission Data for the Proposed Natural-Gas-Fired Auxiliary Boiler

Parameter	Operating and Emission Data[a]
Stack Data (ft)	
Height	65
Diameter	3.67
Operating Data	
Temperature (°F)	305
Velocity (ft/sec)	46.9
Maximum Hourly Emissions (lb/hr)[b]:	
SO_2	0.30
PM	1.00
NO_x	13.0
CO	10.0
VOC	4.30
Sulfuric Acid Mist	0.0231
Maximum Annual Emissions (TPY)[b]:	
SO_2	1.32
PM	4.38
NO_x	56.9
CO	43.8
VOC	18.8
Sulfuric Acid Mist	0.101

Note: Neg. = negligible emissions for applicable pollutant.

[a] Based on the duct burner operating for 8,760 hours at 100 MMBtu per hour and the following emission factors:
PM = 0.01 lb/MMBtu; SO_2 = 1 grain/100 cf of natural gas;
NO_x = 0.13 lb/MMBtu; CO = 0.10 lb/MMBtu; VOC = 0.043 lb/MMBtu, and
H_2SO_4 = 5% of SO_2

Tables A-13 through A-16 present emissions.

[b] Other regulated pollutants are assumed to have negligible or no emissions.

Table 2-6. Summary of the Annual Emissions for the Proposed Combustion Turbines Operating in Simple and Combined Cycle Modes and Auxiliary Boiler

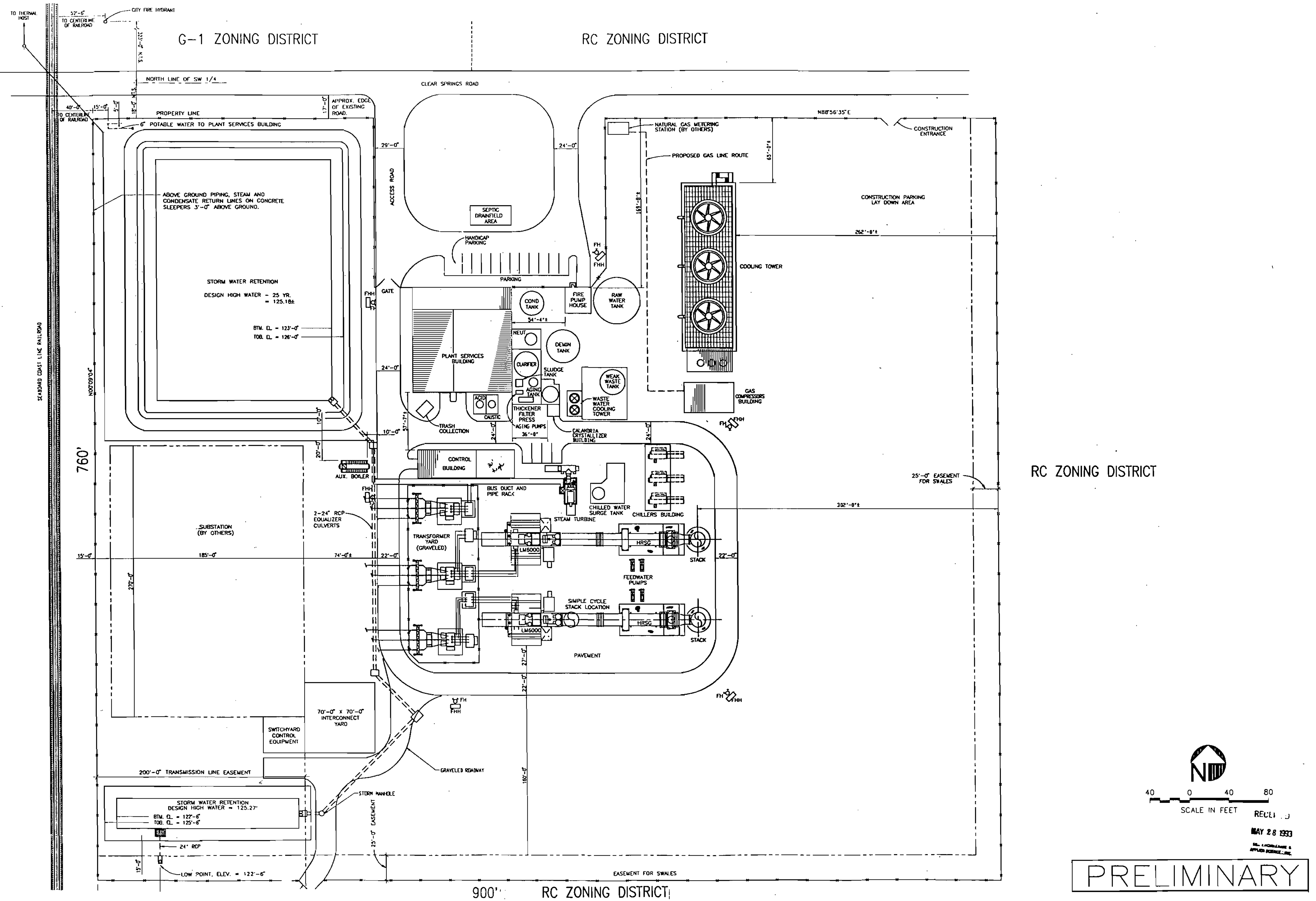
	Emissions (TPY)[a]							
	Simple Cycle		Combined Cycle-- Water Injection			Combined Cycle-- Dry Low NO_x		
Pollutant	CT	Total	CT	AB	Total	CT	AB	Total
SO_2	4.76	4.76	9.52	1.32	10.8	9.03	1.32	10.3
PM	21.90	21.90	43.8	4.38	48.2	43.8	4.38	48.2
NO_x[b]	159.1	159.1	318.2	56.9	375.1	304.6	56.9	361.5
CO	117.5	117.5	235.1	43.8	278.9	236.4	43.8	280.0
VOC	16.8	16.8	33.6	18.8	52.4	33.8	18.8	52.6
Sulfuric Acid Mist	0.36	0.36	0.73	0.101	0.83	0.69	0.101	0.79

Note: CT = combustion turbine.
AB = auxiliary boiler.

Simple cycle operation includes one CT. Combined cycle operation includes two CTs and one AB. The CTs and AB are assumed to operate for 8,760 hours per year.

[a] Based on ambient temperature of 59°F.

[b] Based on 25 ppm, corrected to 15 percent O_2 and dry conditions by volume (ppmvd). After December 31, 1997, NO_x emissions will be limited to 15 ppmvd, corrected to 15 percent O_2.



NOTE:

1. ALL DIMENSIONS ARE APPROXIMATE, FINAL SURVEY WILL BE USED TO FIX SUCH ITEMS AS BOUNDARIES, BUILDING SPACING AND ROAD WIDTHS
2. FIRE PROTECTION SYSTEM INCLUDES HYDRANTS LOCATED AS SHOWN
   FH = FIRE HYDRANT
   FHH = FIRE HOSE HOUSE
3. POWER PLANT IS NATURAL GAS FIRED.
4. PROJECT SITE IS LOCATED WITHIN POLK COUNTY RC ZONING.
5. N.T.S. = NOT TO SCALE

Date: 5/17/93
Drawn By: T. ALEXANDER
Checked By:
Approved By:

Figure 2-2 SITE LAYOUT

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3.0 AIR QUALITY REVIEW REQUIREMENTS AND APPLICABILITY

The following discussion pertains to the federal and state air regulatory requirements and their applicability to the proposed project. These regulations must be satisfied before the proposed facility (combined cycle turbines and auxiliary boilers) can begin operation.

3.1 NATIONAL AND STATE AAQS

The existing applicable national and Florida AAQS are presented in Table 3-1. Primary national AAQS were promulgated to protect the public health, and secondary national AAQS were promulgated to protect the public welfare from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air. Areas of the country in violation of AAQS are designated as nonattainment areas, and new sources to be located in or near these areas may be subject to more stringent air permitting requirements.

3.2 PSD REQUIREMENTS

3.2.1 GENERAL REQUIREMENTS

Under federal and State of Florida PSD review requirements, all major new or modified sources of air pollutants regulated under the Clean Air Act (CAA) must be reviewed and a preconstruction permit issued. Florida's State Implementation Plan (SIP), which contains PSD regulations, has been approved by EPA, and therefore PSD approval authority has been granted to the Florida Department of Environmental Regulation (FDER).

A "major facility" is defined as any one of 28 named source categories that has the potential to emit 100 TPY or more, or any other stationary facility that has the potential to emit 250 TPY or more of any pollutant regulated under CAA. "Potential to emit" means the capability, at maximum design capacity, to emit a pollutant after the application of control equipment.

Table 3-1. National and State AAQS, Allowable PSD Increments, and Significant Impact Levels ($\mu g/m^3$)

Pollutant	Averaging Time	AAQS[a]			PSD Increments[a]		Significant Impact Levels[b]
		National Primary Standard	National Secondary Standard	State of Florida	Class I	Class II	
Particulate Matter (TSP)	Annual Geometric Mean	NA	NA	NA	5	19	1
	24-Hour Maximum	NA	NA	NA	10	37	5
Particulate Matter (PM10)	Annual Arithmetic Mean	50	50	50	4[c]	17[c]	1
	24-Hour Maximum	150	150	150	8[c]	30[c]	5
Sulfur Dioxide	Annual Arithmetic Mean	80	NA	60	2	20	1
	24-Hour Maximum	365	NA	260	5	91	5
	3-Hour Maximum	NA	1,300	1,300	25	512	25
Carbon Monoxide	8-Hour Maximum	10,000	10,000	10,000	NA	NA	500
	1-Hour Maximum	40,000	40,000	40,000	NA	NA	2,000
Nitrogen Dioxide	Annual Arithmetic Mean	100	100	100	2.5	25	1
Ozone	1-Hour Maximum[d]	235	235	235	NA	NA	NA
Lead	Calendar Quarter Arithmetic Mean	1.5	1.5	15	NA	NA	NA

[a] Short-term maximum concentrations are not to be exceeded more than once per year.

[b] Maximum concentrations are not to be exceeded.

[c] Proposed October 5, 1989.

[d] Achieved when the expected number of days per year with concentrations above the standard is fewer than 1.

Note: Particulate matter (TSP) = total suspended particulate matter.
Particulate matter (PM10) = particulate matter with aerodynamic diameter less than or equal to 10 micrometers.

NA = Not applicable, i.e., no standard exists.

Sources: Federal Register, Vol. 43, No. 118, June 19, 1978.
40 CFR 50.
40 CFR 52.21.
Chapter 17-2.400, F.A.C.

A "major modification" is defined under PSD regulations as a change at an existing major facility that increases emissions by greater than significant amounts. PSD significant emission rates are shown in Table 3-2.

PSD review is used to determine whether significant air quality deterioration will result from the new or modified facility. Federal PSD requirements are contained in 40 CFR 52.21, Prevention of Significant Deterioration of Air Quality. The State of Florida has adopted PSD regulations that are essentially identical to federal regulations [Chapter 17-2.510, Florida Administrative Code (F.A.C.)]. Major facilities and major modifications are required to undergo the following analysis related to PSD for each pollutant emitted in significant amounts:

1. Control technology review,
2. Source impact analysis,
3. Air quality analysis (monitoring),
4. Source information, and
5. Additional impact analyses.

In addition to these analyses, a new facility also must be reviewed with respect to Good Engineering Practice (GEP) stack height regulations. Discussions concerning each of these requirements are presented in the following sections.

3.2.2 INCREMENTS/CLASSIFICATIONS

In promulgating the 1977 CAA Amendments, Congress specified that certain increases above an air quality baseline concentration level of SO_2 and total suspended particulate matter [PM(TSP)] concentrations would constitute significant deterioration. The magnitude of the allowable increment depends on the classification of the area in which a new source (or modification) will be located or have an impact. Three classifications were designated, based on criteria established in the CAA Amendments. Initially, Congress promulgated areas as Class I (international parks,

Table 3-2. PSD Significant Emission Rates and *De Minimis* Monitoring Concentrations

Pollutant	Regulated Under	Significant Emission Rate (TPY)	*De Minimis* Monitoring Concentration[a] ($\mu g/m^3$)
Sulfur Dioxide	NAAQS, NSPS	40	13, 24-hour
Particulate Matter (TSP)	NAAQS, NSPS	25	10, 24-hour
Particulate Matter (PM10)	NAAQS	15	10, 24-hour
Nitrogen Oxides	NAAQS, NSPS	40	14, annual
Carbon Monoxide	NAAQS, NSPS	100	575, 8-hour
Volatile Organic Compounds (Ozone)	NAAQS, NSPS	40	100 TPY[b]
Lead	NAAQS	0.6	0.1, 3-month
Sulfuric Acid Mist	NSPS	7	NM
Total Fluorides	NSPS	3	0.25, 24-hour
Total Reduced Sulfur	NSPS	10	10, 1-hour
Reduced Sulfur Compounds	NSPS	10	10, 1-hour
Hydrogen Sulfide	NSPS	10	0.2, 1-hour
Asbestos	NESHAP	0.007	NM
Beryllium	NESHAP	0.0004	0.001, 24-hour
Mercury	NESHAP	0.1	0.25, 24-hour
Vinyl Chloride	NESHAP	1	15, 24-hour
Benzene	NESHAP	[c]	NM
Radionuclides	NESHAP	[c]	NM
Inorganic Arsenic	NESHAP	[c]	NM

[a] Short-term concentrations are not be be exceeded.

[b] No *de minimis* concentration; an increase in VOC emissions of 100 TPY or more will require monitoring analysis for ozone.

[c] Any emission rate of these pollutants.

Note: Ambient monitoring requirements for any pollutant may be exempted if the impact of the increase in emissions is below *de minimis* monitoring concentrations.

NAAQS = National Ambient Air Quality Standards.
NM = No ambient measurement method established; therefore, no *de minimis* concentration has been established.
NSPS = New Source Performance Standards.
NESHAP = National Emission Standards for Hazardous Air Pollutants.
$\mu g/m^3$ = micrograms per cubic meter.

Sources: 40 CFR 52.21.
Chapter 17-2, F.A.C.

national wilderness areas, and memorial parks larger than 5,000 acres, and national parks larger than 6,000 acres) or as Class II (all areas not designated as Class I). No Class III areas, which would be allowed greater deterioration than Class II areas, were designated. EPA then promulgated as regulations the requirements for classifications and area designations.

On October 17, 1988, EPA promulgated regulations to prevent significant deterioration as a result of emissions of NO_x and established PSD increments for NO_2 concentrations. The EPA class designations and allowable PSD increments are presented in Table 3-1. FDER has adopted the EPA class designations and allowable PSD increments for SO_2, PM(TSP), and NO_2 increments.

The term "baseline concentration" evolves from federal and state PSD regulations and refers to a concentration level corresponding to a specified baseline date and certain additional baseline sources. By definition, in the PSD regulations as amended August 7, 1980, baseline concentration means the ambient concentration level that exists in the baseline area at the time of the applicable baseline date. A baseline concentration is determined for each pollutant for which a baseline date is established and includes:

1. The actual emissions representative of facilities in existence on the applicable baseline date; and
2. The allowable emissions of major stationary facilities that commenced construction before January 6, 1975, for SO_2 and PM(TSP) concentrations, or February 8, 1988, for NO_2 concentrations, but that were not in operation by the applicable baseline date.

The following emissions are not included in the baseline concentration and therefore affect PSD increment consumption:

1. Actual emissions from any major stationary facility on which construction commenced after January 6, 1975, for SO_2 and PM(TSP) concentrations, and after February 8, 1988, for NO_2 concentrations; and

2. Actual emission increases and decreases at any stationary facility occurring after the baseline date.

In reference to the baseline concentration, the term "baseline date" actually includes three different dates:

1. The major facility baseline date, which is January 6, 1975, in the cases of SO_2 and PM(TSP), and February 8, 1988, in the case of NO_2.
2. The minor facility baseline date, which is the earliest date after the trigger date on which a major stationary facility or major modification subject to PSD regulations submits a complete PSD application.
3. The trigger date, which is August 7, 1977, for SO_2 and PM(TSP), and February 8, 1988, for NO_2.

The minor source baseline date for SO_2 and PM(TSP) has been set as December 27, 1977, for the entire State of Florida (Chapter 17-2.450, F.A.C.).

3.2.3 CONTROL TECHNOLOGY REVIEW

The control technology review requirements of the federal and state PSD regulations require that all applicable federal and state emission-limiting standards be met, and that Best Available Control Technology (BACT) be applied to control emissions from the source [Chapter 17-2.500(5)(c), F.A.C]. The BACT requirements are applicable to all regulated pollutants for which the increase in emissions from the facility or modification exceeds the significant emission rate (see Table 3-2).

BACT is defined in Chapter 17-2.100(25), F.A.C., as:

> An emissions limitation, including a visible emission standard, based on the maximum degree of reduction of each pollutant emitted which the department, on a case by case basis, taking into account energy, environmental, and economic impacts, and other costs, determines is achievable through application of production processes and available methods, systems, and techniques (including fuel cleaning or treatment or innovative fuel combustion techniques) for control of such pollutant. If the Department determines that technological or economic limitations on the application of measurement methodology to a particular part of a source or facility would make the imposition of an emission standard infeasible, a design, equipment, work practice, operational standard or combination thereof, may be prescribed instead to satisfy the requirement for the application of BACT. Such standard shall, to the degree possible, set forth the emissions reductions achievable by implementation of such design, equipment, work practice, or operation.

BACT was promulgated within the framework of the PSD requirements in the 1977 amendments of the CAA [Public Law 95-95; Part C, Section 165(a)(4)]. The primary purpose of BACT is to optimize consumption of PSD air quality increments and thereby enlarge the potential for future economic growth without significantly degrading air quality (EPA, 1978; 1980). Guidelines for the evaluation of BACT can be found in EPA's Guidelines for Determining Best Available Control Technology (BACT), (EPA, 1978) and in the PSD Workshop Manual (EPA, 1980). These guidelines were promulgated by EPA to provide a consistent approach to BACT and to ensure that the impacts of alternative emission control systems are measured by the same set of parameters. In addition, through implementation of these guidelines, BACT in one area may not be identical to BACT in another area. According to EPA (1980), "BACT analyses for the same types of emissions unit and the same pollutants in different locations or situations may determine that different control strategies should be applied to the different sites, depending on site-specific factors. Therefore, BACT analyses must be conducted on a case-by-case basis."

The BACT requirements are intended to ensure that the control systems incorporated in the design of a proposed facility reflect the latest in control technologies used in a particular industry and take into consideration existing and future air quality in the vicinity of the proposed facility. BACT must, as a minimum, demonstrate compliance with New Source Performance Standards (NSPS) for a source (if applicable). An evaluation of the air pollution control techniques and systems, including a cost-benefit analysis of alternative control technologies capable of achieving a higher degree of emission reduction than the proposed control technology, is required. The cost-benefit analysis requires the documentation of the materials, energy, and economic penalties associated with the proposed and alternative control systems, as well as the environmental benefits derived from these systems. A decision on BACT is to be based on sound judgment, balancing environmental benefits with energy, economic, and other impacts (EPA, 1978).

Historically, a "bottom-up" approach consistent with the BACT Guidelines and PSD Workshop Manual has been used. With this approach, an initial control level, which is usually NSPS, is evaluated against successively more stringent controls until a BACT level is selected. However, EPA developed a concern that the bottom-up approach was not providing the level of BACT decisions originally intended. As a result, in December 1987, the EPA Assistant Administrator for Air and Radiation mandated changes in the implementation of the PSD program, including the adoption of a new "top-down" approach to BACT decisionmaking.

The top-down BACT approach essentially starts with the most stringent (or top) technology and emissions limit that have been applied elsewhere to the same or a similar source category. The applicant must next provide a basis for rejecting this technology in favor of the next most stringent technology or propose to use it. Rejection of control alternatives may be based on technical or economic infeasibility. Such decisions are made on the basis of physical differences (e.g., fuel type), locational differences (e.g., availability of water), or significant differences that may exist in the environmental, economic, or energy impacts. The differences between the proposed facility and the facility on which the control technique was applied previously must be justified. Recently, EPA issued a draft guidance document on the top-down approach entitled Top-Down Best Available Control Technology Guidance Document (EPA, 1990).

3.2.4 AIR QUALITY MONITORING REQUIREMENTS

In accordance with requirements of 40 CFR 52.21(m) and Chapter 17-2.500(f), F.A.C, any application for a PSD permit must contain an analysis of continuous ambient air quality data in the area affected by the proposed major stationary facility or major modification. For a new major facility, the affected pollutants are those that the facility potentially would emit in significant amounts. For a major modification, the pollutants are those for which the net emissions increase exceeds the significant emission rate (see Table 3-2).

Ambient air monitoring for a period of up to 1 year generally is appropriate to satisfy the PSD monitoring requirements. A minimum of 4 months of data is required. Existing data from the vicinity of the proposed source may be used if the data meet certain quality assurance requirements; otherwise, additional data may need to be gathered. Guidance in designing a PSD monitoring network is provided in EPA's Ambient Monitoring Guidelines for Prevention of Significant Deterioration (EPA, 1987a).

The regulations include an exemption that excludes or limits the pollutants for which an air quality analysis must be conducted. This exemption states that FDER may exempt a proposed major stationary facility or major modification from the monitoring requirements with respect to a particular pollutant if the emissions increase of the pollutant from the facility or modification would cause, in any area, air quality impacts less than the *de minimis* levels presented in Table 3-2 [Chapter 17-2.500(3)(e), F.A.C.].

3.2.5 SOURCE IMPACT ANALYSIS

A source impact analysis must be performed for a proposed major source subject to PSD review for each pollutant for which the increase in emissions exceeds the significant emission rate (Table 3-2). The PSD regulations specifically provide for the use of atmospheric dispersion models in performing impact analyses, estimating baseline and future air quality levels, and determining compliance with AAQS and allowable PSD increments. Designated EPA models normally must be used in performing the impact analysis. Specific applications for other than EPA-approved models require EPA's consultation and prior approval. Guidance for the use and application of dispersion models is presented in the EPA publication Guideline on Air Quality Models (Revised). The source impact analysis for criteria pollutants to address compliance with AAQS and PSD Class II increments may be limited to the new or modified source if the net increase in impacts as a result of the new or modified source is below significance levels, as presented in Table 3-1.

EPA and the National Park Service (NPS) has recommended significant impact levels for PSD Class I areas. The levels are as follows:

Pollutant	Averaging Time	Maximum Significance Level ($\mu g/m^3$)
SO_2	3-hour	1.23
	24-hour	0.275
	Annual	0.1
PM(TSP)	24-hour	1.35
	Annual	0.27
NO_2	Annual	0.1

Although these levels were proposed for use in Virginia and may not be binding in other states, the proposed levels serve as a guideline in assessing a source's impact in a Class I area. EPA's Office of Air Quality Planning and Standards has initiated a motion that will lead to rulemaking to address the general need for Class I significant impact levels. The action is part of EPA's efforts to incorporate new source review provisions of the 1990 Clean Air Act Amendments. Because the process of developing the regulations will be lengthy, EPA believes that immediate guidance concerning the significant impact levels is appropriate in order to assist states in implementing the PSD permit process.

Various lengths of record for meteorological data can be used for impact analysis. A 5-year period can be used with corresponding evaluation of highest, second-highest short-term concentrations for comparison to AAQS or PSD increments. The term "highest, second-highest" (HSH) refers to the highest of the second-highest concentrations at all receptors (i.e., the highest concentration at each receptor is discarded). The second-highest concentration is significant because short-term AAQS specify that the standard should not be exceeded at any location more than once a year. If less than 5 years of meteorological data are used in the modeling analysis, the highest concentration at each receptor normally must be used for comparison to air quality standards.

3.2.6 ADDITIONAL IMPACT ANALYSIS

In addition to air quality impact analyses, federal and State of Florida PSD regulations require analyses of the impairment to visibility and the impacts on soils and vegetation that would occur as a result of the proposed source [40 CFR 52.21; Chapter 17-2.500(5)(e), F.A.C.]. These analyses are to be conducted primarily for PSD Class I areas. Impacts as a result of general commercial, residential, industrial, and other growth associated with the source also must be addressed. These analyses are required for each pollutant emitted in significant amounts (Table 3-2).

3.2.7 GOOD ENGINEERING PRACTICE STACK HEIGHT

The 1977 CAA Amendments require that the degree of emission limitation required for control of any pollutant not be affected by a stack height that exceeds GEP or any other dispersion technique. On July 8, 1985, EPA promulgated final stack height regulations (EPA, 1985a). Identical regulations have been adopted by FDER [Chapter 17-2.270, F.A.C.]. GEP stack height is defined as the highest of:

1. 65 meters (m); or
2. A height established by applying the formula:

   $$Hg = H + 1.5L$$

   where: Hg = GEP stack height,
   H = Height of the structure or nearby structure, and
   L = Lesser dimension (height or projected width) of nearby structure(s); or
3. A height demonstrated by a fluid model or field study.

"Nearby" is defined as a distance up to five times the lesser of the height or width dimensions of a structure or terrain feature, but not greater than 0.8 kilometer (km). Although GEP stack height regulations require that the stack height used in modeling for determining compliance with AAQS and PSD increments not exceed the GEP stack height, the actual stack height may be greater.

The stack height regulations also allow increased GEP stack height beyond that resulting from the above formula in cases where plume impaction occurs. Plume impaction is defined as concentrations measured or predicted to occur when the plume interacts with elevated terrain. Elevated terrain is defined as terrain that exceeds the height calculated by the GEP stack height formula.

3.3 NONATTAINMENT RULES

Based on the current nonattainment provisions (Chapter 17-2.510, F.A.C.), all major new facilities and modifications to existing major facilities located in a nonattainment area must undergo nonattainment review. A new major facility is required to undergo this review if the proposed pieces of equipment have the potential to emit 100 TPY or more of the nonattainment pollutant. A major modification at a major facility is required to undergo review if it results in a significant net emission increase of 40 TPY or more of the nonattainment pollutant or if the modification is major (i.e., 100 TPY or more).

For major facilities or major modifications that locate in an attainment or unclassifiable area, the nonattainment review procedures apply if the source or modification is located within the area of influence of a nonattainment area. The area of influence is defined as an area that is outside the boundary of a nonattainment area but within the locus of all points that are 50 km outside the boundary of the nonattainment area. Based on Chapter 17-2.510(2)(a)2.a, F.A.C., all VOC sources that are located within an area of influence are exempt from the provisions of new source review for nonattainment areas. Sources that emit other nonattainment pollutants and are located within the area of influence are subject to nonattainment review unless the maximum allowable emissions from the proposed source do not have a significant impact within the nonattainment area.

3.4 SOURCE APPLICABILITY

3.4.1 AREA CLASSIFICATION

The project site is located in Polk County, which has been designated by EPA and FDER as an attainment area for all criteria pollutants. Polk County and surrounding counties are designated as PSD Class II areas for SO_2, PM(TSP), and NO_x. The site is located approximately 114 km from the closest part of the Chassahowitzka National Wilderness Area.

3.4.2 PSD REVIEW

3.4.2.1 Pollutant Applicability

The proposed project is considered to be a major facility because emissions of any regulated pollutant will exceed 250 TPY (refer to Table 2-2); therefore, PSD review is required for any pollutant for which the net increase in emissions exceeds the PSD significant emission rates presented in Table 3-2 (i.e., major modification). As shown, potential emissions from the proposed project will exceed the PSD significant emission rates for PM(TSP), PM(PM10), NO_2, CO, and VOC. Therefore, the project is subject to PSD review for these pollutants.

3.4.2.2 Ambient Monitoring

Based on the net increase in emissions from the proposed project, presented in Table 3-3, a PSD preconstruction ambient monitoring analysis is required for VOCs. However, if the net increase in impact of a pollutant is less than the *de minimis* monitoring concentration (or, for VOCs, *de minimis* emission rate of 100 TPY), then an exemption from the preconstruction ambient monitoring requirement is provided for in the FDER regulations [FDER Rule 17-2.500(3)(e)]. In addition, if an acceptable ambient monitoring method for the pollutant has not been established by EPA, monitoring is not required.

If preconstruction monitoring data are required to be submitted, data collected at or near the project site can be submitted, based on existing air quality data (e.g., FDER) or the collection of on-site data.

Maximum predicted impacts as a result of the net increase associated with the proposed project are presented in Table 3-4 for pollutants requiring PSD review. The methodology used to predict maximum impacts and the impact analysis results are presented in Sections 6.0 and 7.0. As shown in Table 3-4, the maximum net increase in impact is below the respective *de minimis* monitoring concentration for all pollutants.

3.4.2.3 GEP Stack Height Impact Analysis

The GEP stack height regulations allow any stack to be at least 65 m high. The stacks for the proposed turbine in simple-cycle operation, HRSG, and auxiliary boiler will be 60 feet (ft) (18.3 m), 100 ft (30.5 m), and 65 ft (19.8 m), respectively. These stack heights do not exceed the GEP stack height. The potential for downwash of the units' emissions caused by nearby structures is discussed in Section 6.0, Air Quality Modeling Approach.

3.4.3 NONATTAINMENT REVIEW

The project site is located in Polk County, which is classified as an attainment area for all criteria pollutants. The plant is also located

Table 3-3. Net Increase in Emissions Due To the Proposed Orange Cogeneration Facility Compared to the PSD Significant Emission Rates

	Emissions (TPY)		
Pollutant	Potential Emissions From Proposed Facility[a]	Significant Emission Rate	PSD Review
Sulfur Dioxide	10.8 (WI)	40	No
Particulate Matter (TSP)	48.2 (WI/DLN)	25	Yes
Particulate Matter (PM10)	48.2 (WI/DLN)	15	Yes
Nitrogen Dioxide	375.1 (WI)	40	Yes
Carbon Monoxide	280.0 (DLN)	100	Yes
Volatile Organic Compounds	52.6 (DLN)	40	Yes
Lead	NEG	0.6	No
Sulfuric Acid Mist	0.83 (WI)	7	No
Total Fluorides	NEG	3	No
Total Reduced Sulfur	NEG	10	No
Reduced Sulfur Compounds	NEG	10	No
Hydrogen Sulfide	NEG	10	No
Asbestos	NEG	0.007	No
Beryllium	NEG	0.0004	No
Mercury	NEG	0.1	No
Vinyl Chloride	NEG	1	No
Benzene	NEG	0	No
Radionuclides	NEG	0	No
Inorganic Arsenic	NEG	0	No

Note: NEG = Negligible.
All calculations based on 59°F peak load condition.
WI = water injection
DLN = dry low NO_x

[a] Includes emissions due to two combined cycle CT units and an auxiliary boiler.

Table 3-4. Predicted Net Increase in Impacts Due To the Proposed Orange Cogeneration Facility Compared to PSD *De Minimis* Monitoring Concentrations

Pollutant	Concentration ($\mu g/m^3$) Predicted Net Increase in Impacts[a]	*De Minimis* Monitoring Concentration
Particulate Matter (TSP)	~~0.10~~ 3.47	10, 24-hour
Particulate Matter (PM10)	3.47	10, 24-hour
Nitrogen Dioxide	0.90	14, annual
Carbon Monoxide	34.8	575, 8-hour
Volatile Organic Compounds (VOCs)	52.6 TPY	100 TPY

Note: TPY = tons per year.

[a] See section 7.0 for air dispersion modeling results. PM/PM10 and NO_2 results are based on combined cycle operation with dry low NO_x combustors at an ambient temperature of 100°F. CO results are based on combined cycle operation with dry low NO_x combustors at ambient temperature of 40°F.

more than 50 km from any nonattainment area. Therefore, nonattainment requirements are not applicable.

3.4.4 HAZARDOUS POLLUTANT REVIEW

The FDER has promulgated guidelines (FDER, 1992) to determine whether any emission of a hazardous or toxic pollutant can pose a possible health risk to the public. Maximum concentrations for all regulated pollutants for which an ambient standard does not exist and all nonregulated hazardous pollutants are to be compared to no-threat levels (NTL) for each applicable pollutant. If the maximum predicted concentration for any hazardous pollutant is less than the corresponding NTL for each applicable averaging time, that emission is considered not to pose a significant health risk. The NTLs for pollutants applicable to the proposed project are presented in Table 3-5. Emissions for these pollutants are presented in Appendix A.

Table 3-5. Summary of Florida No-Threat Levels for Toxic Air Pollutants Applicable to the Proposed Facility Analysis

	No-Threat Level (μg/m)		
Pollutant	8-Hour	24-Hour	Annual
Formaldehyde	4.5	1.08	0.077
Sulfuric Acid Mist	10	2.38	NE

Note: NE = none established.

4.0 CONTROL TECHNOLOGY REVIEW

4.1 APPLICABILITY

The control technology review requirements of the PSD regulations are applicable to emissions of PM10, NO_x, CO, and VOC (see Section 3.0). This section presents the applicable NSPS and the proposed BACT for these pollutants. The approach to BACT analysis is based on the regulatory definitions of BACT, as well as EPA's current policy guidelines requiring the top-down approach.

4.2 NEW SOURCE PERFORMANCE STANDARDS

The applicable NSPS for gas turbines are codified in 40 CFR 60, Subpart GG. These regulations apply to:

1. Electric utility stationary gas turbines with a heat input at peak load of greater than 100 x 10^6 Btu/hr [40 CFR 60.332 (b)];
2. Stationary gas turbines with a heat input at peak load between 10 and 100 x 10^6 Btu/hr [40 CFR 60.332 (c)]; or
3. Stationary gas turbines with a manufacturer's rate base load at ISO conditions of 30 MW or less [40 CFR 60.332 (d)].

The electric utility stationary gas turbine provisions apply to stationary gas turbines constructed for the purpose of supplying more than one-third of their potential electric output capacity for sale to any utility power distribution system [40 CFR 60.331 (q)]. The requirements for electric utility stationary gas turbines are applicable to the project and are the most stringent provision of the NSPS. These requirements are summarized in Table 4-1 and were considered in the BACT analysis.

As noted from Table 4-1, the NSPS NO_x emission limit can be adjusted upward to allow for fuel-bound nitrogen (FBN). For a fuel-bound nitrogen concentration of 0.015 percent or less, no increase in the NSPS is provided; for a fuel-bound nitrogen concentration of 0.06 percent, the NSPS is increased by 0.0024 percent or 24 parts per million (ppm).

Table 4-1. Federal NSPS for Electric Utility Stationary Gas Turbines

Pollutant	Emission Limitation[a]
Nitrogen Oxides[b]	0.0075 percent by volume (75 ppm) at 15 percent O_2 on a dry basis adjusted for heat rate and fuel nitrogen

[a] Applicable to electric utility gas turbines with a heat input at peak load of greater than 100 x 10^6 Btu/hr.

[b] Standard is multiplied by 14.4/Y; where Y is the manufacturer's rated heat rate in kilojoules per watt at rated load or actual measured heat rate based on the lower heating value of fuel measured at actual peak load; Y cannot be greater than 14.4. Standard is adjusted upward (additive) by the percent of nitrogen in the fuel:

Fuel-bound nitrogen (percent by weight)	Allowed Increase NO_x percent by volume
$N \leq 0.015$	0
$0.015 < N \leq 0.1$	0.04(N)
$0.1 < N \leq 0.25$	0.004+0.0067(N-0.1)
$N > 0.25$	0.005

where:

N = the nitrogen content of the fuel (percent by weight).

Source: 40 CFR 60 Subpart GG.

For the proposed CTs, the NSPS emission limit would be 112.4 ppm (wet injection) and 115.9 ppm (dry low NO_x) on gas (corrected to 15 percent oxygen at a fuel-bound nitrogen content of 0.015 percent).

The applicable NSPS for the auxiliary boiler will be 40 CFR 60, Subpart Dc. The applicable requirements are presented in Table 4-2.

4.3 BEST AVAILABLE CONTROL TECHNOLOGY - COMBUSTION TURBINE

4.3.1 NITROGEN OXIDES

4.3.1.1 Identification of NO_x Control Technologies

NO_x emissions from combustion of fossil fuels consist of thermal NO_x and fuel-bound NO_x. Thermal NO_x is formed from the reaction of oxygen and nitrogen in the combustion air at combustion temperatures. Formation of thermal NO_x depends on the flame temperature, residence time, combustion pressure, and air-to-fuel ratios in the primary combustion zone. The design and operation of the combustion chamber dictates these conditions. Fuel-bound NO_x is created by the oxidation of volatilized nitrogen in the fuel. Nitrogen content in the fuel is the primary factor in its formation.

Table 4-3 presents a listing of the lowest achievable emission rates/best available control technology (LAER/BACT) decisions made by state environmental agencies and EPA regional offices for gas turbines. This table was developed from the information contained in the LAER/BACT clearinghouse documents (EPA, 1985b, 1986, 1987c, 1988c, 1989) and by contacting state agencies, such as the California Air Control Board, the South Coast Air Quality Management District, the New Jersey Department of Environmental Protection, and the Rhode Island Department of Environmental Management.

The most stringent NO_x controls for CTs established as LAER/BACT by state agencies are selective catalytic reduction (SCR) with wet injection and wet injection alone. When SCR has been employed, wet injection is used initially to reduce NO_x emissions. SCR has been installed or permitted in

Table 4-2. Summary of NSPS For Small Industrial-Commercial-Institutional Steam Generating Units

Unit Size (heat input)	Fuel	Annual Capacity Factor	Emission Standard
PARTICULATE MATTER			
30-100 MMBtu/hr	Coal; Coal w/other fuels	>90% on coal	0.05 lb/MMBtu
		<90% on coal	0.10 lb/MMBtu
	Wood; Wood w/other fuels (except coal)	>30% on wood	0.10 lb/MMBtu
		<30% on wood	0.30 lb/MMBtu
	Oil No limitation	No emission limit	
OPACITY			
30-100 MMBtu/hr	All fuels	No limitation	20% opacity
SULFUR DIOXIDE			
>75 MMBtu/hr	Coal	>55% on coal	1.2 lb/MMBtu; 90% reduction
	Coal	<55% on coal	1.2 lb/MMBtu
	Coal w/emerging SO_2 control technology	>55% on coal	0.6 lb/MMBtu; 50% reduction
	Coal in duct burner of combined cycle system	No limitation	1.2 lb/MMBtu
	Oil	No limitation	0.5 lb/MMBtu or 0.5% S fuel
	Coal refuse in fluidized bed combustor	No limitation	1.2 lb/MMBtu; 80% reduction
30-75 MMBtu/hr	Coal	No limitation	1.2 lb/MMBtu
	Coal w/emerging SO_2 control technology	No limitation	0.6 lb/MMBtu
	Coal in duct burner of combined cycle system	No limitation	0.6 lb/MMBtu
	Oil	No limitation	0.5 lb/MMBtu or 0.5% S fuel
	Coal refuse in fluidized bed combustor	No limitation	1.2 lb/MMBtu

Table 4-3. Summary of BACT Determinations for NO_x from Gas-Fired Turbines (Page 1 of 3)

Company Name	State	Date of Permit	Unit/Process Description	Capacity (Size)	NOx Emission Limit				Control Method	Eff. (%)
					(lb/MMBtu)	(lb/hr)	(TPY)	(ppmvd basis)		
Tiger Bay Cogen	FL	May-93	GE FA	206 MW	--	97.2	425.7	15 @ 15% O_2	Dry low NO_x burners	--
Central Florida Cogen	FL	Nov-92	GE EA	126 MW	--	87.8	384.5	25 @ 15% O_2	Low NO_x burners and water injection	--
University of Florida Cogen	FL	Aug-92	GE LM6000	43 MW	--	35	142.7	25 @ 15% O_2	--	--
Bermuda Hundred Energy	VA	Mar-92	Gas Turbine	1175 MMBtu/hr	--	--	--	9 ppm @ 15% O_2	SCR/Steam Injection	--
Bermuda Hundred Energy	VA	Mar-92	Gas Turbine	1117 MMBtu/hr	--	--	--	15 ppm @ 15% O_2	SCR/Steam Injection	--
Southern California Gas	CA	Oct-91	GT Solar Model H	5500 HP	--	--	--	8 ppm @ 15% O_2	High Temp SCR	--
Southern California Gas	CA	Oct-91	GT Solar Model H	47.64 MMBtu/hr	--	1.92	--	--	SCR	
El Paso Natural Gas	AZ	Oct-91	GT Solar Centaur H	5500 HP	--	--	--	42 ppm @ 15% O_2	Dry Low NO_x Combustor	--
El Paso Natural Gas	AZ	Oct-91	GT Solar Centaur H	5500 HP	--	--	--	85.1 ppm @ 15% O_2	Lean Fuel Mix	--
El Paso Natural Gas	AZ	Oct-91	GT Solar Centaur H	5500 HP	--	--	--	84.9 ppm @ 15% O_2	Lean Burn	--
El Paso Natural Gas	AZ	Oct-91	GE Gas Turbine	12000 HP	--	--	--	42 ppm @ 15% O_2	Dry Low NO_x Combustor	--
El Paso Natural Gas	AZ	Oct-91	GE Gas Turbine	12000 HP	--	--	--	225 ppm @ 15% O_2	Lean Burn	--
Lake Cogen	FL	Nov-91	Combined Cycle	120 MW	--	--	--	25 @ 15% O_2	Steam Injection	--
Pasco Cogen	FL	Nov-91	Combined Cycle	120 MW	--	--	--	25 @ 15% O_2	Steam Injection	--
Florida Power Corporation	FL	Sep-91	Simple Cycle	552 MW	--	--	--	42 @ 15% O_2	Dry Low NO_x Combustor	--
Enron Louisana Energy Co	LA	Aug-91	Gas Turbines (2)	78.2 MMBtu/hr	--	6.3	--	40 ppmv @ 15% O_2	Water Inject 0.67 lb/lb	71.00
City of Lakeland	FL	Jul-91	Combined Cycle	120 MW	--	--	--	25 @ 15% O_2	Dry Low NO_x Combustor	--
Sumas Energy, Inc.	WA	Jun-91	Gas Turbine	80 MW	--	--	--	6 @ 15% O_2	SCR	90.00
Florida P&L Co. (Martin)	FL	Jun-91	Combined Cycle	860 MW	--	--	--	25 @ 15% O_2	Dry Low NO_x Combustor	--
Commonwealth Atlantic LTD Partn.	VA	Mar-91	Gas Turbine	1533 MMBtu/hr	--	139	--	25	H2O Injection & Low NO_x Comb.	--
Commonwealth Atlantic LTD Partn.	VA	Mar-91	Gas Turbine	1400 MMBtu/hr	--	--	1032	42	Water Injection	--
Florida P&L Co. (Ft. Lauderdale)	FL	Mar-91	Combined Cycle	860 MW	--	--	--	42 @ 15% O_2	Steam Injection	--
Hardee Power Station	FL	Dec-90	Combined Cycle	660 MW	--	--	--	42 @ 15% O_2	Wet Injection	--
Salinas River Cogen	CA	Nov-90	Gas Turbine	43.2 MW	--	10	--	6 @ 15% O_2	Dry Low NO_x Comb. & SCR	--
Sargent Canyon Cogen Co	CA	Nov-90	Gas Turbine	42.5 MW	--	10	--	6 @ 15% O_2	Dry Low NO_x Comb. & SCR	--
March Point Cogen	WA	Oct-90	Turbine	80 MW	--	--	--	25 @ 15% O_2	Massive Steam Injection	80.00
Las Vegas Cogen	NV	Oct-90	Turbine, Peaking	397 MMBtu/hr	--	--	--	10 ppm	Water Injection & SCR	--
Delmarva Power Corporation	DE	Sep-90	Combined Cycle	450 MW	0.10	--	--	25 @ 15% O_2	Dry Low NO_x Combustor	--
Doswell Limited Partnership	VA	May-90	Turbine	1,261 MMBtu/hr	--	--	--	9	Dry Comb. to 25 ppm, SCR to 9 ppm	--
Fulton Cogeneration Assoc.	NY	Jan-90	GE LM5000	500 MMBtu/hr	--	--	--	36		--
O'Brian California Cogen II	CA	Jan-90	Gas Turbine	49.50 MW	--	114.6	--	--		--
Arrowhead Cogeneration	VT	Dec-89	Gas Turbine	282.0 MMBtu/hr	--	--	--	9 @ 15% O_2, 1H Avg	Water Injection & SCR	80.00
Richmond Power Enterprise Partn.	VA	Dec-89	Gas Turbine	1,163.5 MMBtu/hr	--	--	--	8.2 @ 15% O_2	Steam Inj. & SCR	--
JMC Selkirk, Inc.	NY	Nov-89	GE Frame 7	80 MW	--	--	--	25 ppm	Steam Injection	--
Badger Creek Limited	CA	Oct-89	GT-Cogen	457.8 MMBtu/hr	0.0135	--	--	--	Steam Injection & SCR	--
Capitol District NRG Ctr	CT	Oct-89	Gas Turbine	738.8 MMBtu/hr	--	--	--	42 @ 15% O_2	Steam Injection	--
City of Anaheim GT Proj.	CA	Sep-89	Gas Turbine	442 MMBtu/hr	--	3.75	--	--	Steam Injection & SCR	69.60

Table 4-3. Summary of BACT Determinations for NO_x from Gas-Fired Turbines (Page 2 of 3)

Company Name	State	Date of Permit	Unit/Process Description	Capacity (Size)	NOx Emission Limit				Control Method	Eff. (%)
					(lb/MMBtu)	(lb/hr)	(TPY)	(ppmvd basis)		
Panda-Rosemary Corp.	NC	Sep-89	GE Frame 6	499 MMBtu/hr	0.17	83	--	--	Water Injection	--
Kamine Syracuse Cogen	NY	Sep-89	Turbine	79 MW	--	--	--	36 ppm	Water Injection	--
Cimarron Chemical Co.	CO	Aug-89	Turbines (2)	271.0 MMBtu/hr	--	--	--	65 ppmv @ 15% O_2	Steam Injection	--
Tropicana Products, Inc.	FL	May-89	Gas Turbine	45.40 MW	--	--	--	42 @ 15% O_2	Steam Injection.	--
Empire Energy - Niagara Cogen	NY	May-89	GE Frame 6 (3)	1,248 MMBtu/hr	--	--	--	42 ppm	Steem Injection	--
Megan-Racine Assoc.	NY	Mar-89	GE LM 5000	430 MMBtu/hr	--	--	--	42 ppm	Water Injection	--
Potomac Electric Power Company	MD	Mar-89	Combined Cycle	860 MW	--	--	--	42 @ 15% O_2	Steam Injection	--
Indec/Oswego Hill Cogen	NY	Feb-89	GE Frame 6	40 MW	--	--	--	42 @ 15% O_2	Water Injection	--
Pawtucket Power	RI	Jan-89	Turbine	58 MW	--	--	--	9 @ 15% O_2	SCR	--
L&J Energy System Cogen	NY	Jan-89	GE LM 5000	40 MW	--	--	--	42 ppm	Steam Injection	--
Mojave Cogen	CA	Jan-89	Turbine	490 MMBtu/hr	0.031	--	--	--	--	--
Ocean State Power	RI	Jan-89	Combine Cycle	500 MW	--	--	--	9 @ 15% O_2	Water Injection & SCR	--
Mojave Cogen	CA	Dec-88	Turbine	45 MW	--	--	--	10 ppm	Steam Injection & SCR	--
Champion International	AL	Nov-88	Gas Turbine	35 MW	--	--	--	42 @ 15% O_2	Steam Injection	70.00
Indeck-Yerka Energy Services	NY	Nov-88	GE Frame 6	40 MW	--	--	--	42 @ 15% O_2	Steam Injection	--
Long Island Lighting Co	NY	Nov-88	Peaking Units (3)	75 MW	--	--	--	55 ppm	Water Injection	--
Amtrak	PA	Oct-88	Turbine (2)	20 MW	--	--	--	42 @ 15% O_2	H_2O Injection	--
Mobile Oil	CA	Sep-88	Turbine (2)	81.40 MMBtu/hr	0.047	3.78	--	--	Water Inj. & SCR	--
Kamine South Glens Falls	NY	Sep-88	GE Frame 6	40 MW	--	--	--	42 ppm	Steam Injection	--
Orlando Utilities	FL	Sep-88	Gas Turbine (2)	35 MW	--	--	--	42 @ 15% O_2	Steam Injection	--
Delmarva Power Corporation	DE	Aug-88	Turbine (2)	200 MW	--	--	--	42 ppm	Low NO_x Burners & Water Inj.	--
O'Brien Cogen	CT	Aug-88	Gas Turbine (2)	499.9 MMBtu/hr	--	--	--	39 @ 15% O_2	Water Injection	--
Kamine Carthage	NY	Jul-88	GE Frame 6	40 MW	--	--	--	42 ppm	Steam Injection	--
ADA Cogeneration	MI	Jun-88	Turbine	245.0 MMBtu/hr	--	--	--	42 @ 15% O_2, 1H Avg	H20 Injection	59.00
CCF-1 Jefferson Station	CT	May-88	Gas Turbines (2)	110 MMBtu/hr	--	--	--	36 @ 15% O_2	Water Injection	--
Merck Sharp & Pohme	PA	May-88	Turbine	310 MMBtu/hr	--	--	--	42 @ 15% O_2	Steam Injection	--
Virginia Power	VA	Apr-88	GE Turbine	1,875 MMBtu/hr	--	490		42 @ 15% O_2	Steam Injection	--
TBG/Grumman	NY	Mar-88	Gas Turbine	16 MW	0.2	--	--	75 ppm	H_2O Inj. & Combustion Controls	--
Combined Energy Resources	CA	Feb-88	Gas Turbine	25.94 MW	--	199.0	--	--	H_2O Injection & SCR	81.00
Texas Gas Transmission Corp.	KY	Feb-88	Gas Turbine	14300 HP	--	--	--	--	NO_x 0.015 % by Volume	--
Midland Cogeneration Venture	MI	Feb-88	Turbines (12)	984.2 MMBtu/hr	--	--	--	42 @ 15% O_2	Steam Injection	--
Midway-Sunset Cogen	CA	Jan-88	GE Frame 7 (3)	75 MW	--	85	--	--	Water Inj. & Quiet Combustion	--
Downtown Cogeneration Assoc.	LA	Aug-87	Gas Turbine	71.9 MMBtu/hr	--	--	--	42 @ 15% O_2	Water Injection	--
BAF Energy	CA	Jul-87	Turbine, Generator	887.2 MMBtu/hr	--	30.1	--	9 ppm @ 15% O_2	Steam Injection & SCR	80.00
AES Placerita, Inc.	CA	Jul-87	Turbine	530 MMBtu/hr	--	14.2	--	9 @ 15% O_2	St./F Ratio 2.2:1 & SCR	--
AES Placerita, Inc.	CA	Jul-87	Gas Turbine	530 MMBtu/hr	--	12.0	--	9 @ 15% O_2	St./F Ratio 2.2:1 & SCR	--
Simpson Paper Co.	CA	Jun-87	Gas Turbine	49.50 MW	--	9.71	--	6 @ 15% O_2	Steam Injection & SCR	--

Table 4-3. Summary of BACT Determinations for NO_x from Gas-Fired Turbines (Page 3 of 3)

Company Name	State	Date of Permit	Unit/Process Description	Capacity (Size)	NOx Emission Limit (lb/MMBtu)	(lb/hr)	(TPY)	(ppmvd basis)	Control Method	Eff. (%)
Power Development Co.	CA	Jun-87	Gas Turbine	49 MMBtu/hr	--	1.5	--	9 @ 15% O_2	H_2O Injection & SCR	--
San Joaquin Cogen Limited	CA	Jun-87	Gas Turbine	48.6 MW	--	10.4	--	6 @ 15% O_2	H_2O Injection & SCR	76.00
Cogen Technologies	NJ	Jun-87	GE Frame 6 (3)	40 MW	--	--	--	9.6 @ 15% O_2	H_2O Injection & SCR	95.00
Trunkline LNG	LA	May-87	Gas Turbine	147,102 SCF/hr	--	59		--	--	--
Pacific Gas Transmission	OR	May-87	Gas Turbine	14,000 HP	--	50.3	--	154	Combustion Control	--
Anheuser-Busch	FL	Apr-87	Gas Turbine	95.7 MMBtu/hr	0.10	--	--	--	--	--
Alaska Elect. Gen. & Trans.	AK	Mar-87	Gas Turbine	80 MW	--	--	--	75 @ 15% O_2	H_2O Injection	--
Sycamore Cogen	CA	Mar-87	Gas Turbine	75 MW	--	--	--	--	--	--
U.S. Borax & Chemical Corp.	CA	Feb-87	Gas Turbine	45 MW	--	40	--	25 ppm @ 15% O_2	Proper Combust. Techniques	--
Sierra LTD.	CA	Feb-87	GE Gas Turbine	11.34 MMCF/D	0.016	4.04	--	--	Steam Injection & SCR	95.86
Midway-Sunset Project	CA	Jan-87	Gas Turbines (3)	973 MMBtu/hr	--	113.4	--	16.31 ppmv	H_2O Injection	73.00
City of Santa Clara	CA	Jan-87	Gas Turbine	--	--	--	--	42 @ 15% O_2	Water Injection	--
O'Brien NRG Systems/Merchants Ref	CA	Dec-86	Gas Turbine	359.5 MMBtu/hr	--	30.3	--	15 @ 15% O_2	Water Injection & SCR	--
California Dept. of Corr.	CA	Dec-86	Gas Turbine	5.1 MW	--	--	--	38 @ 15% O_2	1:1 H_2O Injection	--
Double 'C' Limited	CA	Nov-86	Gas Turbine	25 MW	--	8.08	--	--	H_2O Inj. & Selected Catalytic Red.	--
Kern Front Limited	CA	Nov-86	Gas Turbine (2)	50 MW	--	8.08	--	4.5 @ 15% O_2	Water Injection & SCR	95.80
PG&E, Station T	CA	Aug-86	GE LM5000	396 MMBtu/hr	--	63	--	25 ppm @ 15% O_2	Steam Injection @ St/F Ratio of 1.7/1	75.00
Wichita Falls E. I., I.	TX	Jun-86	Gas Turbine	20 MW	--	--	684	--	Steam Injection	--
Formosa Plastic Corp.	TX	May-86	GE MS 6001	38.4 MW	--	--	640	--	Steam Injection	--
Kern Energy Corp.	CA	Apr-86	Gas Turbine	8.8 MMCF/D	0.023	8.29	--	--	Steam Inj., Low NO_x Config. & SCR	87.00
Monarch Cogen	CA	Apr-86	Combined Cycle	92.20 MMBtu/hr	--	8.02	--	22 @ 15% O_2	SCR	--
Moran Power, Inc.	CA	Apr-86	Gas Turbine	8.0 MMCF/D	0.02	8.29	--	--	Steam Inj., Low NO_x Config. & SCR	87.00
Southeast Energy, Inc.	CA	Apr-86	Gas Turbine	8.0 MMCF/D	0.023	8.29	--	--	Steam Inj., Low NO_x Config. & SCR	87.00
Western Power System, Inc	CA	Mar-86	GE Gas Turbine	26.5 MW	--	--	--	9 @ 15% O_2	H_2O Injection & SCR	80.00
AES Placerita, Inc.	CA	Mar-86	Turbine	519 MMBtu/hr	--	26.2	--	7 @ 15% O_2	H_2O Injection & SCR	--
OLS Energy	CA	Jan-86	GE Gas Turbine	256 MMBtu/hr	--	--	--	9 @ 15% O_2	H_2O Injection & Scrubber	80.00
Union Cogeneration	CA	Jan-86	Gas Turbine	16 MW	--	--	--	25 @ 15% O_2	H_2O Injection & Scrubber	--

about 132 projects. The majority of these projects (more than 90 percent) are cogeneration facilities with capacities of 50 MW or less. About 83 percent (i.e., 109) of the projects have been in California. Of these 109 projects that have either installed SCR or have been permitted with SCR, 43 percent have been in the Southern California NO_2 nonattainment area where SCR was required not as BACT but as LAER, a more stringent requirement. LAER is distinctly different from BACT in that there is no consideration of economic, energy, or environmental impacts; if a control technology has previously been installed, it must be required as LAER. LAER is defined as follows:

> Lowest achievable emission rate means, for any source, the more stringent rate of emissions based on the following: (i) The most stringent emissions limitation which is contained in the implementation plan of any State of such class or category of stationary source, unless the owner or operator of the proposed stationary source demonstrates that such limitations are not achievable; or (ii) The most stringent emissions limitation which is achieved in practice by such class or category of stationary source. This limitation, when applied to a modification, means the lowest achievable emissions rate for the new or modified emissions units within the stationary source. In no event shall the application of this term permit a proposed new modified stationary source to emit any pollutant in excess of the amount allowable under applicable new source standards of performance (40 CFR 51, Appendix S.II, A.18).

As noted previously, there are distinct regulatory and policy differences between LAER and BACT.

All the projects in California have natural gas as the primary fuel, and only 15 of the SCR applications in California have distillate fuel as backup.

The remaining projects with SCR (i.e., 23 projects) are located in the eastern United States. These projects are located in Vermont, Massachusetts, Connecticut, New Jersey, New York, Rhode Island, and Virginia. A majority of these projects are cogenerators or independent power producers. The size of these projects ranges from 22 MW to 450 MW, with 87 percent less than 100 MW in size. While almost all of the facilities have distillate oil as backup fuel, distillate oil generally is restricted by permit to 1,000 hours or less per CT.

Reported and permitted NO_x removal efficiencies of SCR range from 40 to 80 percent. The most stringent emission limiting standards associated with SCR are approximately 9 ppm for natural gas firing. However, two facilities have reported emission limits of about 4.5 ppm. These emission limits were clearly determined to be LAER on CTs using water injection with uncontrolled NO_x levels below 42 ppm. SCR has not been installed or permitted on simple cycle CTs.

Wet injection has been the primary method of reducing NO_x emissions from CTs. This method of control was first mandated by the NSPS to reduce NO_x levels to 75 parts per million by volume, dry (ppmvd) (corrected to 15 percent O_2 and heat rate). Development of improved wet injection combustors reduced NO_x concentrations to 25 ppmvd (corrected to 15 percent O_2) when burning natural gas. More recently, CT manufacturers have developed dry low-NO_x combustors that can initially reduce NO_x concentrations to 25 ppmvd (corrected to 15 percent O_2) when firing natural gas; retrofitting with improved combustors will achieve 15 ppmvd.

In Florida, a majority of the most recent PSD permits and BACT determinations for gas turbines have required either wet injection or dry low-NO_x technology for NO_x control. The emission limits included in these latest permits and BACT determinations are 25/15 ppmvd corrected to 15 percent O_2 for natural-gas firing using combustion technology. These permits require that sources meet 15 ppmvd by December 31, 1997.

4.3.1.2 Technology Description and Feasibility

Selective Catalytic Reduction (SCR)--SCR uses ammonia (NH_3) to react with NO_x in the gas stream in the presence of a catalyst. NH_3, which is diluted with air to about 5 percent by volume, is introduced into the gas stream at reaction temperatures between 600°F and 750°F. The reactions are as follows:

$$4NH_3 + 4NO + O_2 = 4N_2 + 6H_2O$$
$$4NH_3 + 2NO_2 + O_2 = 3N_2 + 6H_2O$$

SCR operating experience, as applied to gas turbines, consists primarily of baseload natural-gas-fired installations either of cogeneration or combined cycle configuration; no simple cycle facilities have SCR. Exhaust gas temperatures of simple cycle CTs generally are in the range of 800°F to 1,000°F, which exceeds the optimum range for SCR. All current SCR applications have the catalyst placed in the HRSG to achieve proper reaction conditions. This allows a relatively constant temperature for the reaction of NH_3 and NO_x on the catalyst surface.

The use of SCR has been limited to facilities that burn natural gas or small amounts of fuel oil since SCR catalysts are contaminated by sulfur-containing fuels (i.e., fuel oil). For most fuel-oil-burning facilities, catalyst operation is discontinued, or the exhaust bypasses the SCR system. While the operating experience has not been extensive, certain cost, technical, and environmental considerations have surfaced. These considerations are summarized in Table 4-4.

As presented in Table 4-4, ammonium salts (ammonium sulfate and bisulfate) are formed by the reaction of NH_3 and sulfur combustion products. Ammonium bisulfate can be corrosive and could cause damage to the HRSG surfaces that follow the catalyst, as well as to the stack. Corrosion protection for these areas would be required. Ammonium sulfate is emitted as particulate matter. While the formation of ammonium salts is primarily associated with oil firing, sulfur combustion products from natural gas also could form small amounts of ammonium salts.

Zeolite catalysts, which are reported to be capable of operating in temperature ranges from 600°F to 950°F, have been available commercially only recently. Their application with SCR primarily has been limited to internal combustion engines which have relatively high NO_x emissions (i.e., 7,500 ppm) and low flow rates. Optimum performance of an SCR system using

Table 4-4. Cost, Technical, and Environmental Considerations of SCR Used on Combustion Turbines (Page 1 of 2)

Consideration	Description
COST:	
Catalyst Replacement	Catalyst life varies depending on the application. Cost ranges from 20 to 40 percent of total capital cost and is the dominant annual cost factor.
Ammonia	Ratio of at least 1:1 NH_3 to NO_x generally needed to obtain high removal efficiencies. Special storage and handling equipment required.
Space Requirements	For new installations, space in the catalyst is needed for replacement layers. Additional space is also required for catalyst maintenance and replacement.
Backup Equipment	Reliability requirements necessitate redundant systems, such as ammonia control and vaporization equipment.
Catalyst Back Pressure Heat Rate Reduction	Addition of catalyst creates backpressure on theturbine, which reduces overall heat rate.
Electrical	Additional usage of energy to operate ammonia pumps and dilution fans.
TECHNICAL:	
Ammonia Flow Distribution	NH_3 must be uniformly distributed in the exhaust stream to assure optimum mixing with NO_x before to reaching the catalyst.
Temperature	The narrow temperature range that SCR systems operate within (i.e., about 100°F) must be maintained even during load changes. Operational problems could occur if this range is not maintained. HRSG duct firing requires careful monitoring.

Table 4-4. Cost, Technical, and Environmental Considerations of SCR Used on Combustion Turbines (Page 2 of 2)

Consideration	Description
Ammonia Control	Quantity of NH_3 introduced must be carefully controlled. With too little NH_3, the desired control efficiency is not reached; with too much NH_3, NH_3 emissions (referred to as slip) occur.
Flow Control	The velocity through the catalyst must be within a range to assure satisfactory residence time.
ENVIRONMENTAL:	
Ammonia Slip	NH_3 slip (NH_3 that passes unreacted through the catalyst and into the atmosphere) can occur if 1) too much ammonia is added, 2) the flow distribution is not uniform, 3) the velocity is not within the optimum range, or 4) the proper temperature is not maintained.
Ammonium Salts	Ammonium salts (ammonium sulfate and bisulfate) can lead to increased corrosion. These salts can occur when firing natural gas. These compounds are emitted as particulates.
Ammonia Transportation and Storage	Storage and handling of anhydrous ammonia produces additional environmental risks. Appropriate controls and contingency plans in the event of a release is required.

a zeolite catalyst is reported to range from about 800°F to 900°F. At temperatures of 1,000°F and above, the zeolite catalyst will be irreparably damaged. Therefore, application of an SCR system using a zeolite catalyst on a simple cycle operation is technically infeasible without exhaust gas cooling. Moreover, since zeolite catalysts have not been operated continuously in combustion exhausts greater than 900°F, the cooling system would have to reduce turbine exhaust temperatures about 200°F (i.e., to around 700°F).

Wet Injection--The injection of water or steam in the combustion zone of CTs reduces the flame temperature with a corresponding decrease of NO_x emissions. The amount of NO_x reduction possible depends on the combustor design and the water-to-fuel ratio employed. An increase in the water-to-fuel ratio will cause a concomitant decrease in NO_x emissions until flame instability occurs. At this point, operation of the CT becomes inefficient and unreliable, and significant increases in products of incomplete combustion will occur (i.e., CO and VOC emissions).

Dry Low-NO_x Combustor--In the past several years, CT manufacturers have offered and installed machines with dry low-NO_x combustors. These combustors, which are offered on machines manufactured by GE, Kraftwork Union, and ABB, can achieve NO_x concentrations of 25 ppmvd or less when firing natural gas. Thermal NO_x formation is inhibited by using combustion techniques where the natural gas and combustion air are premixed before ignition.

NO_xOUT Process--The NO_xOUT process originated from the initial research by the Electric Power Research Institute (EPRI) in 1976 on the use of urea to reduce NO_x. EPRI licensed the proprietary process to Fuel Tech, Inc., for commercialization. In the NO_xOUT process, aqueous urea is injected into the flue gas stream ideally within a temperature range of 1,600°F to 1,900°F.

In the presence of oxygen, the following reaction results:

$$CO(NH_2)_2 + 2NO + 1/2\ O_2 \dashrightarrow 2N_2 + CO_2 + 2H_2O$$

The amount of urea required is most cost-effective when the treatment rate is 0.5 to 2 moles of urea per mole of NO_x. In addition to the original EPRI urea patents, Fuel Tech claims to have a number of proprietary catalysts capable of expanding the effective temperature range of the reaction to between 1,600°F and 1,950°F. Advantages of the system are as follows:

1. Low capital and operating costs as a result of use of urea injection, and
2. The proprietary catalysts used are nontoxic and nonhazardous, thus eliminating potential disposal problems.

Disadvantages of the system are as follows:

1. Formation of ammonia from excess urea treatment rates and/or improper use of reagent catalysts, and
2. Sulfur trioxide (SO_3), if present, will react with ammonia created from the urea to form ammonium bisulfate, potentially plugging the cold end equipment downstream.

Commercial application of the NO_xOUT system is limited to three reported cases:

1. Trial demonstration on a 62.5-ton-per-hour (TPH) stoker-fired wood waste boiler with 60 to 65 percent NO_x reduction,
2. A 600×10^6 Btu CO boiler with 60 to 70 percent NO_x reduction, and
3. A 75-MW pulverized coal-fired unit with 65 percent NO_x reduction.

The NO_xOUT system has not been demonstrated on any combustion turbine/HRSG unit.

The NO_xOUT process is not technically feasible for the proposed project because of the high application temperature of 1,600°F to 1,950°F. The maximum exhaust gas temperature of the CT is about 1,000°F. Raising the exhaust temperature the required amount essentially would require installation of a heater. This would be economically prohibitive and would result in an increase in fuel consumption, an increase in the volume of gases that must be treated by the control system, and an increase in uncontrolled air emissions, including NO_x.

<u>Thermal $DeNO_x$</u>--Thermal $DeNO_x$ is Exxon Research and Engineering Company's patented process for NO_x reduction. The process is a high temperature selective noncatalytic reduction (SNCR) of NO_x using ammonia as the reducing agent. Thermal $DeNO_x$ requires the exhaust gas temperature to be above 1,800°F. However, use of ammonia plus hydrogen lowers the temperature requirement to about 1,000°F. For some applications, this must be achieved by additional firing in the exhaust stream before ammonia injection.

The only known commercial applications of Thermal $DeNO_x$ are on heavy industrial boilers, large furnaces, and incinerators that consistently produce exhaust gas temperatures above 1,800°F. There are no known applications on or experience with CTs. Temperatures of 1,800°F require alloy materials constructed with very large piping and components since the exhaust gas volume would be increased by several times. As with the NO_xOUT process, high capital, operating, and maintenance costs are expected because of construction-specified material, an additional duct burner system, and fuel consumption. Uncontrolled emissions would increase because of the additional fuel burning.

Thus, the Thermal $DeNO_x$ process will not be considered for the proposed project since its high application temperature makes it technically infeasible. The maximum exhaust gas temperature of a combustion turbine is typically about 1,000°F; the cost to raise the exhaust gas to such a high temperature is prohibitively expensive.

Nonselective Catalytic Reduction--Certain manufacturers, such as Engelhard, market a nonselective catalytic reduction system (NSCR) for NO_x control on reciprocating engines. The NSCR process requires a low oxygen content in the exhaust gas stream and high temperature (700°F to 1,400°F) in order to be effective. CTs have the required temperature but also have high oxygen levels (greater than 12 percent) and, therefore, cannot use the NSCR process. As a result, NSCR is not a technically feasible add-on NO_x control device for CTs.

Summary of Technically Feasible NO_x Control Methods--The available information suggests that SCR with dry low-NO_x combustor technology or with wet injection would produce the lowest NO_x emissions and is technically feasible. Dry low-NO_x combustion alone has increasingly been approved by regulatory agencies as BACT and is a technically feasible alternative for the project.

A technical evaluation of other tail gas controls (i.e., NO_xOUT, Thermal DeNO_x, and NSCR) indicates that these processes have not been applied to CT/HRSG and are technically infeasible for the project because of process constraints (e.g., temperature).

For the CT being considered for the project, the combustion chamber design includes the initial use of wet injection with a retrofit to dry low-NO_x/wet combustor technology. The NO_x emission level guaranteed by GE for the project is 25 ppmvd (corrected to 15 percent O_2) for wet injection and 15 ppmvd (corrected) for the retrofit.

For the BACT analysis, SCR with dry low-NO_x combustion is capable of achieving a NO_x emission level of 9 ppm when firing natural gas (corrected to 15 percent O_2 dry conditions). Combustion controls (i.e., wet injection and/or dry low-NO_x combustion) alone can achieve 25 ppmvd (corrected) and 15 ppmvd, respectively.

4.3.1.3 Impact Analysis

A BACT determination requires an analysis of the economic, environmental, and energy impacts of the proposed and alternative control technologies [see 40 CFR 52.21(b)(12), Chapter 17-2.100(25), F.A.C., and Chapter 17-2.500(5)(c), F.A.C.]. The analysis must, by definition, be specific to the project (i.e., case-by-case).

The BACT analysis was performed for the following alternatives:

1. SCR and combustion controls at an emission rate of approximately 9 ppmvd corrected to 15 percent O_2 when firing gas; and
2. Combustion controls (i.e., wet injection and/or dry low NO_x) at emission rates of 25 ppmvd corrected to 15 percent O_2 until December 31, 1997 and 15 ppmvd (corrected) thereafter.

The NO_x removed using SCR under this assumption would be 207 TPY when firing natural gas (i.e., at 25 ppmvd). After the first 2 years of operation (i.e., after 1 year of simple cycle operation), the emission rate would be reduced by 40 percent to 15 ppmvd. Under this operational scenario, approximately 120 TPY of NO_x would be removed with SCR. In order to calculate a cost effectiveness over a 20-year period (i.e., the basis for the economic analysis), the cost effectiveness was weight-adjusted by the number of years under the specific operation scenario; i.e., 2 years at 25 ppmvd and 17 years at 15 ppmvd--the first year would be operating on simple cycle.

<u>Economic</u>--The total capital and annualized costs for SCR are presented in Tables 4-5 and 4-6, respectively. The total annualized cost of applying SCR with dry low-NO_x combustion is $1,648,000. The incremental reduction in NO_x emissions is 207 TPY for the first 2 years of combined cycle operation and about 120 TPY thereafter. The incremental cost effectiveness of SCR over water injection is estimated to be $7,970/ton of NO_x removed for the first 2 years of combined cycle operation and $23,510/ton of NO_x removed thereafter. The average cost effectiveness over the initial 20-year period would be $21,900/ton of NO_x removed.

Table 4-5. Direct and Indirect Capital Cost for Selective Catalytic Reduction (SCR) (Page 1 of 4)

Cost Component	Estimated Cost ($)	Basis for Cost Estimate
<u>Direct Capital Costs</u>		
SCR Associated Equipment	559,200	Developed from manufacturer budget quotations[a]
Ammonia Storage Tank	138,400	Developed from manufacturer budget quotations[b]
HRSG Modification	243,600	Developed from manufacturer budget quotations[c]
<u>Indirect Capital Costs</u>		
Installation	351,100	20% of SCR associated equipment and catalyst[d]
Engineering, Erection Supervision, Startup, and O&M Training	248,800	10% SCR equipment and catalyst with contingency, ammonia storage tank, HRSG costs, installation labor[e]
Project Support	136,900	5% SCR equipment and catalyst with contingency, ammonia storage tank, HRSG engineering costs, and installation labor[f]
Ammonia Emergency Preparedness Program	19,200	Engineering estimate
Liability Insurance	13,700	0.5% SCR equipment and catalyst with contingency, ammonia storage tank, HRSG engineering costs and installation labor
Interest During Construction	436,100	15% of all direct and indirect capital costs, including catalyst cost[g]
Contingency	268,200	15% of all capital costs[h]
<u>Total Capital Costs</u>	2,415,300	Sum of all capital costs

Table 4-5. Direct and Indirect Capital Cost for Selective Catalytic Reduction (SCR) (Page 2 of 4)

Cost Component	Estimated Cost ($)	Basis for Cost Estimate
<u>Annualized Capital Costs</u>	283,700	Capital recovery of 10% over 20 years, 11.74% per year[i]
<u>Recurring Capital Costs</u>		
SCR Catalyst (Materials and Labor)	1,196,000	Developed from manufacturer budget quotations[j]
Contingency	179,400	15% of recurring capital costs[k]
<u>Total Recurring Capital Costs</u>	1,375,400	Sum of recurring capital costs
<u>Annualized Recurring Capital Costs</u>	553,100	Capital recovery of 10% over 3 years, 40.21% per year[l]

Note: HRSG = heat recovery steam generators.
SCR = selective catalytic reduction.

Footnotes for Table 4-5

Note: All calculations rounded to nearest 100.

a. Developed from various vendor data as an algorithim to account for mass flow (lb/hr) through HRSG.

The SCR associated cost is made up of 2 factors:

1. Catalyst Housing, vaporizer, and HRSG wash system is $98.7 per 1,000 lb/hr mass flow at ISO (59°F) conditions.

   $\$98.7 \times 996.7 \times 10^3$ lb/hr x 2CTs = $235,300

2. Control system costs = $362,500

   Total is $559,200

Table 4-5. Direct and Indirect Capital Cost for Selective Catalytic Reduction (SCR) (Page 3 of 4)

Cost Component	Estimated Cost ($)	Basis for Cost Estimate

Footnotes for Table 4-5 (continued)

b. Ammonia tank size is based on SCR size as follows:

$69.45/1,000 lb mass flow x 996.7 x 10^3 lb/hr x 2CTs = $138,400

c. HRSG modifications based on mass flow at $122.2 per 1,000 lb mass flow.

$122.22/$10^3$ lb x 996.7 x 10^3 lb/hr x 2 CTs = $243,600

d. From EPA OAQPS cost control manual

($559,200 + $1,196,000) x 0.2 = $351,100

e. From EPA OAQPS cost control manual

($559,200 + $138,400 + $1,196,000 + $243,600 + $351,100) x 0.10

= $248,800

f. Engineering estimate; same as engineering costs except use 0.05.

g. From OAQPS cost control manual and engineering estimate.

0.15 x ($559,200 + $138,400 + $243,600 + $351,100 + $248,800

+ $136,900 + $19,200 + $13,700 + $1,196,000) = $436,100

h. From EPA OAQPS cost control manual and engineering estimate

0.20 x ($559,200 + $138,400 + $243,600 + $351,100 + $248,800

+ $136,900 + $19,200 + $13,700 + $436,100 - (0.15 x 0.30

x $1,196,400)

= $268,200; note that the (0.15 x 0.30 x $1,196,400)

removes contingency for catalyst.

i. OAQPS cost control manual; standard statistical tables for 10% interest over 20 years

$2,415,300 x 0.1174 = $283,700

Table 4-5. Direct and Indirect Capital Cost for Selective Catalytic Reduction (SCR) (Page 4 of 4)

Cost Component	Estimated Cost ($)	Basis for Cost Estimate

Footnotes for Table 4-5 (continued)

j. Developed from manufacturer data at $0.6/lb mass flow:

$0.6 x 996,700 x 2 = $1,196,000

k. Same rationale as h:

0.25 x $1,196,000 = $179,400

l. Manufacturer guarantees of 3 years life or catalyst. Used OAQPS cost control manual interest of 10 percent over 3 years (40.21 percent per year):

0.4021 x $1,375,400 = $553,100

Table 4-6. Annualized Cost for Selective Catalytic Reduction (SCR) (Page 1 of 4)

Cost Component	Estimated Cost ($)	Basis for Cost Estimate
Direct Annual Costs		
Operating Personnel	15,600	16 hours/week @ $25/hour[a]
Ammonia	22,900	$300/ton; NH_3:NO_x = 1:1 volume[b]
Accident/Emergency Response Plan	8,100	Consultant estimate, 80 hours/year @ $75/hour plus expenses @ 35% labor[c]
Inventory Cost	46,800	Capital recovery (11.74%/year) for 1/3 of catalyst cost[d]
Catalyst Disposal Cost	55,400	Engineering estimate[e]
Contingency	43,900	25% of indirect costs[f]
Energy Costs		
Electrical	35,000	80 kWh/hr; $0.05/kWh[g]
Heat Rate Penalty	173,000	4" back pressure, heat rate reduction of 0.5%, energy loss at $0.05/kWh[h]
MW Loss Penalty	167,800	84 MW lost for 3 days; lost capacity @ $0.05/kW; cost of natural gas @ $2.25/MMBtu subtracted[i]
Fuel Escalation Costs	94,600	Real cost increase of fuel [j]
Contingency	45,400	15% of energy costs; excludes fuel escalation[k]
Total Direct Annual Costs	708,500	Sum of all direct annual costs

Table 4-6. Annualized Cost for Selective Catalytic Reduction (SCR)
(Page 2 of 4)

Cost Component	Estimated Cost ($)	Basis for Cost Estimate
<u>Indirect Annual Costs</u>		
Overhead	26,900	60% of ammonia and 115% of O&M labor, and 15% of O&M labor (OAQPS Cost Control Manual)[l]
Property Taxes and Insurance	75,800	2% of total capital costs[m]
Annualized Capital Costs	283,700	Capital recovery of 10% over 20 years, 11.74% per year (from Table 4-5)
Recurring Capital Costs	553,100	Capital recovery of 10% over 3 years, 40.21% per year (from Table 4-5)
<u>Total Indirect Annual Costs</u>	939,500	Sum of all indirect annual costs
<u>Total Annual Costs</u>	1,648,000	Total annualized cost[n]

Note: All calculations rounded to the nearest $100.

kW = kilowatt.
kWh = kilowatt-hour.
kWh/hr = kilowatt-hour per hour.
MM/Btu = million British thermal units.
NH_3 = ammonia.
NO_x = nitrogen oxides.
O&M = operation and maintenance.

Footnotes for Table 4-6

Note: all calculations rounded to nearest 100

a. Engineering Estimate:

12 hours/week x 52 weeks/year x $25/hour = $15,600

b. Delivered cost of ammonia at $300/ton

207 TPY removed x $300 x 17/46 (molecular weight of ammonia to NO_x)

= 22,900

Table 4-6. Annualized Cost for Selective Catalytic Reduction (SCR) (Page 3 of 4)

Cost Component	Estimated Cost ($)	Basis for Cost Estimate

Footnotes for Table 4-6 (continued)

c. 80 hours/yr x $75 x 1.35 = $8,100

d. Required to purchase and store 1/3 of a catalyst for replacement or required.

$1,196,000 x 0.1174 (20 years @ 10 percent) + 3 = $46,800

e. Estimated as $27.77/1,000 lb mass flow; based on catalyst volume.

$27.77 x 996.7 (1,000 lb mass flow) x 2CTs = $55,400

f. OAQPS cost control manual background documents

0.25 x ($15,600 + $22,900 + $8,100 + $46,800 + $55,400) = $43,900

g. 40 kWh/hr per system; 2 CTs; $0.05/kWh is cost of estimated energy:

40 kWh/hr x $8,760 hr/yr x $0.08/kWh x 2 CTs = $35,000

h. 4" back pressure from SCR manufacturer; 0.8 percent energy loses from general CT performance curver; 39.49 MW power per CT rating at 150 (59°F) conditions.

39.49 MW x 0.005 x 8,760 hrs/yr x 1,000 kW/mw x $0.05/kWh x 2CTs = $173,000

i. 3 days required to change catalyst or maintenance; saving in gas usage subtracted

39.49 MW x 3 days x 24 hours x $0.05/kWh x 1,000 MWh x 2CTs
- (359.8 x 10^6 Btu/hr x 2CTs x 3 days x 24 hours x $2.25/$10^6$ Btu)
= $167,800

j. Escalation of fuel costs over inflation; 3 percent over 20 years; factor calculated as 0.454565; applies to electrical and heat rate costs only:

0.454565 x ($35,000 + $167,800) = $94,600

k. OAQPS cost control manual background documents

0.15 x ($35,000 + $167,800 x $ 173,000) = $45,400

l. 0.6 ($22,900 + 1.15 x $15,600) + 0.15 x $15,600 = $26,900

Table 4-6. Annualized Cost for Selective Catalytic Reduction (SCR)
(Page 4 of 4)

Cost Component	Estimated Cost ($)	Basis for Cost Estimate

Footnotes for Table 4-6 (continued)

m. From OAQPS cost control manual

0.02 x ($2,415,300 + $1,375,400) = $75,800

n. Total direct annual costs plus total indirect annual costs:

$811,200 + $939,500 = $1,648,000

Environmental--The maximum predicted impacts of the alternative technologies are all considerably below the PSD increment for NO_x of 25 $\mu g/m^3$, annual average, and the AAQS for NO_x, 100 $\mu g/m^3$. Indeed, the impacts are less than the significant impact levels. Additional controls beyond wet/dry low-NO_x combustors (i.e., SCR and SCR with water injection) would further reduce predicted impacts by much less than 1 percent of the PSD increment and the AAQS for the project.

The use of wet/dry low-NO_x combustor technology is truly "pollution prevention". In contrast, use of SCR on the proposed project will cause emissions of ammonia and ammonium salts, such as ammonium sulfate and bisulfate. Ammonia emissions associated with SCR are expected to be 10 ppm based on reported experience; previous permit conditions have specified this level. Ammonia emissions could be as high as 53 TPY. Potential emissions of ammonium sulfate and bisulfate will increase emissions of PM10; up to 13.4 TPY could be emitted.

The electrical energy required to run the SCR system and the back pressure from the turbine will generate secondary emissions since this lost energy will necessitate additional generation. These emissions, coupled with potential emissions of ammonia and ammonium salts, are presented in Table 4-7, which shows the emissions balance for the project with and without SCR. Emissions of carbon dioxide were included in this table since this gas is under study as required in the 1990 Clean Air Act Amendments. As noted from this table, the emissions would be greater with SCR than that proposed using wet/dry low-NO_x combustion technology. Indeed, when emissions of CO_2 are included, the environmental impacts favor the use of combustion controls.

The replacement of the SCR catalyst will create additional environmental impacts since certain catalysts contain materials that are listed as hazardous chemical wastes under Resource Conservation and Recovery Act (RCRA) regulations (40 CFR 261).

Table 4-7. Comparison of NO_x Emissions for Combustion Turbines

Type of CT	Size (MW)	Rate NO_x Emissions @ 25 ppm (Btu/kwh)	(lb/hr)	(lb/MW)	Increase From LM6000	Equivalent Emission (ppm)	Equivalent Emission (ppm)
GE 7EA	82.0	10,590	87.8	1.07	16.4%	25.0	15
GE 7FA	151.9	9,750	148.5	0.98	6.4%	22.8	13.7
GE LM6000	39.5	9,111	36.3	0.92		21.5	12.9

Source: GE Data Sheets for the CT listed. All data at ISO conditions except for GE 7FA which was for 64°F.

The use of ammonia is necessary for the reduction of NO_x emissions by means of a catalytic reaction. This process will require the construction and maintenance of storage vessels of anhydrous or aqueous ammonia for use in the reaction. Ammonia has a number of potential health effects, and the construction of ammonia storage facilities triggers the application of at least three major standards: Clean Air Act (section 112), OSHA 29 CFR 1910.1000, and OSHA 29 CFR 1910.119.

Ammonia is a colorless gas with a sharp, pungent odor which can be identified at about 5 ppm. It is lighter than air and very soluble in water. Other chemical and physical properties include:

Molecular weight - 17.03
Density (gas) - 0.5967, (liquid) 0.67
Boiling point - (-33.35°C)
Freezing point - (-77.7°C)
Vapor pressure(liquid) - 8.5 atmospheres at 20°C
Solubility - very soluble in water, alcohol, and ether
Flammable limits in air - LEL 15 percent, UEL 28 percent

Elevated temperatures may contribute to instability and cause containers to burst. Ammonia is incompatible with strong oxidizers, calcium, hypochlorite bleaches, gold, mercury, halogens, and silver. Liquid ammonia will corrode some forms of plastic, rubber, and coatings.

The toxicology of ammonia is well understood from a variety of animal and human studies. Ammonia is a severe irritant of the eyes, especially the cornea, the respiratory tract, and the skin. It is detectable at about 5 ppm and causes respiratory irritation in humans above 25 ppm. The irritating effects of ammonia are less noticeable with chronic exposure. There is at least one reference in the literature that indicates exposure to ammonia and amines increases the incidence of cancer.

The eyes are generally the organ of most concern in an acute exposure. As a strong alkali, ammonia can cause severe burns of the cornea and the effects are often delayed. Even burns that at the time of injury appear to be mild can go on to opacification, vascularization, and ulceration or perforation. Of all the alkali compounds that cause eye damage, ammonia penetrates the cornea the most rapidly, resulting in potentially severe damage to the cornea.

Because ammonia is very soluble in water, it is irritating to the upper respiratory tract. Inhalation of the gas will cause throat and nose irritation and dyspnea as aqueous ammonia is formed. Liquid anhydrous ammonia will cause first and second degree burns on contact with the skin. Standards applicable to ammonia are listed below:

OSHA--35 ppm as a 15-minute short-term exposure limit (STEL), 29 CFR 1910.1000.

ACGIH/NIOSH--25 ppm as an 8-hour TWA, 35 ppm as a 15-minute STEL.

NIOSH has also established an immediately dangerous to life or health (IDLH) recommendation of 500 ppm. The U.S. Navy has established a limit of 25 ppm for continuous exposure to personnel in submarines.

Employee exposure to ammonia should be measured on a regular basis to assure compliance with the applicable standards and verify that the protective equipment chosen is effective. Monitoring should follow the procedures outlined in the NIOSH Manual of Analytical Methods, Number 6701. Air-purifying respirators may be used if concentrations do not exceed 250 ppm. If concentrations exceed 250 ppm, a supplied air system must be used to provide maximum protection. The use of any respirator requires the implementation of a respiratory protection program in compliance with 29 CFR 1910.134.

Protective clothing should be provided to employees if there is any chance of skin or eye contact with solutions of more than 10 percent ammonia. Protective clothing includes goggles or face shields for face and eye protection and impervious clothing. Facilities should be provided for quick drenching of the skin and eyes of employees exposed to ammonia.

The utilization of ammonia will require the installation of one or more pressure vessels (anhydrous ammonia) or atmospheric tanks (aqueous ammonia). OSHA, in 29 CFR 1910.119, requires a stringent process safety review if 10,000 pounds of anhydrous ammonia or 15,000 pounds of aqueous ammonia (> 44 percent ammonia by weight) is stored in one location at the site. Compliance with the standard requires the preparation of a process safety analysis that is updated every 5 years. Other major requirements include: written operating procedures, employee training, pre-startup review, mechanical integrity checks, hot work permit system, incident investigation (releases), emergency action plan, and a compliance audit every 3 years.

Section 112 of the 1990 Clean Air Act Amendments proposes to regulate a number of highly toxic substances. Anhydrous and aqueous ammonia are both listed as compounds that may cause a threat to the public if released to the atmosphere. Regulated facilities must prepare a risk management plan which shall include a hazard assessment to predict the effect of any release. Other requirements include the development of worst-case release scenarios, training, monitoring, and actions to be taken in the event of a spill.

Energy--Energy penalties will occur with all control alternatives evaluated. However, significant energy penalties occur with SCR. With SCR, the output of the CT is reduced by about 0.50 percent over that of wet injection. This penalty is the result of the SCR pressure drop, which would be about 4 inches of water and would amount to about 3,460,000 kilowatt hours (kWh) in potential lost generation per year. The energy required by the SCR equipment would be about 700,800 kilowatt hours per year (kWh/yr). Taken together, the lost generation and energy requirements of SCR could supply the electrical needs of 300 residential customers. To replace this lost energy, an additional 4×10^{10} British thermal units per year (Btu/yr) or about 40 million cubic feet per year (ft^3/yr) of natural gas would be required.

Technology Comparison--The project will use an advanced air craft derivative gas turbine with wet/dry low-NO_x combustors. This type of machine advances the state-of-the-art for CTs by being more efficient and less polluting than previous CTs. Integral to the machine's design will be wet injection with retrofitting dry low-NO_x combustors that prevent the formation of air pollutants within the combustion process, thereby eliminating the need for add-on controls that can have detrimental effects to the environment. An analogy of this technology is a more efficient automotive engine that gives better mileage and reduces pollutant formation without the need of a catalytic converter.

The LM6000 machine is unique from an engineering perspective in two ways. First, the combination of advanced aircraft derivative compressor and turbine sections results in a more thermally efficient machine with a heat rate of 9,111 Btu/kWh at ISO conditions. In contrast, large industrial combustion turbines have heat rates between 10,600 Btu/kWh (conventional) and 9,800 Btu/kWh (advanced frame). This has the added advantage of producing lower air pollutant emissions (e.g., NO_x, PM, and CO) for each MW generated.

The second unique attribute of the proposed CT will be the use of wet/dry low-NO_x combustors that will reduce NO_x emissions to 15 ppmvd corrected to 15 percent oxygen by December 31, 1997. Thermal NO_x formation is inhibited by using staged combustion techniques where the natural gas and combustion air are premixed prior to ignition. This level of control has never before been achieved in an advanced CT and will result in emissions of less than 0.1 $lb/10^6$ Btu, which is more than two times lower than emissions from conventional steam generators.

Since the purpose of the project is to produce electrical energy, and combustion turbine technology is rapidly advancing, it is appropriate to compare the proposed emissions on an equivalent generation basis to that of a conventional CT and advanced CT. The heat rate of an advanced GE Frame

7FA will be 9,750 Btu/kWh at ISO conditions, and the heat rate for the conventional GE Frame 7EA is 10,590 Btu/kWh (see Table 4-7).

Therefore, the NO_x emissions for the LM6000 will be 16 percent less than a conventional CT and 6 percent less than an advanced CT for the same amount of generation.

4.3.1.4 Proposed BACT and Rationale

The proposed BACT for the project is wet and dry low-NO_x combustion technology. When firing natural gas, the proposed NO_x emissions level using this technology is initially 25 ppmvd (corrected to 15 percent oxygen) for the first 2 years of combined cycle operation and 15 ppmvd (corrected) thereafter. This control technology is proposed for the following reasons:

1. SCR was rejected based on technical, economic, environmental, and energy grounds. The estimated incremental cost of SCR is more than $20,000 per ton of NO_x removed. These costs are clearly above the range for other projects that have rejected SCR as unreasonable. This is even more apparent if additional pollutant emissions due to SCR are considered (refer to Table 4-8). SCR is not cost effective when the emissions (exclusive of CO_2) are considered.
2. Additional environmental impacts would result from SCR operation, including emissions of ammonia; from secondary generations (to replace the lost generation); and from the generation of hazardous waste (i.e., spent catalyst replacement).
3. The energy impacts of SCR will reduce potential electrical power generation by more than 4 million kWh.
4. The proposed BACT (i.e, wet and dry low-NO_x combustion) provides the most cost effective control alternative and results in low environmental impacts (less than the significant impact levels). Wet/dry low-NO_x combustion at the proposed emissions levels has been adopted previously in BACT determinations. In addition, CT

Table 4-8. Maximum Potential Emission Differentials TPY With and Without Selective Catalytic Reduction

	Project With SCR			Project Without SCR	
Pollutants	Primary	Secondary[a]	Total	CT/DB	Difference[b]
Particulate	13.4 [c]	2.1	15.5	0	15.5
Sulfur Dioxide	0	23.1	23.1	0	23.1
Nitrogen Oxides	120.0 [d]	11.5	131.5	204.3 [e]	(-72.8)
Carbon Monoxide	0	0.7	0.7	0	0.7
Volatile Organic Compounds	0	0.1	0.1	0	0.1
Ammonia	52.7 [f]	0.00	52.7	0	52.7
Total	186.1	37.5	223.6	204.3	19.3
Carbon Dioxide[g]	--	3,606	3,606	--	3,606

Note:
Btu/kWh = British thermal units per kilowatt-hour.
CT = combustion turbine.
DB = duct burner.
MW = megawatt.
% = percent.
SCR = selective catalytic reduction.
TPY = tons per year.

[a] Lost energy of 0.48 MW from heat rate penalty and electrical for 8,760 hours per year operation (0.5% of 79.88 MW plus 0.080 MW). Assumes Florida Power Corp. baseloaded oil-fired unit would replace lost energy. EPA emission factors used for 1% sulfur fuel oil and an assumed heat rate of 10,000 Btu/kWh. Emission factors use were (lb/10^6 Btu): PM = 0.1; SO_2 = 1.1; NO_x = 0.55, CO = 0.033 and VOC = 0.005. Example calculation for PM: 0.48 MW x 10,000 Btu/kwh x 1,000 kw/MW x 8,760 hr/yr x 0.1 lb PM/10^6 Btu + 2,000 lb/ton = 2.10 TPY.

[b] Difference = Total with SCR minus project without SCR.

[c] Assume sulfur reacts with ammonia; 17 TPY H_2SO_4 x 132 (MW of ammonia salt) + 98 (MW of H_2SO_4).

[d] 9 ppm NO_x emissions on gas.

[e] Weighted average emission; 25 ppm for first 2 years and 15 ppm for 17 years.

[f] 10 ppm ammonia slip (ideal gas law at actual flow rate from stack): 292,495 acfm/CT x 60 m/hr x 10 ppm/10^6 x 2,116.8 lb/ft^2 + 1,545 x 17 (molecular weight of NH_3) + (460 + 220) x 8,760 + 2,000 x 2 CTs.

[g] Reflects differential emissions due to lost energy efficiency with SCR (i.e., 0.48 MW CO_2 calculated based on 85.7% carbon in fuel oil and 18,300 Btu/lb).

manufacturers have been willing to guarantee this level of NO_x emissions.

4.3.2 CARBON MONOXIDE

4.3.2.1 Emission Control Hierarchy

CO emissions are a result of incomplete or partial combustion of fossil fuel. Combustion design and catalytic oxidation are the control alternatives that are viable for the project. Table 4-9 presents a listing of LAER/BACT decisions for CO emissions from combustion turbines. Combustion design is the more common control technique used in CTs. Sufficient time, temperature, and turbulence is required within the combustion zone to maximize combustion efficiency and minimize the emissions of CO. Combustion efficiency is dependent upon combustor design. For the CT being evaluated, CO emissions will not exceed 30 ppmvd, corrected to dry conditions when firing natural gas under full load conditions.

Catalytic oxidation is a post-combustion control that has been employed in CO nonattainment areas where regulations have required CO emission levels to be less than those associated with wet injection. These installations have been required to use LAER technology and typically have CO limits in the 10 ppm range (corrected to dry conditions).

4.3.2.2 Technology Description

In an oxidation catalyst control system, CO emissions are reduced by allowing unburned CO to react with oxygen at the surface of a precious metal catalyst, such as platinum. Combustion of CO starts at about 300°F, with efficiencies above 90 percent occurring at temperatures above 600°F. Catalytic oxidation occurs at temperatures 50 percent lower than that of thermal oxidation, which reduces the amount of thermal energy required. For CTs, the oxidation catalyst can be located directly after the CT. Catalyst size depends upon the exhaust flow, temperature, and desired efficiency. The existing oxidation catalyst applications primarily have been limited to smaller cogeneration facilities burning natural gas.

Table 4-9. Summary of BACT Determinations for CO from Gas-Fired Turbines (Page 1 of 2)

Company Name	State	Date of Permit	Unit/Process Description	Capacity (Size)	CO Emission Limit				Control Method	Eff. (%)
					(lb/MMBtu)	(lb/hr)	(TPY)	(ppmvd basis)		
Tiger Bay Cogen	FL	May-93	GE FA	206 MW	--	48.8	213.7	15 @ 15% O_2	Proper combustion	--
Central Florida Cogen	FL	Nov-92	GE EA	126 MW	--	42.9	187.8	20 @ 15% O_2	Efficient combustion	--
University of Florida Cogen	FL	Aug-92	GE LM6000	43 MW	--	38.8	158	42 @ 15% O_2	--	--
Bermuda Hundred Energy	VA	Mar-92	Gas Turbine	1175 MMBtu/hr	62	--	--	--	Furnace Design	
Bermuda Hundred Energy	VA	Mar-92	Gas Turbine	1117 MMBtu/hr	62	--	--	--	Furnace Design	
Southern California Gas	CA	Oct-91	GT Solar Model H	47.64 MMBtu/hr	--	--	--	7.74 ppm @ 15%	High Temp Oxidation Catalyst	--
El Paso Natural Gas	AZ	Oct-91	GT Solar Centaur H	5500 HP	--	--	--	10.5 ppm @ 15%	Lean Fuel Mix	--
El Paso Natural Gas	AZ	Oct-91	GE Gas Turbine	12000 HP	--	--	--	60	Lean Burn	--
Lake Cogen	FL	Nov-91	Combined Cycle	120 MW	--	--	--	42	78 ppmvd for oil firing	--
Pasco Cogen	FL	Nov-91	Combined Cycle	120 MW	--	--	--	42	78 ppmvd for oil firing	--
Florida Power Corporation	FL	Sep-91	Simple Cycle	552 MW	--	--	--	--	25 ppmvd for oil firing	--
Enron Louisana Energy Co	LA	Aug-91	Gas Turbines (2)	78.2 MMBtu/hr	--	5.8	--	60 @ 15% O_2	Base Case, No Additional Control	--
Sumas Energy, Inc.	WA	Jun-91	Gas Turbine	80 MW	--	--	--	6 @ 15% O_2	CO Catalyst	80.00
Florida P&L Co. (Martin)	FL	Jun-91	Combined Cycle	860 MW	--	--	--	30	33 ppmvd for oil firing	--
Commonwealth Atlantic LTD Partn.	VA	Mar-91	Gas Turbine	1533 MMBtu/hr	--	--	261	30	Combustion control	--
Commonwealth Atlantic LTD Partn.	VA	Mar-91	Gas Turbine	1400 MMBtu/hr	--	--	261	30	Combustion control	--
Florida P&L Co. (Ft. Lauderdale)	FL	Mar-91	Combined Cycle	860 MW	--	--	--	30	33 ppmvd for oil firing	--
Hardee Power Station	FL	Dec-90	Combined Cycle	660 MW	--	--	--	10	26 ppmvd for oil firing	--
March Point Cogen	WA	Oct-90	Turbine	80 MW	--	--	--	37 @ 15% O_2	Combustion Control	--
Delmarva Power Corporation	DE	Sep-90	Combined Cycle	450 MW	--	--	--	15 ppm	Good Combustion	--
Doswell Limited Partnership	VA	May-90	Turbine	1,261 MMBtu/hr	--	25	--	--	Combustor Design & Operation	--
Fulton Cogeneration Assoc.	NY	Jan-90	GE LM5000	500 MMBtu/hr	0.02	--	--	--	--	--
Arrowhead Cogeneration	VT	Dec-89	Gas Turbine	282.0 MMBtu/hr	--	--	--	50 @ ISO Cond & 12% O_2	Design & Good Combustion Techniques	--
JMC Selkirk, Inc.	NY	Nov-89	GE Frame 7	80 MW	--	--	--	25 ppm	Combustion Control	--
Capitol District NRG Ctr	CT	Oct-89	Gas Turbine	738.8 MMBtu/hr	0.112	--	--	--	--	--
Panda-Rosemary Corp.	NC	Sep-89	GE Frame 6	499 MMBtu/hr	0.022	10.8	--	--	Combustion Control	--
Kamine Syracuse Cogen	NY	Sep-89	Turbine	79 MW	0.028	--	--	--	Combustion Control	--
Tropicana Products, Inc.	FL	May-89	Gas Turbine	45.40 MW	--	--	--	10 @ 15% O_2	--	--
Empire Energy - Niagara Cogen	NY	May-89	GE Frame 6 (3)	1,248 MMBtu/hr	0.024	--	--	--	Combustion Control	--
Megan-Racine Assoc.	NY	Mar-89	GE LM 5000	430 MMBtu/hr	0.026	--	--	--	Combustion Control	--
Indec/Oswego Hill Cogen	NY	Feb-89	GE Frame 6	40 MW	0.022	--	--	--	Combustion Control	--
Pawtucket Power	RI	Jan-89	Turbine	58 MW	--	--	--	23 @ 15% O_2	--	--
Ocean State Power	RI	Jan-89	Combine Cycle	500 MW	--	--	--	25 @ 15% O_2	--	--
Champion International	AL	Nov-88	Gas Turbine	35 MW	--	9	--	--	--	--
Long Island Lighting Co	NY	Nov-88	Peaking Units (3)	75 MW	--	--	--	10 ppm	Combustion Control	--
Amtrak	PA	Oct-88	Turbine (2)	20 MW	--	30.76	--	--		
Kamine South Glens Falls	NY	Sep-88	GE Frame 6	40 MW	0.021	--	--	--	Combustion Control	--

Table 4-9. Summary of BACT Determinations for CO from Gas-Fired Turbines (Page 2 of 2)

Company Name	State	Date of Permit	Unit/Process Description	Capacity (Size)	CO Emission Limit				Control Method	Eff. (%)
					(lb/MMBtu)	(lb/hr)	(TPY)	(ppmvd basis)		
Orlando Utilities	FL	Sep-88	Gas Turbine (2)	35 MW	--	--	--	10 @ 15% O_2	Combustion Control	--
Delmarva Power Corporation	DE	Aug-88	Turbine (2)	200 MW	--	--	--	15 ppm	Good Combustion	--
Kamine Carthage	NY	Jul-88	GE Frame 6	40 MW	0.022	--	--	--	Combustion Control	--
ADA Cogeneration	MI	Jun-88	Turbine	245.0 MMBtu/hr	0.1	--		--	Water Injection	--
CCF-1 Jefferson Station	CT	May-88	Gas Turbines (2)	110 MMBtu/hr	0.605	--	--	--	--	--
TBG/Grumman	NY	Mar-88	Gas Turbine	16 MW	0.181	--	--	--	CO Catalyst	80.00
Midland Cogeneration Venture	MI	Feb-88	Turbines (12)	984.2 MMBTU/hr	--	26	--	--	Turbine Design	--
Midway-Sunset Cogen	CA	Jan-88	GE Frame 7 (3)	75 MW	--	94	--	--	Proper Combustion	--
Downtown Cogeneration Assoc.	LA	Aug-87	Gas Turbine	71.9 MMBtu/hr	0.048	--	--	--	--	--
San Joaquin Cogen Limited	CA	Jun-87	Gas Turbine	48.6 MW	--	55.25	--	55 @ 15% O_2	Combustion Control	--
Cogen Technologies	NJ	Jun-87	GE Frame 6 (3)	40 MW	--	--	--	50 @ 15% O_2	--	--
Pacific Gas Transmission	OR	May-87	Gas Turbine	14,000 HP	--	6	25	--	--	--
Alaska Elect. Gen. & Trans.	AK	Mar-87	Gas Turbine	80 MW				109 lb/acf fuel	Water Injection	--
Sycamore Cogen	CA	Mar-87	Gas Turbine	75 MW	--	--	--	10 @ 15% O_2	CO Catalyst & Comb. Control	--
PG&E, Station T	CA	Aug-86	GE LM5000	396 MMBTU/hr	--	--	--	--	CO Catalyst (No limit indicated)	--
Formosa Plastic Corp.	TX	May-86	GE MS 6001	38.4 MW	--	--	32.4	--	--	--

Oxidation catalysts have not been used on fuel-oil-fired CTs or combined cycle facilities. The use of sulfur-containing fuels in an oxidation catalyst system would result in an increase of SO_3 emissions and concomitant corrosive effects to the stack. In addition, trace metals in the fuel could result in catalyst poisoning during prolonged periods of operation.

Since the units likely will require numerous startups, variations in exhaust conditions will influence catalyst life and performance. Very little technical data exist to demonstrate the effect of such cycling.

The lack of demonstrated operation with oil firing suggests rejection of catalytic oxidation as a technically feasible alternative. However, the advent of a second generation catalyst suggests that an oxidation catalyst could be used.

Combustion design is dependent upon the manufacturer's operating specifications, which include the air-to-fuel ratio and the amount of water injected. The CTs proposed for the project have designs to optimize combustion efficiency and minimize CO emissions. Installations with an oxidation catalyst and combustion controls generally have controlled CO levels of 10 ppm as LAER and BACT.

For the project, the following alternatives were evaluated for natural gas firing as BACT:

1. Oxidation catalyst at 10 ppmvd; maximum annual CO emissions are 78 TPY;
2. Combustion controls; maximum annual CO emissions are 236 TPY.

4.3.2.3 Impact Analysis

Economic--The estimated annualized cost of a CO oxidation catalyst is $834,700 (Table 4-10), with a cost effectiveness of over $5,280/ton of CO removed. The cost effectiveness is based on natural gas firing at

Table 4-10. Capital and Annualized Cost for Oxidation Catalyst

Cost Component	Cost ($)	Basis
I. CAPITAL COSTS		
A. DIRECT:		
1. Associated Equipment for Catalyst	145,400	Manufacture Estimate - $1,750 per lb/sec mass flow
2. HRSG Modification	138,400	Engineering Estimate
3. Installation	276,900	25% of Equipment Costs (I.A.1. & 2., and II.A.)
B. INDIRECT:		
1. Engineering & Supervision	83,100	7.5% of Equipment Costs (I.A.1. & 2., and II.A.)
2. Construction and Field Expense	110,700	10% of Equipment Costs (I.A.1. & 2., and II.A.)
3. Construction Contractor Fee	55,400	5% of Equipment Costs (I.A.1. & 2., and II.A.)
4. Startup & Testing	22,100	2% of Equipment Costs (I.A.1. & 2., and II.A.)
5. Contingency	124,800	25% of Direct and Indirect Capital Costs (I.A, and I.B.1-4)
6. Interest During Construction	267,100	15% of Direct and Indirect Capital Costs, and Recurring Capital Costs (I.A., I.B.1.-4 and II.A.)
TOTAL CAPITAL COSTS	1,223,800	Sum of Direct and Indirect Capital Costs
ANNUALIZED CAPITAL COSTS	143,800	Capital Recovery of 10% over 20 years
II. RECURRING CAPITAL COSTS		
A. Catalyst	823,700	Manufacture Estimate - $1,750 per lb/sec mass flow
B. Contingency	123,500	25% of Recurring Capital Costs (II.A)
TOTAL RECURRING CAPITAL COSTS	947,200	Sum of Recurring Capital Costs
ANNUALIZED RECURRING CAPITAL COSTS	380,900	Capital Recovery of 10% over 20 years
III. ANNUALIZED COST		
A. DIRECT:		
1. Labor - Operator & Supervisor	5,300	4 hours/week, 52 weeks/year, $22/hour and 15% supervisor cost
2. Maintenance	10,900	0.5% of Total and Recurring Capital Costs
3. Inventory Cost	32,200	Capital Carrying cost (10% over 20 years) for catalyst for 1 CT
B. ENERGY COSTS		
1. Heat Rate Penalty	69,200	0.2% heat rate penalty. $50/MW energy loss
2. MW Loss Penalty (catalyst changeout)	43,000	Loss of 84.43 MW for one day; cost of natural gas at $\$3/10^6$ Btu deducted from cost
3. Fuel Escalation Costs	31,500	Fuel escalation of 3% over inflation; annualized over 20 years
4. Contingency	21,500	25% of energy costs
C. INDIRECT:		
1. Overhead	9,700	60% of Labor and Maintenance Costs (III.A.1. and 2.)
2. Property Taxes	21,700	1% of Total and Recurring Capital Cost
3. Insurance	21,700	1% of Total and Recurring Capital Cost
4. Administration	43,400	2% of Total and Recurring Capital Cost
Annualized Capital Costs	143,800	
Annualized Recurring Capital Costs	380,900	
TOTAL ANNUALIZED COSTS	834,700	Sum of Operating and Maintenance and Annualized Capital Costs

Note: All calculations using machine performance were based on 59°F conditions.
Assumptions based on percentage of costs were adapted from EPA OAQPS Control Cost Manual (1990).

10 ppmvd. No costs are associated with combustion techniques since they are inherent in the design.

Environmental--The air quality impacts of both oxidation catalyst control and combustion design control techniques are below the significant impact levels for CO. Therefore, no significant environmental benefit would be realized by the installation of a CO catalyst.

Energy--An energy penalty would result from the pressure drop across the catalyst bed. A pressure drop of about 2 inches water gauge would be expected. At a catalyst back pressure of about 2 inches, an energy penalty of about 1,730,000 kWh/yr would result at 100 percent load. This energy penalty is sufficient to supply the electrical needs of about 120 residential customers over a year. To replace this lost energy, about 1.7×10^{10} Btu/yr or about 17 million ft^3/yr of natural gas would be required.

4.3.2.4 Proposed BACT and Rationale

Combustion design is proposed as BACT as a result of the technical and economic consequences of using catalytic oxidation on CTs. Catalytic oxidation is considered unreasonable for the following reasons:

1. Catalytic oxidation will not produce measurable reduction in the air quality impacts; and
2. The economic impacts are significant (i.e., an annualized cost of about $34,700 with a cost effectiveness of over $5,280/ton of CO removed).

Combustion design is proposed as BACT as a result of the technical and economic consequences of using catalytic oxidation on CTs. Catalytic oxidation is considered unreasonable since it will not lower CO emissions substantially and will not produce a measurable reduction in the air quality impacts. Indeed, recent BACT decisions for combustion turbines have set limits in the 30 ppmvd range. The cost of an oxidation catalyst would be significant and not cost-effective given the proposed emission limit of 30 ppmvd for the CT when firing natural gas.

4.3.3 VOLATILE ORGANIC COMPOUNDS

VOCs will be emitted by the CT and are a result of incomplete combustion. The proposed BACT for VOC emissions will be the use of combustion technology and the use of clean fuels so that emissions will not exceed 10 ppmvd when firing natural gas. This emission level is similar to the BACT emission levels established for other similar sources. Combustion controls and the use of clean fuels have been overwhelmingly approved as BACT for CTs. The proposed VOC emission limits for the CT are in the range approved for other similar sources. The environmental effect of reduced emissions would not be significant.

4.3.4 OTHER REGULATED AND NONREGULATED POLLUTANT EMISSIONS

The PSD source applicability analysis shows that the PSD significant emissions level is exceeded for PM/PM10 requiring PSD review (including BACT) for these pollutants. The emission of particulates from the CT is a result of incomplete combustion and trace solids in the fuel. The design of the CT ensures that particulate emissions will be minimized by combustion controls and the use of clean fuels. A review of EPA's BACT/LAER Clearinghouse Documents did not reveal any post-combustion particulate control technologies being used on a gas-fueled CT.

The maximum particulate emissions from the CT will be lower in concentration than that normally specified for fabric filter designs {i.e., the grain loading associated with the maximum particulate emissions [about 5 pounds per hour (lb/hr)]} is less than 0.01 grain per standard cubic foot (gr/scf), which is a typical design specification for a baghouse. This further demonstrates that no further particulate controls are necessary for the proposed project.

Therefore, there are no technically feasible methods for controlling the emissions of these pollutants from CTs, other than the inherent quality of the fuel. Natural gas represents BACT for this pollutant.

For the nonregulated pollutants, none of the control technologies evaluated for other pollutants (i.e., SCR) would reduce such emissions; in fact, SCR would tend to increase emissions. Thus, natural gas represents BACT because of its inherent low contaminant content.

4.4 BEST AVAILABLE CONTROL TECHNOLOGY - AUXILIARY BOILER

As discussed in Section 2.0, the proposed Orange Cogeneration facility will include a natural gas-fired auxiliary boiler with a maximum heat input capability of 100 mmBtu/hr. The auxiliary boiler will be used to provide supplemental steam to the steam electric turbine and the Orange-Co of Florida, Inc. citrus process facility. Applicable NSPS for the auxiliary are the recently promulgated Subpart Dc which specify emission limiting standards for small industrial-commercial-institutional steam generating units (see Table 4-2). These NSPS do not specify emission limiting standards for natural gas-fired boilers.

The proposed control technologies for the auxiliary boiler are the use of clean fuel for limiting PM and SO_2 emissions, and combustion control for limiting emissions of NO_x, CO and VOCs. The proposed emission rates of PM of 0.01 lb/mmBtu, which reflect the use of natural gas, is equivalent to 0.006 grains per standard cubic feet. This emission level is at or lower than that generally specified for a baghouse.

Pollution preventing combustion controls, i.e, low-NO_x combustors, will limit the formation of NO_x, CO and VOCs in the combustion process. Since the formation of NO_x, and CO and VOC formation are interdependent in the combustion process, a design point that provides the optimum (i.e., minimum) emission level has been proposed. The proposed NO_x emission level of 0.13 lb/mmBtu is lower than the NSPS than that for larger steam generators (0.2 lb/mmBtu for Subpart Db) and lower than that being required as BACT for larger steam electric generators using sophisticated control technology (0.17 lb/mmBtu). Control technology such as flue gas recirculation (FGR) and selective catalytic reduction (SCR) are technically feasible for auxiliary boilers of this size but are generally not cost effective due to limitation of scale. Cost effectiveness will exceed \$5,000/ton and provide limited overall benefits. That is, the reduction of NO_x emissions, that will be at most 20 to 40 tons/year with additional control technology, will be offset by decreased thermal efficiency and additional secondary emissions (e.g., ammonia in the case of SCR).

The proposed CO and VOC emission limits are of the lowest being achieved on an auxiliary boiler in Florida and are based on achieving the NO_x emission limit. The Tropicana Products facility (constructed in 1990) has a slightly higher heat input auxiliary boiler (104 mmBtu/hr) with a CO limit of 0.14 lb/mmBtu and an NO_x emission level of 0.1 lb/mmBtu. The auxiliary boiler for the proposed Orange Cogeneration has a lower overall combined emission of CO and NO_x (i.e., 0.23 lb/mmBtu for CO and NO_x compared to 0.24 lb/mmBtu for the Tropicana facility). Post combustion control, such as an oxidation catalyst, are feasible for CO emissions. These controls have principally been added where the AAQS for CO are being exceeded. Moreover, the cost effectiveness is high with limited overall reduction in emissions (at most 20 to 30 tons/year reduction).

Thus, the proposed BACT emissions levels for NO_x, CO and VOC reflect emissions in range of the lowest being established for auxiliary boilers and utilize pollution prevention technology.

5.0 AIR QUALITY MONITORING DATA

5.1 PSD PRECONSTRUCTION MONITORING

The CAA requires that an air quality analysis be conducted for each pollutant subject to regulation under the act before a major stationary source is constructed. This analysis may be performed by the use of modeling and/or by monitoring the air quality. Preconstruction monitoring data generally are not required if the ambient air quality concentration before construction is less than the *de minimis* impact monitoring concentrations. Also, if the maximum predicted impact of the source is less than the *de minimis* impact monitoring concentrations, the source generally would be exempt from preconstruction monitoring.

For noncriteria pollutants, EPA recommends that an analysis based on air quality modeling generally should be used instead of monitoring data.

5.2 PROJECT MONITORING APPLICABILITY

As determined by the source applicability analysis described in Section 3.1, an ambient monitoring analysis is required by PSD regulations for PM(TSP), PM(PM10), NO_2, CO, and O_3 (based on VOC emissions). The maximum concentrations predicted for the proposed project compared to the PSD *de minimis* monitoring concentrations are presented in Table 3-4. Since the maximum predicted impacts from the proposed facility are less than *de minimis* levels for all pollutants, preconstruction monitoring is not required for this project.

6.0 AIR QUALITY IMPACT ANALYSIS

6.1 ANALYSIS APPROACH AND ASSUMPTIONS

6.1.1 GENERAL MODELING APPROACH

The general modeling approach follows EPA and FDER modeling guidelines. The highest predicted concentrations are compared with both PSD significant impact levels and *de minimis* air quality levels. If a facility exceeds the significant impact level for a particular pollutant, current policies stipulate that the highest annual average and HSH short-term (i.e., 24 hours or less) concentrations be compared with AAQS and PSD increments when 5 years of meteorological data are used. The HSH concentration is calculated for a receptor field by:

1. Eliminating the highest concentration predicted at each receptor,
2. Identifying the second-highest concentration at each receptor, and
3. Selecting the highest concentration among these second-highest concentrations.

This approach is consistent with the air quality standards, which permit a short-term average concentration to be exceeded once per year at each receptor.

To develop the maximum short-term concentrations for the facility, the general modeling approach was divided into screening and refined phases to reduce the computation time required to perform the modeling analysis. The basic difference between the two phases is the receptor grid used when predicting concentrations.

Concentrations for the screening phase were predicted using a coarse receptor grid and a 5-year meteorological record. After a final list of maximum short-term concentrations was developed, the refined phase of the analysis was conducted by predicting concentrations for a refined receptor grid centered on the receptor at which the HSH concentration from the screening phase was produced. The air dispersion model then was executed for the entire year during which HSH concentrations were predicted. This approach was used to ensure that valid HSH concentrations were obtained. More detailed descriptions of the emission inventory and receptor grids used in the screening and refined phases of the analysis are presented in the following sections.

6.1.2 MODEL SELECTION

The selection of the appropriate air dispersion model was based on its ability to simulate impacts in areas surrounding the plant site. Within 50 km of the site, the terrain can be described as simple (i.e., flat to gently rolling). As defined in the EPA modeling guidelines, simple terrain is considered to be an area where the terrain features are all lower in elevation than the top of the stack(s) under evaluation. Therefore, a simple terrain model was selected to predict maximum ground-level concentrations.

The Industrial Source Complex (ISC) dispersion model (EPA, 1992) was selected to evaluate the pollutant emissions from the proposed units and other modeled sources. This model is contained in EPA's User's Network for Applied Modeling of Air Pollution (UNAMAP), Version 6 (EPA, 1988b). The ISC model is applicable to sources located in either flat or rolling terrain where terrain heights do not exceed stack heights.

The ISC model consists of two sets of computer codes that are used to calculate short- and long-term ground level concentrations. The main differences between the two codes are the input format of the meteorological data and the method of estimating the plume's horizontal dispersion.

The first model code, the ISCST2 short-term model (ISCST2, Version 9227), is an extended version of the single-source (CRSTER) model (EPA, 1977). The ISCST2 model is designed to calculate hourly concentrations based on hourly meteorological parameters (i.e., wind direction, wind speed, atmospheric stability, ambient temperature, and mixing heights). The hourly concentrations are processed into non-overlapping, short-term, and averaging periods. For example, a 24-hour average concentration is based on twenty-four 1-hour averages calculated from midnight to midnight of each day. For each short-term averaging period selected, the highest and second-highest average concentrations are calculated for each receptor. As an option, a table of the 50 highest concentrations over the entire field of receptors can be produced.

The second model code within the ISC model is the ISC long-term (ISCLT2) model. The ISCLT2 model uses joint frequencies of wind direction, wind speed, and atmospheric stability to calculate seasonal and/or annual average ground-level concentrations. Because the input wind directions are for 16 sectors, with each sector defined as 22.5 degrees, the model calculates concentrations by assuming that the pollutant is uniformly distributed in the horizontal plane within a 22.5-degree sector.

In this analysis, the ISCST2 model was used to calculate both short-term and annual average concentrations because these concentrations are readily obtainable from the model output. Major features of the ISCST2 model are presented in Table 6-1. Concentrations caused by stack and volume sources are calculated by the ISCST2 model using the steady-state Gaussian plume equation for a continuous source. The area source equation in the ISCST2 model is based on the equation for a continuous and finite crosswind line source. The ISCST2 model has rural and urban options that affect the wind speed profile exponent law, dispersion rates, and mixing-height formulations used in calculating ground-level concentrations. The criteria used to determine when the rural or urban mode is appropriate are based on land use near the proposed plant's surroundings (Auer, 1978). If the land use is classified as heavy industrial, light-moderate industrial, commercial, or compact residential for more than 50 percent of the area within a 3-km radius circle centered on the proposed source, the urban option should be selected. Otherwise, the rural option is more appropriate.

Table 6-1. Major Features of the ISCST2 Model

- Polar or Cartesian coordinate systems for receptor locations
- Rural or one of three urban options that affect wind speed profile exponent, dispersion rates, and mixing height calculations
- Plume rise as a result of momentum and buoyancy as a function of downwind distance for stack emissions (Briggs, 1969, 1971, 1972, and 1975)
- Procedures suggested by Huber and Snyder (1976); Huber (1977); Schulmann and Hanna (1986); and Schulmann and Scire (1980) for evaluating building wake effects
- Direction-specific building heights and projected widths for all sources for which downwash is considered
- Procedures suggested by Briggs (1974) for evaluating stack-tip downwash
- Separation of multiple-point sources
- Consideration of the effects of gravitational settling and dry deposition on ambient particulate concentrations
- Capability of simulating point, line, volume, and area sources
- Capability to calculate dry deposition
- Variation of wind speed with height (wind speed-profile exponent law)
- Concentration estimates for 1-hour to annual average
- Terrain-adjustment procedures for elevated terrain, including a terrain truncation algorithm
- Receptors located above local terrain (i.e., "flagpole" receptors)
- Consideration of time-dependent exponential decay of pollutants
- The method of Pasquill (1976) to account for buoyancy-induced dispersion
- A regulatory default option to set various model options and parameters to EPA recommended values (see text for regulatory options used)
- Procedure for calm-wind processing
- Wind speeds less than 1 m/s are set to 1 m/s

Source: EPA, 1992.

For modeling analyses that will undergo regulatory review, such as PSD permit applications, the following model features are recommended by EPA (1987a) and are referred to as the regulatory options in the ISCST model:

1. Final plume rise at all receptor locations,
2. Stack-tip downwash,
3. Buoyancy-induced dispersion,
4. Default wind speed profile coefficients for rural or urban option,
5. Default vertical potential temperature gradients,
6. Calm wind processing, and
7. Reducing calculated SO_2 concentrations in urban areas by using a decay half-life of 4 hours (i.e., reduce the SO_2 concentration emitted by 50 percent for every 4 hours of plume travel time).

In this analysis, the EPA regulatory options were used to address maximum impacts. Based on a review of the land use around the facility, the rural mode was selected because of the lack of residential, industrial, and commercial development within 3 km of the plant site.

6.2 METEOROLOGICAL DATA

Meteorological data used in the ISCST2 model to determine air quality impacts consisted of a concurrent 5-year period of hourly surface weather observations and twice-daily upper air soundings from the National Weather Service (NWS) station at Tampa International Airport and Ruskin, respectively. The 5-year period of meteorological data was from 1982 through 1986. The NWS station in Tampa, located approximately 65 km to the west-northwest of the site, was selected for use in the study because it is the closest primary weather station to the study area considered to have meteorological data representative of the project site. This station has surrounding topographical features similar to the project site and the most readily available and complete database.

The surface observations included wind direction, wind speed, temperature, cloud cover, and cloud ceiling height. The wind speed, cloud cover, and cloud ceiling values were used in the ISCST2 meteorological preprocessor program to determine atmospheric stability using the Turner stability scheme. Based on the temperature measurements at morning and afternoon, mixing heights were calculated from the radiosonde data at Ruskin using the Holzworth approach (Holzworth, 1972). Hourly mixing heights were derived from the morning and afternoon mixing heights using the interpolation method developed by EPA (Holzworth, 1972). The hourly surface data and mixing heights were used to develop a sequential series of hourly meteorological data (i.e., wind direction, wind speed, temperature, stability, and mixing heights). Because the observed hourly wind directions at the NWS stations are classified into one of thirty-six 10-degree sectors, the wind directions were randomized within each sector to account for the expected variability in air flow. These calculations were performed using the EPA RAMMET meteorological preprocessor program.

6.3 EMISSION INVENTORY

Stack operating parameters and emission rates for the proposed facility used in the modeling analysis are presented in Table 6-2. Data are presented for the facility operating in both simple cycle and combined cycle modes for various ambient temperatures. For combined cycle mode, data are presented for the CTs operating using water injection or dry low NO_x burners. Data are also presented for the auxiliary boiler, which will be used only during combined cycle operation. Modeling of the proposed facility demonstrated that the facility's PM, SO_2, NO_2, and CO impacts are below the significant impact levels. Therefore, further modeling for these pollutants for comparison to AAQS and PSD Class II increments is not required.

6.4 RECEPTOR LOCATIONS

For comparison to significant impact levels, concentrations were predicted for the following receptor locations:

1. For simple and combined cycle operation, 81 plant boundary and near-field receptors along 36 radials with each radial spaced at 10-degree increments. These receptors are presented in Table 6-3.

Table 6-2. Stack, Operating, and Emission Data Considered in the Air Quality Impact Assessment for the Proposed Facility

				Combined Cycle Units (each)						
	Simple Cycle Operation			With Water Injection			With Dry Low NO_x Combustor			Auxiliary
Parameter	20°F	40°F	100°F	40°F	59°F	100°F	40°F	59°F	100°F	Boiler
Stack Data (ft)										
Height	60	60	60	100	100	100	100	100	100	65
Diameter	9.0	9.0	9.0	8.5	8.5	8.5	8.5	8.5	8.5	3.67
Operating Data										
Temperature (°F)	754	804	859	215	215	215	215	215	215	305
Velocity (ft/sec)	142.9	149.7	119.6	89.6	85.3	68.6	86.6	82.9	67.6	46.9
Pollutant Emission Rates										
PM (lb/hr)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	1.0
NO_2 (TPY)	156.53	165.73	119.47	165.7	159.1	119.5	159.0	152.3	116.3	56.9
CO (lb/hr)	28.5	28.4	21.3	28.4	26.8	21.3	28.3	27.0	21.4	10.0
Sulfuric Acid Mist (lb/hr)	8.19E-02	8.67E-02	6.25E-02	8.67E-02	8.32E-02	6.25E-02	8.24E-02	7.89E-02	6.03E-02	2.31E-02
Polycyclic Organic Matter (lb/hr)	3.95E-04	4.18E-04	3.02E-04	4.18E-04	4.01E-04	3.02E-04	4.18E-04	4.01E-04	3.02E-04	1.11E-04
Formaldehyde (lb/hr)	3.13E-02	3.31E-02	2.39E-02	3.31E-02	3.18E-02	2.39E-02	3.31E-02	3.18E-02	2.39E-02	8.81E-03

Note:

Simple cycle operation includes one CT unit. Combined cycle operation includes two CT/HRSG units. Emission rates presented for the combined cycle operation are for each CT/HRSG unit. The auxiliary boiler will be used during combined cycle operation only.

Table 6-3. Plant Property and Near-Field Receptors Used in the Screening Modeling Analysis

Receptor Location		Receptor Location	
Direction (degrees)	Distance (meters)	Direction (degrees)	Distance (meters)
10	142/200	190	93/100/200
20	149/200	200	97/100/200
30	162/200	210	106/200
40	142/200	220	119/200
50	119/200	230	142/200
60	106/200	240	183/200
70	97/100/200	250	193/200
80	93/100/200	260	184/200
90	91/100/200	270	182/200
100	93/100/200	280	184/200
110	97/100/200	290	193/200
120	106/200	300	210
130	119/200	310	218
140	119/200	320	115/200
150	106/200	330	102/200
160	97/100/200	340	94/100/200
170	93/100/200	350	142/200
180	91/100/200	360	140/200

Note: Direction and distance are relative to the grid origin which is centered between the two proposed HRSG stack locations.

2. For simple cycle operation, 540 general grid receptors located at distances of 200; 400; 700; 1,000; 1,500; 2,000; 2,500; 3,000; 4,000; 5,000, 6,000; 7,000; 8,000; 9,000; and 10,000 m along 36 radials with each radial spaced at 10-degree increments.
3. For combined cycle operation, 432 general grid receptors located at distances of 400; 600; 800; 1,000; 1,500; 2,000; 2,500; 3,000; 3,500; 4,000; 4,500; and 5,000 m along 36 radials with each radial spaced at 10-degree increments.

These grids were centered between the two proposed CT stack locations.

After the screening modeling was completed, refined modeling was conducted using a receptor grid centered on the receptor that had the highest short-term concentration from the screening analysis. The receptors were located at intervals of 100 m between the distances considered in the screening phase, along 9 radials spaced at 2-degree increments, centered on the radial along which the maximum concentration was produced. For example, if the maximum concentration was produced along the 90-degree radial at a distance of 1.0 km, the refined receptor grid would consist of receptors at the following locations:

Directions (degrees)	Distance (km)
82, 84, 86, 88, 90, 92, 94, 96, 98	0.8, 0.9, 1.0, 1.1, 1.2, 1.3, and 1.4 per direction

To ensure that a valid maximum concentration was calculated, concentrations were predicted using the refined grid for the entire year that produced the highest concentration from the screening receptor grid.

Refined modeling analysis was not performed for the annual averaging period because the spatial distribution of annual average concentrations are not expected to vary significantly from those produced from the screening analysis.

The maximum PSD increment consumption at the Chassahowitzka Wilderness Area was determined for the proposed facility alone at 13 discrete receptors located along the boundary of the Class I area. The highest predicted concentrations for the proposed facility for the 5 years of meteorological data were compared with the recommended NPS Class I significance values for PM and NO_2 (see Section 3.2.6).

6.5 BUILDING DOWNWASH EFFECTS

Based on the building dimensions associated with buildings and structures planned at the plant, the stacks for the proposed units (i.e., CT stack for simple cycle operation, HRSG stack, and auxiliary boiler stack) will comply with the GEP stack height regulations. However, these stacks will be less than GEP. Therefore, the potential for building downwash to occur was considered in the modeling analysis for these stacks.

The ISC model uses two procedures to address the effects of building downwash. For both methods the direction-specific building dimensions are input for H_b and l_b for 36 radial directions, with each direction representing a 10-degree sector, which uses these parameters to modify the dispersion parameters. The H_b is the building height and l_b is the lesser of the building height or projected width. For short stacks (i.e., physical stack height is less than $H_b + 0.5\ l_b$), the Schulman and Scire (1980) method is used. The features of the Schulman and Scire method are as follows:

1. Reduced plume rise as a result of initial plume dilution,
2. Enhanced plume spread as a linear function of the effective plume height, and
3. Specification of building dimensions as a function of wind direction.

For cases where the physical stack is greater than $H_b + 0.5\ l_b$ but less than GEP, the Huber-Snyder (1976) method is used.

The building dimensions considered in the modeling analysis are presented in Table 6-4. A detailed listing of direction-specific building data used in the modeling analysis is given in Appendix B.

Table 6-4. Building Dimensions Used to Address Potential Building Wake Effects

Source							
	Stack Height		Building(s)	Actual Buidling Dimensions (m)			Maximum Projected Width[a]
Unit/Stack	ft	m	of Influence	Length	Width	Height	(m)
Turbine Stack (CT--Simple Cycle)	60	18.3	HRSG Building CT Hood/Intake Structure	19.8 8.8	10.4 16.5	17.1 11.0	22.4 18.7
HRSG Stack (CT--Combined Cycle)	100	30.5	HRSG Building	19.8	10.4	17.1	22.4
Auxiliary Boiler	65	19.8	Plant Services Building Control Building	31.7 12.2	24.4 9.1	8.8 9.1	40.0 15.2
CT Hood/Intake Structure			8.8	16.5	11.0	18.7	

Note: Refer to Appendix C for BREEZEWAKE output depicting direction-specific building data used in the modeling analysis.

[a] Diagonal of actual building dimensions.

7.0 AIR QUALITY MODELING RESULTS

7.1 SIGNIFICANT IMPACT ANALYSIS FOR PROPOSED FACILITY

A summary of the maximum concentrations as a result of the proposed facility operating at simple and combined cycle modes at various design temperatures and with two control technologies (i.e., water injection and dry low NO_x technology) is presented in Table 7-1. The results are presented for all regulated pollutants considered in the modeling analysis. The modeling was performed based on the operating conditions for the ambient temperature that produced the highest emissions or lowest flow rate. This approach ensured that the maximum impacts from the proposed facility were obtained.

The overall maximum impacts from the screening analysis for all scenarios considered in the modeling analysis are presented in Table 7-2. Based on these results, a refined analysis was performed.

A summary of the refined impacts developed from the overall maximum concentrations produced in the screening analysis is presented in Table 7-3 and compared to the significant impact levels and *de minimis* monitoring levels.

The maximum predicted 24-hour and annual average PM(TSP) concentrations due to the proposed facility are 3.47 and 0.10 $\mu g/m^3$, respectively. Maximum PM10 impacts are assumed to be identical to the PM(TSP) impacts. Since these maximum concentrations are below the significance and *de minimis* levels for these pollutants, no further modeling analysis is necessary.

The maximum predicted annual NO_2 concentration due to the proposed facility is 0.90 $\mu g/m^3$. Because this level of impact is below the significance and *de minimis* levels, no further modeling analysis was performed.

The maximum predicted 1- and 8-hour average CO concentrations due to the proposed facility are 71.3 and 34.8 $\mu g/m^3$, respectively. These maximum impacts are less than the CO significance impact levels. Because the

✓Table 7-1. Summary of Screening Modeling Impacts for the Orange Cogeneration Facility

			Maximum Impacts ($\mu g/m^3$)				
				Combined Cycle Units Only		Combined Cycle Units with Aux Boiler	
Pollutant	Averaging Period	Ambient Temp (°F)	Simple Cycle Operation	Water Inj	DLN	Water Inj	DLN
PM(PM10)	Annual	20	0.0059	NM	NM	NM	NM
		40	0.0055	0.055	0.056	0.083	0.084
		59	NM	0.057	0.058	0.085	0.087
		100	0.0130	0.071	0.071	0.10	0.10
	24-Hour	20	1.47	NM	NM	NM	NM
		40	1.14	2.44	2.48	2.57	2.61
		59	NM	2.50	2.54	2.63	2.67
		100	3.41	3.31	3.35	3.43	3.47
NO_2	Annual	20	0.042	NM	NM	NM	NM
		40	0.041	0.41	0.41	0.87	0.88
		59	NM	0.41	0.41	0.88	0.89
		100	0.069	0.39	0.38	0.90	0.90
CO	1-Hour	20	66.51	NM	NM	NM	NM
		40	59.12	44.8	45.9	58.4	58.8
		59	NM	44.0	45.3	57.8	58.3
		100	70.37	41.1	41.8	55.7	56.0
	8-Hour	20	18.53	NM	NM	NM	NM
		40	14.81	24.7	25.1	26.9	29.4
		59	NM	24.0	24.5	28.6	29.1
		100	27.35	21.9	22.3	27.7	28.0

Note: Highest concentrations reported for all averaging periods.
Simple cycle operation includes one CT unit. Combined cycle operation includes two CT/HRSG units.
Refer to Appendix B for location and time period of maximum concentrations.

DLN = dry low NO_x
NM = not modeled
Water Inj = water injection

Table 7-2. Summary of Overall Maximum Screening Modeling Impacts for the Orange Cogeneration Facility

Pollutant	Averaging Period	Maximum Concentration ($\mu g/m^3$)	Operating Condition
PM(PM10)	Annual	0.10	Combined cycle; DLN; 100°F
	24-Hour	3.47	Combined cycle; DLN; 100°F
NO_2	Annual	0.90	Combined cycle; DLN; 100°F
CO	1-Hour	70.4	Simple cycle; 100°F
	8-Hour	29.4	Combined cycle; DLN; 40°F

Note: Highest concentrations reported for all averaging periods. Simple cycle operation includes one CT unit. Combined cycle operation includes two CT/HRSG units.
Refer to Appendix B for location and time period of maximum concentrations.

DLN = dry low NO_x

Table 7-3. Summary of Maximum Refined Modeling Impacts for the Orange Cogeneration Facility

Pollutant	Averaging Period	Maximum Concentration ($\mu g/m^3$)	Significant Impact Levels ($\mu g/m^3$)	*de minimus* Monitoring Level ($\mu g/m^3$)
PM(PM10)	Annual	0.10[a]	1	NA
	24-Hour	3.47[a]	5	10
NO_2	Annual	0.90[a] 0.92	1	14
CO	1-Hour	71.3[b]	2,000	NA
	8-Hour	34.8[c]	500	575

Note: Highest refined concentrations reported for all averaging periods.

NA = not applicable.

[a] Combined cycle operation with DLN combustors at ambient temperature of 100°F.
[b] Simple cycle operation at ambient temperature of 100°F.
[c] Combined cycle operation with DLN combustors at ambient temperature of 40°F.

10-degree increment
2-degree increment

maximum predicted impacts due to the proposed facility are less than the CO significance and *de minimis* levels, additional modeling is not required for this pollutant.

No significance levels have been established for sulfuric acid mist. There is also no ambient measurement method established for this pollutant and, thus, no *de minimis* monitoring concentration. Therefore, no further PSD modeling analysis was conducted. Sulfuric acid mist, along with formaldehyde and polycyclic organic matter were addressed as toxic air pollutants for comparison to the Florida NTLs (refer to Section 7.1.3).

7.2 PSD CLASS I SIGNIFICANCE ANALYSIS

Maximum NO_2 and PM concentrations predicted at the PSD Class I area of the Chassahowitzka National Wilderness Area for comparison to NPS's recommended PSD Class I significance levels are presented in Table 7-4. Results are presented for simple and combined cycle operation. For combined cycle operation, results are presented for the CTs operating with water injection and dry low NO_x combustors. Impacts for 40°F and 100°F are presented, representing the maximum emission—maximum flow and minimum emission—minimum flow cases. The overall maximum concentrations predicted for all modeled scenarios, which are compared to the NPS—recommended Class I significance levels, are presented in Table 7-5.

The maximum predicted PM 24-hour and annual concentrations in the Class I area are 0.030 and 0.0017 $\mu g/m^3$, respectively. These predicted impacts are below the NPS Class I 24-hour and annual significance levels of 0.33 and 0.1 $\mu g/m^3$, respectively.

The maximum predicted NO_2 annual concentration in the Class I area is 0.013 $\mu g/m^3$. This predicted impact is below the NPS Class I annual significance level of 0.025 $\mu g/m^3$.

As the results indicate, the proposed facility's impacts are below the NPS-recommended Class I significance values for all averaging periods and

Table 7-4. Summary of Maximum Predicted PM and NO_2 Concentrations Due to the Proposed Facility at the Class I Area of the Chassahowitzka National Wilderness Area

			Maximum Impacts ($\mu g/m^3$)				
				Combined Cycle Units Only		Combined Cycle Units with Aux Boiler	
Pollutant	Averaging Period	Ambient Temp (°F)	Simple Cycle Operation	Water Inj	DLN	Water Inj	DLN
PM(PM10)	Annual	40	0.00054 ✓	0.0014	0.0014	0.0016	0.0016
		100	0.00060 ✓	0.0014	0.0014	0.0017	0.0017
	24-Hour	40	0.010 ✓	0.024	0.024	0.028	0.028 ✓
		100	0.011 ✓	0.025	0.025	0.030	0.030 ✓
NO_2	Annual	40	0.0041 ✓	0.011	0.010	0.013	0.013
		100	0.0033 ✓	0.0079	0.0077	0.011	0.010

Note: Highest concentrations reported for all averaging periods.
Simple cycle operation includes one CT unit. Combined cycle operation includes two CT/HRSG units.
Refer to Appendix B for location and time period of maximum concentrations.

DLN = dry low NO_x
Water Inj = water injection

Table 7-5. Summary of Overall Maximum Predicted PM and NO_2 Concentrations Due to the Proposed Facility at the Class I Area of the Chassahowitzka National Wilderness Area

Pollutant	Averaging Period	Maximum Concentration (µg/m³)	NPS-Recommended Class I Significance Levels (µg/m³)	Operating Condition
PM(PM10)	Annual	0.0017	0.1 0.08	Combined Cycle; 100°F
	24-Hour	0.030	0.33	Combined Cycle; 100°F
NO_2	Annual	0.013	0.025	Combined Cycle; 40°F

Note: Highest concentrations reported for all averaging periods.
Simple cycle operation includes one CT unit. Combined cycle operation includes two CT/HRSG units and auxiliary boiler.

modeled pollutants. Therefore, no further Class I modeling analysis was conducted.

7.3 TOXIC POLLUTANT IMPACT ANALYSIS

The maximum impacts of regulated and nonregulated toxic air pollutants that will be emitted by the proposed facility are presented in Table 7-6. These impacts represent the highest impacts predicted from the screening analysis for the combined cycle operation with dry low-NO_x combustors. This design case was modeled since the highest concentrations were predicted for the criteria pollutants from among the operating design cases considered for the project.

The maximum 8-hour, 24-hour, and annual concentrations are compared to the Florida NTLs. As shown, the predicted impacts are below the NTLs for all pollutants and averaging times. Therefore, the emissions from the proposed facility are not expected to pose a significant health risk to the public.

7.4 ADDITIONAL IMPACT ANALYSIS

7.4.1 IMPACTS UPON VEGETATION

The response of vegetation to atmospheric pollutants is influenced by the concentration of the pollutant, duration of the exposure and the frequency of exposures. The pattern of pollutant exposure expected from the facility is that of a few episodes of relatively high ground-level concentration which occur during certain meteorological conditions interspersed with long periods of extremely low ground-level concentrations. If there are any effects of stack emissions on plants, they will be from the short-term higher doses. A dose is the product of the concentration of the pollutant and the duration of the exposure. The impact of the proposed facility on regional vegetation was assessed by comparing pollutant doses that are predicted from modeling with threshold doses reported from the scientific literature which could adversely affect plant species typical of those present in the region.

Predicted impacts of all regulated pollutants considered in the analysis are less than the significant impact levels (see Table 7-3). As a result,

Table 7-6. Summary of Maximum Concentrations Due to the Proposed Facility for the Air Toxic Modeling Analysis

Pollutant	Averaging Period	Maximum Concentration ($\mu g/m^3$)	Florida No Threat Levels ($\mu g/m^3$)
Formaldehyde	8-hour	0.031[a] ✓	4.5
	24-hour	0.018[a] ✓	1.08
	Annual	0.00067[b] ✓	0.077
Polycyclic Organic Matter	8-hour	0.00040[a]	NE
	24-hour	0.00022[b]	NE
	Annual	0.00001[b]	NE
Sulfuric Acid Mist	8-hour	0.076[a]	10
	24-hour	0.043[b]	2.38
	Annual	0.0017[b] ✓	NE

Note: Highest concentrations reported for all averaging periods.
NE = none established.

[a] Combined cycle operation with DLN combustors at ambient temperature of 40°F.

[b] Combined cycle operation with DLN combustors at ambient temperature of 100°F.

no impacts are expected to occur to vegetation as a result of the proposed emissions of other regulated pollutants.

7.4.2 IMPACTS TO SOILS

Because the predicted impacts for all pollutants considered in the analysis are less than the significant impact levels, the facility is not expected to have a significant adverse impact on regional vegetation or soils.

7.4.3 IMPACTS DUE TO ADDITIONAL GROWTH

A limited number of personnel will be used to operate the proposed facility. These personnel are not expected to have a significant effect on the residential, commercial, and industrial growth in Polk County.

7.4.4 IMPACTS TO VISIBILITY

The Orange Cogeneration Facility is located approximately 114 km from the Chassahowitzka Wilderness Area, a PSD Class I area. Impacts to visibility were estimated using the VISCREEN computer model. Impacts were calculated for particulates and nitrogen oxides (as nitrogen dioxide). Worst-case NO_x and PM emissions at the 40-degree design temperature for combined cycle operation with water injection were used in order to maximize impacts at the Class I area. The results of the screening analysis are presented in Table 7-7. Based on these results the proposed facility is not expected to significantly impair visibility in the Chassahowitzka Wilderness Area.

Table 7-7. Visibility Analysis for the Orange Cogeneration Facility on the PSD Class I Area

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                 Visual Effects Screening Analysis for
                 Source: ORANGE COGENERATION FACILITY
                   Class I Area: CHASSAHOWITZKA NWA

                   ***   Level-1 Screening   ***
Input Emissions for
   Particulates     11.0  lb/hr
   NOx (as NO2)    88.70  lb/hr
   Primary NO2       .00  lb/hr
   Soot              .00  lb/hr
   Primary SO4       .20  lb/hr

    **** Default Particle Characteristics Assumed

                 Transport Scenario Specifications:

    Background Ozone:                   .04 ppm
    Background Visual Range:          25.00 km
    Source-Observer Distance:        114.00 km
    Min. Source-Class I Distance:    114.00 km
    Max. Source-Class I Distance:    134.00 km
    Plume-Source-Observer Angle:      11.25 degrees
    Stability:   6
    Wind Speed:   1.00 m/s

                            R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

         Maximum Visual Impacts INSIDE  Class I Area
          Screening Criteria ARE NOT Exceeded
                                            Delta E       Contrast
                                         ===========   ============
Backgrnd Theta  Azi Distance Alpha  Crit  Plume    Crit  Plume
======== =====  === ======== =====  ====  =====    ====  =====
 SKY       10.  84.   114.0   84.   2.00   .008     .05   .000
 SKY      140.  84.   114.0   84.   2.00   .002     .05  -.000
 TERRAIN   10.  84.   114.0   84.   2.00   .000     .05   .000
 TERRAIN  140.  84.   114.0   84.   2.00   .000     .05   .000

         Maximum Visual Impacts OUTSIDE Class I Area
          Screening Criteria ARE NOT Exceeded
                                            Delta E       Contrast
                                         ===========   ============
Backgrnd Theta  Azi Distance Alpha  Crit  Plume    Crit  Plume
======== =====  === ======== =====  ====  =====    ====  =====
 SKY       10.  75.   110.4   94.   2.00   .009     .05   .000
 SKY      140.  75.   110.4   94.   2.00   .002     .05  -.000
 TERRAIN   10.  60.   104.3  109.   2.00   .001     .05   .000
 TERRAIN  140.  60.   104.3  109.   2.00   .000     .05   .000
```

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APPENDIX A

DESIGN INFORMATION, STACK PARAMETERS, AND EXAMPLE CALCULATIONS FOR THE PROPOSED ORANGE COGENERATION FACILITY

ORANGE COGENERATION FACILITY
EXAMPLE CALCULATIONS FOR DRY LOW NO_x COMBUSTOR, COMBINED CYCLE OPERATION, AT AMBIENT TEMPERATURE OF 59°F

(Procedures used in the calculations for other combustion turbine operations are identical to these example calculations.)

Table A-9: (Note: all other data not calculated but supplied by Manufacturer)

Heat Input (10^6 Btu/hr):

Power (kW) x Heat Rate (10^6 Btu/kWh)

38,638 x 8,829/10^6 = 341.13 x 10^6 Btu/hr

Natural Gas Consumption (cf/hr):

Heat Input (10^6 Btu/hr) ÷ Fuel Heat Content (Btu/cf) (lower heating value)

341.13 x 10^6 ÷ 946 = 360,608 cf/hr

Volume Flow (acfm) - See Note A:

V = mRT/PM

980,775 lb/hr x 1,545 ft-lb/°R x (873°F + 460°F)

÷ (28.52 x 2,116.8 lb/ft^2) ÷ 60 min/hr

= 557,641 acfm

Volume Flow (scfm) - See Note A:

Same as volume flow (acfm) except adjusted for standard temperature of 68°F

980,775 lb/hr x 1,545 ft-lb/°R x (68°F + 460°F)

÷ (28.52 x 2,116.8 lb/ft^2) ÷ 60 min/hr

= 220,881 scfm

Volume Flow (acfm) from HRSG:

CT exhaust adjusted for HRSG exhaust temperature

557,641 acfm x (215°F + 460°F) ÷ (873°F + 460°F)

= 282,376 acfm

HRSG Exhaust Velocity (ft/sec):

Volume Flow (acfm) ÷ Area (ft^2) ÷ 60 sec/min

282,376 acfm ÷ 60 ÷ (8.5^2 ÷ 4 x 3.14159)

= 82.9 ft/sec

<u>Table A-10</u>:

PM/PM10 Emissions:

5 lb/hr x 8,760 hr/yr ÷ 2,000 lb/ton

= 21.9 ton/yr

SO_2 Emissions:

360,608 cf/hr x 1 gr/100 cf ÷ 7,000 gr/lb x 2 lb SO_2/lb S

= 1.03 lb/hr

= 4.51 ton/year

NO_x Emissions - See Note B:

25 ppm x [20.9 x (1 - 6.58/100) - 14.34] ÷ 5.9 x 2,116.8 lb/ft^2

x 557,641 ft^3/min x 46 (molecular wgt NO_2) x 60 min/hr

÷ [1,545 ft-lb/°F x (873°F + 460°F) x 10^6 (adjust for ppm)]

= 34.8 lb/hr

= 152.3 ton/year

CO Emissions - See Note C:

30 ppm x (1 - 6.58/100) x 557,641 acfm x 2,116.8 lb/ft^2

x 28 (molecular wgt. of carbon) x 60 min/hr ÷ [1,545 ft-lb/°F

x (873 + 460°F) x 10^6]

= 27.0 lb/hr

= 118.2 ton/year

VOC Emissions - See Note C:

10 ppm x (1 - 6.58/100) x 557,641 acfm x 2,116.8 lb/ft^2

x 12 (molecular wgt. of carbon) x 60 min/hr ÷ [1,545 ft-lb/°F

x (873°F + 460°F) x 10^6]

= 3.86 lb/hr

= 16.9 ton/year

Lead Emissions:

Negligible

Table A-11:

H_2SO_4 Mist Emissions:

Based on 5 percent of SO_2 converted to sulfuric acid mist

1.03 lb/hr x 1.53 lb H_2SO_4/lb SO_2 x 0.05 (converted)

= 0.0789 lb/hr

= 0.346 ton/year

Arsenic, Beryllium, Mercury, Fluoride Emissions:

Negligible

Table A-12:

Polycyclic Organic Matter Emissions:

$$\text{Emission factor (pg/J)} \times 2.324\ \frac{\text{lb}/10^{12}\ \text{Btu}}{\text{pg/J}} \times \text{Heat input rate}\ (10^{12}\ \text{Btu/hr})$$

$0.48\ \text{pg/J} \times 2.324 \times 341.13 \times 10^{-6}\ (10^{12}\ \text{Btu/hr})$

= 0.00040 lb/hr

= 0.00176 ton/year

Formaldehyde Emissions:

$$\text{Emission factor (pg/J)} \times 2.324\ \frac{\text{lb}/10^{12}\ \text{Btu}}{\text{pg/J}} \times \text{Heat input rate}\ (10^{12}\ \text{Btu/hr})$$

$38\ \text{pg/J} \times 2.324 \times 341.13 \times 10^{-6}\ (10^{12}\ \text{Btu/hr})$

= 0.0318 lb/hr

= 0.139 ton/year

NOTE A

Volume is calculated based on ideal gas law:

$$PV = mRT \div M$$

where: P = pressure = 2116.8 lb/ft^2
m = mass flow of gas (lb/hr)
R = universal gas constant = 1,545 ft-lb/°R
M = molecular weight of gas
T = temperature (°R)

NOTE B

NO_x is calculated by correcting to 15% O_2 dry conditions using ideal gas law and moisture and O_2 conditions.

Oxygen correction:

$$V_{NOx\ (15\%)} = \frac{V_{NOx\ Dry} * 5.9}{20.9 - \%O_{2\ Dry}}$$

(From 40 CFR Part 60; Appendix A, Method 20, Equation 20-4)

$$V_{NOx\ Dry} = V_{NOx\ (15\%)}\ (20.9 - \%O_{2\ Dry}) \div 5.9$$

$$\%O_{2\ Dry} = \%O_{2\ Act} \div (1 - \%H_2O)\ ;\ \%O_{2\ Act} = \%O_{2\ Dry}\ (1 - \%H_2O)$$

(From Method 20; Equation 20-1)

$V_{NOx\ Act} = V_{NOx\ Dry}\ (1 - \%H_2O)$; (From Method 20; Equation 20-1)

Substituting:

$$V_{NOx\ Act} = V_{NOx\ 15\%}\ (20.9 - \%O_{2\ Dry})\ (1 - \%H_2O) \div 5.9$$

$$= V_{NOx\ (15\%)}\ [20.9 - (\%O_{2\ Act} \div (1 - \%H_2O))]\ (1 - \%H_2O) \div 5.9$$

$$= V_{NOx\ (15\%)}\ [20.9\ (1 - \%H_2O) - \%O_2] \div 5.9$$

$$m_{NOx} = \frac{PVM_{NOx}}{RT} = V_{NOx\ (15\%)}\ [20.9\ (1 - \%H_2O) - \%O_2) * P * M_{NOx} \div (RT * 5.9)$$

NOTE C

Same as Note B except only moisture correction is used:

$$V_{CO\ Act} = V_{CO\ Dry}\ (1 - \%H_2O)$$

$$\begin{aligned} m_{CO} &= PV_{CO\ Act}M_{CO} \div RT \\ &= PV_{CO\ Dry}\ (1 - \%H_2O)\ M_{CO} \div RT \end{aligned}$$

LM6000PA
6/29/93

Table A-1. Design Information and Stack Parameters for the Proposed Orange Cogen Facility, Simple Cycle Operation
GE LM6000-PA, Natural Gas, Water Injection

Data	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
General	16081	16082	16084	16085	16086
Power (kW)	39,571.0	41,505.0	39,493.0	33,598.0	27,715.0
Heat Rate (Btu/kwh)	8,954.0	9,032.0	9,111.0	9,325.0	9,753.0
CT Exhaust Flow					
Mass Flow (lb/hr)	1,046,409	1,049,860	996,693	896,512	797,377
Temperature (oF)	754	804	830	842	859
Moisture (% Vol.)	8.17	9.11	9.65	10.01	10.99
Oxygen (% Vol.)	14.23	13.77	13.61	13.72	13.68
Molecular Weight	28.33	28.24	28.19	28.14	28.02
Heat Input (MMBtu/hr)= Power (kW) x Heat Rate (Btu/kwh) ÷ 1,000,000 Btu/MMBtu					
Power (kW)	39,571.0	41,505.0	39,493.0	33,598.0	27,715.0
Heat Rate (Btu/kwh)	8,954.0	9,032.0	9,111.0	9,325.0	9,753.0
Heat Input (MMBtu/hr)	354.32	374.87	359.82	313.30	270.30
Natural Gas Consumption (lb/hr)= Heat Input (MMBtu/hr) x 1,000,000 Btu/MMBtu ÷ Fuel Heat Content, LHV (Btu/lb) (cf/hr)= Heat Input (MMBtu/hr) x 1,000,000 Btu/MMBtu ÷ Fuel Heat Content, LHV (Btu/cf)					
Heat Input (MMBtu/hr)	354.32	374.87	359.82	313.30	270.30
Heat Content, LHV (Btu/lb)	19,000	19,000	19,000	19,000	19,000
Natural Gas (lb/hr)	18,648.4	19,730.2	18,937.9	16,489.5	14,226.5
Heat Content, LHV (Btu/cf)	946	946	946	946	946
Natural Gas (cf/hr)	374,544	396,272	380,360	331,185	285,734
Volume Flow (acfm)= [(Mass Flow (lb/hr) x 1,545 x (Temp. (°F)+ 460°F)] ÷ [Molecular weight x 2116.8] ÷ 60 min/hr					
Mass Flow (lb/hr)	1,046,409	1,049,860	996,693	896,512	797,377
Temperature (°F)	754	804	830	842	859
Molecular Weight	28.33	28.24	28.19	28.14	28.02
Volume Flow (acfm)	545,404	571,551	554,881	504,616	456,568
Volume Flow (scfm)= [(Mass Flow (lb/hr) x 1,545 x (68°F + 460°F)] ÷ [Molecular weight x 2116.8] ÷ 60 min/hr					
Mass Flow (lb/hr)	1,046,409	1,049,860	996,693	896,512	797,377
Temperature (°F)	68	68	68	68	68
Molecular Weight	28.33	28.24	28.19	28.14	28.02
Volume Flow (scfm)	237,210	238,749	227,114	204,637	182,766
CT Stack Data					
Stack Height (ft)	60	60	60	60	60
Diameter (ft)	9.0	9.0	9.0	9.0	9.0
Volume Flow (acfm) from CT= [Volume flow (acfm) x (CT temp.(°F)+ 460°F)] ÷ [CT temp.(°F)+ 460°F]					
Volume Flow (acfm) from CT	545,404	571,551	554,881	504,616	456,568
CT Temperature (°F)	754	804	830	842	859
CT Temperature (°F)	754	804	830	842	859
Volume Flow (acfm) from CT	545,404	571,551	554,881	504,616	456,568
Velocity (ft/sec)= Volume flow (acfm) from CT ÷ [((diameter)^2÷ 4) x 3.14159] ÷ 60 sec/min					
Volume Flow (acfm) from CT	545,404	571,551	554,881	504,616	456,568
Diameter (ft)	9.0	9.0	9.0	9.0	9.0
Velocity (ft/sec)	142.9	149.7	145.4	132.2	119.6

Note: Universal gas constant= 1,545 ft-lb(force)/°R; atmospheric pressure= 2.116.8 lb(force)/ft^2

Source: Stewart & Stevenson, 1993. (4/13/93)

Table A-2. Maximum Criteria Pollutant Emissions for the Proposed Orange Cogeneration Facility
GE LM6000-PA, Natural Gas, Water Injection

Pollutant	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
Particulate (lb/hr)= Emission rate (lb/hr) from manufacturer					
PM, lb/hr (manufacturer)	5.0	5.0	5.0	5.0	5.0
TPY	21.90	21.90	21.90	21.90	21.90
Sulfur Dioxide (lb/hr)= Natural gas (cf/hr) x sulfur content(gr/100 cf) x 1 lb/7000 gr x (lb SO2/lb S) ÷ 100					
Natural Gas (cf/hr)	374,544	396,272	380,360	331,185	285,734
Basis, gr/100 cf	1.0	1.0	1.0	1.0	1.0
lb SO2/lb S (64/32)	2.0	2.0	2.0	2.0	2.0
SO2, lb/hr	1.07	1.13	1.09	0.95	0.82
TPY	4.69	4.96	4.76	4.14	3.58
Nitrogen Oxides (lb/hr)= NOx(ppm) x [20.9 x (1 - Moisture(%)/100) - Oxygen(%)] x 2116.8 lb/ft2 x Volume flow (acfm) x 46 (mole. wgt NOx) x 60 min/hr ÷ [1545 x (CT temp.(°F) + 460°F) x 5.9 x 1,000,000 (adj. for ppm)]					
Basis, ppm^a	25.0	25.0	25.0	25.0	25.0
Moisture (%)	8.17	9.11	9.6543	10.0102	10.9915
Oxygen (%)	14.23	13.77	13.6119	13.7157	13.6848
Volume Flow (acfm)	545,404	571,551	554,881	504,616	456,568
Temperature (°F)	754	804	830	842	859
NOx, lb/hr	35.7	37.8	36.3	31.6	27.3
TPY	156.53	165.73	159.10	138.51	119.47
Carbon Monoxide (lb/hr)= CO(ppm) x [1 - Moisture(%)/100] x 2116.8 lb/ft2 x Volume flow (acfm) x 28 (mole. wgt CO) x 60 min/hr ÷ [1545 x (CT temp.(°F) + 460°F) x 1,000,000 (adj. for ppm)]					
Basis, ppm^b	30.0	30.0	30.0	30.0	30.0
Moisture (%)	8.1654	9.1117	9.6543	10.0102	10.9915
Volume Flow (acfm)	545,404	571,551	554,881	504,616	456,568
Temperature (°F)	754	804	830	842	859
lb/hr	28.5	28.4	26.8	24.1	21.3
TPY	124.78	124.30	117.54	105.49	93.19
VOCs (lb/hr)= VOC(ppm) x [1 - Moisture(%)/100] x 2116.8 lb/ft2 x Volume flow (acfm) x 12 (mole. wgt as carbon) x 60 min/hr ÷ [1545 x (CT temp.(°F) + 460°F) x 1,000,000 (adj. for ppm)]					
Basis, ppm^b	10.0	10.0	10.0	10.0	10.0
Moisture (%)	8.1654	9.1117	9.6543	10.0102	10.9915
Volume Flow (acfm)	545,404	571,551	554,881	504,616	456,568
Temperature (°F)	754	804	830	842	859
lb/hr	4.07	4.05	3.83	3.44	3.04
TPY	17.8	17.8	16.8	15.1	13.3
Lead (lb/hr)= Negligible					
Basis, lb/10E+12 Btu	NA	NA	NA	NA	NA
HIR (MMBtu/hr)	NA	NA	NA	NA	NA
lb/hr	NA	NA	NA	NA	NA
TPY	NA	NA	NA	NA	NA

Note: Universal gas constant= 1,545 ft-lb(force)/°R; atmospheric pressure= 2.116.8 lb(force)/ft^2

^a corrected to 15% O2 and dry conditions
^b corrected to dry conditions

Table A-3. Other Regulated Pollutant Emissions for the Proposed Orange Cogeneration Facility
GE LM6000-PA, Natural Gas, Water Injection

Pollutant	Units	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
Arsenic (lb/hr)= Negligible						
	lb/10E+12 Btu	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Beryllium (lb/hr)= Negligible						
	lb/10E+12 Btu	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Mercury (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 Btu/MMBtu						
	lb/10E+12 Btu (1)	0.027	0.027	0.027	0.027	0.027
	HIR (MMBtu/hr)	354.3	374.9	359.8	313.3	270.3
	lb/hr	9.57E-06	1.01E-05	9.72E-06	8.46E-06	7.30E-06
	TPY	4.19E-05	4.43E-05	4.26E-05	3.71E-05	3.20E-05
Fluoride (lb/hr)= Negligible						
	lb/10E+12 Btu	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Sulfuric Acid Mist (lb/hr) = Fraction of SO2 Emission Rate x SO2 Emission Rate x lb H2SO4/lb SO2 (98/64)						
	Fraction SO2 (%)	5	5	5	5	5
	SO2 (lb/hr)	1.1	1.1	1.1	0.9	0.8
	lb H2SO4/lb SO2	1.53	1.53	1.53	1.53	1.53
	lb/hr	8.19E-02	8.67E-02	8.32E-02	7.24E-02	6.25E-02
	TPY	3.59E-01	3.80E-01	3.64E-01	3.17E-01	2.74E-01

Source: (1) DER, 1992

Table A-4. Non-Regulated Pollutant Emissions for the Proposed Orange Cogeneration Facility
GE LM6000-PA, Natural Gas, Water Injection

Pollutant	Units	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
Manganese (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Nickel (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Cadmium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Chromium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Copper (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Vanadium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Selenium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Polycyclic Organic Matter (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 Btu/MMBtu						
	lb/10E+12 Btu (1)	1.113	1.113	1.113	1.113	1.113
	HIR (MMBtu/hr)	354.3	374.9	359.8	313.3	270.3
	lb/hr	3.94E-04	4.17E-04	4.00E-04	3.49E-04	3.01E-04
	TPY	1.73E-03	1.83E-03	1.75E-03	1.53E-03	1.32E-03
Formaldehyde (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 Btu/MMBtu						
	lb/10E+12 Btu (1)	88.12	88.12	88.12	88.12	88.12
	HIR (MMBtu/hr)	354.3	374.9	359.8	313.3	270.3
	lb/hr	3.12E-02	3.30E-02	3.17E-02	2.76E-02	2.38E-02
	TPY	1.37E-01	1.45E-01	1.39E-01	1.21E-01	1.04E-01

Source: (1) EPA, 1990

LM6000PA
6/29/93

Table A-5. Design Information and Stack Parameters for the Proposed Orange Cogen Facility, Combined Cycle Operation GE LM6000-PA, Natural Gas, Water Injection

Data	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
General	16081	16082	16084	16085	16086
Power (kW)	39,571.0	41,505.0	39,493.0	33,598.0	27,715.0
Heat Rate (Btu/kwh)	8,954.0	9,032.0	9,111.0	9,325.0	9,753.0
CT Exhaust Flow					
Mass Flow (lb/hr)	1,046,409	1,049,860	996,693	896,512	797,377
Temperature (oF)	754	804	830	842	859
Moisture (% Vol.)	8.17	9.11	9.65	10.01	10.99
Oxygen (% Vol.)	14.23	13.77	13.61	13.72	13.68
Molecular Weight	28.33	28.24	28.19	28.14	28.02
Heat Input (MMBtu/hr)= Power (kW) x Heat Rate (Btu/kwh) ÷ 1,000,000 Btu/MMBtu					
Power (kW)	39,571.0	41,505.0	39,493.0	33,598.0	27,715.0
Heat Rate (Btu/kwh)	8,954.0	9,032.0	9,111.0	9,325.0	9,753.0
Heat Input (MMBtu/hr)	354.32	374.87	359.82	313.30	270.30
Natural Gas Consumption (lb/hr)= Heat Input (MMBtu/hr) x 1,000,000 Btu/MMBtu ÷ Fuel Heat Content, LHV (Btu/lb) (cf/hr)= Heat Input (MMBtu/hr) x 1,000,000 Btu/MMBtu ÷ Fuel Heat Content, LHV (Btu/cf)					
Heat Input (MMBtu/hr)	354.32	374.87	359.82	313.30	270.30
Heat Content, LHV (Btu/lb)	19,000	19,000	19,000	19,000	19,000
Natural Gas (lb/hr)	18,648.4	19,730.2	18,937.9	16,489.5	14,226.5
Heat Content, LHV (Btu/cf)	946	946	946	946	946
Natural Gas (cf/hr)	374,544	396,272	380,360	331,185	285,734
Volume Flow (acfm)= [(Mass Flow (lb/hr) x 1,545 x (Temp. (°F)+ 460°F)] ÷ [Molecular weight x 2116.8] ÷ 60 min/hr					
Mass Flow (lb/hr)	1,046,409	1,049,860	996,693	896,512	797,377
Temperature (°F)	754	804	830	842	859
Molecular Weight	28.33	28.24	28.19	28.14	28.02
Volume Flow (acfm)	545,404	571,551	554,881	504,616	456,568
Volume Flow (scfm)= [(Mass Flow (lb/hr) x 1,545 x (68°F + 460°F)] ÷ [Molecular weight x 2116.8] ÷ 60 min/hr					
Mass Flow (lb/hr)	1,046,409	1,049,860	996,693	896,512	797,377
Temperature (°F)	68	68	68	68	68
Molecular Weight	28.33	28.24	28.19	28.14	28.02
Volume Flow (scfm)	237,210	238,749	227,114	204,637	182,766
HRSG Stack Data					
Stack Height (ft)	100	100	100	100	100
Diameter (ft)	8.5	8.5	8.5	8.5	8.5
Volume Flow (acfm) from HRSG= [Volume flow (acfm) from CT x (HRSG temp.(°F)+ 460°F)] ÷ [CT temp.(°F)+ 460°F]					
Volume Flow (acfm) from CT	545,404	571,551	554,881	504,616	456,568
CT Temperature (°F)	754	804	830	842	859
HRSG Temperature (°F)	215	215	215	215	215
Volume Flow (acfm) from HRSG	303,252	305,219	290,345	261,610	233,649
Velocity (ft/sec)= Volume flow (acfm) from HRSG ÷ [((diameter)^2÷ 4) x 3.14159] ÷ 60 sec/min					
Volume Flow (acfm) from HRSG	303,252	305,219	290,345	261,610	233,649
Diameter (ft)	8.5	8.5	8.5	8.5	8.5
Velocity (ft/sec)	89.1	89.6	85.3	76.8	68.6

Note: Universal gas constant= 1,545 ft-lb(force)/°R; atmospheric pressure= 2.116.8 lb(force)/ft^2

Source: Stewart & Stevenson, 1993. (4/13/93)

Table A-6. Maximum Criteria Pollutant Emissions for the Proposed Orange Cogeneration Facility
GE LM6000-PA, Natural Gas, Water Injection

Pollutant	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
Particulate (lb/hr)= Emission rate (lb/hr) from manufacturer					
PM, lb/hr (manufacturer)	5.0	5.0	5.0	5.0	5.0
TPY	21.90	21.90	21.90	21.90	21.90
Sulfur Dioxide (lb/hr)= Natural gas (cf/hr) x sulfur content(gr/100 cf) x 1 lb/7000 gr x (lb SO2/lb S) ÷ 100					
Natural Gas (cf/hr)	374,544	396,272	380,360	331,185	285,734
Basis, gr/100 cf	1.0	1.0	1.0	1.0	1.0
lb SO2/lb S (64/32)	2.0	2.0	2.0	2.0	2.0
SO2, lb/hr	1.07	1.13	1.09	0.95	0.82
TPY	4.69	4.96	4.76	4.14	3.58
Nitrogen Oxides (lb/hr)= NOx(ppm) x [20.9 x (1 - Moisture(%)/100) - Oxygen(%)] x 2116.8 lb/ft2 x Volume flow (acfm) x 46 (mole. wgt NOx) x 60 min/hr ÷ [1545 x (CT temp.(°F) + 460°F) x 5.9 x 1,000,000 (adj. for ppm)]					
Basis, ppm^a	25.0	25.0	25.0	25.0	25.0
Moisture (%)	8.17	9.11	9.65	10.01	10.99
Oxygen (%)	14.23	13.77	13.61	13.72	13.68
Volume Flow (acfm)	545,404	571,551	554,881	504,616	456,568
Temperature (°F)	754	804	830	842	859
lb/hr	35.7	37.8	36.3	31.6	27.3
TPY	156.53	165.73	159.10	138.51	119.47
Carbon Monoxide (lb/hr)= CO(ppm) x [1 - Moisture(%)/100] x 2116.8 lb/ft2 x Volume flow (acfm) x 28 (mole. wgt CO) x 60 min/hr ÷ [1545 x (CT temp.(°F) + 460°F) x 1,000,000 (adj. for ppm)]					
Basis, ppm^b	30.0	30.0	30.0	30.0	30.0
Moisture (%)	8.17	9.11	9.65	10.01	10.99
Volume Flow (acfm)	545,404	571,551	554,881	504,616	456,568
Temperature (°F)	754	804	830	842	859
lb/hr	28.5	28.4	26.8	24.1	21.3
TPY	124.78	124.30	117.54	105.49	93.19
VOCs (lb/hr)= VOC(ppm) x [1 - Moisture(%)/100] x 2116.8 lb/ft2 x Volume flow (acfm) x 12 (mole. wgt as carbon) x 60 min/hr ÷ [1545 x (CT temp.(°F) + 460°F) x 1,000,000 (adj. for ppm)]					
Basis, ppm^b	10.0	10.0	10.0	10.0	10.0
Moisture (%)	8.17	9.11	9.65	10.01	10.99
Volume Flow (acfm)	545,404	571,551	554,881	504,616	456,568
Temperature (°F)	754	804	830	842	859
lb/hr	4.07	4.05	3.83	3.44	3.04
TPY	17.8	17.8	16.8	15.1	13.3
Lead (lb/hr)= Negligible					
Basis, lb/10E+12 Btu	NA	NA	NA	NA	NA
HIR (MMBtu/hr)	NA	NA	NA	NA	NA
lb/hr	NA	NA	NA	NA	NA
TPY	NA	NA	NA	NA	NA

Note: Universal gas constant= 1,545 ft-lb(force)/°R; atmospheric pressure= 2.116.8 lb(force)/ft^2

^a corrected to 15% O2 and dry conditions
^b corrected to dry conditions

Table A-7. Other Regulated Pollutant Emissions for the Proposed Orange Cogeneration Facility
GE LM6000-PA, Natural Gas, Water Injection

Pollutant	Units	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
Arsenic (lb/hr)= Negligible						
	lb/10E+12 Btu	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Beryllium (lb/hr)= Negligible						
	lb/10E+12 Btu	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Mercury (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 Btu/MMBtu						
	lb/10E+12 Btu (1)	0.027	0.027	0.027	0.027	0.027
	HIR (MMBtu/hr)	354.3	374.9	359.8	313.3	270.3
	lb/hr	9.57E-06	1.01E-05	9.72E-06	8.46E-06	7.30E-06
	TPY	4.19E-05	4.43E-05	4.26E-05	3.71E-05	3.20E-05
Fluoride (lb/hr)= Negligible						
	lb/10E+12 Btu	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Sulfuric Acid Mist (lb/hr) = Fraction of SO2 Emission Rate x SO2 Emission Rate x lb H2SO4/lb SO2 (98/64)						
	Fraction SO2 (%)	5	5	5	5	5
	SO2 (lb/hr)	1.1	1.1	1.1	0.9	0.8
	lb H2SO4/lb SO2	1.53	1.53	1.53	1.53	1.53
	lb/hr	8.19E-02	8.67E-02	8.32E-02	7.24E-02	6.25E-02
	TPY	3.59E-01	3.80E-01	3.64E-01	3.17E-01	2.74E-01

Source: (1) DER, 1992

Table A-8. Non-Regulated Pollutant Emissions for the Proposed Orange Cogeneration Facility
GE LM6000-PA, Natural Gas, Water Injection

Pollutant	Units	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
Manganese (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Nickel (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Cadmium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Chromium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Copper (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Vanadium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Selenium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Polycyclic Organic Matter (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 Btu/MMBtu						
	lb/10E+12 Btu (1)	1.113	1.113	1.113	1.113	1.113
	HIR (MMBtu/hr)	354.3	374.9	359.8	313.3	270.3
	lb/hr	3.94E-04	4.17E-04	4.00E-04	3.49E-04	3.01E-04
	TPY	1.73E-03	1.83E-03	1.75E-03	1.53E-03	1.32E-03
Formaldehyde (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 Btu/MMBtu						
	lb/10E+12 Btu (1)	88.12	88.12	88.12	88.12	88.12
	HIR (MMBtu/hr)	354.3	374.9	359.8	313.3	270.3
	lb/hr	3.12E-02	3.30E-02	3.17E-02	2.76E-02	2.38E-02
	TPY	1.37E-01	1.45E-01	1.39E-01	1.21E-01	1.04E-01

Source: (1) EPA, 1990

LM6000PA
6/29/93

Table A-9. Design Information and Stack Parameters for the Proposed Orange Cogen Facility, Combined Cycle Operation GE LM6000-PA, Natural Gas, Dry Low NOx

Data	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
General	11011	11012	11014	11015	11016
Power (kW)	39,122.0	40,793.0	38,638.0	33,240.0	27,344.0
Heat Rate (Btu/kwh)	8,699.0	8,731.0	8,829.0	9,058.0	9,532.0
CT Exhaust Flow					
Mass Flow (lb/hr)	1,031,596	1,026,032	980,775	887,935	791,613
Temperature (oF)	796	852	873	881	887
Moisture (% Vol.)	5.54	6.08	6.58	7.45	9.02
Oxygen (% Vol.)	14.81	14.44	14.34	14.30	14.15
Molecular Weight	28.62	28.57	28.52	28.42	28.23
Heat Input (MMBtu/hr)= Power (kW) x Heat Rate (Btu/kwh) ÷ 1,000,000 Btu/MMBtu					
Power (kW)	39,122.0	40,793.0	38,638.0	33,240.0	27,344.0
Heat Rate (Btu/kwh)	8,699.0	8,731.0	8,829.0	9,058.0	9,532.0
Heat Input (MMBtu/hr)	340.32	356.16	341.13	301.09	260.64
Natural Gas Consumption (lb/hr)= Heat Input (MMBtu/hr) x 1,000,000 Btu/MMBtu ÷ Fuel Heat Content, LHV (Btu/lb) (cf/hr)= Heat Input (MMBtu/hr) x 1,000,000 Btu/MMBtu ÷ Fuel Heat Content, LHV (Btu/cf)					
Heat Input (MMBtu/hr)	340.32	356.16	341.13	301.09	260.64
Heat Content, LHV (Btu/lb)	19,000	19,000	19,000	19,000	19,000
Natural Gas (lb/hr)	17,911.7	18,745.5	17,954.5	15,846.7	13,718.1
Heat Content, LHV (Btu/cf)	946	946	946	946	946
Natural Gas (cf/hr)	359,749	376,494	360,608	318,275	275,521
Volume Flow (acfm)= [(Mass Flow (lb/hr) x 1,545 x (Temp. (°F)+ 460°F)] ÷ [Molecular weight x 2116.8] ÷ 60 min/hr					
Mass Flow (lb/hr)	1,031,596	1,026,032	980,775	887,935	791,613
Temperature (°F)	796	852	873	881	887
Molecular Weight	28.62	28.57	28.52	28.42	28.23
Volume Flow (acfm)	550,717	573,084	557,641	509,736	459,410
Volume Flow (scfm)= [(Mass Flow (lb/hr) x 1,545 x (68°F + 460°F)] ÷ [Molecular weight x 2116.8] ÷ 60 min/hr					
Mass Flow (lb/hr)	1,031,596	1,026,032	980,775	887,935	791,613
Temperature (°F)	68	68	68	68	68
Molecular Weight	28.62	28.57	28.52	28.42	28.23
Volume Flow (scfm)	231,512	230,632	220,881	200,702	180,081
HRSG Stack Data					
Stack Height (ft)	100	100	100	100	100
Diameter (ft)	8.5	8.5	8.5	8.5	8.5
Volume Flow (acfm) from HRSG= [Volume flow (acfm) from CT x (HRSG temp.(°F)+ 460°F)] ÷ [CT temp.(°F)+ 460°F]					
Volume Flow (acfm) from CT	550,717	573,084	557,641	509,736	459,410
CT Temperature (°F)	796	852	873	881	887
HRSG Temperature (°F)	215	215	215	215	215
Volume Flow (acfm) from HRSG	295,966	294,841	282,376	256,579	230,217
Velocity (ft/sec)= Volume flow (acfm) from HRSG ÷ [((diameter)^2÷ 4) x 3.14159] ÷ 60 sec/min					
Volume Flow (acfm) from HRSG	295,966	294,841	282,376	256,579	230,217
Diameter (ft)	8.5	8.5	8.5	8.5	8.5
Velocity (ft/sec)	86.9	86.6	82.9	75.4	67.6

Note: Universal gas constant= 1,545 ft-lb(force)/°R; atmospheric pressure= 2.116.8 lb(force)/ft^2

Source: Stewart & Stevenson, 1993. (4/13/93)

Table A-10. Maximum Criteria Pollutant Emissions for the Proposed Orange Cogeneration Facility
GE LM6000-PA, Natural Gas, Dry Low NOx

Pollutant	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
Particulate (lb/hr)= Emission rate (lb/hr) from manufacturer					
PM, lb/hr (manufacturer)	5.0	5.0	5.0	5.0	5.0
TPY	21.90	21.90	21.90	21.90	21.90
Sulfur Dioxide (lb/hr)= Natural gas (cf/hr) x sulfur content(gr/100 cf) x 1 lb/7000 gr x (lb SO2/lb S) ÷ 100					
Natural Gas (cf/hr)	359,749	376,494	360,608	318,275	275,521
Basis, gr/100 cf	1.0	1.0	1.0	1.0	1.0
lb SO2/lb S (64/32)	2.0	2.0	2.0	2.0	2.0
SO2, lb/hr	1.03	1.08	1.03	0.91	0.79
TPY	4.50	4.71	4.51	3.98	3.45
Nitrogen Oxides (lb/hr)= NOx(ppm) x [20.9 x (1 - Moisture(%)/100) - Oxygen(%)] x 2116.8 lb/ft2 x Volume flow (acfm) x 46 (mole. wgt NOx) x 60 min/hr ÷ [1545 x (CT temp.(°F) + 460°F) x 5.9 x 1,000,000 (adj. for ppm)]					
Basis, ppm^a	25.0	25.0	25.0	25.0	25.0
Moisture (%)	5.54	6.08	6.58	7.45	9.02
Oxygen (%)	14.81	14.44	14.34	14.30	14.15
Volume Flow (acfm)	550,717	573,084	557,641	509,736	459,410
Temperature (°F)	796	852	873	881	887
lb/hr	34.7	36.3	34.8	30.7	26.6
TPY	151.88	159.03	152.32	134.42	116.34
Carbon Monoxide (lb/hr)= CO(ppm) x [1 - Moisture(%)/100] x 2116.8 lb/ft2 x Volume flow (acfm) x 28 (mole. wgt CO) x 60 min/hr ÷ [1545 x (CT temp.(°F) + 460°F) x 1,000,000 (adj. for ppm)]					
Basis, ppm^b	30.0	30.0	30.0	30.0	30.0
Moisture (%)	5.54	6.08	6.58	7.45	9.02
Volume Flow (acfm)	550,717	573,084	557,641	509,736	459,410
Temperature (°F)	796	852	873	881	887
lb/hr	28.6	28.3	27.0	24.3	21.4
TPY	125.27	124.08	118.21	106.40	93.85
VOCs (lb/hr)= VOC(ppm) x [1 - Moisture(%)/100] x 2116.8 lb/ft2 x Volume flow (acfm) x 12 (mole. wgt as carbon) x 60 min/hr ÷ [1545 x (CT temp.(°F) + 460°F) x 1,000,000 (adj. for ppm)]					
Basis, ppm^b	10.0	10.0	10.0	10.0	10.0
Moisture (%)	5.54	6.08	6.58	7.45	9.02
Volume Flow (acfm)	550,717	573,084	557,641	509,736	459,410
Temperature (°F)	796	852	873	881	887
lb/hr	4.09	4.05	3.86	3.47	3.06
TPY	17.9	17.7	16.9	15.2	13.4
Lead (lb/hr)= Negligible					
Basis, lb/10E+12 Btu	NA	NA	NA	NA	NA
HIR (MMBtu/hr)	NA	NA	NA	NA	NA
lb/hr	NA	NA	NA	NA	NA
TPY	NA	NA	NA	NA	NA

Note: Universal gas constant= 1,545 ft-lb(force)/°R; atmospheric pressure= 2.116.8 lb(force)/ft^2

^a corrected to 15% O2 dry conditions
^b corrected to dry conditions

Table A-11. Other Regulated Pollutant Emissions for the Proposed Orange Cogeneration Facility
GE LM6000-PA, Natural Gas, Dry Low NOx

Pollutant	Units	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
Arsenic (lb/hr)= Negligible						
	lb/10E+12 Btu	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Beryllium (lb/hr)= Negligible						
	lb/10E+12 Btu	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Mercury (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 Btu/MMBtu						
	lb/10E+12 Btu (1)	0.027	0.027	0.027	0.027	0.027
	HIR (MMBtu/hr)	354.3	374.9	359.8	313.3	270.3
	lb/hr	9.57E-06	1.01E-05	9.72E-06	8.46E-06	7.30E-06
	TPY	4.19E-05	4.43E-05	4.26E-05	3.71E-05	3.20E-05
Fluoride (lb/hr)= Negligible						
	lb/10E+12 Btu	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Sulfuric Acid Mist (lb/hr) = Fraction of SO2 Emission Rate x SO2 Emission Rate x lb H2SO4/lb SO2 (98/64)						
	Fraction SO2 (%)	5	5	5	5	5
	SO2 (lb/hr)	1.0	1.1	1.0	0.9	0.8
	lb H2SO4/lb SO2	1.53	1.53	1.53	1.53	1.53
	lb/hr	7.87E-02	8.24E-02	7.89E-02	6.96E-02	6.03E-02
	TPY	3.45E-01	3.61E-01	3.46E-01	3.05E-01	2.64E-01

Source: (1) DER, 1992

Table A-12. Non-Regulated Pollutant Emissions for the Proposed Orange Cogeneration Facility
GE LM6000-PA, Natural Gas, Dry Low NOx

Pollutant	Units	Gas Turbine Natural Gas 20 °F	Gas Turbine Natural Gas 40 °F	Gas Turbine Natural Gas 59 °F	Gas Turbine Natural Gas 80 °F	Gas Turbine Natural Gas 100 °F
Manganese (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Nickel (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Cadmium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Chromium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Copper (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Vanadium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Selenium (lb/hr)= Negligible						
	lb/10E+12 Btu (1)	NA	NA	NA	NA	NA
	HIR (MMBtu/hr)	NA	NA	NA	NA	NA
	lb/hr	NA	NA	NA	NA	NA
	TPY	NA	NA	NA	NA	NA
Polycyclic Organic Matter (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 Btu/MMBtu						
	lb/10E+12 Btu (1)	1.113	1.113	1.113	1.113	1.113
	HIR (MMBtu/hr)	354.3	374.9	359.8	313.3	270.3
	lb/hr	3.94E-04	4.17E-04	4.00E-04	3.49E-04	3.01E-04
	TPY	1.73E-03	1.83E-03	1.75E-03	1.53E-03	1.32E-03
Formaldehyde (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 Btu/MMBtu						
	lb/10E+12 Btu (1)	88.12	88.12	88.12	88.12	88.12
	HIR (MMBtu/hr)	354.3	374.9	359.8	313.3	270.3
	lb/hr	3.12E-02	3.30E-02	3.17E-02	2.76E-02	2.38E-02
	TPY	1.37E-01	1.45E-01	1.39E-01	1.21E-01	1.04E-01

Source: (1) EPA, 1990

Table A-13. Design Information and Stack Parameters for Orange Cogeneration Facility-Auxiliary Boiler

Data	Design Operating Conditions (Maximum Capacity, Percent) 100
General	
Steam Output (lb/hr)	82,993
Heat Input Rate (MMBtu/hr)	100
Hours of Operation	8760
Exhaust Flow Conditions	
Mass Flow Rate (lb/hr)	89,455
Temperature (°F)	305
Moisture Content (% Vol.)	10.39
Natural Gas Consumption (cf/hr)= Heat Input (MMBtu/hr) x 1,000,000 Btu/MMBtu ÷ Fuel Heat Content, LHV (Btu/cf)	
Heat Content, LHV (Btu/cf)	946
Natural Gas Consumption (cf/hr)	105,708
Natural Gas Consumption (MMcf/hr)	0.105708
Volume Flow (acfm)= [(Mass Flow (lb/hr) x 1,545 ft-lb/°R x (Temp. (°F)+ 460°F)] ÷ ÷ [Molecular weight x 2116.8 lb/ft^2 x 60 min/hr]	
Mass Flow (lb/hr)	89,455
Temperature (°F)	305
Molecular Weight	28.00
Volume Flow (acfm)	29,731
Volume Flow (dscfm)= Volume flow (acfm) x [(68°F + 460°F)÷(Exhaust Temperature(°F) + 460°F)] x [(100-(Moisture Content(%)) ÷ 100]	
Volume Flow (acfm)	29,731
Exhaust Temperature (°F)	305
Moisture Content (%)	10.39
Volume Flow (dscfm)	18,388
Stack Data	
Stack Height (ft)	65
Diameter (ft)	3.67
Operating Data	
Velocity (ft/sec)= Volume flow (acfm) ÷ [((diameter)^2÷ 4) x 3.14159] ÷ 60 sec/min	
Volume Flow (acfm)	29,731
Diameter (ft)	3.67
Velocity (ft/sec)	46.9

Note: Universal gas constant= 1,545 ft-lb(force)/°R; atmospheric pressure= 2.116.8 lb(force)/ft^2

Table A-14. Maximum Emissions of Criteria Pollutants for the Orange Cogeneration Facility-Auxiliary Boiler

Pollutant	Design Operating Conditions (Maximum Capacity, Percent)
	100
Particulate Matter (lb/hr)= Emission Factor (lb/MMBtu) x Heat Input Rate (MMBtu/hr)	
Emission Factor, lb/MMBtu	0.010
Heat Input Rate (MMBtu/hr)	100.0
lb/hr	1.00
TPY	4.38
Sulfur Dioxide (lb/hr)= Sulfur Content (gr/100 cf) x [Fuel Consumption (cf/hr) ÷ 100] x 1 lb/7000 gr x (lb SO2/lb S)	
Sulfur content, gr/100 cf	1.0
Fuel Consumption (cf/hr)	105,708
lb SO2/lb S (64/32)	2.0
lb/hr	0.30
TPY	1.32
Nitrogen Oxides (lb/hr)= Emission Factor (lb/MMBtu) x Heat Input Rate (MMBtu/hr)	
Emission Factor (lb/MMBtu)	0.130
Heat Input Rate (MMBtu/hr)	100.0
lb/hr	13.00
TPY	56.94
Carbon Monoxide (lb/hr)= Emission Factor (lb/MMBtu) x Heat Input Rate (MMBtu/hr)	
Emission Factor (lb/MMBtu)	0.100
Heat Input Rate (MMBtu/hr)	100.0
lb/hr	10.00
TPY	43.80
Volatile Organic Compounds (lb/hr)= Emission Factor (lb/MMBtu) x Heat Input Rate (MMBtu/hr)	
Emission Factor (lb/MMBtu)	0.043
Heat Input Rate (MMBtu/hr)	100.0
lb/hr	4.30
TPY	18.83

Table A-15. Maximum Emissions of Other Regulated Pollutants for the Orange Cogeneration Facility Auxiliary Boiler

Pollutant	Design Operating Conditions (Maximum Capacity, Percent)
	100
Arsenic (lb/hr)= Negligible	
Basis, lb/10E+12 Btu	NA
HIR (MMBtu/hr)	NA
lb/hr	NA
TPY	NA
Beryllium (lb/hr)= Negligible	
Basis, lb/10E+12 Btu	NA
HIR (MMBtu/hr)	NA
lb/hr	NA
TPY	NA
Mercury (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 MMBtu/10E+12 Btu	
Basis, lb/10E+12 Btu (1)	0.027
HIR (MMBtu/hr)	100.0
lb/hr	2.70E-06
TPY	1.18E-05
Fluoride (lb/hr)= Negligible	
Basis, lb/10E+12 Btu	NA
HIR (MMBtu/hr)	NA
lb/hr	NA
TPY	NA
Sulfuric Acid Mist (lb/hr) = Fraction of SO2 Emission Rate x SO2 Emission Rate x lb H2SO4/lb SO2	
Fraction SO2 (%)	5
SO2 (lb/hr)	0.30
lb H2SO4/lb SO2 (98/64)	1.53
lb/hr	2.31E-02
TPY	1.01E-01

Source: (1) DER, 1992

Table A-16. Maximum Emissions of Non-Regulated Pollutants for the Orange Cogeneration Facility-Auxiliary Boiler

Pollutant	Design Operating Conditions (Maximum Capacity, Percent) 100
Manganese (lb/hr)= Negligible	
Basis, lb/10E+12 Btu (1)	NA
HIR (MMBtu/hr)	NA
lb/hr	NA
TPY	NA
Nickel (lb/hr)= Negligible	
Basis, lb/10E+12 Btu (1)	NA
HIR (MMBtu/hr)	NA
lb/hr	NA
TPY	NA
Cadmium (lb/hr)= Negligible	
Basis, lb/10E+12 Btu (1)	NA
HIR (MMBtu/hr)	NA
lb/hr	NA
TPY	NA
Chromium (lb/hr)= Negligible	
Basis, lb/10E+12 Btu (1)	NA
HIR (MMBtu/hr)	NA
lb/hr	NA
TPY	NA
Copper (lb/hr)= Negligible	
Basis, lb/10E+12 Btu (1)	NA
HIR (MMBtu/hr)	NA
lb/hr	NA
TPY	NA
Vanadium (lb/hr)= Negligible	
Basis, lb/10E+12 Btu (1)	NA
HIR (MMBtu/hr)	NA
lb/hr	NA
TPY	NA
Selenium (lb/hr)= Negligible	
Basis, lb/10E+12 Btu (1)	NA
HIR (MMBtu/hr)	NA
lb/hr	NA
TPY	NA
Polycyclic Organic Matter (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 MMBtu/10E+12 Btu	
Basis, lb/10E+12 Btu (1)	1.113
HIR (MMBtu/hr)	100.0
lb/hr	1.11E-04
TPY	4.87E-04
Formaldehyde (lb/hr)= Basis (lb/10E+12 Btu) x Heat Input Rate (MMBtu/hr) ÷ 1,000,000 MMBtu/10E+12 Btu	
Basis, lb/10E+12 Btu (1)	88.12
HIR (MMBtu/hr)	100.0
lb/hr	8.81E-03
TPY	3.86E-02

Source: (1) EPA, 1990

Table A-17. Summary of Maximum Pollutant Emissions for the Proposed Orange Cogeneration Facility- Simple Cycle Operation- GE LM6000-PA, Natural Gas, Water Injection

Pollutant	Units	20 °F			40 °F			59 °F			80 °F			100 °F		
		CT	AB	Total	CT	AB	Total	CT	AB	Total	CT	AB	Total	CT	AB	Total
PM	lb/hr	5.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	5.00E+00
	TPY	2.19E+01	0.00E+00	2.19E+01	2.19E+01	0.00E+00	2.19E+01	2.19E+01	0.00E+00	2.19E+01	2.19E+01	0.00E+00	2.19E+01	2.19E+01	0.00E+00	2.19E+01
SO2	lb/hr	1.07E+00	0.00E+00	1.07E+00	1.13E+00	0.00E+00	1.13E+00	1.09E+00	0.00E+00	1.09E+00	9.46E-01	0.00E+00	9.46E-01	8.16E-01	0.00E+00	8.16E-01
	TPY	4.69E+00	0.00E+00	4.69E+00	4.96E+00	0.00E+00	4.96E+00	4.76E+00	0.00E+00	4.76E+00	4.14E+00	0.00E+00	4.14E+00	3.58E+00	0.00E+00	3.58E+00
NOx^a	lb/hr	3.57E+01	0.00E+00	3.57E+01	3.78E+01	0.00E+00	3.78E+01	3.63E+01	0.00E+00	3.63E+01	3.16E+01	0.00E+00	3.16E+01	2.73E+01	0.00E+00	2.73E+01
	TPY	1.57E+02	0.00E+00	1.57E+02	1.66E+02	0.00E+00	1.66E+02	1.59E+02	0.00E+00	1.59E+02	1.39E+02	0.00E+00	1.39E+02	1.19E+02	0.00E+00	1.19E+02
CO	lb/hr	2.85E+01	0.00E+00	2.85E+01	2.84E+01	0.00E+00	2.84E+01	2.68E+01	0.00E+00	2.68E+01	2.41E+01	0.00E+00	2.41E+01	2.13E+01	0.00E+00	2.13E+01
	TPY	1.25E+02	0.00E+00	1.25E+02	1.24E+02	0.00E+00	1.24E+02	1.18E+02	0.00E+00	1.18E+02	1.05E+02	0.00E+00	1.05E+02	9.32E+01	0.00E+00	9.32E+01
VOC	lb/hr	4.07E+00	0.00E+00	4.07E+00	4.05E+00	0.00E+00	4.05E+00	3.83E+00	0.00E+00	3.83E+00	3.44E+00	0.00E+00	3.44E+00	3.04E+00	0.00E+00	3.04E+00
	TPY	1.78E+01	0.00E+00	1.78E+01	1.78E+01	0.00E+00	1.78E+01	1.68E+01	0.00E+00	1.68E+01	1.51E+01	0.00E+00	1.51E+01	1.33E+01	0.00E+00	1.33E+01
Sulfuric Acid Mist	lb/hr	8.19E-02	0.00E+00	8.19E-02	8.67E-02	0.00E+00	8.67E-02	8.32E-02	0.00E+00	8.32E-02	7.24E-02	0.00E+00	7.24E-02	6.25E-02	0.00E+00	6.25E-02
	TPY	3.59E-01	0.00E+00	3.59E-01	3.80E-01	0.00E+00	3.80E-01	3.64E-01	0.00E+00	3.64E-01	3.17E-01	0.00E+00	3.17E-01	2.74E-01	0.00E+00	2.74E-01
POM	lb/hr	3.94E-04	0.00E+00	3.94E-04	4.17E-04	0.00E+00	4.17E-04	4.00E-04	0.00E+00	4.00E-04	3.49E-04	0.00E+00	3.49E-04	3.01E-04	0.00E+00	3.01E-04
	TPY	1.73E-03	0.00E+00	1.73E-03	1.83E-03	0.00E+00	1.83E-03	1.75E-03	0.00E+00	1.75E-03	1.53E-03	0.00E+00	1.53E-03	1.32E-03	0.00E+00	1.32E-03
Formaldehyde	lb/hr	3.12E-02	0.00E+00	3.12E-02	3.30E-02	0.00E+00	3.30E-02	3.17E-02	0.00E+00	3.17E-02	2.76E-02	0.00E+00	2.76E-02	2.38E-02	0.00E+00	2.38E-02
	TPY	1.37E-01	0.00E+00	1.37E-01	1.45E-01	0.00E+00	1.45E-01	1.39E-01	0.00E+00	1.39E-01	1.21E-01	0.00E+00	1.21E-01	1.04E-01	0.00E+00	1.04E-01

Note: CT = 1 combustion turbine; AB = auxiliary boiler (not in operation). All units operating for 8,760 hours per year.

^a NOx emission is based on 25 ppmvd, corrected to 15 % O2.

Table A-18. Summary of Maximum Pollutant Emissions for the Proposed Orange Cogeneration Facility- Combined Cycle Operation- GE LM6000-PA, Natural Gas, Water Injection

Pollutant	Units	20 °F			40 °F			59 °F			80 °F			100 °F		
		CT	AB	Total	CT	AB	Total	CT	AB	Total	CT	AB	Total	CT	AB	Total
PM	lb/hr	1.00E+01	1.00E+00	1.10E+01	1.00E+01	1.00E+00	1.10E+01	1.00E+01	1.00E+00	1.10E+01	1.00E+01	1.00E+00	1.10E+01	1.00E+01	1.00E+00	1.10E+01
	TPY	4.38E+01	4.38E+00	4.82E+01	4.38E+01	4.38E+00	4.82E+01	4.38E+01	4.38E+00	4.82E+01	4.38E+01	4.38E+00	4.82E+01	4.38E+01	4.38E+00	4.82E+01
SO2	lb/hr	2.14E+00	3.02E-01	2.44E+00	2.26E+00	3.02E-01	2.57E+00	2.17E+00	3.02E-01	2.48E+00	1.89E+00	3.02E-01	2.19E+00	1.63E+00	3.02E-01	1.93E+00
	TPY	9.37E+00	1.32E+00	1.07E+01	9.92E+00	1.32E+00	1.12E+01	9.52E+00	1.32E+00	1.08E+01	8.29E+00	1.32E+00	9.61E+00	7.15E+00	1.32E+00	8.47E+00
NOx^a	lb/hr	7.15E+01	1.30E+01	8.45E+01	7.57E+01	1.30E+01	8.87E+01	7.26E+01	1.30E+01	8.56E+01	6.32E+01	1.30E+01	7.62E+01	5.46E+01	1.30E+01	6.76E+01
	TPY	3.13E+02	5.69E+01	3.70E+02	3.31E+02	5.69E+01	3.88E+02	3.18E+02	5.69E+01	3.75E+02	2.77E+02	5.69E+01	3.34E+02	2.39E+02	5.69E+01	2.96E+02
CO	lb/hr	5.70E+01	1.00E+01	6.70E+01	5.68E+01	1.00E+01	6.68E+01	5.37E+01	1.00E+01	6.37E+01	4.82E+01	1.00E+01	5.82E+01	4.26E+01	1.00E+01	5.26E+01
	TPY	2.50E+02	4.38E+01	2.93E+02	2.49E+02	4.38E+01	2.92E+02	2.35E+02	4.38E+01	2.79E+02	2.11E+02	4.38E+01	2.55E+02	1.86E+02	4.38E+01	2.30E+02
VOC	lb/hr	8.14E+00	4.30E+00	1.24E+01	8.11E+00	4.30E+00	1.24E+01	7.67E+00	4.30E+00	1.20E+01	6.88E+00	4.30E+00	1.12E+01	6.08E+00	4.30E+00	1.04E+01
	TPY	3.57E+01	1.88E+01	5.45E+01	3.55E+01	1.88E+01	5.43E+01	3.36E+01	1.88E+01	5.24E+01	3.01E+01	1.88E+01	4.90E+01	2.66E+01	1.88E+01	4.55E+01
Sulfuric Acid Mist	lb/hr	1.64E-01	2.31E-02	1.87E-01	1.73E-01	2.31E-02	1.96E-01	1.66E-01	2.31E-02	1.90E-01	1.45E-01	2.31E-02	1.68E-01	1.25E-01	2.31E-02	1.48E-01
	TPY	7.18E-01	1.01E-01	8.19E-01	7.59E-01	1.01E-01	8.61E-01	7.29E-01	1.01E-01	8.30E-01	6.35E-01	1.01E-01	7.36E-01	5.48E-01	1.01E-01	6.49E-01
POM	lb/hr	7.89E-04	1.11E-04	9.00E-04	8.34E-04	1.11E-04	9.46E-04	8.01E-04	1.11E-04	9.12E-04	6.97E-04	1.11E-04	8.09E-04	6.02E-04	1.11E-04	7.13E-04
	TPY	3.45E-03	4.87E-04	3.94E-03	3.65E-03	4.87E-04	4.14E-03	3.51E-03	4.87E-04	4.00E-03	3.05E-03	4.87E-04	3.54E-03	2.64E-03	4.87E-04	3.12E-03
Formaldehyde	lb/hr	6.24E-02	8.81E-03	7.13E-02	6.61E-02	8.81E-03	7.49E-02	6.34E-02	8.81E-03	7.22E-02	5.52E-02	8.81E-03	6.40E-02	4.76E-02	8.81E-03	5.65E-02
	TPY	2.74E-01	3.86E-02	3.12E-01	2.89E-01	3.86E-02	3.28E-01	2.78E-01	3.86E-02	3.16E-01	2.42E-01	3.86E-02	2.80E-01	2.09E-01	3.86E-02	2.47E-01

Note: CT = 2 combustion turbines; AB = auxiliary boiler. All units operating for 8,760 hours per year.

^a NOx emission is based on 25 ppmvd, corrected to 15 % O2.

LM6000PA
6/29/93

Table A-19. Summary of Maximum Pollutant Emissions for the Proposed Orange Cogeneration Facility-Combined Cycle Operation- GE LM6000-PA, Natural Gas, Dry Low NOx

Pollutant	Units	20 °F			40 °F			59 °F			80 °F			100 °F		
		CT	AB	Total	CT	AB	Total	CT	AB	Total	CT	AB	Total	CT	AB	Total
PM	lb/hr	1.00E+01	1.00E+00	1.10E+01	1.00E+01	1.00E+00	1.10E+01	1.00E+01	1.00E+00	1.10E+01	1.00E+01	1.00E+00	1.10E+01	1.00E+01	1.00E+00	1.10E+01
	TPY	4.38E+01	4.38E+00	4.82E+01	4.38E+01	4.38E+00	4.82E+01	4.38E+01	4.38E+00	4.82E+01	4.38E+01	4.38E+00	4.82E+01	4.38E+01	4.38E+00	4.82E+01
SO2	lb/hr	2.06E+00	3.02E-01	2.36E+00	2.15E+00	3.02E-01	2.45E+00	2.06E+00	3.02E-01	2.36E+00	1.82E+00	3.02E-01	2.12E+00	1.57E+00	3.02E-01	1.88E+00
	TPY	9.00E+00	1.32E+00	1.03E+01	9.42E+00	1.32E+00	1.07E+01	9.03E+00	1.32E+00	1.03E+01	7.97E+00	1.32E+00	9.29E+00	6.90E+00	1.32E+00	8.22E+00
NOx^a	lb/hr	6.94E+01	1.30E+01	8.24E+01	7.26E+01	1.30E+01	8.56E+01	6.96E+01	1.30E+01	8.26E+01	6.14E+01	1.30E+01	7.44E+01	5.31E+01	1.30E+01	6.61E+01
	TPY	3.04E+02	5.69E+01	3.61E+02	3.18E+02	5.69E+01	3.75E+02	3.05E+02	5.69E+01	3.62E+02	2.69E+02	5.69E+01	3.26E+02	2.33E+02	5.69E+01	2.90E+02
CO	lb/hr	5.72E+01	1.00E+01	6.72E+01	5.67E+01	1.00E+01	6.67E+01	5.40E+01	1.00E+01	6.40E+01	4.86E+01	1.00E+01	5.86E+01	4.29E+01	1.00E+01	5.29E+01
	TPY	2.51E+02	4.38E+01	2.94E+02	2.48E+02	4.38E+01	2.92E+02	2.36E+02	4.38E+01	2.80E+02	2.13E+02	4.38E+01	2.57E+02	1.88E+02	4.38E+01	2.31E+02
VOC	lb/hr	8.17E+00	4.30E+00	1.25E+01	8.09E+00	4.30E+00	1.24E+01	7.71E+00	4.30E+00	1.20E+01	6.94E+00	4.30E+00	1.12E+01	6.12E+00	4.30E+00	1.04E+01
	TPY	3.58E+01	1.88E+01	5.46E+01	3.55E+01	1.88E+01	5.43E+01	3.38E+01	1.88E+01	5.26E+01	3.04E+01	1.88E+01	4.92E+01	2.68E+01	1.88E+01	4.56E+01
Sulfuric Acid Mist	lb/hr	1.57E-01	2.31E-02	1.81E-01	1.65E-01	2.31E-02	1.88E-01	1.58E-01	2.31E-02	1.81E-01	1.39E-01	2.31E-02	1.62E-01	1.21E-01	2.31E-02	1.44E-01
	TPY	6.89E-01	1.01E-01	7.91E-01	7.21E-01	1.01E-01	8.23E-01	6.91E-01	1.01E-01	7.92E-01	6.10E-01	1.01E-01	7.11E-01	5.28E-01	1.01E-01	6.29E-01
POM	lb/hr	7.89E-04	1.11E-04	9.00E-04	8.34E-04	1.11E-04	9.46E-04	8.01E-04	1.11E-04	9.12E-04	6.97E-04	1.11E-04	8.09E-04	6.02E-04	1.11E-04	7.13E-04
	TPY	3.45E-03	4.87E-04	3.94E-03	3.65E-03	4.87E-04	4.14E-03	3.51E-03	4.87E-04	4.00E-03	3.05E-03	4.87E-04	3.54E-03	2.64E-03	4.87E-04	3.12E-03
Formaldehyde	lb/hr	6.24E-02	8.81E-03	7.13E-02	6.61E-02	8.81E-03	7.49E-02	6.34E-02	8.81E-03	7.22E-02	5.52E-02	8.81E-03	6.40E-02	4.76E-02	8.81E-03	5.65E-02
	TPY	2.74E-01	3.86E-02	3.12E-01	2.89E-01	3.86E-02	3.28E-01	2.78E-01	3.86E-02	3.16E-01	2.42E-01	3.86E-02	2.80E-01	2.09E-01	3.86E-02	2.47E-01

Note: CT = 2 combustion turbines; AB = auxiliary boiler. All units operating for 8,760 hours per year.

^a NOx emission is based on 25 ppmvd, corrected to 15 % O2.

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October 1990

TOXIC AIR POLLUTANT EMISSION FACTORS - A COMPILATION FOR SELECTED AIR TOXIC COMPOUNDS AND SOURCES, SECOND EDITION

By

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INDUSTRIAL PROCESS	SIC CODE	EMISSION SOURCE	SCC CODE	POLLUTANT	CAS NUMBER	EMISSION FACTOR	NOTES	REFERENCE
Municipal waste combustion	4953	Mass burn waterwall combustor, small size new model to any age medium	501001	Tetrachlorodibenzo-p-dioxins, total		3.2 x 10E-8 lb/ton feed	Capacity < 600 tons/day, ESP control only, overall average of several source averages, range is 1.26 x 10E-8 - 5.2 x 10E-8 lb/ton	180
Municipal waste combustion	4953	Mass burn waterwall combustor, small size new model to any age medium	501001	Tetrachlorodibenzo-p-dioxins, total		0.74 ug/Mg feed	Capacity < 600 tons/day, spray drying after acid gas and PM control, one data point only	180
Municipal waste combustion	4953	Mass burn waterwall combustor, small size new model to any age medium	501001	Tetrachlorodibenzo-p-dioxins, total		2.0 x 10E-8 lb/ton feed	Capacity < 600 tons/day, dry sorbent injection after acid gas and PM control, range is 1.08 x 10E-8 - 2.4 x 10E-8 lb/ton	180
Municipal waste combustion	4953	Mass burn waterwall combustor, built before 1980	501001	Tetrachlorodibenzo-p-dioxins, total		2.8 x 10E-6 lb/ton feed	ESP control only, overall average of several source averages, range is 6.4 x 10E-8 - 6.0 x 10E-6 lb/ton	180
Municipal waste combustion	4953	Mass burn, refractory facility	501001	Tetrachlorodibenzo-p-dioxins, total		3.4 x 10E-6 lb/ton feed	ESP control only, overall average of several source averages, range is 3.0 x 10E-6 - 3.6 x 10E-6 lb/ton	180
Municipal waste combustion	4953	Incinerator stack	501001	Zinc	7440666	1.0 lb/ton munic. solid waste-dry wt.	Controlled by spray-baffle scrubber, based on material balance for model incinerator	98
Naphthalene production		Process emissions		Naphthalene	91203	0.478 lb/ton naphthalene produced	Based on POM emissions and 87% naphthalene	99
Naphthalene production		Storage		Naphthalene	91203	0.0454 lb/ton produced	Based on data from State files and engineering judgement	99
Natural gas combustion		Commercial boiler	10300601	Ammonia	7664417	0.49 lb/10E6 cubic feet gas burned	Sources emitting > 100 tons NH3/year	179
Natural gas combustion		Industrial boilers	10200601	Ammonia	7664417	3.2 lbs/10E6 cubic feet gas burned	Sources emitting > 100 tons NH3/year	179
Natural gas combustion		Boilers, exhaust system	102006	Benzene	71432	1.18% by vol (or 4% by wt) of total VOC	South Coast study, California, engineering judgement	132
Natural gas combustion		Commercial/institutional	103006	Formaldehyde	50000	220.3 lb/10E12 Btu heat input	Control status unspecified, based on source tests	106
Natural gas combustion		Domestic		Formaldehyde	50000	997 lb/10E12 Btu heat input	Control status unspecified, based on source tests	106
Natural gas combustion		Industrial	102006	Formaldehyde	50000	88.12 lb/10E12 Btu heat input	Control status unspecified, based on source tests	106
Natural gas combustion		Double shell boilers, home heating		Polycyclic organic matter		1.113 lb/10E12 Btu heat input	Represents primarily particulate POM, uncontrolled	114
Natural gas combustion		Firetube boiler, process heater	10200601	Polycyclic organic matter		0.649 lb/10E12 Btu heat input	Represents primarily particulate POM, uncontrolled	114

MERCURY EMISSIONS TO THE ATMOSPHERE IN FLORIDA

FINAL REPORT

Prepared For:

Florida Department of Environmental Regulation
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Prepared By:

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August 1992
91166C1

Table 2.2-2. Mercury Emission Factors Used for Florida Electric Utility Sources

Fuel	Removal	Units	Emission Factor Low	 Average	 High
Coal-Uncontrolled	NA	lb/10^{12} Btu [a]	10	16	21
		lb/Mton	0.25	0.42	0.546
w/ESP	25%	lb/10^{12} Btu	7.2	12.0	15.6
		lb/Mton	0.19	0.32	0.41
w/Scrubber	70%	lb/10^{12} Btu	2.9	4.8	6.3
		lb/Mton	0.08	0.13	0.16
Residual Oil	NA	lb/10^{12} Btu	0.4	3.6	9.3
		lb/10^3 gal [b]	5.79E-05	5.46E-04	1.41E-03
Distillate Oil	NA	lb/10^{12} Btu	0.4	3.4	8.8
		lb/10^3 gal [c]	4.99E-05	4.71E-04	1.21E-03
Natural Gas	NA	lb/10^{12} Btu [d]	0.001	0.014	0.027
		lb/MMcf	1.25E-06	1.44E-05	2.75E-05

Note: NA = not applicable.
Units: M = 1,000

[a] Calculated based on 13,100 Btu/lb coal.
[b] Calculated based on 18,500 Btu/lb and 8.2 lb/gal.
[c] Calculated based on 19,500 Btu/lb and 7.1 lb/gal.
[d] Calculated based on 1,024 Btu/scf.

Source: KBN, 1992.

APPENDIX B

ISCST MODEL RESULTS SUMMARY

Summary of Screening Air Dispersion Impacts for the Orange Cogeneration Facility, Bartow, Florida; Simple Cycle Operation
(Three Ambient Temperatures)

OCSSGENR
06/22/93

Ambient Temperature (°F)	Number of Units	Pollutant	Emission Rate Basis		Per Unit Emission Rate		Total Facility Emission Rate			Modeled Emission Rate (g/s)	Averaging Period	Generic Modeled Conc (μg/m³)	Actual Conc (μg/m³)	EPA Sig. Values (μg/m³)	
			Rate	Units	Rate	Units	Rate	Units	(g/s)						
20	1	Particulate	5	lb/hr	5.0	lb/hr	5.0	lb/hr	0.63✓	10.00	24-hour	23.40✓	1.47✓	5	
											Annual	0.094✓	0.0059✓	1	
		Nitrogen Dioxide	25	ppm	156.5	TPY	156.5	TPY	4.50✓	10.00	Annual	0.094✓	0.042✓	1	
		Carbon Monoxide	30	ppm	28.5	lb/hr	28.5	lb/hr	3.59✓	10.00	1-hour	185.2✓	66.51✓	2000	66.49
											8-hour	51.6✓	18.53✓	500	
40	1	Particulate	5	lb/hr	5.0	lb/hr	5.0	lb/hr	0.63✓	10.00	24-hour	18.10✓	1.14✓	5	
											Annual	0.087✓	0.0055✓	1	
		Nitrogen Dioxide	25	ppm	165.7	TPY	165.7	TPY	4.77✓	10.00	Annual	0.087✓	0.041✓	1	
		Carbon Monoxide	30	ppm	28.4	lb/hr	28.4	lb/hr	3.58✓	10.00	1-hour	165.20✓	59.12✓	2000	59.14
											8-hour	41.4✓	14.81✓	500	14.82
100	1	Particulate	5	lb/hr	5.0	lb/hr	5.0	lb/hr	0.63✓	10.00	24-hour	54.20✓	3.41✓	5	
											Annual	0.20✓	0.013✓	1	
		Nitrogen Dioxide	25	ppm	119.5	TPY	119.5	TPY	3.44✓	10.00	Annual	0.20✓	0.069✓	1	
		Carbon Monoxide	30	ppm	21.3	lb/hr	21.3	lb/hr	2.68✓	10.00	1-hour	262.2✓	70.37	2000	70.27
											8-hour	101.9✓	27.35	500	27.31

Note: All stack parameters and emission rates apply to the CT operating in simple cycle mode with water injection using natural gas.

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                                                    ISCBOB2 RELEASE 93165
 ST2 OUTPUT FILE NUMBER 1 :OCSSGENR.082
 ST2 OUTPUT FILE NUMBER 2 :OCSSGENR.083
ISCST2 OUTPUT FILE NUMBER 3 :OCSSGENR.084
ISCST2 OUTPUT FILE NUMBER 4 :OCSSGENR.085
 ST2 OUTPUT FILE NUMBER 5 :OCSSGENR.086
 rst title for first output file is   1982 ARK ENERGY-ORANGECO / SIMPLE CYCLE / GENERIC EMISSIONS 10 G/S
Second title for first output file is  20,40, and 100 DEG / 60' CT STACK


AVERAGING TIME     YEAR      CONC         DIR (deg)    DIST (m)    PERIOD ENDING
                            (ug/m3)       or X (m)     or Y (m)    (YYMMDDHH)
-----------------------------------------------------------------------------
SOURCE GROUP ID:  GSS020
 nual
                   1982     0.09044         240.        9000.        82------
                   1983     0.06770         250.        7000.        83------
                   1984     0.09431         240.        8000.        84------
                   1985     0.08706         240.        9000.        85------
                   1986     0.08504          90.        3000.        86------
HIGH  1-Hour
                   1982   154.44221         150.         106.        82011414
                   1983   185.19388          90.          91.        83032414
                   1984   144.28180         110.          97.        84032908
                   1985    73.47141         360.         140.        85083119
                   1986    59.64932         340.          94.        86031412
HSH  1-Hour
                   1982    52.79645         130.         200.        82011415
                   1983    75.60313         280.         184.        83022712
                   1984   120.47332         150.         106.        84022811
                   1985    42.89340          20.         149.        85083117
                   1986     7.12177         110.         100.        86012711
 IGH  3-Hour
                   1982    73.16328         140.         119.        82011415
                   1983    66.30235          90.          91.        83032415
                   1984    94.83561         150.         106.        84022812
                   1985    28.56992         360.         140.        85083121
                   1986    19.88311         340.          94.        86031412
 SH  3-Hour
                   1982     9.57439         130.         119.        82011418
                   1983    25.21534         280.         184.        83022712
                   1984    45.71914         140.         119.        84032912
                   1985    17.44268         130.         119.        85021218
                   1986     3.10454         230.       10000.        86032706
HIGH  8-Hour
                   1982    28.00793         140.         119.        82011416
                   1983    29.35867         280.         184.        83022716
                   1984    51.59492         150.         106.        84022816
                   1985    12.71086          20.         149.        85083116
                   1986     7.45617         340.          94.        86031416
HSH  8-Hour
                   1982     2.42431         140.         119.        82011424
                   1983     6.01550          90.          91.        83031724
                   1984    30.58204         140.         119.        84032916
                   1985     6.54659         130.         119.        85021224
                   1986     1.84591          90.        2500.        86100516
HIGH 24-Hour
                   1982    10.14408         140.         119.        82011424
                   1983     9.78623         280.         184.        83022724
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                    1984   23.36542         150.       106.      84022824
                    1985    6.33263          20.       149.      85083124
                    1986    2.59345         340.        94.      86031424
HSH 24-Hour
                    1982    0.77859         240.      3000.      82082924
                    1983    2.00517          90.        91.      83031724
                    1984   10.25467         140.       119.      84032924
                    1985    0.78318         120.      7000.      85021224
                    1986    0.75215          90.      3000.      86040824
URCE GROUP ID:      GSS040
Annual
                    1982    0.08372         240.      9000.      82------
                    1983    0.06292         240.      8000.      83------
                    1984    0.08699         240.      8000.      84------
                    1985    0.08034         240.     10000.      85------
                    1986    0.07803          90.      3000.      86------
GH  1-Hour
                    1982  129.31621         150.       106.      82011414
                    1983  165.15565          90.        91.      83032414
                    1984  120.22223         110.        97.      84032908
                    1985   56.07795         360.       140.      85083119
                    1986   44.30790         340.        94.      86031412
H  1-Hour
                    1982   43.81917         130.       200.      82011415
                    1983   58.17887         280.       184.      83022712
                    1984   97.56460         150.       106.      84022811
                    1985   31.41789          20.       149.      85083117
                    1986    5.16054         100.      1000.      86080112
IGH  3-Hour
                    1982   60.93316         140.       119.      82011415
                    1983   58.11613          90.        91.      83032415
                    1984   76.08755         150.       106.      84022812
                    1985   21.40800         360.       140.      85083121
                    1986   14.76930         340.        94.      86031412
HSH  3-Hour
                    1982    5.97315         130.       119.      82011418
                    1983   19.39811         280.       184.      83022712
                    1984   34.89723         140.       119.      84032912
                    1985   12.13949         130.       119.      85021215
                    1986    2.90621         230.     10000.      86032706
IGH  8-Hour
                    1982   23.20721         140.       119.      82011416
                    1983   24.59791         280.       184.      83022716
                    1984   41.44559         150.       106.      84022816
                    1985    9.37802          20.       149.      85083116
                    1986    5.53849         340.        94.      86031416
SH  8-Hour
                    1982    1.56001         360.      2500.      82082716
                    1983    3.97531          90.        91.      83031724
                    1984   22.35923         140.       119.      84032916
                    1985    4.76691         130.       119.      85021224
                    1986    1.68468          90.      3000.      86100516
IGH 24-Hour
                    1982    8.24165         140.       119.      82011424
                    1983    8.19930         280.       184.      83022724
                    1984   18.13896         150.       106.      84022824
                    1985    4.62480          20.       149.      85083124
                    1986    1.92643         340.        94.      86031424
HSH 24-Hour
                    1982    0.71859         240.      3000.      82082924
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                1983      1.32510           90.           91.       83031724
                1984      7.47854          140.          119.       84032924
                1985      0.71667          120.         7000.       85021224
                1986      0.70370           90.         3000.       86040824
SOURCE GROUP ID:  GSS100
```

100 °F

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A ual
                1982      0.10095          240.         8000.       82------
                1983      0.07879          100.           93.       83------
                1984      0.20368          140.          119.       84------
                1985      0.09606          240.         9000.       85------
                1986      0.09200           90.         3000.       86------
HIGH   1-Hour
                1982    262.19177          150.          106.       82011414
                1983    258.46442           90.           91.       83032414
                1984    245.76088          110.           97.       84032908
                1985    158.52286          360.          140.       85083119
                1986    147.63962          340.           94.       86031412
HSH  1-Hour
                1982     87.90906          130.          200.       82011415
                1983    161.78177          280.          184.       83022712
                1984    225.89149          150.          106.       84022811
                1985    103.41029           20.          149.       85083117
                1986     41.70058          110.          100.       86012711
HIGH   3-Hour
                1982    124.44328          140.          119.       82011415
                1983    105.48948           90.           91.       83032415
                1984    185.65222          150.          106.       84022812
                1985     67.97526          140.          119.       85021215
                1986     49.21321          340.           94.       86031412
 SH  3-Hour
                1982     38.94577          130.          119.       82011418
                1983     55.37284           90.           91.       83031724
                1984    107.61301          140.          119.       84032912
                1985     45.62215          130.          119.       85021218
                1986     15.88226          110.          100.       86012715
 IGH   8-Hour
                1982     48.98525          140.          119.       82011416
                1983     51.12876          280.          184.       83022716
                1984    101.93536          150.          106.       84022816
                1985     36.04826          140.          119.       85021216
                1986     18.45495          340.           94.       86031416
HSH  8-Hour
                1982      9.80539          140.          119.       82011424
                1983     20.76481           90.           91.       83031724
                1984     68.83555          140.          119.       84022816
                1985     17.40616          130.          119.       85021224
                1986      5.82260          150.          106.       86012724
HIGH 24-Hour
                1982     19.59688          140.          119.       82011424
                1983     17.04990          280.          184.       83022724
                1984     54.16481          150.          106.       84022824
                1985     19.13910          130.          119.       85021224
                1986      6.41911          340.           94.       86031424
 SH 24-Hour
                1982      1.19343          260.          184.       82061524
                1983      6.92160           90.           91.       83031724
                1984     28.50564          140.          119.       84032924
                1985      2.56146          140.          119.       85010424
                1986      2.14240          150.          106.       86012724
 All receptor computations reported with respect to a user-specified origin
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GRID	0.00	0.00
DISCRETE	0.00	0.00

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                                                  ISCBOB2 RELEASE 93165

ISCST2 OUTPUT FILE NUMBER 1 :OCWIPM.082
 CST2 OUTPUT FILE NUMBER 2 :OCWIPM.083
 CST2 OUTPUT FILE NUMBER 3 :OCWIPM.084
ISCST2 OUTPUT FILE NUMBER 4 :OCWIPM.085
 CST2 OUTPUT FILE NUMBER 5 :OCWIPM.086
 rst title for first output file is   1982 ARK ENERGY-ORANGECO / COMBINED CYCLE-WATER INJECTION / PM
Second title for first output file is  40,59, and 100 DEG / 65' AUX and 100' HRSG STACKS



AVERAGING TIME      YEAR     CONC         DIR (deg)    DIST (m)    PERIOD ENDING
                            (ug/m3)       or X (m)     or Y (m)    (YYMMDDHH)
----------------------------------------------------------------------------
SOURCE GROUP ID:  ALL040
 nual
                    1982     0.08267         250.        1000.        82------
                    1983     0.06294         250.        1000.        83------
                    1984     0.07632         240.        1500.        84------
                    1985     0.06969          70.        1000.        85------
                    1986     0.08058          90.        1000.        86------
HIGH 24-Hour
                    1982     0.92654         120.         200.        82011424
                    1983     1.45181         290.         200.        83022724
                    1984     2.56726         130.         200.        84022824
                    1985     2.38860         360.         200.        85083124
                    1986     0.83515         300.         210.        86031324
 HSH 24-Hour
                    1982     0.77915         290.         200.        82120124
                    1983     1.18654         110.         200.        83020324
                    1984     1.27560         120.         200.        84022824
                    1985     0.91056         120.         400.        85010424
                    1986     0.81211         300.         210.        86031824
 OURCE GROUP ID:  ALL059
 Annual
                    1982     0.08508         250.        1000.        82------
                    1983     0.06484         250.        1000.        83------
                    1984     0.07874         240.        1500.        84------
                    1985     0.07229          70.        1000.        85------
                    1986     0.08374          90.        1000.        86------
 IGH 24-Hour
                    1982     0.94803         120.         200.        82011424
                    1983     1.61343         290.         193.        83022724
                    1984     2.62976         130.         200.        84022824
                    1985     2.45507         360.         200.        85083124
                    1986     0.83515         300.         210.        86031324
 SH 24-Hour
                    1982     0.77915         290.         200.        82120124
                    1983     1.27563         110.         200.        83020324
                    1984     1.30729         120.         200.        84022824
                    1985     1.38883         120.         200.        85010424
                    1986     0.81211         300.         210.        86031824
 SOURCE GROUP ID:  ALL100
 nnual
                    1982     0.10047         250.        1000.        82------
                    1983     0.07473         250.        1000.        83------
                    1984     0.09134         240.        1500.        84------
                    1985     0.08582          80.        1000.        85------
                    1986     0.09941          90.        1000.        86------
 IGH 24-Hour
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40°F ALL SOURCES

59°F

100°F

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            1982     1.56366        240.        183.      82042324
            1983     2.34028        290.        193.      83022724
            1984     3.43134        130.        200.      84022824
            1985     2.90536        120.        200.      85010424
            1986     1.19577        230.        200.      86010824
HSH 24-Hour
            1982     1.40756        240.        183.      82032824
            1983     1.82606        100.        200.      83042424
            1984     1.67573        120.        106.      84022824
            1985     2.56048        120.        200.      85021224
            1986     0.84785        300.        210.      86031824
```

40°F CT ONLY

```
SOURCE GROUP ID:  CT040
Annual
            1982     0.04843        240.       2500.      82------
            1983     0.03452        240.       2500.      83------
            1984     0.04509        240.       2500.      84------
            1985     0.04537         80.       1500.      85------
            1986     0.05453         90.       1500.      86------
HIGH 24-Hour
            1982     0.84757        120.        200.      82011424
            1983     1.16574        110.        200.      83042424
            1984     2.44159        130.        200.      84022824
            1985     2.37983        360.        200.      85083124
            1986     0.62733        130.        200.      86030124
HSH 24-Hour
            1982     0.50632        240.       1500.      82082924
            1983     1.08294        110.        200.      83020324
            1984     1.22520        120.        200.      84022824
            1985     0.73004        120.        200.      85010424
            1986     0.57872        130.        200.      86012724
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59°F CT ONLY

```
SOURCE GROUP ID:  CT059
Annual
            1982     0.05066        240.       2500.      82------
            1983     0.03642        240.       2000.      83------
            1984     0.04731        240.       2000.      84------
            1985     0.04790         70.       1000.      85------
            1986     0.05678         90.       1500.      86------
HIGH 24-Hour
            1982     0.86906        120.        200.      82011424
            1983     1.26649        110.        200.      83042424
            1984     2.50408        130.        200.      84022824
            1985     2.44630        360.        200.      85083124
            1986     0.64865        130.        200.      86030124
HSH 24-Hour
            1982     0.52443        240.       1500.      82082924
            1983     1.17202        110.        200.      83020324
            1984     1.25824        120.        106.      84022824
            1985     1.23738        120.        200.      85010424
            1986     0.59914        130.        200.      86012724
```

100°F CT ONLY

```
SOURCE GROUP ID:  CT100
Annual
            1982     0.06355        240.       2000.      82------
            1983     0.04505        240.       2000.      83------
            1984     0.05864        240.       2000.      84------
            1985     0.06112         80.       1000.      85------
            1986     0.07080         90.       1000.      86------
HIGH 24-Hour
            1982     1.56366        240.        183.      82042324
            1983     1.94624        100.        200.      83031824
            1984     3.30567        130.        200.      84022824
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                    1985       2.83316            360.         200.       85083124
                    1986       1.19577            230.         200.       86010824
H H 24-Hour
                    1982       1.40756            240.         183.       82032824
                    1983       1.68144            100.         200.       83042424
                    1984       1.66936            120.         106.       84022824
                    1985       2.41983            120.         200.       85021224
                    1986       0.71988            130.         200.       86012724
 URCE GROUP ID:     AUXBLR
 nual
                    1982       0.05687            290.         200.       82------
                    1983       0.04732            290.         200.       83------
                    1984       0.04514            250.         800.       84------
                    1985       0.04435             70.         400.       85------
                    1986       0.05285             80.         400.       86------
  GH 24-Hour
                    1982       0.84948            300.         210.       82122424
                    1983       0.93817            300.         210.       83030524
                    1984       0.79311            300.         210.       84022624
                    1985       0.89812            300.         210.       85083024
                    1986       0.83515            300.         210.       86031324
HSH 24-Hour
                    1982       0.77915            290.         200.       82120124
                    1983       0.64075            300.         210.       83020124
                    1984       0.73540            300.         210.       84030524
                    1985       0.61206            300.         210.       85112124
                    1986       0.81211            300.         210.       86031824
 All receptor computations reported with respect to a user-specified origin
GRID              0.00           0.00
 SCRETE           0.00           0.00
```

AUX. BLR.

```
                                                  ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCWINOX.082
I[illegible]ST2 OUTPUT FILE NUMBER 2 :OCWINOX.083
ISCST2 OUTPUT FILE NUMBER 3 :OCWINOX.084
ISCST2 OUTPUT FILE NUMBER 4 :OCWINOX.085
I[illegible]ST2 OUTPUT FILE NUMBER 5 :OCWINOX.086
F[illegible]st title for first output file is   1982 ARK ENERGY-ORANGECO / COMBINED CYCLE-WATER INJECTION / NO2
Second title for first output file is  40,59, and 100 DEG / 65' AUX and 100' HRSG STACKS
```

✓

```
AVERAGING TIME      YEAR      CONC          DIR (deg)     DIST (m)     PERIOD ENDING
                              (ug/m3)       or X (m)      or Y (m)     (YYMMDDHH)
-----------------------------------------------------------------------------------
SOURCE GROUP ID:  ALL040
[illegible]ual
                    1982      0.87495          250.         1000.        82------
                    1983      0.66418          250.         1000.        83------
                    1984      0.77046          250.         1000.        84------
                    1985      0.69116          250.         1000.        85------
                    1986      0.76842           90.          800.        86------
```

40°F ALL SOURCES

```
SOURCE GROUP ID:  ALL059
[illegible]nual
                    1982      0.88242          250.         1000.        82------
                    1983      0.67023          250.         1000.        83------
                    1984      0.77676          250.         1000.        84------
                    1985      0.69749          250.         1000.        85------
                    1986      0.77815           90.          800.        86------
```

59°F

```
SOURCE GROUP ID:  ALL100
[illegible]nual
                    1982      0.90262          250.         1000.        82------
                    1983      0.68826          290.          200.        83------
                    1984      0.78191          250.         1000.        84------
                    1985      0.70671          250.         1000.        85------
                    1986      0.78457           90.          800.        86------
```

100°F

```
SOURCE GROUP ID:  CT040
[illegible]nnual
                    1982      0.36594          240.         2500.        82------
                    1983      0.26082          240.         2500.        83------
                    1984      0.34068          240.         2500.        84------
                    1985      0.34277           80.         1500.        85------
                    1986      0.41200           90.         1500.        86------
```

40°F CT ONLY

```
SOURCE GROUP ID:  CT059
Annual
                    1982      0.36747          240.         2500.        82------
                    1983      0.26416          240.         2000.        83------
                    1984      0.34315          240.         2000.        84------
                    1985      0.34749           70.         1000.        85------
                    1986      0.41188           90.         1500.        86------
```

59°F

```
SOURCE GROUP ID:  CT100
Annual
                    1982      0.34702          240.         2000.        82------
                    1983      0.24600          240.         2000.        83------
                    1984      0.32021          240.         2000.        84------
                    1985      0.33372           80.         1000.        85------
                    1986      0.38657           90.         1000.        86------
```

100°F

```
SOURCE GROUP ID:  AUXBLR
Annual
                    1982      0.71747          290.          200.        82------
                    1983      0.59700          290.          200.        83------
```

AUX. BLR.

```
                1984    0.56945          250.         800.       84------
                1985    0.55944           70.         400.       85------
                1986    0.66668           80.         400.       86------
 All receptor computations reported with respect to a user-specified origin
GRID            0.00          0.00
D[illegible]CRETE        0.00          0.00
```

```
[redacted]
                                                  ISCBOB2 RELEASE 93165
I[redacted]ST2 OUTPUT FILE NUMBER 1 :OCWICO.082
I  ST2 OUTPUT FILE NUMBER 2 :OCWICO.083
ISCST2 OUTPUT FILE NUMBER 3 :OCWICO.084
ISCST2 OUTPUT FILE NUMBER 4 :OCWICO.085
I[redacted]ST2 OUTPUT FILE NUMBER 5 :OCWICO.086
F  st title for first output file is   1982 ARK ENERGY-ORANGECO / COMBINED CYCLE-WATER INJECTION / CO  ✓
Second title for first output file is  40,59, and 100 DEG / 65' AUX and 100' HRSG STACKS

[redacted]

AVERAGING TIME     YEAR     CONC         DIR (deg)     DIST (m)    PERIOD ENDING
[redacted]                 (ug/m3)       or X (m)      or Y (m)    (YYMMDDHH)
-----------------------------------------------------------------------------

SOURCE GROUP ID:  ALL040                                                    40°F    ALL SOURCES
H[redacted]H  1-Hour
                   1982     36.62535         120.          200.         82011415
                   1983     58.38681         290.          193.         83070622
                   1984     39.98288         220.          200.         84081704
[redacted]
                   1985     44.84493         190.          200.         85031006
                   1986     37.07120          10.          200.         86031412
HSH   1-Hour
                   1982     30.88519         120.          200.         82011413
[redacted]         1983     55.29050         290.          200.         83022712
                   1984     35.65929         100.          200.         84041613
[redacted]         1985     40.56778         190.          200.         85012306
                   1986     31.56118         300.          210.         86031823
HIGH   8-Hour
                   1982     15.17585         300.          210.         82122416
[redacted]         1983     26.82116         290.          193.         83022716
                   1984     26.92858         120.          200.         84032916
                   1985     22.35588         360.          200.         85083116
                   1986     15.55304         300.          210.         86031308
[redacted]H  8-Hour
                   1982     12.66530         300.          210.         82121516
                   1983     12.61085         110.          200.         83042416
[redacted]         1984     19.69659         130.          200.         84022808
                   1985     12.45903          30.          162.         85083124
                   1986     15.31325         300.          210.         86031824
[redacted]URCE GROUP ID:  ALL059                                           59°F
  GH   1-Hour
                   1982     47.86941         290.          200.         82013011
[redacted]         1983     57.80543         290.          193.         83070622
                   1984     38.80351         220.          200.         84081704
                   1985     44.00381         190.          200.         85031006
                   1986     35.90173          10.          200.         86031412
[redacted]SH  1-Hour
                   1982     29.86980         120.          200.         82011413
                   1983     54.28680         290.          200.         83022712
[redacted]         1984     35.10567         100.          200.         84041613
                   1985     39.87309         190.          200.         85012306
                   1986     31.56118         300.          210.         86031823
[redacted]IGH   8-Hour
                   1982     15.17585         300.          210.         82122416
                   1983     28.62789         290.          193.         83022716
                   1984     26.17939         120.          200.         84032916
[redacted]         1985     21.65367         360.          200.         85083116
                   1986     15.55304         300.          210.         86031308
 HSH   8-Hour
                   1982     13.01664         300.          210.         82121516
[redacted]
```

```
                  1983    13.17905          110.          200.       83042416
                  1984    19.16915          130.          200.       84022808
                  1985    12.63220          120.          200.       85021216
                  1986    15.31325          300.          210.       86031824
SOURCE GROUP ID:  ALL100                                                           100 °F
H  H  1-Hour
                  1982    46.28763          290.          200.       82013011
                  1983    55.72725          290.          193.       83070622
                  1984    44.78695          290.          200.       84102020
                  1985    44.24531          290.          200.       85041823
                  1986    33.19429           10.          142.       86031412
HSH  1-Hour
                  1982    44.42138          290.          200.       82051021
                  1983    53.90086          290.          200.       83051424
                  1984    44.42138          290.          200.       84102024
                  1985    39.29859          290.          200.       85112020
                  1986    31.75222          300.          210.       86031823
HIGH  8-Hour
                  1982    19.90525          290.          200.       82122424
                  1983    27.65517          290.          193.       83022716
                  1984    24.06155          120.          200.       84032916
                  1985    19.91609          360.          200.       85083116
                  1986    15.77560          300.          210.       86031308
   H  8-Hour
                  1982    15.12149          290.          200.       82120124
                  1983    13.39733          120.          200.       83020316
                  1984    17.59592          130.          200.       84022808
                  1985    14.15406          120.          200.       85110516
                  1986    15.76922          300.          210.       86031824
  URCE GROUP ID:  CT040                                                            40°F   CT ONLY
  GH  1-Hour
                  1982    34.27558           50.          200.       82061805
                  1983    38.54921          350.          200.       83040212
                  1984    39.98288          220.          200.       84081704
                  1985    44.84493          190.          200.       85031006
                  1986    37.07120           10.          200.       86031412
   H  1-Hour
                  1982    29.34603          120.          200.       82011413
                  1983    31.97799           10.          200.       83042311
                  1984    34.19050          130.          200.       84022811
                  1985    40.56778          190.          200.       85012306
                  1986    25.42013          130.          200.       86030117
  IGH  8-Hour
                  1982    11.06264          120.          200.       82011416
                  1983    15.73972          110.          200.       83020316
                  1984    24.71782          120.          200.       84032916
                  1985    22.17671          360.          200.       85083116
                  1986     8.70269          100.          200.       86012716
HSH  8-Hour
                  1982     5.91079          300.         1500.       82051416
                  1983     9.81146          110.          200.       83042416
                  1984    17.93479          130.          200.       84022808
                  1985    12.45903           30.          162.       85083124
                  1986     7.07129          130.          200.       86030116
SOURCE GROUP ID:  CT059                                                            59 °F
HIGH  1-Hour
                  1982    33.20836           50.          200.       82061805
                  1983    37.39183          350.          200.       83040212
                  1984    38.80351          220.          200.       84081704
                  1985    44.00381          190.          200.       85031006
```

```
            1986   35.90173        10.        200.      86031412
HSH  1-Hour
            1982   28.33064       120.        200.      82011413
            1983   31.18593        10.        200.      83042311
            1984   33.05038       130.        200.      84022811
            1985   39.87309       190.        200.      85012306
            1986   24.83786       130.        200.      86030117
HIGH  8-Hour
            1982   10.69695       120.        200.      82011416
            1983   16.61674       290.        193.      83022716
            1984   23.96863       120.        200.      84032916
            1985   21.47450       360.        200.      85083116
            1986    8.47999       100.        200.      86012716
 H  8-Hour
            1982    5.91482       360.       1000.      82082716
            1983   10.37966       110.        200.      83042416
            1984   17.40735       130.        200.      84022808
            1985   12.08110        30.        162.      85083124
            1986    6.90051       130.        200.      86030116
 URCE GROUP ID:  CT100
```

100°

```
 GH  1-Hour
            1982   32.51016       130.        200.      82011414
            1983   33.69687       350.        200.      83040212
            1984   38.75000       220.        200.      84081704
            1985   41.07350       190.        200.      85031006
            1986   33.19429        10.        142.      86031412
 H  1-Hour
            1982   27.87585       120.        200.      82011413
            1983   28.35765        10.        200.      83042311
            1984   31.99312       130.        200.      84022811
            1985   37.48651       190.        200.      85012306
            1986   22.77267       130.        200.      86030117
 GH  8-Hour
            1982   14.64153       240.        183.      82042316
            1983   15.64402       290.        193.      83022716
            1984   21.85078       120.        200.      84032916
            1985   19.76684       360.        140.      85083116
            1986   10.10853       160.        200.      86010516
HSH  8-Hour
            1982    8.77448       230.        200.      82110716
            1983   11.14336       100.        200.      83042408
            1984   15.83412       130.        200.      84022808
            1985   12.99793       120.        200.      85110516
            1986    7.81427       230.        200.      86101824
 OURCE GROUP ID:  AUXBLR
```

AUX. BLR.

```
HIGH  1-Hour
            1982   28.92957       290.        200.      82051021
            1983   37.10068       290.        200.      83051424
            1984   30.42903       300.        210.      84052203
            1985   30.64110       300.        210.      85022212
            1986   32.78995       300.        210.      86052520
HSH  1-Hour
            1982   28.92957       290.        200.      82120322
            1983   36.25010       290.        200.      83070622
            1984   30.39415       300.        210.      84042705
            1985   30.27352       300.        210.      85022324
            1986   31.56118       300.        210.      86031823
 IGH  8-Hour
            1982   15.17585       300.        210.      82122416
            1983   12.45329       290.        200.      83022716
```

```
               1984     15.22147           300.          210.        84022624
               1985     11.65628           290.          200.        85112024
               1986     15.55304           300.          210.        86031308
HSH  8-Hour
               1982     12.55088           290.          200.        82122424
               1983     10.85351           290.          200.        83012024
               1984     15.10129           300.          210.        84030508
               1985     10.37806           300.          210.        85021116
               1986     15.31325           300.          210.        86031824
 l receptor computations reported with respect to a user-specified origin
GRID           0.00          0.00
DISCRETE       0.00          0.00
```

47°F

```
                                   ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCDNPM.082
I  ST2 OUTPUT FILE NUMBER 2 :OCDNPM.083
I  ST2 OUTPUT FILE NUMBER 3 :OCDNPM.084
ISCST2 OUTPUT FILE NUMBER 4 :OCDNPM.085
I  ST2 OUTPUT FILE NUMBER 5 :OCDNPM.086
F  st title for first output file is   1982 ARK ENERGY-ORANGECO /COMBINED CYCLE-DLNOX/ PM
Second title for first output file is  40,59, and 100 DEG / 65' AUX and 100' HRSG STACKS


AVERAGING TIME     YEAR     CONC         DIR (deg)    DIST (m)    PERIOD ENDING
                            (ug/m3)      or X (m)     or Y (m)    (YYMMDDHH)
-------------------------------------------------------------------------------
SOURCE GROUP ID:   ALL040
   ual
                   1982     0.08433         250.        1000.        82------
                   1983     0.06420         250.        1000.        83------
                   1984     0.07792         240.        1500.        84------
                   1985     0.07147          70.        1000.        85------
                   1986     0.08275          90.        1000.        86------
HIGH 24-Hour
                   1982     0.94134         120.         200.       82011424
                   1983     1.60243         290.         193.       83022724
                   1984     2.61026         130.         200.       84022824
                   1985     2.43435         360.         200.       85083124
                   1986     0.83515         300.         210.       86031324
 GH 24-Hour
                   1982     0.77915         290.         200.       82120124
                   1983     1.26437         110.         200.       83020324
                   1984     1.29741         120.         200.       84022824
                   1985     1.37547         120.         200.       85010424
                   1986     0.81211         300.         210.       86031824
 URCE GROUP ID:    ALL059
Annual
                   1982     0.08703         250.        1000.        82------
                   1983     0.06593         250.        1000.        83------
                   1984     0.08034         240.        1500.        84------
                   1985     0.07390          70.        1000.        85------
                   1986     0.08563          90.        1000.        86------
  IGH 24-Hour
                   1982     1.08901         120.         200.       82011424
                   1983     1.80039         290.         193.       83022724
                   1984     2.66631         130.         200.       84022824
                   1985     2.49389         360.         200.       85083124
                   1986     0.91563         130.         200.       86030124
  SH 24-Hour
                   1982     0.77915         290.         200.       82120124
                   1983     1.38276         110.         200.       83020324
                   1984     1.32578         120.         200.       84022824
                   1985     2.03876         120.         200.       85010424
                   1986     0.81211         300.         210.       86031824
SOURCE GROUP ID:   ALL100
 nnual
                   1982     0.10188         250.        1000.        82------
                   1983     0.07566         250.        1000.        83------
                   1984     0.09238         240.        1500.        84------
                   1985     0.08676          80.        1000.        85------
                   1986     0.10056          90.        1000.        86------
 IGH 24-Hour
```

40°F ALL SOURCES

59 °F

100 °F

```
                  1982   1.60853        290.       193.     82120324
                  1983   2.36194        290.       193.     83022724
                  1984   3.47289        130.       200.     84022824
                  1985   2.93480        120.       200.     85010424
                  1986   1.21025        230.       200.     86010824
H[redacted] 24-Hour
                  1982   1.42234        240.       183.     82032824
                  1983   1.84261        100.       200.     83042424
                  1984   1.70580        120.       106.     84022824
                  1985   2.59220        120.       200.     85021224
                  1986   0.84818        300.       210.     86031824
SOURCE GROUP ID:  CT040
```

40°F CT ONLY

```
[redacted]nual
                  1982   0.04997        240.      2500.     82------
                  1983   0.03563        240.      2500.     83------
                  1984   0.04649        240.      2000.     84------
                  1985   0.04709         70.      1000.     85------
                  1986   0.05609         90.      1500.     86------
HIGH 24-Hour
                  1982   0.86237        120.       200.     82011424
                  1983   1.25377        110.       200.     83042424
                  1984   2.48459        130.       200.     84022824
                  1985   2.42558        360.       200.     85083124
                  1986   0.64199        130.       200.     86030124
HSH 24-Hour
                  1982   0.51878        240.      1500.     82082924
                  1983   1.16076        110.       200.     83020324
                  1984   1.24701        120.       200.     84022824
                  1985   1.22402        120.       200.     85010424
                  1986   0.59276        130.       200.     86012724
[redacted]OURCE GROUP ID:  CT059
```

54°F

```
Annual
                  1982   0.05208        240.      2000.     82------
                  1983   0.03743        240.      2000.     83------
                  1984   0.04887        240.      2000.     84------
                  1985   0.04952         70.      1000.     85------
                  1986   0.05808         90.      1500.     86------
HIGH 24-Hour
                  1982   1.03009        240.       183.     82042324
                  1983   1.33645        100.       200.     83042424
                  1984   2.54064        130.       200.     84022824
                  1985   2.48512        360.       200.     85083124
                  1986   0.89414        130.       200.     86030124
[redacted]SH 24-Hour
                  1982   0.64246        240.       183.     82032824
                  1983   1.27915        110.       200.     83020324
                  1984   1.30548        120.       106.     84022824
                  1985   1.88731        120.       200.     85010424
                  1986   0.61114        130.       200.     86012724
SOURCE GROUP ID:  CT100
```

100°F

```
Annual
                  1982   0.06448        240.      2000.     82------
                  1983   0.04574        240.      2000.     83------
                  1984   0.05955        240.      2000.     84------
                  1985   0.06206         80.      1000.     85------
                  1986   0.07194         90.      1000.     86------
HIGH 24-Hour
                  1982   1.58041        240.       183.     82042324
                  1983   2.02259        100.       200.     83031824
                  1984   3.34721        130.       200.     84022824
```

```
                 1985     2.86830          360.         200.        85083124
                 1986     1.21025          230.         200.        86010824
H  24-Hour
                 1982     1.42234          240.         183.        82032824
                 1983     1.69799          100.         200.        83042424
                 1984     1.69943          120.         106.        84022824
                 1985     2.45154          120.         200.        85021224
                 1986     0.72708          130.         200.        86012724
S URCE GROUP ID:  AUXBLR
 nual
                 1982     0.05687          290.         200.        82------
                 1983     0.04732          290.         200.        83------
                 1984     0.04514          250.         800.        84------
                 1985     0.04435           70.         400.        85------
                 1986     0.05285           80.         400.        86------
  GH 24-Hour
                 1982     0.84948          300.         210.        82122424
                 1983     0.93817          300.         210.        83030524
                 1984     0.79311          300.         210.        84022624
                 1985     0.89812          300.         210.        85083024
                 1986     0.83515          300.         210.        86031324
HSH 24-Hour
                 1982     0.77915          290.         200.        82120124
                 1983     0.64075          300.         210.        83020124
                 1984     0.73540          300.         210.        84030524
                 1985     0.61206          300.         210.        85112124
                 1986     0.81211          300.         210.        86031824
 All receptor computations reported with respect to a user-specified origin
GRID             0.00          0.00
  SCRETE         0.00          0.00
```

AUX. BLR.

47°F

```
                                   ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCDNNOX.082
I[illegible]ST2 OUTPUT FILE NUMBER 2 :OCDNNOX.083
I[illegible]ST2 OUTPUT FILE NUMBER 3 :OCDNNOX.084
ISCST2 OUTPUT FILE NUMBER 4 :OCDNNOX.085
I[illegible]ST2 OUTPUT FILE NUMBER 5 :OCDNNOX.086
F[illegible]st title for first output file is   1982 ARK ENERGY-ORANGECO / COMBINED CYCLE-DLNOX / NO2
Second title for first output file is  40,59, and 100 DEG / 65' AUX and 100' HRSG STACKS


AVERAGING TIME     YEAR     CONC         DIR (deg)     DIST (m)    PERIOD ENDING
                           (ug/m3)       or X (m)      or Y (m)    (YYMMDDHH)
--------------------------------------------------------------------------------
SOURCE GROUP ID:  ALL040
A[illegible]nual
                  1982     0.87698          250.         1000.        82------
                  1983     0.66564          250.         1000.        83------
                  1984     0.77187          250.         1000.        84------
                  1985     0.69285          250.         1000.        85------
                  1986     0.77103           90.          800.        86------
SOURCE GROUP ID:  ALL059
[illegible]nual
                  1982     0.88528          250.         1000.        82------
                  1983     0.66949          250.         1000.        83------
                  1984     0.77601          250.         1000.        84------
                  1985     0.69746          250.         1000.        85------
                  1986     0.77741           90.          800.        86------
SOURCE GROUP ID:  ALL100
[illegible]nual
                  1982     0.90281          250.         1000.        82------
                  1983     0.69552          290.          200.        83------
                  1984     0.78257          250.         1000.        84------
                  1985     0.70598          250.         1000.        85------
                  1986     0.78222           90.          800.        86------
SOURCE GROUP ID:  CT040
[illegible]nual
                  1982     0.36247          240.         2500.        82------
                  1983     0.25842          240.         2500.        83------
                  1984     0.33722          240.         2000.        84------
                  1985     0.34160           70.         1000.        85------
                  1986     0.40685           90.         1500.        86------
SOURCE GROUP ID:  CT059
[illegible]nnual
                  1982     0.36208          240.         2000.        82------
                  1983     0.26022          240.         2000.        83------
                  1984     0.33974          240.         2000.        84------
                  1985     0.34427           70.         1000.        85------
                  1986     0.40382           90.         1500.        86------
[illegible]OURCE GROUP ID:  CT100
[illegible]nnual
                  1982     0.34290          240.         2000.        82------
                  1983     0.24322          240.         2000.        83------
                  1984     0.31666          240.         2000.        84------
                  1985     0.32998           80.         1000.        85------
                  1986     0.38254           90.         1000.        86------
[illegible]OURCE GROUP ID:  AUXBLR
[illegible]nnual
                  1982     0.71747          290.          200.        82------
                  1983     0.59700          290.          200.        83------
```

40°F ALL SOURCES

59°F

100°F

40°F CT ONLY

59°F

100°F

AUX. BLR

```
                1984    0.56945          250.          800.       84------
                1985    0.55944           70.          400.       85------
                1986    0.66668           80.          400.       86------
All receptor computations reported with respect to a user-specified origin
GRID            0.00          0.00
[illegible]SCRETE        0.00          0.00
```

```
[redacted]
                                                       ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCDNCO.082
I[redacted]ST2 OUTPUT FILE NUMBER 2 :OCDNCO.083
I[redacted]ST2 OUTPUT FILE NUMBER 3 :OCDNCO.084
ISCST2 OUTPUT FILE NUMBER 4 :OCDNCO.085
I[redacted]ST2 OUTPUT FILE NUMBER 5 :OCDNCO.086
F[redacted]st title for first output file is   1982 ARK ENERGY-ORANGECO / COMBINED CYCLE-DLNOX / CO   ✓        47°F
Second title for first output file is  40,59, and 100 DEG / 65' AUX and 100' HRSG STACKS

[redacted]

AVERAGING TIME    YEAR     CONC          DIR (deg)    DIST (m)    PERIOD ENDING
                          (ug/m3)        or X (m)     or Y (m)    (YYMMDDHH)
[redacted]---------------------------------------------------------------------------
SOURCE GROUP ID:  ALL040                                                             40°F   ALL SOURCES
[redacted]GH   1-Hour
                  1982    48.81420          290.         200.        82013011
                  1983    58.80875          290.         193.        83070622
                  1984    40.46173          220.         200.        84081704
[redacted]
                  1985    45.92739          190.         200.        85031006
                  1986    37.62341           10.         200.        86031412
HSH  1-Hour
[redacted]
                  1982    31.25737          120.         200.        82011413
                  1983    55.72579          290.         200.        83022712
                  1984    36.12712          130.         200.        84022813
[redacted]
                  1985    41.59468          190.         200.        85012306
                  1986    31.56118          300.         210.        86031823
[redacted]GH   8-Hour
                  1982    15.17585          300.         210.        82122416
[redacted]
                  1983    29.37497          290.         193.        83022716
                  1984    27.31887          120.         200.        84032916
                  1985    22.68431          360.         200.        85083116
                  1986    15.55304          300.         210.        86031308
[redacted]H  8-Hour
                  1982    13.17452          300.         210.        82121516
                  1983    13.65508          110.         200.        83042416
[redacted]
                  1984    19.99147          130.         200.        84022808
                  1985    13.17420          120.         200.        85021216
                  1986    15.31325          300.         210.        86031824
[redacted]URCE GROUP ID:  ALL059                                                         59°F
[redacted]GH   1-Hour
                  1982    48.44765          290.         200.        82013011
                  1983    58.32696          290.         193.        83070622
[redacted]
                  1984    40.34258          220.         200.        84081704
                  1985    45.25053          190.         200.        85031006
                  1986    36.64240           10.         200.        86031412
[redacted]H  1-Hour
                  1982    43.65388          290.         193.        82020404
                  1983    54.88261          290.         200.        83022712
[redacted]
                  1984    35.65252          100.         200.        84041613
                  1985    41.04202          190.         200.        85012306
                  1986    31.56118          300.         210.        86031823
HIGH   8-Hour
[redacted]
                  1982    15.17585          300.         210.        82122416
                  1983    29.06007          290.         193.        83022716
                  1984    26.69195          120.         200.        84032916
[redacted]
                  1985    22.09525          360.         200.        85083116
                  1986    15.55304          300.         210.        86031308
HSH  8-Hour
                  1982    13.09269          300.         210.        82121516
[redacted]
```

```
                1983    14.19674          120.        200.      83032116
                1984    19.55088          130.        200.      84022808
                1985    14.91416          120.        200.      85021216
                1986    15.31325          300.        210.      86031824
SOURCE GROUP ID:  ALL100
```

100°F

```
 GH   1-Hour
                1982    46.63850          290.        200.      82013011
                1983    56.04659          290.        193.      83070622
                1984    45.12063          290.        200.      84102020
                1985    44.55350          290.        200.      85041823
                1986    34.14188           10.        142.      86031412
HSH  1-Hour
                1982    44.73096          290.        200.      82051021
                1983    54.24386          290.        200.      83051424
                1984    44.73096          290.        200.      84102024
                1985    39.61539          290.        200.      85112020
                1986    31.75400          300.        210.      86031823
HIGH  8-Hour
                1982    20.05154          290.        200.      82122424
                1983    27.97041          290.        193.      83022716
                1984    24.52362          120.        200.      84032916
                1985    20.33607          360.        200.      85083116
                1986    15.77972          300.        210.      86031308
 SH  8-Hour
                1982    15.83042          290.        200.      82013024
                1983    13.57748          120.        200.      83020316
                1984    17.91063          130.        200.      84022808
                1985    14.39722          120.        200.      85110516
                1986    15.77691          300.        210.      86031824
 OURCE GROUP ID:  CT040
```

40°F CT ONLY

```
 IGH  1-Hour
                1982    34.79632           50.        200.      82061805
                1983    39.16595          350.        200.      83040212
                1984    40.46173          220.        200.      84081704
                1985    45.92739          190.        200.      85031006
                1986    37.62341           10.        200.      86031412
 SH  1-Hour
                1982    29.71820          120.        200.      82011413
                1983    32.61107           10.        200.      83042311
                1984    34.65522          130.        200.      84022811
                1985    41.59468          190.        200.      85012306
                1986    25.95756          130.        200.      86030117
HIGH  8-Hour
                1982    11.21531          120.        200.      82011416
                1983    17.36382          290.        193.      83022716
                1984    25.10810          120.        200.      84032916
                1985    22.50515          360.        200.      85083116
                1986     8.86980          100.        200.      86012716
HSH  8-Hour
                1982     6.13279          360.       1000.      82082716
                1983    10.85569          110.        200.      83042416
                1984    18.22966          130.        200.      84022808
                1985    12.65551           30.        162.      85083124
                1986     7.21441          130.        200.      86030116
SOURCE GROUP ID:  CT059
```

59°F

```
HIGH  1-Hour
                1982    33.90173           50.        200.      82061805
                1983    38.19755          350.        200.      83040212
                1984    40.34258          220.        200.      84081704
                1985    45.25053          190.        200.      85031006
```

```
                  1986    36.64240          10.        200.      86031412
HSH   1-Hour
                  1982    28.86300         120.        200.      82011413
                  1983    31.95679          10.        200.      83042311
                  1984    33.69641         130.        200.      84022811
                  1985    41.04202         190.        200.      85012306
                  1986    25.47978         130.        200.      86030117
HIGH   8-Hour
                  1982    13.38774         160.        200.      82022216
                  1983    17.07178         110.        200.      83020316
                  1984    24.48118         120.        200.      84032916
                  1985    21.91609         360.        200.      85083116
                  1986     8.81901         130.        200.      86030116
  H   8-Hour
                  1982     6.15625         360.       1000.      82082716
                  1983    11.57532          90.        200.      83042408
                  1984    17.78908         130.        200.      84022808
                  1985    13.45233         120.        200.      85010416
                  1986     7.61747         130.        200.      86012724
 URCE GROUP ID:   CT100
```

100°F

```
  GH   1-Hour
                  1982    33.24274         130.        200.      82011414
                  1983    34.58192         350.        200.      83040212
                  1984    39.59442         220.        200.      84081704
                  1985    41.82648         190.        200.      85031006
                  1986    34.14188          10.        142.      86031412
  H   1-Hour
                  1982    28.50003         120.        200.      82011413
                  1983    28.82767          10.        200.      83042311
                  1984    32.74077         130.        200.      84022811
                  1985    38.19214         190.        200.      85012306
                  1986    23.16296         130.        200.      86030117
 IGH   8-Hour
                  1982    14.90806         240.        183.      82042316
                  1983    15.95926         290.        193.      83022716
                  1984    22.31285         120.        200.      84032916
                  1985    20.23825         360.        140.      85083116
                  1986    10.30637         160.        200.      86010516
HSH   8-Hour
                  1982     9.70267         250.        193.      82043024
                  1983    11.34429         100.        200.      83042408
                  1984    16.14883         130.        200.      84022808
                  1985    13.24109         120.        200.      85110516
                  1986     7.97033         230.        200.      86101824
SOURCE GROUP ID:  AUXBLR
```

Aux. BLR

```
HIGH   1-Hour
                  1982    28.92957         290.        200.      82051021
                  1983    37.10068         290.        200.      83051424
                  1984    30.42903         300.        210.      84052203
                  1985    30.64110         300.        210.      85022212
                  1986    32.78995         300.        210.      86052520
HSH   1-Hour
                  1982    28.92957         290.        200.      82120322
                  1983    36.25010         290.        200.      83070622
                  1984    30.39415         300.        210.      84042705
                  1985    30.27352         300.        210.      85022324
                  1986    31.56118         300.        210.      86031823
 IGH   8-Hour
                  1982    15.17585         300.        210.      82122416
                  1983    12.45329         290.        200.      83022716
```

```
                 1984    15.22147          300.          210.        84022624
                 1985    11.65628          290.          200.        85112024
                 1986    15.55304          300.          210.        86031308
HSH  8-Hour
                 1982    12.55088          290.          200.        82122424
                 1983    10.85351          290.          200.        83012024
                 1984    15.10129          300.          210.        84030508
                 1985    10.37806          300.          210.        85021116
                 1986    15.31325          300.          210.        86031824
 ll receptor computations reported with respect to a user-specified origin
GRID            0.00           0.00
DISCRETE        0.00           0.00
```

```
                                                ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCSSREF.082
F  st title for first output file is   1982 ARK ENERGY-ORANGECO / SIMPLE CYCLE / GENERIC EMISSIONS 10 G/S
S  ond title for first output file is  REFINEMENT / 100 DEG / 60' CT STACK


AVERAGING TIME     YEAR     CONC         DIR (deg)     DIST (m)    PERIOD ENDING
                           (ug/m3)       or X (m)      or Y (m)    (YYMMDDHH)
-------------------------------------------------------------------------------
S  RCE GROUP ID:  GSS100
HIGH  1-Hour
                   1982   265.70499           152.          104.      82011414
H    1-Hour
                   1982   154.80836           144.          113.      82011414
 l receptor computations reported with respect to a user-specified origin
G  ID             0.00            0.00
DISCRETE          0.00            0.00
```

✓ 47°F ✓

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                                                            ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCDNPMRF.084
  rst title for first output file is   1984 ARK ENERGY-ORANGECO / COMBINED CYCLE-DLNOX / PM / REFINEMENT /
Second title for first output file is  100 DEG / 65' AUX and 100' HRSG STACKS


AVERAGING TIME    YEAR     CONC        DIR (deg)    DIST (m)    PERIOD ENDING
                          (ug/m3)      or X (m)     or Y (m)    (YYMMDDHH)
---------------------------------------------------------------------------------
SOURCE GROUP ID:  ALL100
HIGH 24-Hour
                  1984     3.47289          130.         200.       84022824
  H 24-Hour
                  1984     2.60184          124.         200.       84022824
SOURCE GROUP ID:  CT100
  GH 24-Hour
                  1984     3.34721          130.         200.       84022824
HSH 24-Hour
                  1984     2.52872          124.         200.       84022824
SOURCE GROUP ID:  AUXBLR
HIGH 24-Hour
                  1984     0.51024          134.         400.       84022824
  H 24-Hour
                  1984     0.37851          124.         400.       84040524
 All receptor computations reported with respect to a user-specified origin
 RID             0.00          0.00
DISCRETE         0.00          0.00
```

✓ 47°F higher

```
                                                            ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCDNCORF.083
F  st title for first output file is   1983 ARK ENERGY-ORANGECO / COMBINED CYCLE-DLNOX / CO / REFINEMENT
S  ond title for first output file is  40 DEG / 65' AUX and 100' HRSG STACKS


AVERAGING TIME     YEAR     CONC        DIR (deg)     DIST (m)    PERIOD ENDING
                           (ug/m3)      or X (m)      or Y (m)    (YYMMDDHH)
 --------------------------------------------------------------------------------
S  RCE GROUP ID:  ALL040
HIGH  8-Hour
                   1983    34.83726         286.          200.       83022716
   H  8-Hour
                   1983    14.06484         286.          200.       83022016
S  RCE GROUP ID:  CT040
   GH  8-Hour
                   1983    18.15022         288.          191.       83022716
HSH  8-Hour
                   1983     3.77474         296.          202.       83070624
   RCE GROUP ID:  AUXBLR
HIGH  8-Hour
                   1983    17.60450         286.          200.       83022716
   H  8-Hour
                   1983    14.06484         286.          200.       83022016
  All receptor computations reported with respect to a user-specified origin
  ID              0.00          0.00
  SCRETE          0.00          0.00
```

✓

47°F higher

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                                          ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCDNFORM.082
ISCST2 OUTPUT FILE NUMBER 2 :OCDNFORM.083
ISCST2 OUTPUT FILE NUMBER 3 :OCDNFORM.084
ISCST2 OUTPUT FILE NUMBER 4 :OCDNFORM.085
ISCST2 OUTPUT FILE NUMBER 5 :OCDNFORM.086
First title for first output file is   1982 ARK ENERGY-ORANGECO / COMBINED CYCLE-DLNOX / FORMALDEHYDE
Second title for first output file is  40 and 100 DEG / 65' AUX and 100' HRSG STACKS
```

✓

40°F ALL SOURCES

```
AVERAGING TIME     YEAR     CONC          DIR (deg)    DIST (m)    PERIOD ENDING
                            (ug/m3)       or X (m)     or Y (m)    (YYMMDDHH)
-------------------------------------------------------------------------------
SOURCE GROUP ID:  ALL040
Annual
                   1982     0.00065          250.        1000.      82------
                   1983     0.00049          250.        1000.      83------
                   1984     0.00058          240.        1500.      84------
                   1985     0.00052           70.         800.      85------
                   1986     0.00060           90.        1000.      86------
HIGH  8-Hour
                   1982     0.01468          120.         200.      82011416
                   1983     0.03091          290.         193.      83022716
                   1984     0.03147          120.         200.      84032916
                   1985     0.02663          360.         200.      85083116
                   1986     0.01358          300.         210.      86031308
HSH  8-Hour
                   1982     0.01257          300.         210.      82121516
                   1983     0.01522          110.         200.      83042416
                   1984     0.02298          130.         200.      84022808
                   1985     0.01514          120.         200.      85021216
                   1986     0.01337          300.         210.      86031824
HIGH 24-Hour
                   1982     0.00719          300.         210.      82122424
                   1983     0.01176          290.         200.      83022724
                   1984     0.01763          130.         200.      84022824
                   1985     0.01624          360.         200.      85083124
                   1986     0.00707          300.         210.      86031324
HSH 24-Hour
                   1982     0.00659          290.         200.      82120124
                   1983     0.00862          110.         200.      83020324
                   1984     0.00874          120.         200.      84022824
                   1985     0.00944          120.         200.      85010424
                   1986     0.00687          300.         210.      86031824
```

100°F ALL SOURCES

```
SOURCE GROUP ID:  ALL100
Annual
                   1982     0.00067          250.        1000.      82------
                   1983     0.00050          250.        1000.      83------
                   1984     0.00058          250.        1000.      84------
                   1985     0.00053          250.        1000.      85------
                   1986     0.00060           90.         800.      86------
HIGH  8-Hour
                   1982     0.01929          290.         200.      82122424
                   1983     0.02822          290.         193.      83022716
                   1984     0.02672          120.         200.      84032916
                   1985     0.02255          360.         200.      85083116
                   1986     0.01388          300.         210.      86031824
HSH  8-Hour
                   1982     0.01500          290.         200.      82013024
                   1983     0.01450          120.         200.      83020316
                   1984     0.01948          130.         200.      84022808
                   1985     0.01572          120.         200.      85110516
                   1986     0.01383          300.         210.      86031308
HIGH 24-Hour
                   1982     0.01055          290.         193.      82120324
```

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                    1983     0.01340          290.          193.      83022724
                    1984     0.01700          130.          200.      84022824
                    1985     0.01454          120.          200.      85010424
                    1986     0.00747          300.          210.      86031324
HSH 24-Hour
                    1982     0.00767          290.          200.      82122424
                    1983     0.01099          290.          200.      83012024
                    1984     0.00815          120.          106.      84022824
                    1985     0.01286          120.          200.      85021224
                    1986     0.00704          300.          210.      86031824
```

40°F CT ONLY

```
SOURCE GROUP ID:    CT040
Annual
                    1982     0.00033          240.         2500.      82------
                    1983     0.00024          240.         2500.      83------
                    1984     0.00031          240.         2000.      84------
                    1985     0.00031           70.         1000.      85------
                    1986     0.00037           90.         1500.      86------
HIGH  8-Hour
                    1982     0.01319          120.          200.      82011416
                    1983     0.02043          290.          193.      83022716
                    1984     0.02954          120.          200.      84032916
                    1985     0.02648          360.          200.      85083116
                    1986     0.01044          100.          200.      86012716
HSH  8-Hour
                    1982     0.00722          360.         1000.      82082716
                    1983     0.01277          110.          200.      83042416
                    1984     0.02145          130.          200.      84022808
                    1985     0.01489           30.          162.      85083124
                    1986     0.00849          130.          200.      86030116
HIGH 24-Hour
                    1982     0.00575          120.          200.      82011424
                    1983     0.00836          110.          200.      83042424
                    1984     0.01656          130.          200.      84022824
                    1985     0.01617          360.          200.      85083124
                    1986     0.00428          130.          200.      86030124
HSH 24-Hour
                    1982     0.00346          240.         1500.      82082924
                    1983     0.00774          110.          200.      83020324
                    1984     0.00831          120.          200.      84022824
                    1985     0.00816          120.          200.      85010424
                    1986     0.00395          130.          200.      86012724
```

100°F

```
SOURCE GROUP ID:    CT100
Annual
                    1982     0.00031          240.         2000.      82------
                    1983     0.00022          240.         2000.      83------
                    1984     0.00028          240.         2000.      84------
                    1985     0.00030           80.         1000.      85------
                    1986     0.00034           90.         1000.      86------
HIGH  8-Hour
                    1982     0.01656          240.          183.      82042316
                    1983     0.01773          290.          193.      83022716
                    1984     0.02479          120.          200.      84032916
                    1985     0.02249          360.          140.      85083116
                    1986     0.01145          160.          200.      86010516
HSH  8-Hour
                    1982     0.01078          250.          193.      82043024
                    1983     0.01260          100.          200.      83042408
                    1984     0.01794          130.          200.      84022808
                    1985     0.01471          120.          200.      85110516
                    1986     0.00886          230.          200.      86101824
HIGH 24-Hour
                    1982     0.00753          240.          183.      82042324
                    1983     0.00963          100.          200.      83031824
                    1984     0.01594          130.          200.      84022824
                    1985     0.01366          360.          200.      85083124
                    1986     0.00576          230.          200.      86010824
```

```
HSH 24-Hour
                   1982     0.00677          240.          183.       82032824
                   1983     0.00809          100.          200.       83042424
                   1984     0.00809          120.          106.       84022824
                   1985     0.01167          120.          200.       85021224
                   1986     0.00346          130.          200.       86012724
SOURCE GROUP ID:   AUXBLR
Annual
                   1982     0.00048          290.          200.       82------
                   1983     0.00040          290.          200.       83------
                   1984     0.00038          250.          800.       84------
                   1985     0.00038           70.          400.       85------
                   1986     0.00045           80.          400.       86------
HIGH  8-Hour
                   1982     0.01325          300.          210.       82122416
                   1983     0.01087          290.          200.       83022716
                   1984     0.01329          300.          210.       84022624
                   1985     0.01018          290.          200.       85112024
                   1986     0.01358          300.          210.       86031308
HSH  8-Hour
                   1982     0.01096          290.          200.       82122424
                   1983     0.00948          290.          200.       83012024
                   1984     0.01318          300.          210.       84030508
                   1985     0.00906          300.          210.       85021116
                   1986     0.01337          300.          210.       86031824
HIGH 24-Hour
                   1982     0.00719          300.          210.       82122424
                   1983     0.00794          300.          210.       83030524
                   1984     0.00671          300.          210.       84022624
                   1985     0.00760          300.          210.       85083024
                   1986     0.00707          300.          210.       86031324
HSH 24-Hour
                   1982     0.00659          290.          200.       82120124
                   1983     0.00542          300.          210.       83020124
                   1984     0.00622          300.          210.       84030524
                   1985     0.00518          300.          210.       85112124
                   1986     0.00687          300.          210.       86031824
 All receptor computations reported with respect to a user-specified origin
GRID              0.00          0.00
DISCRETE          0.00          0.00
```

AVX. BLR.

```
                                                            ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCDNPOM.082
ISCST2 OUTPUT FILE NUMBER 2 :OCDNPOM.083
ISCST2 OUTPUT FILE NUMBER 3 :OCDNPOM.084
ISCST2 OUTPUT FILE NUMBER 4 :OCDNPOM.085
ISCST2 OUTPUT FILE NUMBER 5 :OCDNPOM.086
First title for first output file is   1982 ARK ENERGY-ORANGECO / COMBINED CYCLE-DLNOX / POM'S
Second title for first output file is  40 and 100 DEG / 65' AUX and 100' HRSG STACKS


AVERAGING TIME      YEAR     CONC          DIR (deg)    DIST (m)    PERIOD ENDING
                            (ug/m3)        or X (m)     or Y (m)    (YYMMDDHH)
--------------------------------------------------------------------------------
```

40°F ALL SOURCES

```
SOURCE GROUP ID:  ALL040
Annual
                    1982     0.00001          250.        1000.         82------
                    1983     0.00001          250.        1000.         83------
                    1984     0.00001          240.        1500.         84------
                    1985     0.00001           70.         800.         85------
                    1986     0.00001           90.        1000.         86------
HIGH   8-Hour
                    1982     0.00019          120.         200.         82011416
                    1983     0.00039          290.         193.         83022716
                    1984     0.00040          120.         200.         84032916
                    1985     0.00034          360.         200.         85083116
                    1986     0.00017          300.         210.         86031308
HSH   8-Hour
                    1982     0.00016          300.         210.         82121516
                    1983     0.00019          110.         200.         83042416
                    1984     0.00029          130.         200.         84022808
                    1985     0.00019          120.         200.         85021216
                    1986     0.00017          300.         210.         86031824
HIGH 24-Hour
                    1982     0.00009          300.         210.         82122424
                    1983     0.00015          290.         200.         83022724
                    1984     0.00022          130.         200.         84022824
                    1985     0.00021          360.         200.         85083124
                    1986     0.00009          300.         210.         86031324
HSH 24-Hour
                    1982     0.00008          290.         200.         82120124
                    1983     0.00011          110.         200.         83020324
                    1984     0.00011          120.         200.         84022824
                    1985     0.00012          120.         200.         85010424
                    1986     0.00009          300.         210.         86031824
```

100°F ALL SOURCES

```
SOURCE GROUP ID:  ALL100
Annual
                    1982     0.00001          250.        1000.         82------
                    1983     0.00001          250.        1000.         83------
                    1984     0.00001          250.        1000.         84------
                    1985     0.00001          250.        1000.         85------
                    1986     0.00001           90.         800.         86------
HIGH   8-Hour
                    1982     0.00025          290.         200.         82122424
                    1983     0.00036          290.         193.         83022716
                    1984     0.00034          120.         200.         84032916
                    1985     0.00029          360.         200.         85083116
                    1986     0.00018          300.         210.         86031824
HSH   8-Hour
                    1982     0.00019          290.         200.         82013024
                    1983     0.00018          120.         200.         83020316
                    1984     0.00025          130.         200.         84022808
                    1985     0.00020          120.         200.         85110516
                    1986     0.00018          300.         210.         86031308
HIGH 24-Hour
                    1982     0.00013          290.         193.         82120324
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                  1983     0.00017           290.        193.      83022724
                  1984     0.00022           130.        200.      84022824
                  1985     0.00018           120.        200.      85010424
                  1986     0.00010           300.        210.      86031324
HSH 24-Hour
                  1982     0.00010           290.        200.      82122424
                  1983     0.00014           290.        200.      83012024
                  1984     0.00010           120.        106.      84022824
                  1985     0.00016           120.        200.      85021224
                  1986     0.00009           300.        210.      86031824
SOURCE GROUP ID:  CT040                                                          40°F  CT ONLY
Annual
                  1982     0.00000           240.       2500.      82------
                  1983     0.00000           240.       2500.      83------
                  1984     0.00000           240.       2000.      84------
                  1985     0.00000            70.       1000.      85------
                  1986     0.00000            90.       1500.      86------
HIGH  8-Hour
                  1982     0.00017           120.        200.      82011416
                  1983     0.00026           290.        193.      83022716
                  1984     0.00037           120.        200.      84032916
                  1985     0.00033           360.        200.      85083116
                  1986     0.00013           100.        200.      86012716
HSH  8-Hour
                  1982     0.00009           360.       1000.      82082716
                  1983     0.00016           110.        200.      83042416
                  1984     0.00027           130.        200.      84022808
                  1985     0.00019            30.        162.      85083124
                  1986     0.00011           130.        200.      86030116
HIGH 24-Hour
                  1982     0.00007           120.        200.      82011424
                  1983     0.00011           110.        200.      83042424
                  1984     0.00021           130.        200.      84022824
                  1985     0.00020           360.        200.      85083124
                  1986     0.00005           130.        200.      86030124
HSH 24-Hour
                  1982     0.00004           240.       1500.      82082924
                  1983     0.00010           110.        200.      83020324
                  1984     0.00010           120.        200.      84022824
                  1985     0.00010           120.        200.      85010424
                  1986     0.00005           130.        200.      86012724
SOURCE GROUP ID:  CT100                                                          100°F
Annual
                  1982     0.00000           240.       2000.      82------
                  1983     0.00000           240.       2000.      83------
                  1984     0.00000           240.       2000.      84------
                  1985     0.00000            80.       1000.      85------
                  1986     0.00000            90.       1000.      86------
HIGH  8-Hour
                  1982     0.00021           240.        183.      82042316
                  1983     0.00022           290.        193.      83022716
                  1984     0.00031           120.        200.      84032916
                  1985     0.00028           360.        140.      85083116
                  1986     0.00015           160.        200.      86010516
HSH  8-Hour
                  1982     0.00014           250.        193.      82043024
                  1983     0.00016           100.        200.      83042408
                  1984     0.00023           130.        200.      84022808
                  1985     0.00019           120.        200.      85110516
                  1986     0.00011           230.        200.      86101824
HIGH 24-Hour
                  1982     0.00010           240.        183.      82042324
                  1983     0.00012           100.        200.      83031824
                  1984     0.00020           130.        200.      84022824
                  1985     0.00017           360.        200.      85083124
                  1986     0.00007           230.        200.      86010824
```

```
HSH 24-Hour
                    1982    0.00009           240.         183.        82032824
                    1983    0.00010           100.         200.        83042424
                    1984    0.00010           120.         106.        84022824
                    1985    0.00015           120.         200.        85021224
                    1986    0.00004           130.         200.        86012724
```

AUX. BLR.

```
SOURCE GROUP ID:    AUXBLR
Annual
                    1982    0.00001           290.         200.        82------
                    1983    0.00001           290.         200.        83------
                    1984    0.00000           250.         800.        84------
                    1985    0.00000            70.         400.        85------
                    1986    0.00001            80.         400.        86------
HIGH  8-Hour
                    1982    0.00017           300.         210.        82122416
                    1983    0.00014           290.         200.        83022716
                    1984    0.00017           300.         210.        84022624
                    1985    0.00013           290.         200.        85112024
                    1986    0.00017           300.         210.        86031308
HSH  8-Hour
                    1982    0.00014           290.         200.        82122424
                    1983    0.00012           290.         200.        83012024
                    1984    0.00017           300.         210.        84030508
                    1985    0.00012           300.         210.        85021116
                    1986    0.00017           300.         210.        86031824
HIGH 24-Hour
                    1982    0.00009           300.         210.        82122424
                    1983    0.00010           300.         210.        83030524
                    1984    0.00009           300.         210.        84022624
                    1985    0.00010           300.         210.        85083024
                    1986    0.00009           300.         210.        86031324
HSH 24-Hour
                    1982    0.00008           290.         200.        82120124
                    1983    0.00007           300.         210.        83020124
                    1984    0.00008           300.         210.        84030524
                    1985    0.00007           300.         210.        85112124
                    1986    0.00009           300.         210.        86031824
 All receptor computations reported with respect to a user-specified origin
GRID               0.00         0.00
DISCRETE           0.00         0.00
```

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                                                           ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCDNMIST.082
ISCST2 OUTPUT FILE NUMBER 2 :OCDNMIST.083
ISCST2 OUTPUT FILE NUMBER 3 :OCDNMIST.084
ISCST2 OUTPUT FILE NUMBER 4 :OCDNMIST.085
ISCST2 OUTPUT FILE NUMBER 5 :OCDNMIST.086
First title for first output file is   1982 ARK ENERGY-ORANGECO / COMBINED CYCLE-DLNOX / SULF ACID MIST
Second title for first output file is  40 and 100 DEG / 65' AUX and 100' HRSG STACKS


AVERAGING TIME     YEAR      CONC          DIR (deg)    DIST (m)   PERIOD ENDING
                            (ug/m3)        or X (m)     or Y (m)   (YYMMDDHH)
-----------------------------------------------------------------------------
SOURCE GROUP ID:  ALL040                                                          40°F  ALL SOURCES
Annual
                  1982     0.00166           250.        1000.       82------
                  1983     0.00126           250.        1000.       83------
                  1984     0.00146           250.        1000.       84------
                  1985     0.00132           250.        1000.       85------
                  1986     0.00150            90.         800.       86------
HIGH  8-Hour
                  1982     0.03532           120.         200.       82011416
                  1983     0.07628           290.         193.       83022716
                  1984     0.07542           120.         200.       84032916
                  1985     0.06345           360.         200.       85083116
                  1986     0.03580           300.         210.       86031308
HSH  8-Hour
                  1982     0.03208           300.         210.       82121516
                  1983     0.03685           110.         200.       83042416
                  1984     0.05512           130.         200.       84022808
                  1985     0.03630           120.         200.       85021216
                  1986     0.03524           300.         210.       86031824
HIGH 24-Hour
                  1982     0.01895           300.         210.       82122424
                  1983     0.02932           290.         200.       83022724
                  1984     0.04224           130.         200.       84022824
                  1985     0.03870           360.         200.       85083124
                  1986     0.01863           300.         210.       86031324
HSH 24-Hour
                  1982     0.01738           290.         200.       82120124
                  1983     0.02074           110.         200.       83020324
                  1984     0.02092           120.         200.       84022824
                  1985     0.02281           120.         200.       85010424
                  1986     0.01812           300.         210.       86031824
SOURCE GROUP ID:  ALL100                                                          100°F ALL SOURCES
Annual
                  1982     0.00174           250.        1000.       82------
                  1983     0.00129           250.        1000.       83------
                  1984     0.00150           250.        1000.       84------
                  1985     0.00136           250.        1000.       85------
                  1986     0.00155            90.         800.       86------
HIGH  8-Hour
                  1982     0.05000           290.         200.       82122424
                  1983     0.07257           290.         193.       83022716
                  1984     0.06789           120.         200.       84032916
                  1985     0.05715           360.         200.       85083116
                  1986     0.03655           300.         210.       86031824
HSH  8-Hour
                  1982     0.03898           290.         200.       82013024
                  1983     0.03695           120.         200.       83020316
                  1984     0.04951           130.         200.       84022808
                  1985     0.03993           120.         200.       85110516
                  1986     0.03643           300.         210.       86031308
HIGH 24-Hour
                  1982     0.02741           290.         193.       82120324
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                  1983     0.03445          290.          193.      83022724
                  1984     0.04318          130.          200.      84022824
                  1985     0.03696          120.          200.      85010424
                  1986     0.01966          300.          210.      86031324
HSH 24-Hour
                  1982     0.01993          290.          200.      82122424
                  1983     0.02857          290.          200.      83012024
                  1984     0.02064          120.          106.      84022824
                  1985     0.03271          120.          200.      85021224
                  1986     0.01855          300.          210.      86031824
SOURCE GROUP ID:  CT040
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40°F CT ONLY

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Annual
                  1982     0.00079          240.         2500.      82------
                  1983     0.00057          240.         2500.      83------
                  1984     0.00074          240.         2000.      84------
                  1985     0.00075           70.         1000.      85------
                  1986     0.00089           90.         1500.      86------
HIGH  8-Hour
                  1982     0.03142          120.          200.      82011416
                  1983     0.04864          290.          193.      83022716
                  1984     0.07033          120.          200.      84032916
                  1985     0.06304          360.          200.      85083116
                  1986     0.02485          100.          200.      86012716
HSH  8-Hour
                  1982     0.01718          360.         1000.      82082716
                  1983     0.03041          110.          200.      83042416
                  1984     0.05106          130.          200.      84022808
                  1985     0.03545           30.          162.      85083124
                  1986     0.02021          130.          200.      86030116
HIGH 24-Hour
                  1982     0.01369          120.          200.      82011424
                  1983     0.01990          110.          200.      83042424
                  1984     0.03944          130.          200.      84022824
                  1985     0.03850          360.          200.      85083124
                  1986     0.01019          130.          200.      86030124
HSH 24-Hour
                  1982     0.00823          240.         1500.      82082924
                  1983     0.01842          110.          200.      83020324
                  1984     0.01979          120.          200.      84022824
                  1985     0.01943          120.          200.      85010424
                  1986     0.00941          130.          200.      86012724
SOURCE GROUP ID:  CT100
```

100°F CT ONLY

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Annual
                  1982     0.00078          240.         2000.      82------
                  1983     0.00055          240.         2000.      83------
                  1984     0.00072          240.         2000.      84------
                  1985     0.00075           80.         1000.      85------
                  1986     0.00087           90.         1000.      86------
HIGH  8-Hour
                  1982     0.04196          240.          183.      82042316
                  1983     0.04492          290.          193.      83022716
                  1984     0.06281          120.          200.      84032916
                  1985     0.05697          360.          140.      85083116
                  1986     0.02901          160.          200.      86010516
HSH  8-Hour
                  1982     0.02731          250.          193.      82043024
                  1983     0.03193          100.          200.      83042408
                  1984     0.04546          130.          200.      84022808
                  1985     0.03727          120.          200.      85110516
                  1986     0.02244          230.          200.      86101824
HIGH 24-Hour
                  1982     0.01907          240.          183.      82042324
                  1983     0.02440          100.          200.      83031824
                  1984     0.04038          130.          200.      84022824
                  1985     0.03460          360.          200.      85083124
                  1986     0.01460          230.          200.      86010824
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HSH 24-Hour
                  1982     0.01716          240.         183.       82032824
                  1983     0.02048          100.         200.       83042424
                  1984     0.02050          120.         106.       84022824
                  1985     0.02957          120.         200.       85021224
                  1986     0.00877          130.         200.       86012724
SOURCE GROUP ID:  AUXBLR
Annual
                  1982     0.00127          290.         200.       82------
                  1983     0.00106          290.         200.       83------
                  1984     0.00101          250.         800.       84------
                  1985     0.00099           70.         400.       85------
                  1986     0.00118           80.         400.       86------
HIGH  8-Hour
                  1982     0.03493          300.         210.       82122416
                  1983     0.02866          290.         200.       83022716
                  1984     0.03503          300.         210.       84022624
                  1985     0.02683          290.         200.       85112024
                  1986     0.03580          300.         210.       86031308
HSH  8-Hour
                  1982     0.02889          290.         200.       82122424
                  1983     0.02498          290.         200.       83012024
                  1984     0.03476          300.         210.       84030508
                  1985     0.02389          300.         210.       85021116
                  1986     0.03524          300.         210.       86031824
HIGH 24-Hour
                  1982     0.01895          300.         210.       82122424
                  1983     0.02093          300.         210.       83030524
                  1984     0.01769          300.         210.       84022624
                  1985     0.02003          300.         210.       85083024
                  1986     0.01863          300.         210.       86031324
HSH 24-Hour
                  1982     0.01738          290.         200.       82120124
                  1983     0.01429          300.         210.       83020124
                  1984     0.01641          300.         210.       84030524
                  1985     0.01365          300.         210.       85112124
                  1986     0.01812          300.         210.       86031824
 All receptor computations reported with respect to a user-specified origin
GRID             0.00          0.00
DISCRETE         0.00          0.00
```

AUX. BLR.

Summary of PSD Class 1 Air Dispersion Impacts for the Orange Cogeneration Facility, Bartow, Florida; Simple Cycle Operation
(Three Ambient Temperatures)

OCSSC1GN
06/25/93

Ambient Temperature (°F)	Number of Units	Pollutant	Emission Rate Basis		Per Unit Emission Rate		Total Facility Emission Rate			Modeled Emission Rate (g/s)	Averaging Period	Generic Modeled Conc (µg/m³)	Actual Conc (µg/m³)	Class 1 Sig. Values (µg/m³)
			Rate	Units	Rate	Units	Rate	Units	(g/s)					
20	1	Particulate	5	lb/hr	5.0	lb/hr	5.0	lb/hr	0.63	10.00	24-hour	0.16	0.010	0.33
											Annual	0.0089	0.00056	0.1
		Nitrogen Dioxide	25	ppmvd	156.5	TPY	156.5	TPY	4.50	10.00	Annual	0.0089	0.0031	0.025
40	1	Particulate	5	lb/hr	5.0	lb/hr	5.0	lb/hr	0.63	10.00	24-hour	0.16	0.010	0.33
											Annual	0.0086	0.00054	0.1
		Nitrogen Dioxide	25	ppmvd	165.7	TPY	165.73	TPY	4.77	10.00	Annual	0.0086	0.0041	0.025
100	1	Particulate	5	lb/hr	5.0	lb/hr	5.0	lb/hr	0.63	10.00	24-hour	0.18	0.011	0.33
											Annual	0.0095	0.00060	0.1
		Nitrogen Dioxide	25	ppmvd	119.5	TPY	119.5	TPY	3.44	10.00	Annual	0.0095	0.0033	0.025

Note: All stack parameters and emission rates apply to the CT operating in simple cycle mode with water injection using natural gas.

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                                          ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCSSC1.082
ISCST2 OUTPUT FILE NUMBER 2 :OCSSC1.083
ISCST2 OUTPUT FILE NUMBER 3 :OCSSC1.084
ISCST2 OUTPUT FILE NUMBER 4 :OCSSC1.085
ISCST2 OUTPUT FILE NUMBER 5 :OCSSC1.086
First title for first output file is   1982 ARK ENERGY-ORANGECO / CLASS 1 / SIMPLE CYCLE / GENERIC EMISSION
Second title for first output file is  20,40, and 100 DEG / 60' CT STACK


AVERAGING TIME      YEAR      CONC         DIR (deg)     DIST (m)     PERIOD ENDING
                             (ug/m3)       or X (m)      or Y (m)     (YYMMDDHH)
-------------------------------------------------------------------------------
SOURCE GROUP ID:  GSS020                                                          20°F  ALL
Annual
                    1982    0.00891        340300.      3165700.       82------
                    1983    0.00620        343700.      3178300.       83------
                    1984    0.00572        340300.      3165700.       84------
                    1985    0.00578        340300.      3165700.       85------
                    1986    0.00791        340300.      3165700.       86------
HIGH 24-Hour
                    1982    0.16398        340300.      3169800.       82122124
                    1983    0.13602        342400.      3180600.       83090424
                    1984    0.09497        343000.      3176200.       84041924
                    1985    0.13397        340300.      3165700.       85082224
                    1986    0.12120        342000.      3174000.       86080324
HSH 24-Hour
                    1982    0.12950        340300.      3165700.       82122124
                    1983    0.11327        341100.      3183400.       83120224
                    1984    0.08020        340300.      3165700.       84082124
                    1985    0.10110        340300.      3165700.       85082124
                    1986    0.10707        342000.      3174000.       86053024
SOURCE GROUP ID:  GSS040                                                          40°F  ALL
Annual
                    1982    0.00862        340300.      3165700.       82------
                    1983    0.00599        343700.      3178300.       83------
                    1984    0.00558        340300.      3165700.       84------
                    1985    0.00560        340300.      3165700.       85------
                    1986    0.00764        340300.      3165700.       86------
HIGH 24-Hour
                    1982    0.15798        340300.      3169800.       82122124
                    1983    0.13152        342400.      3180600.       83090424
                    1984    0.09129        343000.      3176200.       84041924
                    1985    0.12819        340300.      3165700.       85082224
                    1986    0.11777        342000.      3174000.       86080324
HSH 24-Hour
                    1982    0.12482        340300.      3165700.       82122124
                    1983    0.10890        341100.      3183400.       83120224
                    1984    0.07695        340300.      3165700.       84082124
                    1985    0.09069        340300.      3165700.       85082124
                    1986    0.10300        343000.      3176200.       86120124
SOURCE GROUP ID:  GSS100                                                          100°F  ALL
Annual
                    1982    0.00946        340300.      3165700.       82------
                    1983    0.00648        343700.      3178300.       83------
                    1984    0.00598        340300.      3165700.       84------
                    1985    0.00613        340300.      3165700.       85------
                    1986    0.00846        340300.      3165700.       86------
HIGH 24-Hour
                    1982    0.17789        340300.      3169800.       82122124
                    1983    0.14834        342400.      3180600.       83090424
                    1984    0.10145        343000.      3176200.       84041924
                    1985    0.14303        340300.      3165700.       85082224
                    1986    0.12635        342000.      3174000.       86080324
HSH 24-Hour
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                1982     0.14136        340300.     3165700.       82122124
                1983     0.12181        341100.     3183400.       83120224
                1984     0.08518        340300.     3165700.       84082124
                1985     0.10645        340300.     3165700.       85082124
                1986     0.11652        342000.     3174000.       86051924
 All receptor computations reported with respect to a user-specified origin
GRID             0.00           0.00
DISCRETE         0.00           0.00
```

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                                                          ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCWIC1PM.082
ISCST2 OUTPUT FILE NUMBER 2 :OCWIC1PM.083
ISCST2 OUTPUT FILE NUMBER 3 :OCWIC1PM.084
ISCST2 OUTPUT FILE NUMBER 4 :OCWIC1PM.085
ISCST2 OUTPUT FILE NUMBER 5 :OCWIC1PM.086
First title for first output file is   1982 ARK ENERGY-ORANGECO / CLASS 1 / COMBINED CYCLE-WATER INJ / PM   ✓
Second title for first output file is  40,59, and 100 DEG / 65' AUX and 100' HRSG STACKS


AVERAGING TIME      YEAR     CONC          DIR (deg)     DIST (m)     PERIOD ENDING
                            (ug/m3)        or X (m)      or Y (m)     (YYMMDDHH)
--------------------------------------------------------------------------------------
SOURCE GROUP ID:   ALL040
Annual                                                                                  40°F ALL
                     1982    0.00160       340300.      3165700.       82------
                     1983    0.00108       343700.      3178300.       83------
                     1984    0.00104       340300.      3165700.       84------
                     1985    0.00102       340300.      3165700.       85------
                     1986    0.00143       340300.      3165700.       86------
HIGH 24-Hour
                     1982    0.02810       340300.      3165700.       82081424
                     1983    0.02159       343700.      3178300.       83090424
                     1984    0.02006       343000.      3176200.       84041924
                     1985    0.02666       340300.      3165700.       85082224
                     1986    0.02448       342000.      3174000.       86080324
HSH 24-Hour
                     1982    0.02509       343700.      3178300.       82062524
                     1983    0.02052       342400.      3180600.       83120224
                     1984    0.01632       343000.      3176200.       84050224
                     1985    0.01889       340300.      3165700.       85082124
                     1986    0.02195       342000.      3174000.       86053024
SOURCE GROUP ID:   ALL059
Annual                                                                                  59°F ALL
                     1982    0.00162       340300.      3165700.       82------
                     1983    0.00110       343700.      3178300.       83------
                     1984    0.00106       340300.      3165700.       84------
                     1985    0.00103       340300.      3165700.       85------
                     1986    0.00146       340300.      3165700.       86------
HIGH 24-Hour
                     1982    0.02838       340300.      3165700.       82081424
                     1983    0.02175       343700.      3178300.       83090424
                     1984    0.02024       343000.      3176200.       84041924
                     1985    0.02693       340300.      3165700.       85082224
                     1986    0.02462       342000.      3174000.       86080324
HSH 24-Hour
                     1982    0.02536       343700.      3178300.       82062524
                     1983    0.02071       342400.      3180600.       83120224
                     1984    0.01649       343000.      3176200.       84050224
                     1985    0.01904       340300.      3165700.       85082124
                     1986    0.02214       342000.      3174000.       86053024
SOURCE GROUP ID:   ALL100                                                               100°F ALL
Annual
                     1982    0.00165       340300.      3165700.       82------
                     1983    0.00113       343700.      3178300.       83------
                     1984    0.00108       340300.      3165700.       84------
                     1985    0.00108       340300.      3165700.       85------
                     1986    0.00149       340300.      3165700.       86------
HIGH 24-Hour
                     1982    0.02960       340300.      3165700.       82081424
                     1983    0.02239       343700.      3178300.       83090424
                     1984    0.02099       343000.      3176200.       84041924
                     1985    0.02807       340300.      3165700.       85082224
                     1986    0.02521       342000.      3174000.       86080324
HSH 24-Hour
```

```
                1982      0.02649         343700.      3178300.       82062524
                1983      0.02151         342400.      3180600.       83120224
                1984      0.01724         343000.      3176200.       84050224
                1985      0.01972         340300.      3165700.       85082124
                1986      0.02293         342000.      3174000.       86053024
```

400°F CT ONLY

```
SOURCE GROUP ID:  CT040
Annual
                1982      0.00139         340300.      3165700.       82------
                1983      0.00094         343700.      3178300.       83------
                1984      0.00090         340300.      3165700.       84------
                1985      0.00089         340300.      3165700.       85------
                1986      0.00123         340300.      3165700.       86------
HIGH 24-Hour
                1982      0.02371         340300.      3169800.       82122124
                1983      0.01850         343700.      3178300.       83090424
                1984      0.01708         343000.      3176200.       84041924
                1985      0.02248         340300.      3165700.       85082224
                1986      0.02128         342000.      3174000.       86080324
HSH 24-Hour
                1982      0.02110         343700.      3178300.       82062524
                1983      0.01756         341100.      3183400.       83090424
                1984      0.01371         343000.      3176200.       84050224
                1985      0.01614         340300.      3165700.       85082124
                1986      0.01869         342000.      3174000.       86053024
```

59 °F

```
SOURCE GROUP ID:  CT059
Annual
                1982      0.00141         340300.      3165700.       82------
                1983      0.00096         343700.      3178300.       83------
                1984      0.00092         340300.      3165700.       84------
                1985      0.00089         340300.      3165700.       85------
                1986      0.00125         340300.      3165700.       86------
HIGH 24-Hour
                1982      0.02397         340300.      3165700.       82081424
                1983      0.01865         343700.      3178300.       83090424
                1984      0.01725         343000.      3176200.       84041924
                1985      0.02274         340300.      3165700.       85082224
                1986      0.02141         342000.      3174000.       86080324
HSH 24-Hour
                1982      0.02137         343700.      3178300.       82062524
                1983      0.01770         341100.      3183400.       83090424
                1984      0.01389         343000.      3176200.       84050224
                1985      0.01630         340300.      3165700.       85082124
                1986      0.01888         342000.      3174000.       86053024
```

100°F

```
SOURCE GROUP ID:  CT100
Annual
                1982      0.00144         340300.      3165700.       82------
                1983      0.00099         343700.      3178300.       83------
                1984      0.00094         340300.      3165700.       84------
                1985      0.00094         340300.      3165700.       85------
                1986      0.00129         340300.      3165700.       86------
HIGH 24-Hour
                1982      0.02518         340300.      3165700.       82081424
                1983      0.01930         343700.      3178300.       83090424
                1984      0.01801         343000.      3176200.       84041924
                1985      0.02389         340300.      3165700.       85082224
                1986      0.02200         342000.      3174000.       86080324
HSH 24-Hour
                1982      0.02251         343700.      3178300.       82062524
                1983      0.01840         342400.      3180600.       83120224
                1984      0.01464         343000.      3176200.       84050224
                1985      0.01697         340300.      3165700.       85082124
                1986      0.01967         342000.      3174000.       86053024
```

AUX. BLR.

```
SOURCE GROUP ID:  AUXBLR
Annual
                1982      0.00021         340300.      3165700.       82------
                1983      0.00014         343700.      3178300.       83------
```

```
                1984     0.00013        340300.     3165700.      84------
                1985     0.00013        340300.     3165700.      85------
                1986     0.00020        340300.     3165700.      86------
HIGH 24-Hour
                1982     0.00505        343700.     3178300.      82072924
                1983     0.00314        341100.     3183400.      83120224
                1984     0.00298        343000.     3176200.      84041924
                1985     0.00418        340300.     3165700.      85082224
                1986     0.00327        340300.     3167700.      86061224
HSH 24-Hour
                1982     0.00399        343700.     3178300.      82062524
                1983     0.00308        342400.     3180600.      83090424
                1984     0.00260        343000.     3176200.      84050224
                1985     0.00274        340300.     3165700.      85082124
                1986     0.00321        342000.     3174000.      86080324
 All receptor computations reported with respect to a user-specified origin
GRID            0.00          0.00
DISCRETE        0.00          0.00
```

```
                                                ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCWIC1NO.082
ISCST2 OUTPUT FILE NUMBER 2 :OCWIC1NO.083
ISCST2 OUTPUT FILE NUMBER 3 :OCWIC1NO.084
ISCST2 OUTPUT FILE NUMBER 4 :OCWIC1NO.085
ISCST2 OUTPUT FILE NUMBER 5 :OCWIC1NO.086
First title for first output file is   1982 ARK ENERGY-ORANGECO / CLASS 1 / COMBINED CYCLE-WATER INJ / NO2  ✓
Second title for first output file is  40,59, and 100 DEG / 65' AUX and 100' HRSG STACKS


AVERAGING TIME     YEAR     CONC         DIR (deg)    DIST (m)    PERIOD ENDING
                           (ug/m3)       or X (m)     or Y (m)    (YYMMDDHH)
------------------------------------------------------------------------------
SOURCE GROUP ID:  ALL040                                                         40°F ALL
Annual
                   1982    0.01314       340300.     3165700.      82------
                   1983    0.00886       343700.     3178300.      83------
                   1984    0.00851       340300.     3165700.      84------
                   1985    0.00838       340300.     3165700.      85------
                   1986    0.01184       340300.     3165700.      86------
SOURCE GROUP ID:  ALL059                                                         59°F ALL
Annual
                   1982    0.01284       340300.     3165700.      82------
                   1983    0.00874       343700.     3178300.      83------
                   1984    0.00838       340300.     3165700.      84------
                   1985    0.00814       340300.     3165700.      85------
                   1986    0.01164       340300.     3165700.      86------
SOURCE GROUP ID:  ALL100                                                         100°F ALL
Annual
                   1982    0.01052       340300.     3165700.      82------
                   1983    0.00718       343700.     3178300.      83------
                   1984    0.00683       340300.     3165700.      84------
                   1985    0.00681       340300.     3165700.      85------
                   1986    0.00957       340300.     3165700.      86------
SOURCE GROUP ID:  CT040
Annual                                                                           40°F CT ONLY
                   1982    0.01050       340300.     3165700.      82------
                   1983    0.00707       343700.     3178300.      83------
                   1984    0.00682       340300.     3165700.      84------
                   1985    0.00672       340300.     3165700.      85------
                   1986    0.00930       340300.     3165700.      86------
SOURCE GROUP ID:  CT059
Annual                                                                           59°F CT ONLY
                   1982    0.01020       340300.     3165700.      82------
                   1983    0.00694       343700.     3178300.      83------
                   1984    0.00669       340300.     3165700.      84------
                   1985    0.00648       340300.     3165700.      85------
                   1986    0.00910       340300.     3165700.      86------
SOURCE GROUP ID:  CT100                                                          100°F CT ONLY
Annual
                   1982    0.00787       340300.     3165700.      82------
                   1983    0.00539       343700.     3178300.      83------
                   1984    0.00514       340300.     3165700.      84------
                   1985    0.00515       340300.     3165700.      85------
                   1986    0.00703       340300.     3165700.      86------
SOURCE GROUP ID:  AUXBLR                                                         AUX. BLR.
Annual
                   1982    0.00264       340300.     3165700.      82------
                   1983    0.00180       343700.     3178300.      83------
                   1984    0.00169       340300.     3165700.      84------
                   1985    0.00166       340300.     3165700.      85------
                   1986    0.00254       340300.     3165700.      86------
 All receptor computations reported with respect to a user-specified origin
GRID             0.00          0.00
DISCRETE         0.00          0.00
```

```
                                                          ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCDNC1PM.082
ISCST2 OUTPUT FILE NUMBER 2 :OCDNC1PM.083
ISCST2 OUTPUT FILE NUMBER 3 :OCDNC1PM.084
ISCST2 OUTPUT FILE NUMBER 4 :OCDNC1PM.085
ISCST2 OUTPUT FILE NUMBER 5 :OCDNC1PM.086
First title for first output file is   1982 ARK ENERGY-ORANGECO / CLASS 1 / COMBINED CYCLE-DLNOX / PM
Second title for first output file is  40,59, and 100 DEG / 65' AUX and 100' HRSG STACKS
```

✓

```
AVERAGING TIME     YEAR      CONC          DIR (deg)    DIST (m)    PERIOD ENDING
                            (ug/m3)        or X (m)     or Y (m)    (YYMMDDHH)
--------------------------------------------------------------------------------
```

40°F ALL

```
SOURCE GROUP ID:  ALL040
Annual
                  1982      0.00161        340300.      3165700.       82------
                  1983      0.00108        343700.      3178300.       83------
                  1984      0.00104        340300.      3165700.       84------
                  1985      0.00102        340300.      3165700.       85------
                  1986      0.00145        340300.      3165700.       86------
HIGH 24-Hour
                  1982      0.02829        340300.      3165700.       82081424
                  1983      0.02170        343700.      3178300.       83090424
                  1984      0.02018        343000.      3176200.       84041924
                  1985      0.02684        340300.      3165700.       85082224
                  1986      0.02458        342000.      3174000.       86080324
HSH 24-Hour
                  1982      0.02527        343700.      3178300.       82062524
                  1983      0.02065        342400.      3180600.       83120224
                  1984      0.01644        343000.      3176200.       84050224
                  1985      0.01900        340300.      3165700.       85082124
                  1986      0.02208        342000.      3174000.       86053024
```

59°F ALL

```
SOURCE GROUP ID:  ALL059
Annual
                  1982      0.00162        340300.      3165700.       82------
                  1983      0.00110        343700.      3178300.       83------
                  1984      0.00106        340300.      3165700.       84------
                  1985      0.00103        340300.      3165700.       85------
                  1986      0.00146        340300.      3165700.       86------
HIGH 24-Hour
                  1982      0.02855        340300.      3165700.       82081424
                  1983      0.02183        343700.      3178300.       83090424
                  1984      0.02034        343000.      3176200.       84041924
                  1985      0.02708        340300.      3165700.       85082224
                  1986      0.02470        342000.      3174000.       86080324
HSH 24-Hour
                  1982      0.02551        343700.      3178300.       82062524
                  1983      0.02082        342400.      3180600.       83120224
                  1984      0.01659        343000.      3176200.       84050224
                  1985      0.01913        340300.      3165700.       85082124
                  1986      0.02225        342000.      3174000.       86053024
```

100°F ALL

```
SOURCE GROUP ID:  ALL100
Annual
                  1982      0.00165        340300.      3165700.       82------
                  1983      0.00113        343700.      3178300.       83------
                  1984      0.00108        340300.      3165700.       84------
                  1985      0.00108        340300.      3165700.       85------
                  1986      0.00151        340300.      3165700.       86------
HIGH 24-Hour
                  1982      0.02968        340300.      3165700.       82081424
                  1983      0.02243        343700.      3178300.       83090424
                  1984      0.02104        343000.      3176200.       84041924
                  1985      0.02815        340300.      3165700.       85082224
                  1986      0.02525        342000.      3174000.       86080324
HSH 24-Hour
```

```
                   1982      0.02657        343700.      3178300.      82062524
                   1983      0.02156        342400.      3180600.      83120224
                   1984      0.01729        343000.      3176200.      84050224
                   1985      0.01976        340300.      3165700.      85082124
                   1986      0.02299        342000.      3174000.      86053024
SOURCE GROUP ID:   CT040
```

40°F CT ONLY

```
Annual
                   1982      0.00140        340300.      3165700.      82------
                   1983      0.00094        343700.      3178300.      83------
                   1984      0.00091        340300.      3165700.      84------
                   1985      0.00089        340300.      3165700.      85------
                   1986      0.00125        340300.      3165700.      86------
HIGH 24-Hour
                   1982      0.02389        340300.      3169800.      82122124
                   1983      0.01860        343700.      3178300.      83090424
                   1984      0.01720        343000.      3176200.      84041924
                   1985      0.02266        340300.      3165700.      85082224
                   1986      0.02137        342000.      3174000.      86080324
HSH 24-Hour
                   1982      0.02129        343700.      3178300.      82062524
                   1983      0.01766        341100.      3183400.      83090424
                   1984      0.01384        343000.      3176200.      84050224
                   1985      0.01625        340300.      3165700.      85082124
                   1986      0.01882        342000.      3174000.      86053024
SOURCE GROUP ID:   CT059
```

59°F CT ONLY

```
Annual
                   1982      0.00141        340300.      3165700.      82------
                   1983      0.00096        343700.      3178300.      83------
                   1984      0.00092        340300.      3165700.      84------
                   1985      0.00090        340300.      3165700.      85------
                   1986      0.00126        340300.      3165700.      86------
HIGH 24-Hour
                   1982      0.02413        340300.      3165700.      82081424
                   1983      0.01874        343700.      3178300.      83090424
                   1984      0.01735        343000.      3176200.      84041924
                   1985      0.02290        340300.      3165700.      85082224
                   1986      0.02149        342000.      3174000.      86080324
HSH 24-Hour
                   1982      0.02152        343700.      3178300.      82062524
                   1983      0.01778        341100.      3183400.      83090424
                   1984      0.01399        343000.      3176200.      84050224
                   1985      0.01639        340300.      3165700.      85082124
                   1986      0.01898        342000.      3174000.      86053024
SOURCE GROUP ID:   CT100
```

100°F CT ONLY

```
Annual
                   1982      0.00144        340300.      3165700.      82------
                   1983      0.00099        343700.      3178300.      83------
                   1984      0.00094        340300.      3165700.      84------
                   1985      0.00095        340300.      3165700.      85------
                   1986      0.00131        340300.      3165700.      86------
HIGH 24-Hour
                   1982      0.02527        340300.      3165700.      82081424
                   1983      0.01934        343700.      3178300.      83090424
                   1984      0.01806        343000.      3176200.      84041924
                   1985      0.02397        340300.      3165700.      85082224
                   1986      0.02204        342000.      3174000.      86080324
HSH 24-Hour
                   1982      0.02258        343700.      3178300.      82062524
                   1983      0.01845        342400.      3180600.      83120224
                   1984      0.01469        343000.      3176200.      84050224
                   1985      0.01702        340300.      3165700.      85082124
                   1986      0.01972        342000.      3174000.      86053024
SOURCE GROUP ID:   AUXBLR
```

AUX. BLR

```
Annual
                   1982      0.00021        340300.      3165700.      82------
                   1983      0.00014        343700.      3178300.      83------
```

```
                 1984     0.00013        340300.     3165700.       84------
                 1985     0.00013        340300.     3165700.       85------
                 1986     0.00020        340300.     3165700.       86------
HIGH 24-Hour
                 1982     0.00505        343700.     3178300.       82072924
                 1983     0.00314        341100.     3183400.       83120224
                 1984     0.00298        343000.     3176200.       84041924
                 1985     0.00418        340300.     3165700.       85082224
                 1986     0.00327        340300.     3167700.       86061224
HSH 24-Hour
                 1982     0.00399        343700.     3178300.       82062524
                 1983     0.00308        342400.     3180600.       83090424
                 1984     0.00260        343000.     3176200.       84050224
                 1985     0.00274        340300.     3165700.       85082124
                 1986     0.00321        342000.     3174000.       86080324
 All receptor computations reported with respect to a user-specified origin
GRID             0.00          0.00
DISCRETE         0.00          0.00
```

```
                                                    ISCBOB2 RELEASE 93165
ISCST2 OUTPUT FILE NUMBER 1 :OCDNC1NO.082
ISCST2 OUTPUT FILE NUMBER 2 :OCDNC1NO.083
ISCST2 OUTPUT FILE NUMBER 3 :OCDNC1NO.084
ISCST2 OUTPUT FILE NUMBER 4 :OCDNC1NO.085
ISCST2 OUTPUT FILE NUMBER 5 :OCDNC1NO.086
First title for first output file is   1982 ARK ENERGY-ORANGECO / CLASS 1 / COMBINED CYCLE-DLNOX / NO2  ✓
Second title for first output file is  40,59, and 100 DEG / 65' AUX and 100' HRSG STACKS


AVERAGING TIME     YEAR      CONC         DIR (deg)    DIST (m)    PERIOD ENDING
                           (ug/m3)        or X (m)     or Y (m)    (YYMMDDHH)
-----------------------------------------------------------------------------
SOURCE GROUP ID:  ALL040
Annual                                                                          40°F ALL
                   1982     0.01282        340300.     3165700.       82------
                   1983     0.00861        343700.     3178300.       83------
                   1984     0.00826        340300.     3165700.       84------
                   1985     0.00813        340300.     3165700.       85------
                   1986     0.01162        340300.     3165700.       86------
SOURCE GROUP ID:  ALL059
Annual                                                                          59°F ALL
                   1982     0.01245        340300.     3165700.       82------
                   1983     0.00848        343700.     3178300.       83------
                   1984     0.00812        340300.     3165700.       84------
                   1985     0.00789        340300.     3165700.       85------
                   1986     0.01129        340300.     3165700.       86------
SOURCE GROUP ID:  ALL100
Annual                                                                          100°F ALL
                   1982     0.01032        340300.     3165700.       82------
                   1983     0.00705        343700.     3178300.       83------
                   1984     0.00671        340300.     3165700.       84------
                   1985     0.00669        340300.     3165700.       85------
                   1986     0.00952        340300.     3165700.       86------
SOURCE GROUP ID:  CT040
Annual                                                                          40°F CT ONLY
                   1982     0.01018        340300.     3165700.       82------
                   1983     0.00681        343700.     3178300.       83------
                   1984     0.00657        340300.     3165700.       84------
                   1985     0.00647        340300.     3165700.       85------
                   1986     0.00908        340300.     3165700.       86------
SOURCE GROUP ID:  CT059
Annual                                                                          59°F CT ONLY
                   1982     0.00980        340300.     3165700.       82------
                   1983     0.00668        343700.     3178300.       83------
                   1984     0.00643        340300.     3165700.       84------
                   1985     0.00623        340300.     3165700.       85------
                   1986     0.00875        340300.     3165700.       86------
SOURCE GROUP ID:  CT100
Annual                                                                          100°F CT ONLY
                   1982     0.00768        340300.     3165700.       82------
                   1983     0.00525        343700.     3178300.       83------
                   1984     0.00502        340300.     3165700.       84------
                   1985     0.00503        340300.     3165700.       85------
                   1986     0.00697        340300.     3165700.       86------
SOURCE GROUP ID:  AUXBLR                                                        AUX. BLR.
Annual
                   1982     0.00264        340300.     3165700.       82------
                   1983     0.00180        343700.     3178300.       83------
                   1984     0.00169        340300.     3165700.       84------
                   1985     0.00166        340300.     3165700.       85------
                   1986     0.00254        340300.     3165700.       86------
 All receptor computations reported with respect to a user-specified origin
GRID              0.00           0.00
DISCRETE          0.00           0.00
```

APPENDIX C

BREEZEWAKE OUTPUT

```
1                      RBRZWAKE
                       IBM-PC VERSION (2.1 )
                       (C) COPYRIGHT 1989, TRINITY CONSULTANTS, INC.
                       SERIAL NUMBER 7474 SOLD TO KBN
                       RUN NAME: ocss
                       RUN BEGAN ON 06-30-93 AT 12:48:20
1
               BREEZE WAKE DOWNWASH ANALYSIS


  e following options have been chosen:

  (1) Calculations are made for the ISCST model.
  (2) All stacks must be within 5L to be considered for direction specific
      downwash.
  (3) Downwash is calculated in 360 radial directions.
  (4) Buildings are combined.

Note:  This analysis determines the direction specific downwash parameters
  r the flow vector pointing in the direction listed.

Round figures are converted into 8-sided figures for the downwash analysis.



                              Algorithms:
                    ___________________________
                    0 = No Downwash
                    1 = Huber-Snyder Downwash
                    2 = Schulman-Scire Downwash
                    ___________________________

1


                     Input Buildings

 Description       Bldg #   Bldg Ht(m)  # of Corners    X(m)        Y(m)
____________________________________________________________________________
 HRSG North          1       17.07          4
                                                          -4.57        7.62
                                                          -4.57       17.98
                                                         -24.38       17.98
                                                         -24.38        7.62
 HRSG South          2       17.07          4
                                                          -4.57       -7.62
                                                          -4.57      -17.98
                                                         -24.38      -17.98
                                                         -24.38       -7.62
 Cooling Tower       3       16.31          4
                                                          12.19       69.80
                                                          12.19      121.92
                                                          -4.27      121.92
                                                          -4.27       69.80
 Raw Water Tank      4       16.31          8
                                                         -19.42       92.13
                                                         -17.37       87.17
                                                         -19.42       82.21
                                                         -24.38       80.16
                                                         -29.34       82.21
```

```
                                                              -31.39        87.17
                                                              -29.34        92.13
                                                              -24.38        94.18
 North LM6000          5       10.97          4
                                                              -48.77         4.57
                                                              -48.77        21.03
                                                              -57.61        21.03
                                                              -57.61         4.57
 South LM6000          6       10.97          4
                                                              -48.77        -4.57
                                                              -48.77       -21.03
                                                              -57.61       -21.03
                                                              -57.61        -4.57
 Plant Services        7        8.84          4
                                                              -57.61        59.74
                                                              -57.61        84.12
                                                              -89.31        84.12
                                                              -89.31        59.74
 Control Bldg          8        9.14          4
                                                              -56.08        30.48
                                                              -56.08        39.62
                                                              -68.28        39.62
                                                              -68.28        30.48
______________________________________________________________________________________
1

                           Input Stacks

Stack ID #     Stack #            Stack Ht(m)           X(m)        Y(m)
__________________________________________________________________________
     1            1                  18.29             -39.62      -12.80
__________________________________________________________________________
1

                     Downwash Structures

tructure    1:  Ht=  17.07 m, MPW=   41.06 m, GEP=  42.67 m
__________________________________________________________________________
      Contains the following buildings:
            Building #  1:  HRSG North
            Building #  2:  HRSG South
      The following stacks are within 5L:
            Stack #  1:    1

Structure    2:  Ht=  16.31 m, MPW=   57.46 m, GEP=  40.77 m
__________________________________________________________________________
      Contains the following buildings:
            Building #  3:  Cooling Tower
            Building #  4:  Raw Water Tank
      The following stacks are within 5L:

Structure    3:  Ht=  10.97 m, MPW=   42.98 m, GEP=  27.43 m
__________________________________________________________________________
      Contains the following buildings:
            Building #  5:  North LM6000
            Building #  6:  South LM6000
      The following stacks are within 5L:
            Stack #  1:    1

Structure    4:  Ht=   9.14 m, MPW=   63.71 m, GEP=  22.85 m
```

```
----------------------------------------------------------------------------
      Contains the following buildings:
            Building #  5:  North LM6000
            Building #  6:  South LM6000
            Building #  8:  Control Bldg
      The following stacks are within 5L:
            Stack #  1:   1

Structure   5:  Ht=   8.84 m, MPW=   39.99 m, GEP=  22.10 m
----------------------------------------------------------------------------
      Contains the following buildings:
            Building #  7:  Plant Services
      The following stacks are within 5L:

NUMBER OF SOURCES =   1
            Stack ID #  1,   Stack #  1

             The Dominant Structure Within 5L is:
        STRUC=   1  H=   17.07  W=   41.06  GEP=  42.67

                Direction Specific Building Downwash
        Degree   Structure #  Height      Width       GEP    Algorithm
      ---------------------------------------------------------------------
          10          1        17.07      28.44      42.67       2
          20          1        17.07      33.15      42.67       2
          30          1        17.07      36.85      42.67       2
          40          1        17.07      39.44      42.67       2
          50          1        17.07      40.82      42.67       2
          60          1        17.07      41.06      42.67       2
          70          1        17.07      40.91      42.67       2
          80          1        17.07      39.68      42.67       2
          90          1        17.07      37.55      42.67       2
         100          1        17.07      39.86      42.67       2
         110          1        17.07      40.96      42.67       2
         120          1        17.07      41.06      42.67       2
         130          1        17.07      40.74      42.67       2
         140          1        17.07      39.23      42.67       2
         150          3        10.97      30.85      27.43       1
         160          3        10.97      25.18      27.43       1
         170          3        10.97      18.75      27.43       1
         180          0          .00        .00        .00       0
         190          1        17.07      28.44      42.67       2
         200          1        17.07      33.15      42.67       2
         210          1        17.07      36.85      42.67       2
         220          1        17.07      39.44      42.67       2
         230          1        17.07      40.82      42.67       2
         240          1        17.07      41.06      42.67       2
         250          1        17.07      40.91      42.67       2
         260          1        17.07      39.68      42.67       2
         270          1        17.07      37.55      42.67       2
         280          1        17.07      39.86      42.67       2
         290          1        17.07      40.96      42.67       2
         300          1        17.07      41.06      42.67       2
         310          1        17.07      40.74      42.67       2
         320          1        17.07      39.23      42.67       2
         330          3        10.97      30.85      27.43       1
         340          3        10.97      25.18      27.43       1
         350          3        10.97      18.75      27.43       1
         360          0          .00        .00        .00       0
      ---------------------------------------------------------------------
```

```
1
                        Stack #   1
 ack ID:  1,    Building Height: 17.070,    Building Width: 41.056
 .07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.070
17.07017.07010.97010.97010.970.0000017.07017.07017.07017.07017.07017.070
 .07017.07017.07017.07017.07017.07017.07017.07010.97010.97010.970.00000
 .44233.15136.85339.43540.81941.05540.90939.68437.55039.86240.96341.055
40.73639.23030.84825.18318.753.0000028.44233.15136.85339.43540.81941.055
40.90939.68437.55039.86240.96341.05540.73639.23030.84825.18318.753.00000
1                    RUN ENDED ON 06-30-93 AT 12:48:22
```

```
1                    RBRZWAKE
                     IBM-PC VERSION (2.1 )
                     (C) COPYRIGHT 1989, TRINITY CONSULTANTS, INC.
                     SERIAL NUMBER 7474 SOLD TO KBN
                     RUN NAME: occc
                     RUN BEGAN ON 06-30-93 AT 12:48:29
1
              BREEZE WAKE DOWNWASH ANALYSIS


 e following options have been chosen:

 (1) Calculations are made for the ISCST model.
 (2) All stacks must be within 5L to be considered for direction specific
     downwash.
 (3) Downwash is calculated in 360 radial directions.
 (4) Buildings are combined.

Note:  This analysis determines the direction specific downwash parameters
 r the flow vector pointing in the direction listed.

Round figures are converted into 8-sided figures for the downwash analysis.



                              Algorithms:
                   ___________________________
                   0 = No Downwash
                   1 = Huber-Snyder Downwash
                   2 = Schulman-Scire Downwash
                   ___________________________

1


                    Input Buildings

 Description       Bldg #   Bldg Ht(m)  # of Corners     X(m)        Y(m)
_________________________________________________________________________
 HRSG North          1        17.07          4
                                                         -4.57        7.62
                                                         -4.57       17.98
                                                        -24.38       17.98
                                                        -24.38        7.62
 HRSG South          2        17.07          4
                                                         -4.57       -7.62
                                                         -4.57      -17.98
                                                        -24.38      -17.98
                                                        -24.38       -7.62
 Cooling Tower       3        16.31          4
                                                         12.19       69.80
                                                         12.19      121.92
                                                         -4.27      121.92
                                                         -4.27       69.80
 Raw Water Tank      4        16.31          8
                                                        -19.42       92.13
                                                        -17.37       87.17
                                                        -19.42       82.21
                                                        -24.38       80.16
                                                        -29.34       82.21
```

```
                                                             -31.39       87.17
                                                             -29.34       92.13
                                                             -24.38       94.18
 North LM6000         5      10.97          4
                                                             -48.77        4.57
                                                             -48.77       21.03
                                                             -57.61       21.03
                                                             -57.61        4.57
 South LM6000         6      10.97          4
                                                             -48.77       -4.57
                                                             -48.77      -21.03
                                                             -57.61      -21.03
                                                             -57.61       -4.57
 Plant Services       7       8.84          4
                                                             -57.61       59.74
                                                             -57.61       84.12
                                                             -89.31       84.12
                                                             -89.31       59.74
 Control Bldg         8       9.14          4
                                                             -56.08       30.48
                                                             -56.08       39.62
                                                             -68.28       39.62
                                                             -68.28       30.48
 ______________________________________________________________________________
1

                        Input Stacks

 Stack ID #     Stack #           Stack Ht(m)         X(m)        Y(m)
 ____________________________________________________________________
     1             1                 30.48              .00         12.80
     2             2                 30.48              .00        -12.80
     3             3                 19.81          -108.51         34.14
 ____________________________________________________________________
1

                  Downwash Structures

Structure    1:  Ht=  17.07 m, MPW=   41.06 m, GEP=  42.67 m
 ____________________________________________________________________
       Contains the following buildings:
             Building #  1:  HRSG North
             Building #  2:  HRSG South
       The following stacks are within 5L:
             Stack #  1:   1
             Stack #  2:   2

tructure    2:  Ht=  16.31 m, MPW=   57.46 m, GEP=  40.77 m
 ____________________________________________________________________
       Contains the following buildings:
             Building #  3:  Cooling Tower
             Building #  4:  Raw Water Tank
       The following stacks are within 5L:
             Stack #  1:   1

Structure    3:  Ht=  10.97 m, MPW=   42.98 m, GEP=  27.43 m
 ____________________________________________________________________
       Contains the following buildings:
             Building #  5:  North LM6000
             Building #  6:  South LM6000
```

```
      The following stacks are within 5L:
            Stack #  1:   1
            Stack #  2:   2
            Stack #  3:   3

Structure   4:  Ht=   9.14 m, MPW=   63.71 m, GEP=  22.85 m
 ------------------------------------------------------------------------
      Contains the following buildings:
            Building #  5:  North LM6000
            Building #  6:  South LM6000
            Building #  8:  Control Bldg
      The following stacks are within 5L:
            Stack #  3:   3

Structure   5:  Ht=   8.84 m, MPW=   39.99 m, GEP=  22.10 m
 ------------------------------------------------------------------------
      Contains the following buildings:
            Building #  7:  Plant Services
      The following stacks are within 5L:
            Stack #  3:   3

NUMBER OF SOURCES =   3
1           Stack ID #  1,   Stack #  1

             The Dominant Structure Within 5L is:
        STRUC=   1  H=   17.07  W=   41.06  GEP=  42.67

                Direction Specific Building Downwash
        Degree   Structure #  Height     Width       GEP     Algorithm
      -----------------------------------------------------------------
          10         1         17.07     28.44      42.67        1
          20         1         17.07     33.15      42.67        1
          30         1         17.07     36.85      42.67        1
          40         1         17.07     39.44      42.67        1
          50         1         17.07     40.82      42.67        1
          60         1         17.07     41.06      42.67        1
          70         1         17.07     40.91      42.67        1
          80         1         17.07     39.68      42.67        1
          90         1         17.07     37.55      42.67        1
         100         1         17.07     39.86      42.67        1
         110         1         17.07     40.96      42.67        1
         120         1         17.07     41.06      42.67        1
         130         1         17.07     40.74      42.67        1
         140         1         17.07     39.23      42.67        1
         150         1         17.07     36.53      42.67        1
         160         1         17.07     32.72      42.67        1
         170         1         17.07     27.92      42.67        1
         180         1         17.07     22.87      42.67        1
         190         1         17.07     28.44      42.67        1
         200         1         17.07     33.15      42.67        1
         210         1         17.07     36.85      42.67        1
         220         1         17.07     39.44      42.67        1
         230         1         17.07     40.82      42.67        1
         240         1         17.07     41.06      42.67        1
         250         1         17.07     40.91      42.67        1
         260         1         17.07     39.68      42.67        1
         270         1         17.07     37.55      42.67        1
         280         1         17.07     39.86      42.67        1
         290         1         17.07     40.96      42.67        1
         300         1         17.07     41.06      42.67        1
```

```
     310          1          17.07       40.74       42.67        1
     320          1          17.07       39.23       42.67        1
     330          1          17.07       36.53       42.67        1
     340          1          17.07       32.72       42.67        1
     350          1          17.07       27.92       42.67        1
     360          1          17.07       22.87       42.67        1

1          Stack ID #  2,    Stack #  2

            The Dominant Structure Within 5L is:
        STRUC=   1  H=    17.07  W=    41.06  GEP=  42.67

                Direction Specific Building Downwash
        Degree   Structure #  Height      Width         GEP     Algorithm

         10           1          17.07       28.44       42.67        1
         20           1          17.07       33.15       42.67        1
         30           1          17.07       36.85       42.67        1
         40           1          17.07       39.44       42.67        1
         50           1          17.07       40.82       42.67        1
         60           1          17.07       41.06       42.67        1
         70           1          17.07       40.91       42.67        1
         80           1          17.07       39.68       42.67        1
         90           1          17.07       37.55       42.67        1
        100           1          17.07       39.86       42.67        1
        110           1          17.07       40.96       42.67        1
        120           1          17.07       41.06       42.67        1
        130           1          17.07       40.74       42.67        1
        140           1          17.07       39.23       42.67        1
        150           1          17.07       36.53       42.67        1
        160           1          17.07       32.72       42.67        1
        170           1          17.07       27.92       42.67        1
        180           1          17.07       22.87       42.67        1
        190           1          17.07       28.44       42.67        1
        200           1          17.07       33.15       42.67        1
        210           1          17.07       36.85       42.67        1
        220           1          17.07       39.44       42.67        1
        230           1          17.07       40.82       42.67        1
        240           1          17.07       41.06       42.67        1
        250           1          17.07       40.91       42.67        1
        260           1          17.07       39.68       42.67        1
        270           1          17.07       37.55       42.67        1
        280           1          17.07       39.86       42.67        1
        290           1          17.07       40.96       42.67        1
        300           1          17.07       41.06       42.67        1
        310           1          17.07       40.74       42.67        1
        320           1          17.07       39.23       42.67        1
        330           1          17.07       36.53       42.67        1
        340           1          17.07       32.72       42.67        1
        350           1          17.07       27.92       42.67        1
        360           1          17.07       22.87       42.67        1

1          Stack ID #  3,    Stack #  3

            The Dominant Structure Within 5L is:
        STRUC=   3  H=    10.97  W=    42.98  GEP=  27.43

                Direction Specific Building Downwash
        Degree   Structure #  Height      Width         GEP     Algorithm

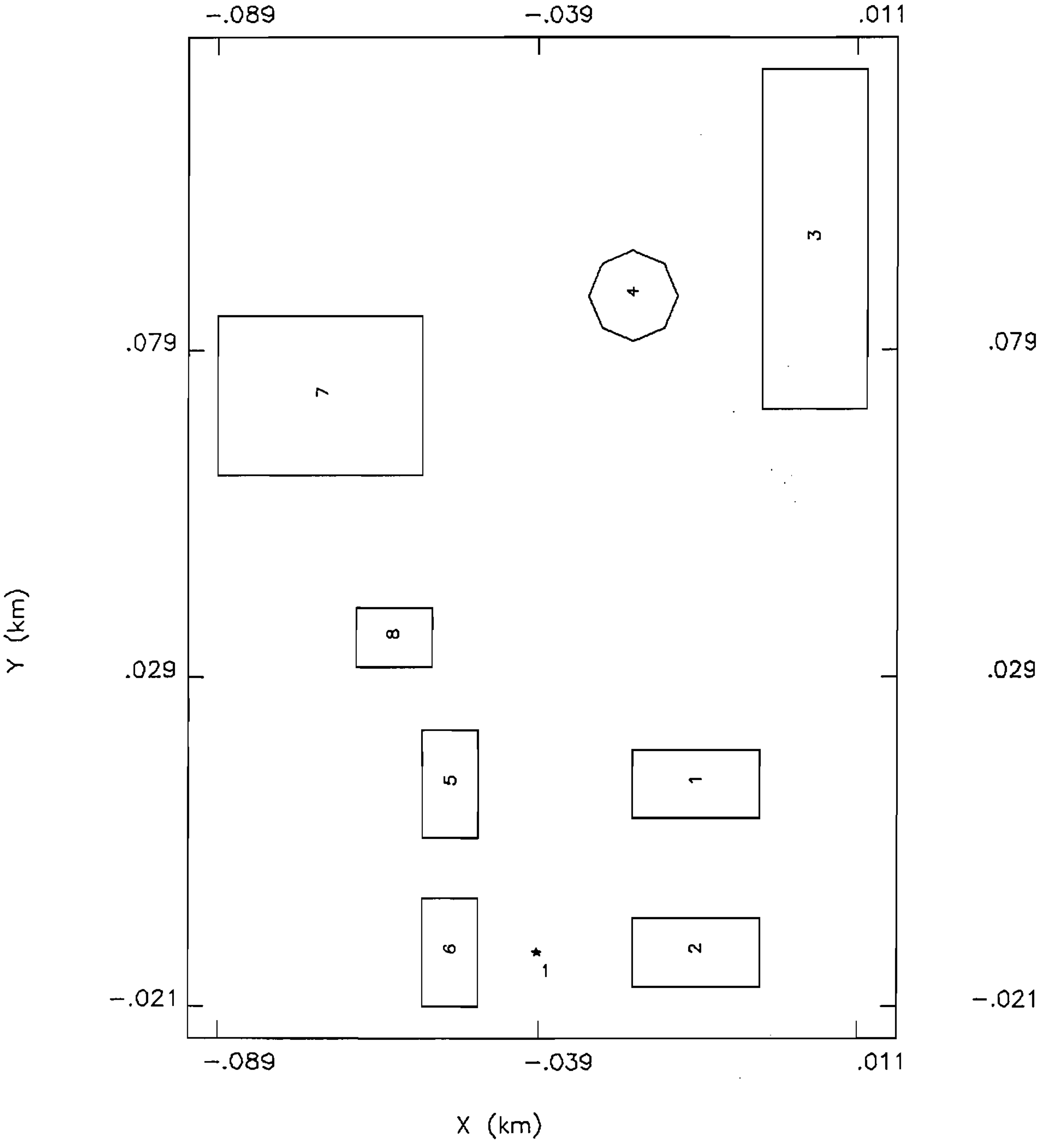
```

```
      10        0        .00       .00       .00      0
      20        0        .00       .00       .00      0
      30        0        .00       .00       .00      0
      40        0        .00       .00       .00      0
      50        0        .00       .00       .00      0
      60        0        .00       .00       .00      0
      70        0        .00       .00       .00      0
      80        0        .00       .00       .00      0
      90        0        .00       .00       .00      0
     100        0        .00       .00       .00      0
     110        0        .00       .00       .00      0
     120        0        .00       .00       .00      0
     130        0        .00       .00       .00      0
     140        0        .00       .00       .00      0
     150        0        .00       .00       .00      0
     160        0        .00       .00       .00      0
     170        0        .00       .00       .00      0
     180        0        .00       .00       .00      0
     190        0        .00       .00       .00      0
     200        5       8.84     39.03     22.10      1
     210        5       8.84     39.95     22.10      1
     220        5       8.84     39.99     22.10      1
     230        5       8.84     39.56     22.10      1
     240        5       8.84     37.94     22.10      1
     250        5       8.84     35.17     22.10      1
     260        4       9.14     63.57     22.85      1
     270        4       9.14     61.86     22.85      1
     280        3      10.97     42.98     27.43      1
     290        3      10.97     42.87     27.43      1
     300        3      10.97     41.68     27.43      1
     310        3      10.97     39.22     27.43      1
     320        3      10.97     35.58     27.43      1
     330        0        .00       .00       .00      0
     340        0        .00       .00       .00      0
     350        0        .00       .00       .00      0
     360        0        .00       .00       .00      0
```

```
                    Stack #   1
tack ID:  1,    Building Height: 17.070,    Building Width: 41.056
7.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.070
17.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.070
17.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.070
3.44233.15136.85339.43540.81941.05540.90939.68437.55039.86240.96341.055
40.73639.23036.53232.72427.92122.86928.44233.15136.85339.43540.81941.055
40.90939.68437.55039.86240.96341.05540.73639.23036.53232.72427.92122.869
                    Stack #   2
tack ID:  2,    Building Height: 17.070,    Building Width: 41.056
17.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.070
17.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.070
7.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.07017.070
28.44233.15136.85339.43540.81941.05540.90939.68437.55039.86240.96341.055
40.73639.23036.53232.72427.92122.86928.44233.15136.85339.43540.81941.055
0.90939.68437.55039.86240.96341.05540.73639.23036.53232.72427.92122.869
                    Stack #   3
Stack ID:  3,    Building Height: 10.970,    Building Width: 42.979
00000.00000.00000.00000.00000.00000.00000.00000.00000.00000.00000.00000
00000.00000.00000.00000.00000.00000.000008.84008.84008.84008.84008.8400
8.84009.14009.140010.97010.97010.97010.97010.970.00000.00000.00000.00000
00000.00000.00000.00000.00000.00000.00000.00000.00000.00000.00000.00000
```

```
.00000.00000.00000.00000.00000.00000.0000039.03339.95139.99039.55837.938
35.16663.56861.86342.97942.86741.67839.22335.576.00000.00000.00000.00000
1                      RUN ENDED ON 06-30-93 AT 12:48:31
```

ORANGE COGEN–SIMPLE CYCLE



ORANGE COGEN-COMBINED CYCLE