



Lawton Chiles  
Governor

# Florida Department of Environmental Protection

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

Virginia B. Wetherell  
Secretary

September 17, 1993

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Allan Weatherford  
Compliance Environmentalist  
Florida Gas Transmission Company  
P. O. Box 94500  
Maitland, Florida 32794-5100

Dear Mr. Weatherford:

Re: Request for Amendments and Extensions to Air Construction Permits AC57-188869, AC67-189220, AC20-189438, AC62-189439, AC04-189454, AC42-189455, AC48-189456, AC05-189655, and AC56-189457

The Department is in receipt of your letter dated June 29, 1993, requesting to extend the expiration date and to change the engine horsepower (HP) capacity, fuel consumption and heat input at various compressor stations. The Department has reviewed this request and has determined to amend the above mentioned permits as requested since there is no increase in permitted emission levels (lbs/hr and tons/yr).

The following changes are allowed by the Department:

**COMPRESSOR STATION NO. 12 - SANTA ROSA COUNTY:**

**Description**

**FROM:** For the construction of one 4,000 bhp natural gas fired engine to be located at the Florida Gas Transmission facility in Munson, Santa Rosa County, Florida. The UTM coordinates are Zone 16, 510.83 km East and 3419.03 km North.

**TO:** For the construction of one 4,100 bhp natural gas fired engine to be located at the Florida Gas Transmission facility in Munson, Santa Rosa County, Florida. The UTM coordinates are Zone 16, 510.83 km East and 3419.03 km North.

**Specific Condition No. 1**

**FROM:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	17.6	77.2	2.0 g/bhp-hr
Carbon Monoxide	22.1	96.6	2.5 g/bhp-hr
Volatile Organic Compounds (non-methane)	8.8	38.6	1.0 g/bhp-hr
Particulate Matter (TSP)	0.14	0.61	5 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.14	0.61	5 lbs/MMscf
Sulfur Dioxide	0.8	3.5	10 gr/100scf

**TO:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	17.6	77.2	<b>1.95</b> g/bhp-hr
Carbon Monoxide	22.1	96.6	<b>2.44</b> g/bhp-hr
Volatile Organic Compounds (non-methane)	8.8	38.6	<b>0.97</b> g/bhp-hr
Particulate Matter (TSP)	0.14	0.61	<b>4.03</b> lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.14	0.61	<b>4.03</b> lbs/MMscf
Sulfur Dioxide	0.8	3.5	<b>8.06</b> gr 8/100scf

Specific Condition No. 5

**FROM:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 27,810 scf/hr.
- Maximum heat input shall not exceed 29.20 MMBtu/hr.

**TO:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 34,525 scf/hr.
- Maximum heat input shall not exceed 36.25 MMBtu/hr.

**COMPRESSOR STATION NO. 13 - WASHINGTON COUNTY:**

**Description**

**FROM:** For the construction of one 2,400 bhp natural gas fired engine to be located 9 miles south of Caryville on CR 284. The UTM coordinates are Zone 16, 610.69 km East and 3394.28 km North.

**TO:** For the construction of one 2,700 bhp natural gas fired engine to be located at the Florida Gas Transmission facility in Caryville, Washington County, Florida. The UTM coordinates are Zone 16, 610.69 km East and 3394.28 km North.

**Specific Condition No. 1**

**FROM:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	10.6	46.3	2.0 g/bhp-hr
Carbon Monoxide	11.1	48.7	2.1 g/bhp-hr
Volatile Organic Compounds (non-methane)	2.6	11.6	0.5 g/bhp-hr
Particulate Matter (TSP)	0.08	0.4	5 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.08	0.4	5 lbs/MMscf
Sulfur Dioxide	0.46	2.0	10 gr/100scf

**TO:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	10.6	46.3	1.78 g/bhp-hr
Carbon Monoxide	11.1	48.7	1.87 g/bhp-hr
Volatile Organic Compounds (non-methane)	2.6	11.6	0.44 g/bhp-hr
Particulate Matter (TSP)	0.08	0.4	3.87 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.08	0.4	3.87 lbs/MMscf
Sulfur Dioxide	0.46	2.0	7.74 gr S/100scf

**Specific Condition No. 5**

**FROM:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 16,154 scf/hr.
- Maximum heat input shall not exceed 16.80 MMBtu/hr.

**TO:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 20,856 scf/hr.
- Maximum heat input shall not exceed 21.69 MMBtu/hr.

**COMPRESSOR STATION NO. 14 - GADSDEN COUNTY:**

Description

**FROM:** For the construction of one 2,400 bhp natural gas fired engine to be located 8 miles southwest of Quincy on SR 65. The UTM coordinates are Zone 16, 719.97 km East and 3377.39 km North.

**TO:** For the construction of one 2,700 bhp natural gas fired engine to be located at the Florida Gas Transmission facility in Quincy, Gadsden County, Florida. The UTM coordinates are Zone 16, 719.97 km East and 3377.39 km North.

Specific Condition No. 1

**FROM:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	10.6	46.3	2.0 g/bhp-hr
Carbon Monoxide	11.1	48.7	2.1 g/bhp-hr
Volatile Organic Compounds (non-methane)	2.6	11.6	0.5 g/bhp-hr
Particulate Matter (TSP)	0.08	0.4	5 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.08	0.4	5 lbs/MMscf
Sulfur Dioxide	0.46	2.0	10 gr/100scf

**TO:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	10.6	46.3	1.78 g/bhp-hr
Carbon Monoxide	11.1	48.7	1.87 g/bhp-hr

Volatile Organic Compounds (non-methane)	2.6	11.6	0.44 g/bhp-hr
Particulate Matter (TSP)	0.08	0.4	3.87 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.08	0.4	3.87 lbs/MMscf
Sulfur Dioxide	0.46	2.0	7.74 gr S/100scf

Specific Condition No. 5

**FROM:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 16,154 scf/hr.
- Maximum heat input shall not exceed 16.80 MMBtu/hr.

**TO:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 20,856 scf/hr.
- Maximum heat input shall not exceed 21.69 MMBtu/hr.

COMPRESSOR STATION NO. 18 - ORANGE COUNTY:

**FROM:** For the construction of one 2,400 bhp natural gas fired engine to be located at 7990 Steer Lake Road. The UTM coordinates are Zone 17, 451.86 km East and 3154.79 km North.

**TO:** For the construction of one 2,700 bhp natural gas fired engine to be located at the Florida Gas Transmission facility in Orlando, Orange County, Florida. The UTM coordinates are Zone 16, 451.86 km East and 3154.79 km North.

Specific Condition No. 1

**FROM:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

Pollutant	lbs/hr	tons/yr	Emission Factor
Nitrogen Oxides	10.6	46.3	2.0 g/bhp-hr
Carbon Monoxide	11.1	48.7	2.1 g/bhp-hr

Volatile Organic Compounds (non-methane)	2.6	11.6	0.5 g/bhp-hr
Particulate Matter (TSP)	0.08	0.4	5 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.08	0.4	5 lbs/MMscf
Sulfur Dioxide	0.476	2.2	10 gr/100scf

**TO:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

Pollutant	lbs/hr	tons/yr	Emission Factor
Nitrogen Oxides	10.6	46.3	1.78 g/bhp-hr
Carbon Monoxide	11.1	48.7	1.87 g/bhp-hr
Volatile Organic Compounds (non-methane)	2.6	11.6	0.44 g/bhp-hr
Particulate Matter (TSP)	0.08	0.4	3.95 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.08	0.4	3.95 lbs/MMscf
Sulfur Dioxide	0.476	2.2	7.90 gr S/100scf

Specific Condition No. 5

**FROM:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 16,311 scf/hr.
- Maximum heat input shall not exceed 16.80 MMBtu/hr.

**TO:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 20,640 scf/hr.
- Maximum heat input shall not exceed 21.26 MMBtu/hr.

COMPRESSOR STATION NO. 19 - BREVARD COUNTY:

Description

**FROM:** For the construction of two 2,500 bhp natural gas fired engines to be located 6 miles west-southwest of Melbourne Regional Airport. The UTM coordinates are Zone 17, 528.67 km East and 3101.64 km North.

**TO:** For the construction of two 2,600 bhp natural gas fired engine to be located at the Florida Gas Transmission facility in Melbourne, Brevard County, Florida. The UTM coordinates are Zone 17, 528.67 km East and 3101.64 km North.

Specific Condition No. 1

**FROM:** The maximum allowable emissions from each engine shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	11.0	48.3	2.0 g/bhp-hr
Carbon Monoxide	15.4	67.6	2.8 g/bhp-hr
Volatile Organic Compounds (non-methane)	9.4	41.0	1.7 g/bhp-hr
Particulate Matter (TSP)	0.09	0.4	5 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.09	0.4	5 lbs/MMscf
Sulfur Dioxide	0.51	2.2	10 gr/100scf

**TO:** The maximum allowable emissions from each engine shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	11.0	48.3	1.92 g/bhp-hr
Carbon Monoxide	15.4	67.6	2.69 g/bhp-hr
Volatile Organic Compounds (non-methane)	9.4	41.0	1.64 g/bhp-hr
Particulate Matter (TSP)	0.09	0.4	3.90 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.09	0.4	3.90 lbs/MMscf
Sulfur Dioxide	0.51	2.2	7.80 gr S/100scf

Specific Condition No. 5

**FROM:** The permitted operating parameters and utilization rates for these natural gas compressor engines shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 17,718 scf/hr per engine.
- Maximum heat input shall not exceed 36.50 MMBtu/hr for both engines.

**TO:** The permitted operating parameters and utilization rates for these natural gas compressor engines shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 22,703 scf/hr per engine.
- Maximum heat input shall not exceed 46.77 MMBtu/hr for both engines.

**COMPRESSOR STATION NO. 15 - TAYLOR COUNTY:**

**Specific Condition No. 1**

**FROM:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	17.6	77.2	2.0 g/bhp-hr
Carbon Monoxide	22.0	96.6	2.5 g/bhp-hr
Volatile Organic Compounds (non-methane)	8.8	38.6	1.0 g/bhp-hr
Particulate Matter (TSP)	0.13	0.6	5 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.13	0.6	5 lbs/MMscf
Sulfur Dioxide	0.75	3.3	10 gr/100scf

**TO:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	17.6	77.2	2.0 g/bhp-hr
Carbon Monoxide	22.0	96.6	2.5 g/bhp-hr
Volatile Organic Compounds (non-methane)	8.8	38.6	1.0 g/bhp-hr
Particulate Matter (TSP)	0.13	0.6	4.23 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.13	0.6	4.23 lbs/MMscf
Sulfur Dioxide	0.75	3.3	8.53 gr S/100scf

**Specific Condition No. 5**

**FROM:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 26,154 scf/hr.
- Maximum heat input shall not exceed 27.20 MMBtu/hr.



**TO:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 30,943 scf/hr.
- Maximum heat input shall not exceed 32.18 MMBtu/hr.

**COMPRESSOR STATION NO. 16 - BRADFORD COUNTY:**

**Specific Condition No. 1**

**FROM:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	17.6	77.2	2.0 g/bhp-hr
Carbon Monoxide	22.0	96.6	2.5 g/bhp-hr
Volatile Organic Compounds (non-methane)	8.8	38.6	1.0 g/bhp-hr
Particulate Matter (TSP)	0.13	0.6	5 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.13	0.6	5 lbs/MMscf
Sulfur Dioxide	0.75	3.3	10 gr/100scf

**TO:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	17.6	77.2	2.0 g/bhp-hr
Carbon Monoxide	22.0	96.6	2.5 g/bhp-hr
Volatile Organic Compounds (non-methane)	8.8	38.6	1.0 g/bhp-hr
Particulate Matter (TSP)	0.13	0.6	3.90 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.13	0.6	3.90 lbs/MMscf
Sulfur Dioxide	0.75	3.3	7.80 gr S/100scf

**Specific Condition No. 5**

**FROM:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 26,408 scf/hr.
- Maximum heat input shall not exceed 27.20 MMBtu/hr.

**TO:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 33,833 scf/hr.
- Maximum heat input shall not exceed 34.85 MMBtu/hr.

**COMPRESSOR STATION NO. 17 - MARION COUNTY**

**Specific Condition No. 1**

**FROM:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	10.6	46.3	2.0 g/bhp-hr
Carbon Monoxide	14.8	64.9	2.8 g/bhp-hr
Volatile Organic Compounds (non-methane)	9.0	39.4	1.7 g/bhp-hr
Particulate Matter (TSP)	0.09	0.4	5 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.09	0.4	5 lbs/MMscf
Sulfur Dioxide	0.49	2.2	10 gr/100scf

**TO:** The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	10.6	46.3	2.0 g/bhp-hr
Carbon Monoxide	14.8	64.9	2.8 g/bhp-hr
Volatile Organic Compounds (non-methane)	9.0	39.4	1.7 g/bhp-hr
Particulate Matter (TSP)	0.09	0.4	4.13 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.09	0.4	4.13 lbs/MMscf
Sulfur Dioxide	0.49	2.2	8.27 gr 8/100scf

**Specific Condition No. 5**

**FROM:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 17,010 scf/hr.
- Maximum heat input shall not exceed 17.52 MMBtu/hr.

**TO:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 20,569 scf/hr.
- Maximum heat input shall not exceed 21.19 MMBtu/hr.

**COMPRESSOR STATION NO. 20 - ST. LUCIE COUNTY**

**FROM:** The maximum allowable emissions from this unit shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	10.6	46.3	2.0 g/bhp-hr
Carbon Monoxide	14.8	64.9	2.8 g/bhp-hr
Volatile Organic Compounds (non-methane)	9.0	39.4	1.7 g/bhp-hr
Particulate Matter (TSP)	0.09	0.4	5 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.09	0.4	5 lbs/MMscf
Sulfur Dioxide	0.49	2.0	10 qr/100scf

**TO:** The maximum allowable emissions from this unit shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	10.6	46.3	2.0 g/bhp-hr
Carbon Monoxide	14.8	64.9	2.8 g/bhp-hr
Volatile Organic Compounds (non-methane)	9.0	39.4	1.7 g/bhp-hr
Particulate Matter (TSP)	0.09	0.4	4.13 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.09	0.4	4.13 lbs/MMscf
Sulfur Dioxide	0.49	2.0	8.27 qr S/100scf

**Specific Condition No. 5**

**FROM:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 17,010 scf/hr.
- Maximum heat input shall not exceed 17.52 MMBtu/hr.

Mr. Allan Weatherford  
Request for Amendments and Extensions  
Page 12

**TO:** The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed **20,569** scf/hr.
- Maximum heat input shall not exceed **21.19** MMBtu/hr.

**Expiration Date**

The expiration date of the above mentioned permit will be changed from June 30, 1993, to **December 31, 1993.**

This letter must be attached to the above mentioned permits and shall become a part of each permit. If you have any questions, please call Teresa Heron at (904) 488-1344.

Sincerely,



Howard L. Rhodes  
Director  
Division of Air Resources  
Management

HLR/TH/plm

**Attachment to be Incorporated:**

Mr. Allan Weatherford's letter of June 29, 1993

cc: E. Middleswart, NWD  
Robert Leetch, NED  
Charles Collins, CD  
Isidore Goldman, SED  
Duane Pierce, FGTC  
Barry Andrews, ENSR



ENSR Consulting  
and Engineering  
2809 West Mall Drive  
Florence, AL 35630  
(205) 767-1210  
FAX (205) 767-1211

December 3, 1993

Mr. Clair Fancy, P.E.  
Chief, Bureau of Air Regulation  
Florida Department of Environmental Protection  
2600 Blairstone Road  
Tallahassee, FL 32399-2400

RECEIVED  
DEC - 6 1993  
Division of Air  
Resources Management

Dear Clair:

**RE: Request for Amendments to Permits  
Florida Gas Transmission Company**

**Station 12 - Permit No. AC57-188869**  
Munson, Santa Rosa County, Florida

**Station 13 - Permit No. AC67-189220**  
Caryville, Washington county, Florida

**Station 14 - Permit No. AC20-189438**  
Quincy, Gadsden County, Florida

**Station 15 - Permit No. AC62-189439**  
Perry, Taylor County, Florida

**Station 16 - Permit No. AC04-189454**  
Brooker, Bradford County, Florida

**Station 17 - Permit No. AC42-189455**  
Salt Springs, Marion County, Florida

**Station 18 - Permit No. AC48-189456**  
Orlando, Orange County, Florida

**Station 19 - Permit No. AC05-189665**  
Melbourne, Brevard County, Florida

**Station 20 - Permit No. AC56-189457**  
Ft. Pierce, St. Lucie County, Florida



December 3, 1993  
Mr. Clair Fancy  
Page 2

This letter is in response to our recent conversation regarding a previous request by Florida Gas Transmission Company (FGTC) to amend the above permits to include Method 3A instead of Method 3.

On June 29, 1993, FGTC requested that the permits for the compressor engines referenced in this letter be amended to adjust the horsepower ratings and heat input rates. On September 9, 1993 (letter attached), FGTC further requested that specific condition 8 in each of the permits be amended to replace Method 3 with 3A, and that the SO<sub>2</sub> emission limits be clarified to base SO<sub>2</sub> emissions on the fuels sulfur content.

On September 17, 1993 the Division of Air Resources Management (DARM) responded to FGTC's request with a letter amending the permits. Included were the amendments for horsepower ratings, heat input, restrictions, and clarification of sulfur as the basis for SO<sub>2</sub> emissions.

It has recently come to FGTC's attention through the process of obtaining operating permits from the district offices that the request to replace Method 3 with Method 3A was not included in DARM's response. Until now it was assumed that the request had been included in the September 17, 1993 letter of amendment.

Accordingly, FGTC requests that DARM evaluate the request for the amendment to the testing method. This should not require an alternate sampling procedure since there is no regulatory requirement for determining the oxygen and carbon dioxide concentrations from compressor station engines.

Your expedited response to this request is appreciated since it relates to the issuance of our operating permits. Should you need additional information or have any questions please contact Mr. Alan Weatherford with FGTC at (407) 875-5816.

Sincerely,

A handwritten signature in cursive script that reads "Barry Andrews".

Barry D. Andrews, P.E.  
Manager, Air Quality Services

cc : Alan Weatherford

Enclosure



Lawton Chiles  
Governor

# Florida Department of Environmental Protection

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

Virginia B. Wetherell  
Secretary

December 9, 1993

Mr. Allan Weatherford  
Compliance Environmentalist  
Florida Gas Transmission Company  
P.O. Box 94500  
Maitland, Florida 32794-5100

Dear Mr. Weatherford:

RE: Request for Amendments and Extensions to Air Construction  
Permits AC 57-188869, AC 67-189220, AC 20-189438,  
AC 62-189439, AC 04-189454, AC 42-189455, AC 48-189456,  
AC 05-189655, and AC 56-189457  
Phase II - Florida Gas Transmission Company

The Department is in receipt of Mr. Barry Andrew's letter dated December 3, 1993, on behalf of your company, requesting to amend the above permits to use EPA Method 3A instead of EPA Method 3 for Gas Analysis. The Department has reviewed this request and has determined to amend the above mentioned permits as requested.

Specific Condition No. 8 of the above mentioned permits will be amended as follows:

## SPECIFIC CONDITION NO. 8

### FROM:

8. Compliance with the NO<sub>x</sub>, SO<sub>2</sub>, CO, VE, and VOC standards shall be determined by the following reference methods as described in 40 CFR 60, Appendix A (July 1, 1988) and adopted by reference in F.A.C. Rule 17-2.700.

- Method 1. Sample and Velocity Traverses
- Method 2. Volumetric Flow Rate
- Method 3. Gas Analysis
- Method 7E. Determination of Nitrogen Oxides Emissions from Stationary Sources
- Method 9. Determination of the Opacity of the Emissions from Stationary Sources
- Method 10. Determination of the Carbon Monoxide Emission from Stationary Sources
- Method 25. Determination of Total Gaseous Nonmethane Organic Emissions as Carbon

Mr. Allan Weatherford  
December 9, 1993  
Page Two

TO:

8. Compliance with the NO<sub>x</sub>, SO<sub>2</sub>, CO, VE, and VOC standards shall be determined by the following reference methods as described in 40 CFR 60, Appendix A (July 1, 1992) and adopted by reference in F.A.C. Rule 17-2.700.

- Method 1. Sample and Velocity Traverses
- Method 2. Volumetric Flow Rate
- **Method 3A. Gas Analysis**
- Method 7E. Determination of Nitrogen Oxides Emissions from Stationary Sources
- Method 9. Determination of the Opacity of the Emissions from Stationary Sources
- Method 10. Determination of the Carbon Monoxide Emission from Stationary Sources
- **Method 25A. Determination of Total Gaseous Organic Concentrations Using a Flame Ionization Analyses**

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. Petitions filed by the applicant of the amendment request/application and the parties listed below must be filed within 14 days of receipt of this amendment. Petitions filed by other persons must be filed within 14 days of the amendment issuance or within 14 days of their receipt of this amendment, whichever occurs first. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information:

- (a) The name, address and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed;
- (b) A statement of how and when each petitioner received notice of the Department's action or proposed action;
- (c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action;
- (d) A statement of the material facts disputed by Petitioner, if any;



Mr. Allan Weatherford  
December 9, 1993  
Page Three

(e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action;

(f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action;

(g) A statement of the relief sought by petitioner, stating precisely the action the petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this amendment. Persons whose substantial interests will be affected by any decision of the Department with regard to the request/application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of receipt of this amendment in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

This letter must be attached to the above mentioned permits and shall become a part of each permit.

Sincerely,



Howard Rhodes  
Director  
Division of Air Resources  
Management

Attachment to be Incorporated

Mr. Barry Andrew's letter of December 3, 1993.

cc: E. Middleswart, NWD  
Robert Leetch, NED  
Charles Collins, CD  
Isidore Goldman, SED  
Duane Pierce, FGTC  
Barry Andrews, ENSR

Mr. Allan Weatherford  
December 9, 1993  
Page Four

CERTIFICATE OF SERVICE

The undersigned duly designated deputy clerk hereby certifies that this AMENDMENT and all copies were mailed by certified mail before the close of business on 12/21/93 to the listed persons.

Clerk Stamp

FILING AND ACKNOWLEDGMENT FILED,  
on this date, pursuant to  
§120.52(11), Florida Statutes,  
with the designated Department  
Clerk, receipt of which is hereby  
acknowledged.

Barbara J. Boutwell  
Clerk

12/21/93  
Date



# Florida Gas Transmission Company

P. O. Box 945100 Maitland, Florida 32794-5100 (407) 875-5800

June 29, 1993

VIA FEDERAL EXPRESS  
(overnight delivery)

Mr. Clair Fancy, P.E.  
Chief, Bureau of Air Regulation  
Florida Department of Environmental Regulation  
2600 Blair Stone Road  
Tallahassee, FL 32399-2400

Dear Mr. Fancy:

**RE: Request for Amendments and Extensions to Air  
Construction Permits**

Permit No. AC57-188869  
Florida Gas Transmission Company, Station 12 ←  
Munson, Santa Rosa County, Florida

Permit No. AC67-189220  
Florida Gas Transmission Company, Station 13  
Caryville, Washington County, Florida

Permit No. AC20-189438  
Florida Gas Transmission Company, Station 14  
Quincy, Gadsden County, Florida

Permit No. AC62-189439  
Florida Gas Transmission Company, Station 15  
Perry, Taylor County, Florida

Permit No. AC04-189454  
Florida Gas Transmission Company, Station 16  
Brooker, Bradford County, Florida

Permit No. AC42-189455  
Florida Gas Transmission Company, Station 17  
Salt Springs, Marion County, Florida

Permit No. AC48-189456  
Florida Gas Transmission Company, Station 18  
Orlando, Orange County, Florida

Permit No. AC05-189665  
Florida Gas Transmission Company, Station 19  
Melbourne, Brevard County, Florida

Permit No. AC56-189457  
Florida Gas Transmission Company, Station 20  
Ft. Pierce, St. Lucie County, Florida

On May 27, 1993, Florida Gas Transmission Company (FGT) submitted Certificates of Completion of Construction to the appropriate district offices to obtain operating permits for

RECEIVED  
MAIL ROOM  
1993 JUN 30 11:19:10

*This file contains  
all the attachments  
related to this  
correspondence.*

Department of Environmental Regulation

# Routing and Transmittal Slip

To: (Name, Office, Location)

① ~~Jason~~ - file  
② Pally

1. ~~Preston Lewis, P.E. III~~

2. ARM BAR Permit

3. T L II

4.

Remarks:

RECEIVED

JUN 11 1993

Division of Air  
Resources Management

From: Alan Zahn

Date 6/10/93

Phone

STATION 18

ORLANDO, FLORIDA

Station	Model Run Factor	MAXIMUM 1-HR CONCENTRATION (ug/m**3)					Maximum Emission (lb/hr)				
		NOx	CO	VOCs	Particulates	SO2	NOx	CO	VOCs	Particulates	SO2
18 Permitted	4.843	51.336	53.757	12.592	0.387	2.276	10.60	11.10	2.60	0.08	0.47
18 Revised	3.888	46.267	48.600	11.586	0.428	2.100	11.90	12.50	2.98	0.11	0.54

Model Run Factor is maximum 1 – hr concentration based on emission of 1 lb/hr.  
 Maximum 1 – hr concentrations calculated as (Model Run Factor) X (Maximum Emission).

\*\*\* SCREEN-1.1 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 88300 \*\*\*

Station 18--Permit--Simple Terrain, no Downwash

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .1260  
STACK HEIGHT (M) = 12.19  
STK INSIDE DIAM (M) = .44  
STK EXIT VELOCITY (M/S) = 23.49  
STK GAS EXIT TEMP (K) = 560.93  
AMBIENT AIR TEMP (K) = 293.00  
RECEPTOR HEIGHT (M) = .00  
IOPT (1=URB,2=RUR) = 2  
BUILDING HEIGHT (M) = .00  
MIN HORIZ BLDG DIM (M) = .00  
MAX HORIZ BLDG DIM (M) = .00

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF .00 M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES \*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
1.	.0000	0	.0	.0	.0	.0	.0	.0	
100.	1.950	2	5.0	5.1	1600.0	26.9	19.6	11.1	NO
200.	4.736	3	8.0	8.2	2560.0	21.3	23.8	14.3	NO
300.	4.755	3	5.0	5.1	1600.0	26.8	34.5	20.8	NO
400.	4.332	3	3.0	3.1	960.0	36.6	45.2	27.3	NO
500.	4.146	4	5.0	5.2	1600.0	26.7	36.4	18.8	NO
600.	3.951	4	4.0	4.1	1280.0	30.3	43.0	21.8	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND				1. M:					
DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
268.	4.843	3	5.0	5.1	1600.0	26.8	31.3	18.9	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	4.843	268.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*

\*\*\* SCREEN-1.1 MODEL RUN \*\*\*  
\*\*\* VERSION DATED 88300 \*\*\*

Station 18--Actual--Simple Terrain, no Downwash

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT  
EMISSION RATE (G/S) = .1260  
STACK HEIGHT (M) = 15.24  
STK INSIDE DIAM (M) = .66  
STK EXIT VELOCITY (M/S) = 10.35  
STK GAS EXIT TEMP (K) = 560.93  
AMBIENT AIR TEMP (K) = 293.00  
RECEPTOR HEIGHT (M) = .00  
IOPT (1=URB,2=RUR) = 2  
BUILDING HEIGHT (M) = .00  
MIN HORIZ BLDG DIM (M) = .00  
MAX HORIZ BLDG DIM (M) = .00

\*\*\* FULL METEOROLOGY \*\*\*

\*\*\*\*\*  
\*\*\* SCREEN AUTOMATED DISTANCES \*\*\*  
\*\*\*\*\*

\*\*\* TERRAIN HEIGHT OF .00 M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES \*\*\*

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
1.	.0000	0	.0	.0	.0	.0	.0	.0	
100.	1.005	1	3.0	3.1	960.0	39.4	27.4	15.0	NO
200.	3.673	2	5.0	5.1	1600.0	29.7	36.4	20.7	NO
300.	3.888	3	5.0	5.2	1600.0	29.6	34.5	20.7	NO
400.	3.728	3	3.0	3.1	960.0	39.1	45.2	27.3	NO
500.	3.493	3	3.0	3.1	960.0	39.1	55.2	33.1	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 1. M:  
300. 3.888 3 5.0 5.2 1600.0 29.6 34.5 20.7 NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)  
DWASH=NO MEANS NO BUILDING DOWNWASH USED  
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED  
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED  
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3\*LB

\*\*\*\*\*  
\*\*\* SUMMARY OF SCREEN MODEL RESULTS \*\*\*  
\*\*\*\*\*

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.888	300.	0.

\*\*\*\*\*  
\*\* REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS \*\*  
\*\*\*\*\*



**Air Emissions Estimates for Permitting  
Station 18 Orlando, FL**

	NOX (TPY)	CO (TPY)	NMHC (TPY)	SO2 (TPY)	PM (TPY)
<b>Engines</b>					
Compressor Engine 1	212.47	27.04	8.50	1.79	0.31
Compressor Engine 2	212.47	27.04	8.50	1.79	0.31
Compressor Engine 3	212.47	27.04	8.50	1.79	0.31
Compressor Engine 4	212.47	27.04	8.50	1.79	0.31
Compressor Engine 5	46.36	48.68	11.59	2.09	0.41
Emergency Generator Engine No. 1	1.57	0.15	0.04	0.01	0.00
Emergency Generator Engine No. 2	1.94	0.18	0.09	0.01	0.00
Air Compressor Engine No. 1	0.07	0.39	0.00	0.00	0.00
<b>Tanks</b>					
Oil & Water Separator No. 1	0.00	0.00	0.81	0.00	0.00
Oil & Water Separator No. 2	0.00	0.00	0.81	0.00	0.00
Pipeline Condensate Tank No. 1	0.00	0.00	0.13	0.00	0.00
Lube Oil Storage Tank No. 1	0.00	0.00	0.00	0.00	0.00
Waste Oil Tank No. 1	0.00	0.00	0.00	0.00	0.00
Gasoline Tank No. 1	0.00	0.00	0.22	0.00	0.00
Kerosene Tank No. 1	0.00	0.00	0.00	0.00	0.00
Diesel Tank No. 1	0.00	0.00	0.00	0.00	0.00
Diesel Tank No. 2	0.00	0.00	0.00	0.00	0.00
<b>Cleaning Machines</b>					
Parts Cleaner No. 1	0.00	0.00	0.10	0.00	0.00
<b>Blowdown</b>					
ESD and Maintenance Blowdowns	0.00	0.00	1.64	0.00	0.00
<b>Fugitive Emissions</b>					
Fugitive Emissions	0.00	0.00	?	0.00	0.00
<b>Total Emissions (Except for indicated item)</b>	<b>899.82</b>	<b>157.56</b>	<b>49.43</b>	<b>9.27</b>	<b>1.65</b>

Compressor Station: Number 18  
 Name: Orlando  
 County: Orange  
 Nearest City: Orlando  
 Compressor Supervisor: Wayne Daniels  
 Mailing Address: Box 618898  
 Orlando, Florida 32861-6898  
 Telephone: 407-225-4342 Fax: 407-578-2308  
 Latitude: 28-31-15  
 Longitude: 81-29-31  
 UTM Zone: 17  
 UTM Easting: 451.86 km  
 UTM Northing: 3,154.79 km  
 Elevation (ft): 103

Phase I Engine Characteristics

	1801	1802	1803	1804
Engine Identification				
Permit Number				
Serial Number	G-2315	G-2457	G-2458	G-2778
Operating Time				
Hours/Day	24	24	24	24
Days/Week	7	7	7	7
Weeks/Year	52	52	52	52
Engine Type	Recip	Recip	Recip	Recip
Date of Installation	1959	1959	1959	1968
Engine Make	Worthington	Worthington	Worthington	Worthington
Engine Model	SEHG-8	SEHG-8	SEHG-8	SEHG-8
Horsepower Rating	2000	2000	2000	2000
Air Charging	Turbo	Turbo	Turbo	Turbo
Exhaust Temperature (F)	600	600	600	600
Mass Flow Rate (lb/hr) (a)	29172	29172	29172	29172
Volumetric Flow Rate (acfm)	11637	11637	11637	11637
Volumetric Flow Rate (dscfm)	5333	5333	5333	5333
Exit Velocity (ft/s)	95.96	95.96	95.96	95.96
Water Vapor Content (%)	8	8	8	8
Ave. Fuel Consumption (MMCF/Hr) (b)	0.0148	0.0148	0.0148	0.0148
Max. Fuel Consumption (MMCF/Hr) (b)	0.0148	0.0148	0.0148	0.0148
Specific Fuel Consomp. (BTU/bhp-hr)	6350	6350	6350	6350
Maximum Heat Input (MMBTU/Hr)	12	12	12	12
Stack Height (ft)	31.75	31.75	31.75	31.75
Stack Diameter (in)	19.25	19.25	19.25	19.25
Stack to Building Offset (ft)	17.00	17.00	17.00	17.00
Building Height (ft) (c)	31.75			
Building Length (ft) (c)	201'-3"	← Same	← Same	← Same
Building Width (ft) (c)	52'-8 1/4"			

Phase I Fuel Characteristics

	N.G.	N.G.	N.G.	N.G.
Fuel Type	N.G.	N.G.	N.G.	N.G.
Heating Value (BTU/CF)	1030	1030	1030	1030
Heat Capacity (BTU/lb)	22637	22637	22637	22637
Density (lb/cubic ft)	0.0455	0.0455	0.0455	0.0455
Percent Sulfur (%) (d)	0.031	0.031	0.031	0.031
Percent Ash (%)	N/A	N/A	N/A	N/A

Phase I Emissions Rates by Engine for Station 18

Engine Identification	1	2	3	4
<b>Grams/BHP-Hour</b>				
NOX	11.000	11.000	11.000	11.000
CO	1.400	1.400	1.400	1.400
NMHC	0.440	0.440	0.440	0.440
SO2 (e)	0.093	0.093	0.093	0.093
PM (f)	0.016	0.016	0.016	0.016
<b>Pounds/Hour</b>				
NOX	48.51	48.51	48.51	48.51
CO	6.17	6.17	6.17	6.17
NMHC	1.94	1.94	1.94	1.94
SO2	0.41	0.41	0.41	0.41
PM	0.07	0.07	0.07	0.07
<b>Tons/Year</b>				
NOX	212.47	212.47	212.47	212.47
CO	27.04	27.04	27.04	27.04
NMHC	8.50	8.50	8.50	8.50
SO2	1.79	1.79	1.79	1.79
PM	0.31	0.31	0.31	0.31

Phase I Emissions Rates for Total Station

<b>Grams/BHP-Hour</b>		
NOX		11.000
CO		1.400
NMHC		0.440
SO2		0.093
PM		0.016
<b>Pounds/Hour</b>		
NOX		194.04
CO		24.70
NMHC		7.78
SO2		1.63
PM		0.29
<b>Tons/Year</b>		
NOX		849.90
CO		108.17
NMHC		34.00
SO2		7.16
PM		1.25

SOURCE CLASSIFICATION WITH RESPECT TO PSD

MAJOR SOURCE

Notes:

- (a) Wet mass flow (@ 60 F, 14.7 psi).
- (b) Based on heating value of fuel gas.
- (c) All engines enclosed in one building.
- (d) Percent by weight.
- (e) Based on 10 grains/SCF.
- (f) Based AP-42 factor of 5 lbs/MMSCF.

Compressor Station Number 18  
 Name: Orlando  
 County: Orange  
 Nearest City: Orlando  
 Compressor Supervisor: Wayne Daniels  
 Mailing Address: Box 616898  
 Orlando, Florida 32861-6898  
 Telephone: 407-295-4342  
 Latitude: 28-31-15  
 Longitude: 81-29-31  
 UTM Zone: 17  
 UTM Easting: 451.88 km  
 UTM Northing: 3,154.79 km  
 Elevation (ft): 103

Phase II Engine Characteristics

Engine Identification	1805
Permit Number	
Serial Number	49118
Operating Time	
Hours/Day	24
Days/Week	7
Weeks/Year	52
Engine Type	Recip
Date of Installation	1891
Engine Make	Cooper-Bessmer
Engine Model	GMVH-12
Horsepower Rating	2400
Air Charging	Turbo
Exhaust Temperature (F)	550
Mass Flow Rate (lbs/hr) (a)	36860
Volumetric Flow Rate (acfm)	19753.2
Volumetric Flow Rate (dscfm)	7511
Exit Velocity (ft/s)	89.29
Water Vapor Content (%)	8
Ave. Fuel Consumption (MMCF/Hr) (b)	0.0163
Max. Fuel Consumption (MMCF/Hr) (b)	0.0163
Specific Fuel Consump. (BTU/bhp-hr)	7000
Maximum Heat Input (MMBTU/Hr)	16.8
Stack Height (ft)	50
Stack Diameter (in)	28
Stack to Building Offset (ft)	17.00
Building Height (ft) (c)	31.75
Building Length (ft) (c)	58.00
Building Width (ft) (c)	49.00

*201'-3"  
52'-8 1/4"*

*in same building with engines #1 - #4*

Phase II Fuel Characteristics

Fuel Type	N.G.
Heating Value (BTU/CF)	1030
Heat Capacity (BTU/lb)	22637
Density (lb/cubic ft)	0.0455
Percent Sulfur (%) (d)	0.031
Percent Ash (%)	N/A

30-Jul-92  
CS18.WK1

Phase II Emissions Rates by Engine for Station 18  
Engine Identification

5

Grams/BHP-Hour		
	NOX	2.000
	CO	2.100
	NMHC	0.500
	SO2 (e)	0.090
	PM (f)	0.018
Pounds/Hour		
	NOX	10.58
	CO	11.11
	NMHC	2.65
	SO2	0.48
	PM	0.09
Tons/Year		
	NOX	46.36
	CO	48.68
	NMHC	11.59
	SO2	2.09
	PM	0.41

Phase II Emissions Rates for Total Station

Grams/BHP-Hour		
	NOX	8.923
	CO	1.561
	NMHC	0.454
	SO2	0.092
	PM	0.017
Pounds/Hour		
	NOX	204.62
	CO	35.81
	NMHC	10.41
	SO2	2.11
	PM	0.38
Tons/Year		
	NOX	896.25
	CO	158.84
	NMHC	45.59
	SO2	9.24
	PM	1.68

SOURCE CLASSIFICATION WITH RESPECT TO PSD

MAJOR SOURCE

Notes:

- (a) Wet mass flow (@ 60 F, 14.7 psi).
- (b) Based on heating value of fuel gas.
- (c) All engines enclosed in one building.
- (d) Percent by weight.
- (e) Based on 10 grains/SCF.
- (f) Based AP-42 factor of 5 lbs/MMSCF.

**Engine Emission Calculation Worksheet  
Station 18; Orlando, FL**

**Emergency Generator Engine 1**

**Engine data**

Annual use (maximum); hr./yr.	400 hr./yr.
Power; Hp	170 Hp
Power; Btu/hr. (@ 8026 (Btu/hr.)/Hp)	1364420 Btu/hr.
Fuel consumption; scf/hr. (@ 1040 Btu/scf)	1312 scf/hr.

**Emission factors**

NOx	21.0 g/Hp-hr.
CO	2.0 g/Hp-hr.
NMHC	0.5 g/Hp-hr.
SO2	0.1 grains/scf
PM	5.0 lb/MMscf

**Calculated emissions**

NOx	1.57 TPY
CO	0.15 TPY
NMHC	0.04 TPY
SO2	0.01 TPY
PM	0.00 TPY

**Engine Emission Calculation Worksheet  
Station 18; Orlando, FL**

**Emergency Generator Engine 2**

**Engine data**

Annual use (maximum); hr./yr.	400 hr./yr.
Power; Hp	200 Hp
Power; Btu/hr. (@ 8026 (Btu/hr.)/Hp)	1605200 Btu/hr.
Fuel consumption; scf/hr. (@ 1040 Btu/scf)	1543 scf/hr.

**Emission factors**

NOx	22.0 g/Hp-hr.
CO	2.0 g/Hp-hr.
NMHC	1.0 g/Hp-hr.
SO2	0.1 grains/scf
PM	5.0 lb/MMscf

**Calculated emissions**

NOx	1.94 TPY
CO	0.18 TPY
NMHC	0.09 TPY
SO2	0.01 TPY
PM	0.00 TPY

**Engine Emission Calculation Worksheet  
Station 18: Orlando, FL****Air Compressor Engine 1****Engine data**

Annual use (maximum); hr./yr.	150 hr./yr.
Power; Hp	52 Hp
Power; Btu/hr. (@ 8026 (Btu/hr.)/Hp)	417352 Btu/hr.
Fuel consumption; scf/hr. (@ 1040 Btu/scf)	401 scf/hr.

**Emission factors**

NOx	8.0 g/Hp-hr.
CO	45.0 g/Hp-hr.
NMHC	0.5 g/Hp-hr.
SO2	0.1 grains/scf
PM	5.0 lb/MMscf

**Calculated emissions**

NOx	0.07 TPY
CO	0.39 TPY
NMHC	0.00 TPY
SO2	0.00 TPY
PM	0.00 TPY



## FIXED ROOF TANK VOLATILE ORGANIC COMPOUND EMISSIONS (Rev. 6/90)

(C) COPYRIGHT 1990, PHOENIX ENGINEERING, INC.

CLIENT: Florida Gas Transmission

DATE: 05/18/93

LOCATION: Station 18

JOB NO:

CALCULATED USING AP-42, FOURTH EDITION SEP. 85, EQUATIONS 4.3-(1)&amp;(2)

## TANK PHYSICAL DATA

TANK IDENTIFICATION NUMBER	Oil & Water Separator 1
EMISSION CONTROLS	None
PERCENT EFFICIENCY	0 %
TANK PAINT COLOR	Black
TANK DIAMETER (FT), D	10.0
TANK HEIGHT (FT), H	15.0
PAINT FACTOR, FsubP	1.58
TANK CAPACITY (BBLs), VB	210
TANK CAPACITY (GALLONS), V	8820
ADJUSTMENT FACTOR FOR DIA., C	0.53

## WEATHER DATA

Orlando

AVG. DAILY TEMP. CHANGE (DEG F), DeltaT	20.0
STORAGE TEMP. (DEG. F)	77.4
AVG. ATM. PRESS. (PSIA), PsubA	14.7

## PRODUCT PHYSICAL DATA

MATERIAL STORED	Oily Wastewater
MOLECULAR WEIGHT (#/#MOLE) MsubV	53.00
VAPOR PRESS. AT STG. TEMP. (DEG. F), P	2.80
PRODUCT FACTOR, KsubC (CRUDE 0.65, OTHER 1.0)	1.00

## THROUGHPUT DATA

DAYS IN SERVICE, DsubS	365
VAPOR SPACE HEIGHT (FT), VH	7.50
TANK THROUGHPUT (BBLs FOR DAYS IN SERVICE), TT	21429
FILLING RATE (BBLs/HR), FR	85.70
NUMBER OF TURNOVERS FOR DAYS IN SERVICE, N	102.0
TURNOVER FACTOR, KsubN	0.43

FIXED ROOF TANK BREATHING LOSS, # LsubB =

$$2.26 \times 10^{-2} * (M_{subV}) * (P / (P_{subA} - P)) \text{ EXP } 0.68 * (D) \text{ EXP } 1.73 * (VH) \text{ EXP } 0.51 * (\Delta T) \text{ EXP } 0.5 * (F_{subP}) * (C) * (K_{subC}) * D_{subS} / 365 * (100 - \% \text{eff}) / 100$$

FIXED ROOF TANK WORKING LOSS, # LsubW =

$$2.4 \text{ EXP } -05 * M_{subV} * P * V * N * K_{subN} * K_{subC} * (100 - \% \text{eff}) / 100$$

VOLATILE ORGANIC COMPOUND LOSSES	BREATHING	WORKING	TOTAL
POUNDS FOR DAYS SERVICE =	252	1378	1629
TONS FOR DAYS SERVICE =	0.13	0.69	0.81
ANNUALIZED POUNDS =	252	1378	1629
ANNUALIZED TONS =	0.13	0.69	0.81
POUND/HR (AVG) =	0.03	0.16	0.19
MAXIMUM EMISSION RATE (#/HR) =			

## FIXED ROOF TANK VOLATILE ORGANIC COMPOUND EMISSIONS (Rev. 6/90)

(C) COPYRIGHT 1990, PHOENIX ENGINEERING, INC.

CLIENT: Florida Gas Transmission DATE: 05/18/93  
 LOCATION: Station 18 JOB NO:

-----  
 CALCULATED USING AP-42, FOURTH EDITION SEP. 85, EQUATIONS 4.3-(1)&(2)  
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## TANK PHYSICAL DATA

TANK IDENTIFICATION NUMBER	Oil & Water Separator 2
EMISSION CONTROLS	None
PERCENT EFFICIENCY	0 %
TANK PAINT COLOR	Black
TANK DIAMETER (FT), D	10.0
TANK HEIGHT (FT), H	15.0
PAINT FACTOR, FsubP	1.58
TANK CAPACITY (BBLs), VB	210
TANK CAPACITY (GALLONS), V	8820
ADJUSTMENT FACTOR FOR DIA., C	0.53

## WEATHER DATA

AVG. DAILY TEMP. CHANGE (DEG F), DeltaT	Orlando	20.0
STORAGE TEMP. (DEG. F)		77.4
AVG. ATM. PRESS. (PSIA), PsubA		14.7

## PRODUCT PHYSICAL DATA

MATERIAL STORED	Oily Wastewater
MOLECULAR WEIGHT (#/#MOLE) MsubV	53.00
VAPOR PRESS. AT STG. TEMP. (DEG. F), P	2.80
PRODUCT FACTOR, KsubC (CRUDE 0.65, OTHER 1.0)	1.00

## THROUGHPUT DATA

DAYS IN SERVICE, DsubS	365
VAPOR SPACE HEIGHT (FT), VH	7.50
TANK THROUGHPUT (BBLs FOR DAYS IN SERVICE), TT	21429
FILLING RATE (BBLs/HR), FR	85.70
NUMBER OF TURNS FOR DAYS IN SERVICE, N	102.0
TURNOVER FACTOR, KsubN	0.43

FIXED ROOF TANK BREATHING LOSS, # LsubB =

$$2.26 \times 10^{-2} * (M_{subV}) * (P / (P_{subA} - P)) \text{ EXP } 0.68 * (D) \text{ EXP } 1.73 * (VH) \text{ EXP } 0.51 * (\Delta T) \text{ EXP } 0.5 * (F_{subP}) * (C) * (K_{subC}) * D_{subS} / 365 * (100 - \% \text{eff}) / 100$$

FIXED ROOF TANK WORKING LOSS, # LsubW =

$$2.4 \text{ EXP } -05 * M_{subV} * P * V * N * K_{subN} * K_{subC} * (100 - \% \text{eff}) / 100$$

VOLATILE ORGANIC COMPOUND LOSSES	BREATHING	WORKING	TOTAL
POUNDS FOR DAYS SERVICE =	252	1378	1629
TONS FOR DAYS SERVICE =	0.13	0.69	0.81
ANNUALIZED POUNDS =	252	1378	1629
ANNUALIZED TONS =	0.13	0.69	0.81
POUND/HR (AVG) =	0.03	0.16	0.19
MAXIMUM EMISSION RATE (#/HR) =			

## FIXED ROOF TANK VOLATILE ORGANIC COMPOUND EMISSIONS (Rev. 6/90)

(C) COPYRIGHT 1990, PHOENIX ENGINEERING, INC.

CLIENT: Florida Gas Transmission

DATE: 05/18/93

LOCATION: Station 18

JOB NO:

CALCULATED USING AP-42, FOURTH EDITION SEP. 85, EQUATIONS 4.3-(1)&amp;(2)

## TANK PHYSICAL DATA

TANK IDENTIFICATION NUMBER

Condensate 1

EMISSION CONTROLS

None

PERCENT EFFICIENCY

0 %

TANK PAINT COLOR

Black

TANK DIAMETER (FT), D

10.0

TANK HEIGHT (FT), H

15.0

PAINT FACTOR, FsubP

1.58

TANK CAPACITY (BBLs), VB

210

TANK CAPACITY (GALLONS), V

8820

ADJUSTMENT FACTOR FOR DIA., C

0.53

## WEATHER DATA

Orlando

AVG. DAILY TEMP. CHANGE (DEG F), DeltaT

20.0

STORAGE TEMP. (DEG. F)

77.4

AVG. ATM. PRESS. (PSIA), PsubA

14.7

## PRODUCT PHYSICAL DATA

MATERIAL STORED

Condensate

MOLECULAR WEIGHT (#/#MOLE) MsubV

53.00

VAPOR PRESS. AT STG. TEMP. (DEG. F), P

2.80

PRODUCT FACTOR, KsubC (CRUDE 0.65, OTHER 1.0)

1.00

## THROUGHPUT DATA

DAYS IN SERVICE, DsubS

365

VAPOR SPACE HEIGHT (FT), VH

7.50

TANK THROUGHPUT (BBLs FOR DAYS IN SERVICE), TT

95.2

FILLING RATE (BBLs/HR), FR

142.9

NUMBER OF TURNS FOR DAYS IN SERVICE, N

0.45

TURNOVER FACTOR, KsubN

1.00

FIXED ROOF TANK BREATHING LOSS, # LsubB =

$$2.26 \times 10^{-2} * (M_{subV}) * (P / (P_{subA} - P)) \text{ EXP } 0.68 * (D) \text{ EXP } 1.73 * (VH) \text{ EXP } 0.51 * (\Delta T) \text{ EXP } 0.5 * (F_{subP}) * (C) * (K_{subC}) * D_{subS} / 365 * (100 - \% \text{eff}) / 100$$

FIXED ROOF TANK WORKING LOSS, # LsubW =

$$2.4 \text{ EXP } -05 * M_{subV} * P * V * N * K_{subN} * K_{subC} * (100 - \% \text{eff}) / 100$$

VOLATILE ORGANIC COMPOUND LOSSES	BREATHING	WORKING	TOTAL
POUNDS FOR DAYS SERVICE =	252	14	266
TONS FOR DAYS SERVICE =	0.13	0.01	0.13
ANNUALIZED POUNDS =	252	14	266
ANNUALIZED TONS =	0.13	0.01	0.13
POUND/HR (AVG) =	0.03	0.00	0.03
MAXIMUM EMISSION RATE (#/HR) =	0.06	21.22	21.28

## FIXED ROOF TANK VOLATILE ORGANIC COMPOUND EMISSIONS (Rev. 6/90)

(C) COPYRIGHT 1990, PHOENIX ENGINEERING, INC.

CLIENT: Florida Gas Transmission

DATE: 05/18/93

LOCATION: Station 18

JOB NO:

CALCULATED USING AP-42, FOURTH EDITION SEP. 85, EQUATIONS 4.3-(1)&amp;(2)

## TANK PHYSICAL DATA

TANK IDENTIFICATION NUMBER	Waste Oil Tank 1	
EMISSION CONTROLS	None	
PERCENT EFFICIENCY		0 %
TANK PAINT COLOR	Black	
TANK DIAMETER (FT), D		7.8
TANK HEIGHT (FT), H		10.0
PAINT FACTOR, FsubP		1.58
TANK CAPACITY (BBLs), VB		90
TANK CAPACITY (GALLONS), V		3780
ADJUSTMENT FACTOR FOR DIA., C		0.41

## WEATHER DATA

	Orlando	
AVG. DAILY TEMP. CHANGE (DEG F), DeltaT		20.0
STORAGE TEMP. (DEG. F)		77.4
AVG. ATM. PRESS. (PSIA), PsubA		14.7

## PRODUCT PHYSICAL DATA

MATERIAL STORED	Waste oil	
MOLECULAR WEIGHT (#/#MOLE) MsubV		190.00
VAPOR PRESS. AT STG. TEMP. (DEG. F), P		0.0019
PRODUCT FACTOR, KsubC (CRUDE 0.65, OTHER 1.0)		1.00

## THROUGHPUT DATA

DAYS IN SERVICE, DsubS		365
VAPOR SPACE HEIGHT (FT), VH		5.00
TANK THROUGHPUT (BBLs FOR DAYS IN SERVICE), TT		310
FILLING RATE (BBLs/HR), FR		28.6
NUMBER OF TURNS FOR DAYS IN SERVICE, N		3.4
TURNOVER FACTOR, KsubN		1.00

FIXED ROOF TANK BREATHING LOSS, # LsubB =

$$2.26 \times 10^{-2} * (M_{subV}) * (P / (P_{subA} - P)) \text{ EXP } 0.68 * (D) \text{ EXP } 1.73 * (VH) \text{ EXP } 0.51 * (\Delta T) \text{ EXP } 0.5 * (F_{subP}) * (C) * (K_{subC}) * D_{subS} / 365 * (100 - \% \text{eff}) / 100$$

FIXED ROOF TANK WORKING LOSS, # LsubW =

$$2.4 \text{ EXP } -05 * M_{subV} * P * V * N * K_{subN} * K_{subC} * (100 - \% \text{eff}) / 100$$

VOLATILE ORGANIC COMPOUND LOSSES	BREATHING	WORKING	TOTAL
POUNDS FOR DAYS SERVICE =	2	0	2
TONS FOR DAYS SERVICE =	0.00	0.00	0.00
ANNUALIZED POUNDS =	2	0	2
ANNUALIZED TONS =	0.00	0.00	0.00
POUND/HR (AVG) =	0.00	0.00	0.00
MAXIMUM EMISSION RATE (#/HR) =			

FIXED ROOF TANK VOLATILE ORGANIC COMPOUND EMISSIONS (Rev. 6/90)

(C) COPYRIGHT 1990, PHOENIX ENGINEERING, INC.

CLIENT: Florida Gas Transmission

DATE: 05/18/93

LOCATION: Station 18

JOB NO:

CALCULATED USING AP-42, FOURTH EDITION SEP. 85, EQUATIONS 4.3-(1)&(2)

TANK PHYSICAL DATA

TANK IDENTIFICATION NUMBER

Lube Oil Storage Tank 1

EMISSION CONTROLS

None

PERCENT EFFICIENCY

0 %

TANK PAINT COLOR

White

TANK DIAMETER (FT), D

17.2

TANK HEIGHT (FT), H

7.0

PAINT FACTOR, FsubP

1.00

TANK CAPACITY (BBLs), VB

238

TANK CAPACITY (GALLONS), V

10000

ADJUSTMENT FACTOR FOR DIA., C

0.82

WEATHER DATA

Orlando

AVG. DAILY TEMP. CHANGE (DEG F), DeltaT

20.0

STORAGE TEMP. (DEG. F)

72.4

AVG. ATM. PRESS. (PSIA), PsubA

14.7

PRODUCT PHYSICAL DATA

MATERIAL STORED

Lube oil

MOLECULAR WEIGHT (#/#MOLE) MsubV

190.00

VAPOR PRESS. AT STG. TEMP. (DEG. F), P

0.0019

PRODUCT FACTOR, KsubC (CRUDE 0.65, OTHER 1.0)

1.00

THROUGHPUT DATA

DAYS IN SERVICE, DsubS

365

VAPOR SPACE HEIGHT (FT), VH

3.50

TANK THROUGHPUT (BBLs FOR DAYS IN SERVICE), TT

571

FILLING RATE (BBLs/HR), FR

71.4

NUMBER OF TURNOVERS FOR DAYS IN SERVICE, N

2.4

TURNOVER FACTOR, KsubN

1.00

FIXED ROOF TANK BREATHING LOSS, # LsubB =

$$2.26 \times 10^{-2} * (MsubV) * (P / (PsubA - P)) \text{ EXP } 0.68 * (D) \text{ EXP } 1.73 * (VH) \text{ EXP } 0.51 * (\text{DeltaT}) \text{ EXP } 0.5 * (FsubP) * (C) * (KsubC) * DsubS / 365 * (100 - \%eff) / 100$$

FIXED ROOF TANK WORKING LOSS, # LsubW =

$$2.4 \text{ EXP } -05 * MsubV * P * V * N * KsubN * KsubC * (100 - \%eff) / 100$$

VOLATILE ORGANIC COMPOUND LOSSES	BREATHING	WORKING	TOTAL
POUNDS FOR DAYS SERVICE =	9	0	9
TONS FOR DAYS SERVICE =	0.00	0.00	0.00
ANNUALIZED POUNDS =	9	0	9
ANNUALIZED TONS =	0.00	0.00	0.00
POUND/HR (AVG) =	0.00	0.00	0.00
MAXIMUM EMISSION RATE (#/HR) =			

**Effective Diameter for a Horizontal Fixed Roof Tank  
(From Supplement E of AP-42)**

**FGT Station 18**

**Lube Oil Storage Tank No. 1**

**Tank Measurements**

Length of Tank (ft) - L	33
Actual Diameter of Tank (ft) - D	7

**Calculated Values**

Effective Tank Diameter (ft) - D <sub>eff</sub>	17.2
Vapor Space Outage (ft) - H <sub>vo</sub>	3.5

**Equations:**

$D_{eff} = \text{SQRT}(L \cdot D / 0.785)$  Equation 1-5 of Chapter 12

$H_{vo} = D / 2$  Equation 1-6 of Chapter 12

FIXED ROOF TANK VOLATILE ORGANIC COMPOUND EMISSIONS (Rev. 6/90)

(C) COPYRIGHT 1990, PHOENIX ENGINEERING, INC.

CLIENT: Florida Gas Transmission

DATE: 05/18/93

LOCATION: Station 18

JOB NO:

CALCULATED USING AP-42, FOURTH EDITION SEP. 85, EQUATIONS 4.3-(1)&(2)

TANK PHYSICAL DATA

TANK IDENTIFICATION NUMBER	Gasoline Tank 1	
EMISSION CONTROLS	None	
PERCENT EFFICIENCY		0 %
TANK PAINT COLOR	White	
TANK DIAMETER (FT), D		5.5
TANK HEIGHT (FT), H		2.0
PAINT FACTOR, FsubP		1.00
TANK CAPACITY (BBLs), VB		6.7
TANK CAPACITY (GALLONS), V		280
ADJUSTMENT FACTOR FOR DIA., C		0.27

WEATHER DATA

	Orlando	
AVG. DAILY TEMP. CHANGE (DEG F), DeltaT		20.0
STORAGE TEMP. (DEG. F)		72.4
AVG. ATM. PRESS. (PSIA), PsubA		14.7

PRODUCT PHYSICAL DATA

MATERIAL STORED	Gasoline	
MOLECULAR WEIGHT (#/#MOLE) MsubV		66.00
VAPOR PRESS. AT STG. TEMP. (DEG. F), P		8.7000
PRODUCT FACTOR, KsubC (CRUDE 0.65, OTHER 1.0)		1.00

THROUGHPUT DATA

DAYS IN SERVICE, DsubS		365
VAPOR SPACE HEIGHT (FT), VH		1.00
TANK THROUGHPUT (BBLs FOR DAYS IN SERVICE), TT		19.0
FILLING RATE (BBLs/HR), FR		71.4
NUMBER OF TURNS FOR DAYS IN SERVICE, N		2.9
TURNOVER FACTOR, KsubN		1.00

FIXED ROOF TANK BREATHING LOSS, # LsubB =

$$2.26 \times 10^{-2} * (MsubV) * (P / (PsubA - P)) \text{ EXP } 0.68 * (D) \text{ EXP } 1.73 * (VH) \text{ EXP } 0.51 * (\text{DeltaT}) \text{ EXP } 0.5 * (FsubP) * (C) * (KsubC) * DsubS / 365 * (100 - \%eff) / 100$$

FIXED ROOF TANK WORKING LOSS, # LsubW =

$$2.4 \text{ EXP } -05 * MsubV * P * V * N * KsubN * KsubC * (100 - \%eff) / 100$$

VOLATILE ORGANIC COMPOUND LOSSES	BREATHING	WORKING	TOTAL
POUNDS FOR DAYS SERVICE =	44	400	444
TONS FOR DAYS SERVICE =	0.02	0.20	0.22
ANNUALIZED POUNDS =	44	400	444
ANNUALIZED TONS =	0.02	0.20	0.22
POUND/HR (AVG) =	0.01	0.05	0.05
MAXIMUM EMISSION RATE (#/HR) =			

**Effective Diameter for a Horizontal Fixed Roof Tank**  
(From Supplement E of AP-42)

**FGT Station 18**  
**Gasoline Tank No. 1**

**Tank Measurements**

Length of Tank (ft) - L	12
Actual Diameter of Tank (ft) - D	2

**Calculated Values**

Effective Tank Diameter (ft) - Deff	5.5
Vapor Space Outage (ft) - Hvo	1

**Equations:**

$Deff = \text{SQRT}(L \cdot D / 0.785)$	Equation 1-5 of Chapter 12
$Hvo = D / 2$	Equation 1-6 of Chapter 12



## FIXED ROOF TANK VOLATILE ORGANIC COMPOUND EMISSIONS (Rev. 6/90)

(C) COPYRIGHT 1990, PHOENIX ENGINEERING, INC.

CLIENT: Florida Gas Transmission

DATE: 05/18/93

LOCATION: Station 18

JOB NO:

CALCULATED USING AP-42, FOURTH EDITION SEP. 85, EQUATIONS 4.3-(1)&amp;(2)

## TANK PHYSICAL DATA

TANK IDENTIFICATION NUMBER	Kerosene Tank 1	
EMISSION CONTROLS	None	
PERCENT EFFICIENCY		0 %
TANK PAINT COLOR	White	
TANK DIAMETER (FT), D		3.9
TANK HEIGHT (FT), H		2.0
PAINT FACTOR, FsubP		1.00
TANK CAPACITY (BBLs), VB		3.35
TANK CAPACITY (GALLONS), V		140
ADJUSTMENT FACTOR FOR DIA., C		0.20

## WEATHER DATA

Orlando

AVG. DAILY TEMP. CHANGE (DEG F), DeltaT	20.0
STORAGE TEMP. (DEG. F)	72.4
AVG. ATM. PRESS. (PSIA), PsubA	14.7

## PRODUCT PHYSICAL DATA

Kerosene

MATERIAL STORED	Kerosene	
MOLECULAR WEIGHT (#/#MOLE) MsubV		130.00
VAPOR PRESS. AT STG. TEMP. (DEG. F), P		0.0120
PRODUCT FACTOR, KsubC (CRUDE 0.65, OTHER 1.0)		1.00

## THROUGHPUT DATA

DAYS IN SERVICE, DsubS	365
VAPOR SPACE HEIGHT (FT), VH	1.00
TANK THROUGHPUT (BBLs FOR DAYS IN SERVICE), TT	4.8
FILLING RATE (BBLs/HR), FR	28.6
NUMBER OF TURNS FOR DAYS IN SERVICE, N	1.4
TURNOVER FACTOR, KsubN	1.00

## FIXED ROOF TANK BREATHING LOSS, # LsubB =

$$2.26 \times 10^{-2} * (M_{subV}) * (P / (P_{subA} - P)) \text{ EXP } 0.68 * (D) \text{ EXP } 1.73 * (VH) \text{ EXP } 0.51 * (\Delta T) \text{ EXP } 0.5 * (F_{subP}) * (C) * (K_{subC}) * D_{subS} / 365 * (100 - \% \text{eff}) / 100$$

## FIXED ROOF TANK WORKING LOSS, # LsubW =

$$2.4 \text{ EXP } -05 * M_{subV} * P * V * N * K_{subN} * K_{subC} * (100 - \% \text{eff}) / 100$$

VOLATILE ORGANIC COMPOUND LOSSES	BREATHING	WORKING	TOTAL
POUNDS FOR DAYS SERVICE =	0	0	0
TONS FOR DAYS SERVICE =	0.00	0.00	0.00
ANNUALIZED POUNDS =	0	0	0
ANNUALIZED TONS =	0.00	0.00	0.00
POUND/HR (AVG) =	0.00	0.00	0.00
MAXIMUM EMISSION RATE (#/HR) =			

Effective Diameter for a Horizontal Fixed Roof Tank  
(From Supplement E of AP-42)

FGT Station 18  
Kerosene Tank No. 1

Tank Measurements

Length of Tank (ft) - L	6
Actual Diameter of Tank (ft) - D	2

Calculated Values

Effective Tank Diameter (ft) - D <sub>eff</sub>	3.9
Vapor Space Outage (ft) - H <sub>vo</sub>	1

Equations:

$$D_{eff} = \text{SQRT}(L \cdot D / 0.785) \quad \text{Equation 1-5 of Chapter 12}$$

$$H_{vo} = D/2 \quad \text{Equation 1-6 of Chapter 12}$$

## FIXED ROOF TANK VOLATILE ORGANIC COMPOUND EMISSIONS (Rev. 6/90)

(C) COPYRIGHT 1990, PHOENIX ENGINEERING, INC.

CLIENT: Florida Gas Transmission DATE: 05/18/93  
 LOCATION: Station 18 JOB NO:

CALCULATED USING AP-42, FOURTH EDITION SEP. 85, EQUATIONS 4.3-(1)&amp;(2)

## TANK PHYSICAL DATA

TANK IDENTIFICATION NUMBER	Diesel Tank No. 1	
EMISSION CONTROLS	None	
PERCENT EFFICIENCY		0 %
TANK PAINT COLOR	Silver	
TANK DIAMETER (FT), D		4.4
TANK HEIGHT (FT), H		3.0
PAINT FACTOR, FsubP		1.20
TANK CAPACITY (BBLs), VB		6.04
TANK CAPACITY (GALLONS), V		254
ADJUSTMENT FACTOR FOR DIA., C		0.10

## WEATHER DATA

AVG. DAILY TEMP. CHANGE (DEG F), DeltaT	Orlando	20.0
STORAGE TEMP. (DEG. F)		74.9
AVG. ATM. PRESS. (PSIA), PsubA		14.7

## PRODUCT PHYSICAL DATA

MATERIAL STORED	Diesel	
MOLECULAR WEIGHT (#/#MOLE) MsubV		130.00
VAPOR PRESS. AT STG. TEMP. (DEG. F), P		0.0090
PRODUCT FACTOR, KsubC (CRUDE 0.65, OTHER 1.0)		1.00

## THROUGHPUT DATA

DAYS IN SERVICE, DsubS		365
VAPOR SPACE HEIGHT (FT), VH		1.50
TANK THROUGHPUT (BBLs FOR DAYS IN SERVICE), TT		19.0
FILLING RATE (BBLs/HR), FR		28.6
NUMBER OF TURNS FOR DAYS IN SERVICE, N		3.1
TURNOVER FACTOR, KsubN		1.00

FIXED ROOF TANK BREATHING LOSS, # LsubB =

$$2.26 \times 10^{-2} * (M_{subV}) * (P / (P_{subA} - P)) \text{ EXP } 0.68 * (D) \text{ EXP } 1.73 * (VH) \text{ EXP } 0.51 * (\Delta T) \text{ EXP } 0.5 * (F_{subP}) * (C) * (K_{subC}) * D_{subS} / 365 * (100 - \% \text{eff}) / 100$$

FIXED ROOF TANK WORKING LOSS, # LsubW =

$$2.4 \text{ EXP} -05 * M_{subV} * P * V * N * K_{subN} * K_{subC} * (100 - \% \text{eff}) / 100$$

VOLATILE ORGANIC COMPOUND LOSSES	BREATHING	WORKING	TOTAL
POUNDS FOR DAYS SERVICE =	0	0	0
TONS FOR DAYS SERVICE =	0.00	0.00	0.00
ANNUALIZED POUNDS =	0	0	0
ANNUALIZED TONS =	0.00	0.00	0.00
POUND/HR (AVG) =	0.00	0.00	0.00
MAXIMUM EMISSION RATE (#/HR) =			

Effective Diameter for a Horizontal Fixed Roof Tank  
(From Supplement E of AP-42)

FGT Station 18  
Diesel Tank No. 1

Tank Measurements

Length of Tank (ft) - L	5
Actual Diameter of Tank (ft) - D	3

Calculated Values

Effective Tank Diameter (ft) - Deff	4.4
Vapor Space Outage (ft) - Hvo	1.5

Equations:

$Deff = \text{SQRT}(L \cdot D / 0.785)$	Equation 1-5 of Chapter 12
$Hvo = D / 2$	Equation 1-6 of Chapter 12

FIXED ROOF TANK VOLATILE ORGANIC COMPOUND EMISSIONS (Rev. 6/90)

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CLIENT: Florida Gas Transmission

DATE: 05/18/93

LOCATION: Station 18

JOB NO:

CALCULATED USING AP-42, FOURTH EDITION SEP. 85, EQUATIONS 4.3-(1)&(2)

TANK PHYSICAL DATA

TANK IDENTIFICATION NUMBER	Diesel Tank No. 2	
EMISSION CONTROLS	None	
PERCENT EFFICIENCY		0 %
TANK PAINT COLOR	Silver	
TANK DIAMETER (FT), D		5.2
TANK HEIGHT (FT), H		2.5
PAINT FACTOR, FsubP		1.20
TANK CAPACITY (BBLs), VB		7.20
TANK CAPACITY (GALLONS), V		303
ADJUSTMENT FACTOR FOR DIA., C		0.27

WEATHER DATA

Orlando

AVG. DAILY TEMP. CHANGE (DEG F), DeltaT	20.0
STORAGE TEMP. (DEG. F)	74.9
AVG. ATM. PRESS. (PSIA), PsubA	14.7

PRODUCT PHYSICAL DATA

MATERIAL STORED	Diesel	
MOLECULAR WEIGHT (#/#MOLE) MsubV		130.00
VAPOR PRESS. AT STG. TEMP. (DEG. F), P		0.0090
PRODUCT FACTOR, KsubC (CRUDE 0.65, OTHER 1.0)		1.00

THROUGHPUT DATA

DAYS IN SERVICE, DsubS	365
VAPOR SPACE HEIGHT (FT), VH	1.25
TANK THROUGHPUT (BBLs FOR DAYS IN SERVICE), TT	19.0
FILLING RATE (BBLs/HR), FR	28.6
NUMBER OF TURNOVERS FOR DAYS IN SERVICE, N	2.6
TURNOVER FACTOR, KsubN	1.00

FIXED ROOF TANK BREATHING LOSS, # LsubB =

$$2.26 \times 10^{-2} * (MsubV) * (P / (PsubA - P)) \text{ EXP } 0.68 * (D) \text{ EXP } 1.73 * (VH) \text{ EXP } 0.51 * (\text{DeltaT}) \text{ EXP } 0.5 * (FsubP) * (C) * (KsubC) * DsubS / 365 * (100 - \%eff) / 100$$

FIXED ROOF TANK WORKING LOSS, # LsubW =

$$2.4 \text{ EXP } -05 * MsubV * P * V * N * KsubN * KsubC * (100 - \%eff) / 100$$

VOLATILE ORGANIC COMPOUND LOSSES	BREATHING	WORKING	TOTAL
POUNDS FOR DAYS SERVICE =	1	0	1
TONS FOR DAYS SERVICE =	0.00	0.00	0.00
ANNUALIZED POUNDS =	1	0	1
ANNUALIZED TONS =	0.00	0.00	0.00
POUND/HR (AVG) =	0.00	0.00	0.00
MAXIMUM EMISSION RATE (#/HR) =			

**Calculation of annual HC emissions from blowdowns  
(for a typical station)**

unmetered gas released (due to blowdowns)	300 Mscf/mo.
unmetered gas released (due to blowdowns)	3.6 MMscf/yr.
unmetered gas released (due to blowdowns) (@21.98 scf/lb)	0.16 MMlb/yr.
unmetered gas released (due to blowdowns) (@21.98 scf/lb)	81.89 TPY
VOCs released (due to blowdowns) (@2% VOCs)	1.64 TPY

Effective Diameter for a Horizontal Fixed Roof Tank  
(From Supplement E of AP-42)

FGT Station 18  
Diesel Tank No. 2

**Tank Measurements**

Length of Tank (ft) - L	8.6
Actual Diameter of Tank (ft) - D	2.5

**Calculated Values**

Effective Tank Diameter (ft) - D <sub>eff</sub>	5.2
Vapor Space Outage (ft) - H <sub>vo</sub>	1.25

**Equations:**

$D_{eff} = \text{SQRT}(L \cdot D / 0.785)$	Equation 1-5 of Chapter 12
$H_{vo} = D / 2$	Equation 1-6 of Chapter 12

## BLOWDOWNS

Estimated number of blowdowns (in a year with the most blowdowns):

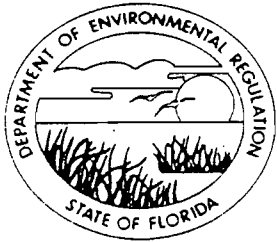
ESD/Station Blowdowns: 0

Maintenance (Compressor ) Blowdowns: 180

## Stack/Vent Measurements:

	<u>ESD/Station Vent</u>	<u>Maintenance/Compressor Vent</u>
Number of vents	<u>2</u>	<u>1</u>
Height of vent above the ground	<u>13<math>\frac{1}{2}</math> ft</u>	<u>10 ft</u>
Diameter of vent at exit to atmosphere	<u>7 ft</u>	<u>10 ft</u>





# Florida Department of Environmental Regulation

Central District • 3319 Maguire Boulevard, Suite 232 • Orlando, Florida 32803-3767

Lawton Chiles, Governor

~~Carol M. Browner, Secretary~~

## COMPLETENESS SUMMARY AIR POLLUTION SOURCES

SOURCE NAME: Station 18 (AC48-189456)      DATE RECEIVED: 6/1/93  
                   Station 17 (AC42-189455)  
                   Station 19 (AC05-189665)

NAME: Alan Weatherford, Compliance      DATE REVIEWED: 6/9/92  
        Environmentalist

ADDRESS: Florida Gas Transmission Co.  
            P.O. Box 945100      REVIEWED BY: John Turner  
            Maitland, Fl 32794-5100            (AO48-232110)  
    (AO42-232109)  
    (AO05-232111)

Your application for a permit to operate this referenced project has been received and reviewed for completeness. The following items are needed from your professional engineer to complete your application.

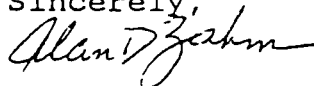
1. Submit the heat input rates (MMBTU/hr) during the compliance testing. If any permit limit is exceeded, submit evidence the construction permit has been modified such that compliance is shown. Copy Mr. Preston Lewis, DER Tallahassee, on the application package and advise him of any change in engine size, heat input rate, potential emissions or other factor.
2. Submit page two of the revised construction application signed by the professional engineer.

Pursuant to Section 120.60(2) F.S., the Department may deny an application if the applicant, after receiving timely notice fails to correct errors, omissions or supply additional information within a reasonable period of time.

Florida Gas Transmission Co.  
Page Two

If you have any questions, please call John Turner at 407/894-7555  
or write to the above address.


Sincerely,



Alan D. Zahm, P.E.  
Supervisor, Permitting  
Air Resources Management

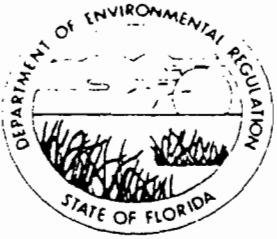
10 June 1993

Date

AZ/jt 

cc: Barry Andrews, P.E.  
Preston Lewis, P.E.

DER Form 17-1.202(2)



# Florida Department of Environmental Regulation

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

Lawton Chiles, Governor

Carol M. Browner, Secretary

February 12, 1993

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Alan Weatherford  
Compliance Environmentalist  
Florida Gas Transmission Company  
P.O. Box 945100  
Maitland, Florida 32794-5100

Dear Mr. Weatherford:

Re: Permits AC57-188869, AC67-189220, AC20-189438, AC62-189439,  
AC04-189454, AC42-189455, AC48-189456, AC05-189665 and  
AC56-189457; Permit Amendment Request

The Department is in receipt of your letter dated January 18, 1993, requesting an amendment of the specific condition regarding test method for measuring VOC emissions for each one of the above referenced permits. The Department has reviewed your request and has determined to change Specific Condition No. 10 for each one of the permits as follows:

Specific Condition No. 10:

FROM: Initial compliance with the volatile organic compound emission (VOC) limits will be demonstrated by EPA Method 25, thereafter, compliance with the VOC emission limits will be assumed, provided the CO allowable emission rate is achieved.

TO: Initial compliance with the volatile organic compound emission (VOC) limits will be demonstrated by EPA Method 25A, thereafter, compliance with the VOC emission limits will be assumed, provided the CO allowable emission rate is achieved.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. Petitions filed by the permit applicant and the parties listed below must be filed within

14 days of receipt of this intent. Petitions filed by other persons must be filed within 14 days of publication of the public notice or within 14 days of their receipt of this intent, whichever first occurs. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information:

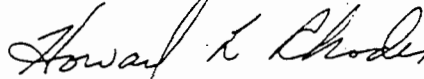
- (a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed;
- (b) A statement of how and when each petitioner received notice of the Department's action or proposed action;
- (c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action;
- (d) A statement of the material facts disputed by Petitioner, if any;
- (e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action;
- (f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and
- (g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this intent. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of receipt of this intent in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

Mr. Alan Weatherford  
Florida Gas Transmission Company  
Page 3

A copy of this letter shall be attached to the above mentioned permit and shall become a part of that permit.

Sincerely,



Howard L. Rhodes  
Director  
Division of Air Resources  
Management

HLR/TH/plm

Attachment to be Incorporated:

Mr. Alan Weatherford's letter of December 7, 1992

cc: Ed Middleswart, NWD  
Charles Collins, CD  
Isidore Goldman, SED  
Andy Kutyna, NED



## Florida Gas Transmission Company

P. O. Box 945100 Maitland, Florida 32794-5100 (407) 875-5800

Certified Mail

December 7 , 1992

Mr. Clair Fancy  
Florida Department of  
Environmental Regulation  
Twin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

Dear Mr. Fancy:

**RE: Request for Modification to Permits**

Permit No. AC57-188869  
Florida Gas Transmission Company, Station 12  
Munson, Santa Rosa County, Florida

Permit No. AC67-189220  
Florida Gas Transmission Company, Station 13  
Caryville, Washington County, Florida

Permit No. AC20-189438  
Florida Gas Transmission Company, Station 14  
Quincy, Gadsden County, Florida

Permit No. AC62-189439  
Florida Gas Transmission Company, Station 15  
Perry, Taylor County, Florida

Permit No. AC04-189454  
Florida Gas Transmission Company, Station 16  
Brooker, Bradford County, Florida

Permit No. AC42-189455  
Florida Gas Transmission Company, Station 17  
Salt Springs, Marion County, Florida

Permit No. AC48-189456  
Florida Gas Transmission Company, Station 18  
Orlando, Orange County, Florida

Permit No. AC05-189665  
Florida Gas Transmission Company, Station 19  
Melbourne, Brevard County, Florida

Permit No. AC56-189457  
Florida Gas Transmission Company, Station 20  
Ft. Pierce, St. Lucie County, Florida

RECEIVED

DEC 17 1992

An **ENRON/SONAT** Affiliate

Division of Air  
Resources Management

Mr. Clair Fancy  
Page 2 of 2  
December 7, 1992

Florida Gas Transmission Company (FGT) requests that the permits referenced above be modified as follows:

Modify Specific Condition 10 which currently reads

"Initial compliance with the volatile organic compound (VOC) emissions limits will be demonstrated by EPA Method 25, thereafter, compliance with the VOC emission limits will be assumed, provided the CO allowable emission rate is achieved."

so that it reads

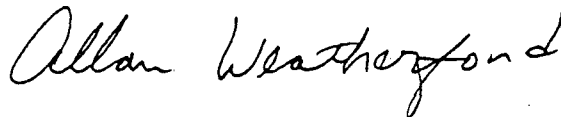
"Initial compliance with the volatile organic compound (VOC) emissions limits will be demonstrated by EPA Method 25A, thereafter, compliance with the VOC emission limits will be assumed, provided the CO allowable emission rate is achieved."

FGT has supplied your office with evidence supporting our contention that the use of Method 25 to measure VOC emissions in compressor engines is questionable. We believe the evidence supports the use of Method 25A. Mr. Barry Andrews, ENSR Consulting & Engineering, has spoken to you about this on FGT's behalf.

Since no specific test method is listed for our source (i.e. NSPS or 17-2.700), we ask that this change be made through a simple permit modification.

Please call me at 407-875-5816 if you have any questions.

Sincerely,



Allan Weatherford  
Compliance Environmentalist

bc  
awl207cf

cc: Chuck Truby  
Raymond Young  
Fred Griffin  
Barry Andrews, ENSR

*J. Wilson*  
*L. Middleton*



# Florida Department of Environmental Regulation

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

Lawton Chiles, Governor

Carol M. Browner, Secretary

May 15, 1992

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Allan Weatherford  
Compliance Environmentalist  
Florida Gas Transmission Company  
P.O. Box 945100  
Maitland, Florida 32399-2400

Dear Mr. Weatherford:

Re: Construction Permits Nos. AC 57-188869, AC 67-189220,  
AC 20-189438, AC 62-189439, AC 04-189454, AC 42-189455,  
AC 48-189456, AC 05-189665, and AC 56-189457

The Department is in receipt of your letter dated April 29, 1992, requesting the extension of the expiration dates of the above referenced permits. This request is acceptable. The expiration dates of these construction permits will be changed as follows:

FROM: June 30, 1992  
TO: June 30, 1993

This letter must be attached to the above mentioned permits and shall become a part of each permit.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. Petitions filed by the permit applicant and the parties listed below must be filed within 14 days of receipt of this intent. Petitions filed by other persons must be filed within 14 days of publication of the public notice or within 14 days of their receipt of this intent, whichever first occurs. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.




The Petition shall contain the following information:

- (a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed;
- (b) A statement of how and when each petitioner received notice of the Department's action or proposed action;
- (c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action;
- (d) A statement of the material facts disputed by Petitioner, if any;
- (e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action;
- (f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and
- (g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this intent. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of receipt of this intent in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

Sincerely,

  
for STEVE SMALLWOOD, P.E.  
Director  
Division of Air Resources Mgmt.

SS/TH/plm

Attachment to be Incorporated:

Mr. Weatherford's letter of April 29, 1992

cc: Ed Middleswart                      Andy Kutyna  
Charles Collins                        Isidore Goldman



# Florida Gas Transmission Company

P. O. Box 945100 Maitland, Florida 32794-5100 (407) 875-5800

Federal Express

RECEIVED  
DER - MAIL ROOM  
1992 APR 30 AM 10:49

April 29, 1992

Mr. Clair Fancy  
Florida Department of  
Environmental Regulation  
Bureau of Air Regulation  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

Dear Mr. Fancy:

RE: Request for Extensions of Construction Permits  
Phase II Air Permits

Permit No. AC57-188869  
Florida Gas Transmission Company, Station 12  
Munson, Santa Rosa County, Florida

Permit No. AC67-189220  
Florida Gas Transmission Company, Station 13  
Caryville, Washington County, Florida

Permit No. AC20-189438  
Florida Gas Transmission Company, Station 14  
Quincy, Gadsden County, Florida

Permit No. AC62-189439  
Florida Gas Transmission Company, Station 15  
Perry, Taylor County, Florida

Permit No. AC04-189454  
Florida Gas Transmission Company, Station 16  
Brooker, Bradford County, Florida

Permit No. AC42-189455  
Florida Gas Transmission Company, Station 17  
Salt Springs, Marion County, Florida

Permit No. AC48-189456  
Florida Gas Transmission Company, Station 18  
Orlando, Orange County, Florida

Permit No. AC05-189665  
Florida Gas Transmission Company, Station 19  
Melbourne, Brevard County, Florida

Permit No. AC56-189457  
Florida Gas Transmission Company, Station 20  
Ft. Pierce, St. Lucie County, Florida

Mr. Clair Fancy  
Page 2 of 2  
April 29, 1992

On behalf of Florida Gas Transmission Company, I respectfully request extensions of the construction permits referenced above. The permits are due to expire on June 30, 1992 and FGT needs more time to evaluate the operation and performance of the engines.

Emissions tests were done on the engines in March 1992. The test reports will be submitted to DER within the next two weeks. Preliminary results indicate that all emission limits were met.

FGT requests the expiration dates be extended to June 30, 1993. This 12-month extension will allow FGT the necessary time to thoroughly evaluate the operation of the new engines and to determine if additions or revisions to the permits are needed.

In anticipation of your approval, I've enclosed a check for \$450 to cover the permit extension fee for each of the nine stations.

Sincerely,

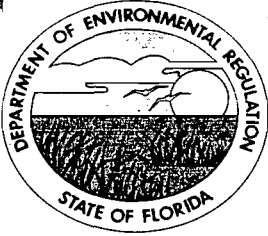


Allan Weatherford  
Compliance Environmentalist

bc  
aw0429cf

cc: Chuck Truby  
Raymond Young  
Fred Griffin  
Bill Osborne  
Glenn Sellars  
Levon Carroll  
Bob Beckham  
Don Sterba  
Duwood Mulford  
Buddy Morris  
James Dollar  
Jim Read  
Les Shadd  
Leroy Coker  
Wayne Daniels  
Riley Jackson  
Donnie Owings  
Joe Kolb  
Tom Gardiner, ENSR

*S. Nelson*



# Florida Department of Environmental Regulation

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

Lawton Chiles, Governor

Carol M. Browner, Secretary

## STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION NOTICE OF PERMIT

Mr. William R. Osborne, Project Environmentalist  
Environmental Affairs Department  
Florida Gas Transmission Company  
Post Office Box 1188  
Houston, Texas 77251-1188

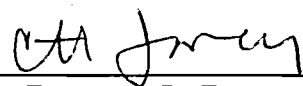
May 9, 1991

Enclosed is construction permit AC 48-189456 (PSD-FL-163) to install one natural gas-fired engine at the Florida Gas Transmission facility in Orange County, Florida. This permit is issued pursuant to Section 403, Florida Statutes.

Any party to this permit has the right to seek judicial review of the permit pursuant to Section 120.68, Florida Statutes, by the filing of a Notice of Appeal pursuant to Rule 9.110, Florida Rules of Appellate Procedure, with the Clerk of the Department in the Office of General Counsel, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400; and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date this permit is filed with the Clerk of the Department.

Executed in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT  
OF ENVIRONMENTAL REGULATION

  
\_\_\_\_\_  
C. H. Fancy, P.E.  
Chief  
Bureau of Air Regulation

Copy furnished to:

C. Collins, CD  
D. Buff, P.E.  
B. Beals, U.S. EPA  
D. Nester, Orange County

CERTIFICATE OF SERVICE

The undersigned duly designated deputy clerk hereby certifies that this NOTICE OF PERMIT and all copies were mailed before the close of buisness on 5-10-91.

FILING AND ACKNOWLEDGEMENT  
FILED, on this date, pursuant to  
§120.52(9), Florida Statutes, with  
the designated Department Clerk,  
receipt of which is hereby  
acknowledged.

Kyra Deber  
Clerk

5-10-91  
Date

Final Determination

Florida Gas Transmission Company  
Orange County, Florida

Natural Gas Engine  
AC 48-189456  
PSD-FL-163

Department of Environmental Regulation  
Division of Air Resources Management  
Bureau of Air Regulation

May 9, 1991

## Final Determination

The Technical Evaluation and Preliminary Determination for the permit to construct one natural gas engine at the Florida Gas Transmission Company's facility in Orlando, Orange County, Florida, was distributed on March 15, 1991. The Notice of Intent to Issue was published in the The Orlando Sentinel on March 21, 1991. Copies of the evaluation were available for public inspection at the Department of Environmental Regulation, Bureau of Air Regulation, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400 and the Department of Environmental Regulation, Central District Office, 3319 Maguire Blvd., Suite 232, Orlando, Florida 32803-3767.

Comments were received from Mr. David Buff, P.E., from KBN Engineering and Applied Sciences, Inc. Mr. Buff requested some clarification regarding the requirement and time of the compliance tests. Also, Mr. Buff pointed out some minor typographical errors. As results of his comments, all typographical errors were corrected and an additional sentence was added to the Compliance Determination Section of each permit that reads:

### Compliance Determination:

"This source shall demonstrate compliance with its limits for each affected pollutant within 60 days after completion of construction and annually thereafter, as follows:"

The final action of the Department will be to issue construction permit No. AC 48-189456, PSD-FL-163 with the changes as requested by Mr. Buff and noted above.



# Florida Department of Environmental Regulation

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

Lawton Chiles, Governor

Carol M. Browner, Secretary

**PERMITTEE:**

Florida Gas Transmission Company  
P. O. Box 1188  
Houston, Texas 77251-1188

Permit Number: AC 48-189456  
PSD-FL-163

Expiration Date: June 30, 1992  
County: Orange  
Latitude/Longitude: 28°31'15"N  
81°29'31"W

Project: Natural Gas Compressor  
Engine (Unit No. 5)

This permit is issued under the provisions of Chapter 403, Florida Statutes, and Florida Administrative Code Chapters 17-2 and 17-4. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawings, plans, and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

For the construction of one natural gas fired engine to be located at 7990 Steer Lake Road. The UTM coordinates are Zone 17, 451.86 km East and 3154.79 km North.

The source shall be constructed in accordance with the permit application, plans, documents, amendments and drawings, except as otherwise noted in the General and Specific Conditions.

Attachments are listed below:

1. Application to Construct/Operate Air Pollution Sources  
DER Form 17-1.202(1).
2. Department's letter dated November 20, 1990.
3. KBN Engineering and Applied Services, Inc.'s letter dated  
December 17, 1990.



**PERMITTEE:**  
Florida Gas Transmission Company

**Permit Number:** AC 48-189456  
**PSD-FL-163**  
**Expiration Date:** June 30, 1992

**GENERAL CONDITIONS:**

1. The terms, conditions, requirements, limitations, and restrictions set forth in this permit are "Permit Conditions" and are binding and enforceable pursuant to Sections 403.141, 403.727, or 403.859 through 403.861, Florida Statutes. The permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violation of these conditions.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.

3. As provided in Subsections 403.087(6) and 403.722(5), Florida Statutes, the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in the permit.

4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgement of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.

6. The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit, as required by Department rules.

PERMITTEE:  
Florida Gas Transmission Company

Permit Number: AC 48-189456  
PSD-FL-163  
Expiration Date: June 30, 1992

**GENERAL CONDITIONS:**

This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at a reasonable time, access to the premises, where the permitted activity is located or conducted to:

- a. Have access to and copy any records that must be kept under the conditions of the permit;
- b. Inspect the facility, equipment, practices, or operations regulated or required under this permit; and
- c. Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:

- a. a description of and cause of non-compliance; and
- b. the period of noncompliance, including dates and times; or, if not corrected, the anticipated time the non-compliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the non-compliance.

The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source

PERMITTEE:  
Florida Gas Transmission Company

Permit Number: AC 48-189456  
PSD-FL-163  
Expiration Date: June 30, 1992

**GENERAL CONDITIONS:**

which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Sections 403.73 and 403.111, Florida Statutes. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance, provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules.

11. This permit is transferable only upon Department approval in accordance with Florida Administrative Code Rules 17-4.120 and 17-730.300, F.A.C., as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. This permit or a copy thereof shall be kept at the work site of the permitted activity.

13. This permit also constitutes:

- (x) Determination of Best Available Control Technology (BACT)
- (x) Determination of Prevention of Significant Deterioration (PSD)
- ( ) Compliance with New Source Performance Standards (NSPS)

14. The permittee shall comply with the following:

- a. Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department.
- b. The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the

PERMITTEE:  
Florida Gas Transmission Company

Permit Number: AC 48-189456  
PSD-FL-163  
Expiration Date: June 30, 1992

**GENERAL CONDITIONS:**

permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three years from the date of the sample, measurement, report, or application unless otherwise specified by Department rule.

c. Records of monitoring information shall include:

- the date, exact place, and time of sampling or measurements;
- the person responsible for performing the sampling or measurements;
- the dates analyses were performed;
- the person responsible for performing the analyses;
- the analytical techniques or methods used; and
- the results of such analyses.

15. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware that relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

**SPECIFIC CONDITIONS:**

Emission Limits

1. The maximum allowable emissions from this source shall not exceed the emission rates as follows:

<u>Pollutant</u>	<u>lbs/hr</u>	<u>tons/yr</u>	<u>Emission Factor</u>
Nitrogen Oxides	10.6	46.3	2.0 g/bhp-hr
Carbon Monoxide	11.1	48.7	2.1 g/bhp-hr
Volatile Organic Compounds (non-methane)	2.6	11.6	0.5 g/bhp-hr
Particulate Matter (TSP)	0.08	0.4	5 lbs/MMscf
Particulate Matter (PM <sub>10</sub> )	0.08	0.4	5 lbs/MMscf
Sulfur Dioxide	0.476	2.2	10 gr/100scf

2. Visible emissions shall not exceed 10% opacity.

PERMITTEE:  
Florida Gas Transmission Company

Permit Number: AC 48-189456  
PSD-FL-163  
Expiration Date: June 30, 1992

**SPECIFIC CONDITIONS:**

Operating Rates

3. This source is allowed to operate continuously (8760 hours per year).

4. This source is allowed to burn natural gas only.

5. The permitted operating parameters and utilization rates for this natural gas compressor engine shall not exceed the values stated in the application. The parameters include, but are not limited to:

- Maximum natural gas consumption shall not exceed 16,311 scf/hr.
- Maximum heat input shall not exceed 16.80 MMBtu/hr.

6. Any change in the method of operation, equipment or operating hours shall be submitted to the DER's Bureau of Air Regulation and Central District offices.

7. Any other operating parameters established during compliance testing and/or inspection that will ensure the proper operation of this facility shall be included in the operating permit.

Compliance Determination

8. Compliance with the NO<sub>x</sub>, SO<sub>2</sub>, CO, VE, and VOC standards shall be determined by the following reference methods as described in 40 CFR 60, Appendix A (July 1, 1988) and adopted by reference in F.A.C. Rule 17-2.700.

- Method 1. Sample and Velocity Traverses
- Method 2. Volumetric Flow Rate
- Method 3. Gas Analysis
- Method 7E. Determination of Nitrogen Oxides Emissions from Stationary Sources
- Method 9. Determination of the Opacity of the Emissions from Stationary Sources
- Method 10. Determination of the Carbon Monoxide Emission from Stationary Sources
- Method 25. Determination of Total Gaseous Nonmethane Organic Emissions as Carbon

9. Compliance with the SO<sub>2</sub> emission limit can be determined by calculations based on fuel analysis using ASTM D1072-80, D3031-81, D4084-82, or D3246-81 for sulfur content of gaseous fuels.

PERMITTEE:  
Florida Gas Transmission Company

Permit Number: AC 48-189456  
PSD-FL-163  
Expiration Date: June 30, 1992

**SPECIFIC CONDITIONS:**

10. Initial compliance with the volatile organic compound (VOC) emissions limits will be demonstrated by EPA Method 25, thereafter, compliance with the VOC emission limits will be assumed, provided the CO allowable emission rate is achieved.

11. Test results will be the average of 3 valid runs. The Central District office will be notified at least 15 days in advance of the compliance test. The source shall operate between 90% and 100% of permitted capacity during the compliance test. Compliance test results shall be submitted to the Central District office no later than 45 days after completion.

Rule Requirements

12. This source shall comply with all applicable provisions of Chapter 403, Florida Statutes and Chapters 17-2 and 17-4, Florida Administrative Code.

13. Issuance of this permit does not relieve the facility owner or operator from compliance with any applicable federal, state, or local permitting requirements and regulations (F.A.C. Rule 17-2.210(1)).

14. This source shall comply with F.A.C. Rule 17-2.700, Stationary Point Source Emission Test Procedures.

15. Pursuant to F.A.C. Rule 17-2.210(2), Air Operating Permits, the permittee is required to submit annual reports on the actual operating rates and emissions from this facility. These reports shall include, but are not limited to the following: fuel usage, hours of operation, air to fuel ratio, air emissions limits, stack test results, etc. Annual reports shall be sent to the Department's Central District office.

16. The permittee, for good cause, may request that this construction permit be extended. Such a request shall be submitted to the Bureau of Air Regulation prior to 60 days before the expiration of the permit (F.A.C. Rule 17-4.090).

17. An application for an operation permit must be submitted to the Central District office at least 90 days prior to the expiration date of this construction permit or within 45 days after completion of compliance testing, whichever occurs first. To properly apply

PERMITTEE:  
Florida Gas Transmission Company

Permit Number: AC 48-189456  
PSD-FL-163  
Expiration Date: June 30, 1992

**SPECIFIC CONDITIONS:**

for an operation permit, the applicant shall submit the appropriate application form, fee, certification that construction was completed noting any deviations from the conditions in the construction permit, and compliance test reports as required by this permit (F.A.C. Rule 17-4.220).

Issued this \_\_\_\_\_ day  
of \_\_\_\_\_, 1991

STATE OF FLORIDA DEPARTMENT  
OF ENVIRONMENTAL REGULATION

---

Carol M. Browner, Secretary

Best Available Control Technology (BACT) Determination  
Florida Gas Transmission Company  
Orange County

The applicant proposes to expand its existing natural gas pipeline compressor station No. 18 in Orlando, Orange County, Florida. The proposed expansion consists of adding one new 2,400 brake horsepower (BHP) natural-gas-fired, reciprocating internal combustion engine.

The applicant has indicated the maximum total annual tonnage of regulated air pollutants emitted from the compressor engine based on 8,760 hrs/year operation to be as follows:

<u>Pollutant</u>	<u>Max. Net Increase in Emissions (TPY)</u>	<u>PSD Significant Emission Rate (TPY)</u>
NOx	46.3	40
SO <sub>2</sub>	2.04	40
PM/PM <sub>10</sub>	0.36	25/15
CO	48.7	100
VOC	11.6	40

Rule 17-2.500(2)(f)(3) of the Florida Administrative Code (F.A.C.) requires a BACT review for all regulated pollutants emitted in an amount equal to or greater than the significant emission rates listed in the previous table.

BACT Determination Requested by the Applicant

The BACT Determination requested by the applicant is given below:

<u>Pollutant</u>	<u>Determination</u>
NOx	2.0 g/bhp-hr

Date of Receipt of a BACT Application

December 18, 1990

Review Group Members

This determination was based upon comments received from the applicant and the Permitting and Standards Section.



BACT Determination Procedure

In accordance with Florida Administrative Code Chapter 17-2, Air Pollution, this BACT determination is 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. In addition, the regulations state that in making the BACT determination the Department shall give consideration to:

- (a) Any Environmental Protection Agency determination of Best Available Control Technology pursuant to Section 169, and any emission limitation contained in 40 CFR Part 60 (Standards of Performance for New Stationary Sources) or 40 CFR Part 61 (National Emission Standards for Hazardous Air Pollutants).
- (b) All scientific, engineering, and technical material and other information available to the Department.
- (c) The emission limiting standards or BACT determinations of any other state.
- (d) The social and economic impact of the application of such technology.

The EPA currently stresses that BACT should be determined using the "top-down" approach. The first step in this approach is to determine the most stringent control available for a similar or identical source or source category. If it is shown that this level of control is technically or economically infeasible for the source in question, then the next most stringent level of control is determined and similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by any substantial or unique technical, environmental, or economic objections.

BACT Analysis

A review of previous BACT determinations and control measures utilized for natural gas compressor engines indicates that in general the nitrogen oxides emission rate proposed by the applicant is representative of BACT. BACT for nitrogen oxides has been established for reciprocating engines based on the following techniques:

BACT  
Florida Gas Transmission  
Orange County - Page 3

- o engine modifications, and
- o add-on control technology

A review of the BACT/LAER Clearinghouse does not indicate the use of engine modifications on natural gas fired engines as representing BACT. A few engines have, however, been required to use selective catalytic reduction.

Selective catalytic reduction is a post-combustion method for control of NOx emissions. The SCR process combines vaporized ammonia with NOx in the presence of a catalyst to form nitrogen and water. The vaporized ammonia is injected into the exhaust gases prior to passage through the catalyst bed. The SCR process can achieve up to 90% reduction of NOx with a new catalyst. As the catalyst ages, the maximum NOx reduction will decrease to approximately 86 percent.

Given the applicant's proposed BACT level for nitrogen oxides control stated above, an evaluation can be made of the cost and associated benefit of using SCR as follows:

The applicant has indicated that the total levelized annual cost (operating plus amortized capital cost) to install SCR at 100 percent capacity factor is \$406,225. Taking into consideration the total levelized annual cost, a cost/benefit analysis of using SCR can now be developed.

Based on the information supplied by the applicant, it is estimated that the maximum annual NOx emissions with the proposed compressor engines will be 46.3 tons/year. Assuming that SCR would reduce NOx emissions by an additional 80%, the SCR would control 37 tons of NOx annually. When this reduction is taken into consideration with the total levelized annual cost of \$406,225, the cost per ton of controlling NOx is \$10,979. This cost (\$10,979/ton) is not representative of costs that have been previously justified as BACT and is judged to be cost prohibitive for this facility.

In addition to evaluating the use of SCR, the applicant has examined the energy and economic impacts of using nonselective catalytic reduction, air-to-fuel ratio changes, ignition timing retardation, derating, and exhaust gas recirculation. In each case these alternatives resulted in emissions that were essentially equivalent to that proposed or provided little benefit for the associated expense. As this is the case, none of these control strategies will be elaborated upon in this determination.

BACT  
Florida Gas Transmission Company  
Orange County-Page 4

Environmental Impact Analysis

The predominant environmental impacts would be related to the use of SCR. The use of SCR could result in accidental spills, emissions of ammonia, and the handling of spent catalyst which is sometimes classified as hazardous waste. Other control techniques such as ignition timing retardation and power derating result in increases of carbon monoxide and hydrocarbons which reduce the gains provided by controlling nitrogen oxides.

In addition to nitrogen oxides, the impacts of toxic pollutants associated with the combustion of natural gas have been evaluated. These toxics (formaldehyde and polycyclic organic matter) common to the combustion of natural gas, are expected to be emitted in minimal amounts and will not have an impact on air quality or this BACT analysis.

BACT Determination by DER

Based on the information presented by the applicant and the studies conducted, the Department believes that the compressor engine proposed by the applicant satisfies the BACT requirement for nitrogen oxides. Although engine modifications and add-on control (SCR) could be used to provide additional control, the benefits that would be obtained do not warrant the cost. The emission limit for the compressor engine is thereby established as follows:

<u>Pollutant</u>	<u>Emission Limit</u>
NOx	2.0 grams/bhp-hr

Details of the Analysis May be Obtained by Contacting:

Barry Andrews, P.E., BACT Coordinator  
Department of Environmental Regulation  
Bureau of Air Regulation  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

Recommended by:

Approved by:

\_\_\_\_\_  
C. H. Fancy, P.E., Chief  
Bureau of Air Regulation

\_\_\_\_\_  
Carol M. Browner, Secretary  
Dept. of Environmental Regulation

\_\_\_\_\_  
Date 1991

\_\_\_\_\_  
Date 1991

File Copy

DM  
4-2-91  
Gainesville, FL



April 2, 1991

Mr. C. H. Fancy, P.E.  
Chief, Bureau of Air Regulation  
Florida Department of Environmental Regulation  
2600 Blair Stone Road  
Tallahassee, FL 32399-2400

RECEIVED  
APR 3 1991  
DER - BAQM

Re: AC 48-189456; PSD-FL-163  
Florida Gas Transmission Co.  
Station 18, Unit No. 5  
Orange County; Orlando, Florida

Dear Mr. Fancy:

On behalf of Florida Gas Transmission Co. (FGTC), KBN has reviewed the Technical Evaluation and Preliminary Determination (TE&PD) and the draft construction permit for the above referenced PSD permit application. Based on this review, I offer the following comments for your consideration.

In the draft construction permit, under Compliance Determination, it is not specifically stated what initial compliance tests will be required, or when such tests must be conducted.

Thank you for consideration of these comments.

Sincerely,

*David A. Buff*  
David A. Buff, M.E., P.E.  
Principal Engineer

cc: Bill Osborne  
Jim Alves  
Teresa Heron  
BA/CHF  
Chuck Collins, CO

} 4-4-91 BSN

**KBN ENGINEERING AND APPLIED SCIENCES, INC.**  
1034 Northwest 57th Street Gainesville, Florida 32605 904/331-9000 FAX: 904/332-4189



# Florida Gas Transmission Company

P. O. Box 945100 Maitland, Florida 32794-5100 (407) 875-5800

Certified Mail

April 01, 1991

Mr. Barry Andrews  
Florida Department of Environmental Regulation  
Division of Air Resources Management  
Bureau of Air Regulation  
Twin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Fl 32399-2400

Dear Mr. Andrews:

Re: Intent to Issue Permit  
Proof of Publication - Air Permit  
Florida Gas Transmission Company  
Compressor Station 18, Orlando, Fl

I hereby submit one (1) affidavit as proof of publication of the intent issue notice for the site referenced above.

Sincerely,

Allan Weatherford  
Compliance Environmentalist

RECEIVED  
APR 4 1991  
DER-BAQM

AW:kb  
letter.38

cc: Chuck Truby  
Raymond Young  
Bob Beckham  
Wayne Daniels  
Joe Kolb  
Bill Osborne  
E. Andersen Olson  
Teresa Heron }  
Chuck Collins, CO } 4-5-91 RAL

**The Orlando Sentinel**

Published Daily  
Orlando, Orange County, Florida

State of Florida } ss.  
COUNTY OF ORANGE }

Before the undersigned authority personally appeared \_\_\_\_\_

Noemi R. Lucero, who on oath says that

she is the Legal Advertising Representative of the Orlando Sentinel, a Daily newspaper published at Orlando, in Orange County, Florida; that the attached copy of advertisement, being a intent to issue in the matter of ONE NATURAL GAS FIRED ENGINE

\_\_\_\_\_ in the \_\_\_\_\_ Court, was published in said newspaper in the issues of \_\_\_\_\_  
March 21, 1991

Affiant further says that the said Orlando Sentinel is a newspaper published at Orlando, in said Orange County, Florida, and that the said newspaper has heretofore been continuously published in said Orange County, Florida, each Week Day and has been entered as second-class mail matter at the post office in Orlando, in said Orange County, Florida for a period of one year next preceding the first publication of the attached copy of advertisement; and affiant further says that he/she has neither paid nor promised any person, firm or corporation any discount, rebate, commission or refund for the purpose of securing this advertisement for publication in the said newspaper.

*Noemi R. Lucero*

Sworn to and subscribed before me this 21st day

of March A.D., 1991



*[Signature]*  
\_\_\_\_\_  
Notary Public

Notary Public:  
State of Florida at Large  
My Commission Expires:  
June 18, 1994

FORM NO. AD-262

RECEIVED

APR 4 - 1991

ADVERTISING CHARGE \$173.20

DER - BAQM

State of Florida  
Department of Environmental  
Regulation

Notice of Intent to Issue  
The Department of Environmental Regulation hereby gives notice of its intent to issue a permit to Florida Gas Transmission Company, P.O. Box 1188, Houston, Texas 77251-1188, to install one natural gas fired engine. The Company's facility is located at 7990 Steer Lake Road, Orlando, Orange County, Florida. The maximum annual NO<sub>2</sub> Class II increment consumed is 4.0%. A determination of Best Available Control Technology (BACT) was required. The Department is issuing this Intent to Issue for the reasons stated in the Technical Evaluation and Preliminary Determination.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within fourteen (14) days of publication of this notice. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information:

- (a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number, and the county in which the project is proposed;
- (b) A statement of how and when each petitioner received notice of the Department's action or proposed action;
- (c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action;
- (d) A statement of the material facts disputed by Petitioner, if any;
- (e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action;

(f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and

(g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this Notice. Persons whose substantial interests will be affected by any decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of publication of this notice in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

The application is available for public inspection during business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at:  
Department of Environmental Regulation  
Bureau of Air Regulation  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400  
Department of Environmental Regulation  
Central District  
3319 Maguire Blvd., Suite 232  
Orlando, Florida 32803-3767

Any person may send written comments on the proposed action to Mr. Barry Andrews at the Department's Tallahassee address. All comments mailed within 30 days of the publication of this notice will be considered in the Department's final determination. Further, a public hearing can be requested by any person. Such requests must be submitted within 30 days of this notice.  
CL-160

Mar. 21, 1991

BEST AVAILABLE COPY



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.  
ATLANTA, GEORGIA 30365

APR 9 1991

4APT-AEB

RECEIVED

APR 15 1991

DER-BAQM

Mr. Clair H. Fancy, P.E., Chief  
Bureau of Air Regulation  
Florida Department of Environmental  
Regulation  
Twin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

RE: Florida Gas Transmission Company Compressor Stations  
PSD-FL-158 Washington County  
PSD-FL-159 Gadsden County  
PSD-FL-160 Taylor County  
PSD-FL-161 Bradford County  
PSD-FL-162 Marion County  
PSD-FL-163 Orange County  
PSD-FL-164 St. Lucie County

Dear Mr. Fancy:

This is to acknowledge receipt of your preliminary determinations and draft permits for modifications to Compressor Station Nos. 13 through 18 and 20 of the above referenced source, by letters dated March 14, 1991.

The proposed projects are similar in scope in that they each consist of the addition of one reciprocating internal combustion engine to an existing compressor station. The engines proposed for the stations in Taylor and Bradford Counties will be sized at 4000 brake horsepower. The engines for the remaining five counties will be sized at 2400 brake horsepower. We have reviewed the package as requested and have no adverse comments at this time. There is however a typographical error in the draft permit for the Marion County Station. The federal permit number for this Station should be listed as PSD-FL-162.

Thank you for the opportunity to review and comment on this application. If you have any questions or comments on this package, please contact Mr. Gregg Worley of my staff at (404) 347-2904.

Sincerely yours,

Jewell A. Harper, Chief  
Air Enforcement Branch  
Air, Pesticides, and Toxics  
Management Division

cc: J. Deon



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.  
ATLANTA, GEORGIA 30365

4APT-AEB

MAY 31 1991

Mr. Clair H. Fancy, P.E., Chief  
Bureau of Air Regulation  
Florida Department of Environmental  
Regulation  
Twin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

RE: Florida Gas Transmission Company Compressor Stations  
PSD-FL-156 Santa Rosa County  
PSD-FL-158 Washington County  
PSD-FL-159 Gadsden County  
PSD-FL-160 Taylor County  
PSD-FL-161 Bradford County  
PSD-FL-162 Marion County  
PSD-FL-163 Orange County  
PSD-FL-164 St. Lucie County

RECEIVED

JUN 03 1991

Division of Air  
Resources Management

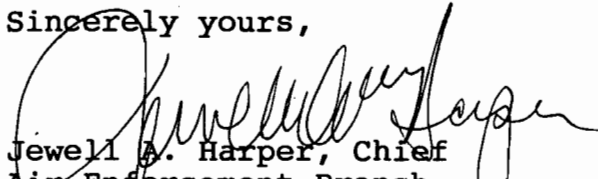
Dear Mr. Fancy:

This is to acknowledge receipt of your final determinations and permits for modifications to Compressor Station Nos. 12 through 18 and 20 of the above referenced source, by letters dated May 9, 1991.

The proposed projects are similar in scope in that they each consist of the addition of one reciprocating internal combustion engine to an existing compressor station. The engines proposed for the stations in Santa Rosa, Taylor and Bradford Counties will be sized at 4000 brake horsepower. The engines for the remaining five counties will be sized at 2400 brake horsepower. We have reviewed the packages as requested and have no adverse comments.

Thank you for the opportunity to review and comment on this application. If you have any questions or comments on this package, please contact Mr. Gregg Worley of my staff at (404) 347-2904.

Sincerely yours,

  
Jewell A. Harper, Chief  
Air Enforcement Branch  
Air, Pesticides, and Toxics  
Management Division

J. DeLeon  
CHF/BA





# Florida Department of Environmental Regulation

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

Lawton Chiles, Governor

Carol M. Browner, Secretary

March 14, 1991

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Mr. William R. Osborne, Project Environmentalist  
Environmental Affairs  
Florida Gas Transmission Company  
P. O. Box 1188  
Houston, Texas 77251-1188

Dear Mr. Osborne:

Attached is one copy of the Technical Evaluation and Preliminary Determination and proposed permit to install one natural gas fired engine.

Please submit any written comments you wish to have considered concerning the Department's proposed action to Mr. Barry Andrews of the Bureau of Air Regulation.

Sincerely,

C. H. Fancy, P.E.  
Chief  
Bureau of Air Regulation

CHF/TH/plm

Attachments

c: Charles Collins, CD  
David Buff, P.E.  
Brian Beals, U.S. EPA  
Dennis Nester, Orange Cty.

BEFORE THE STATE OF FLORIDA  
DEPARTMENT OF ENVIRONMENTAL REGULATION

In the Matter of  
Application for Permit by:

Florida Gas Transmission Company  
P. O. Box 1188  
Houston, Texas 77251-1188

DER File No. AC 48-189456  
PSD-FL-163

---

INTENT TO ISSUE

The Department of Environmental Regulation hereby gives notice of its intent to issue an air construction permit (copy attached) for the proposed project as detailed in the application specified above. The Department is issuing this Intent to Issue for the reasons stated in the attached Technical Evaluation and Preliminary Determination.

The applicant, Florida Gas Transmission Company, applied on November 20, 1990, to the Department of Environmental Regulation for a permit to install one natural gas fired engine.

The Department has permitting jurisdiction under Chapter 403, Florida Statutes, and Florida Administrative Code Chapters 17-2 and 17-4. The project is not exempt from permitting procedures. The Department has determined that an air construction permit is required for the proposed work.

Pursuant to Section 403.815, F.S. and DER Rule 17-103.150, F.A.C., you (the applicant) are required to publish at your own expense the enclosed Notice of Intent to Issue Permit. The notice shall be published one time only within 30 days, in the legal ad section of a newspaper of general circulation in the area affected. For the purpose of this rule, "publication in a newspaper of general circulation in the area affected" means publication in a newspaper meeting the requirements of Sections 50.011 and 50.031, F.S., in the county where the activity is to take place. The applicant shall provide proof of publication to the Department, at the address specified within seven days of publication. Failure to publish the notice and provide proof of publication within the allotted time may result in the denial of the permit.

The Department will issue the permit with the attached conditions unless a petition for an administrative proceeding (hearing) is filed pursuant to the provisions of Section 120.57, F.S.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. Petitions filed by the permit applicant and the parties listed below must be filed within 14 days of receipt of this intent. Petitions filed by other persons must be filed within 14 days of publication of the public notice or within 14 days of receipt of this intent, whichever first occurs. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information:

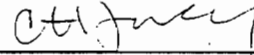
- (a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed;
- (b) A statement of how and when each petitioner received notice of the Department's action or proposed action;
- (c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action;
- (d) A statement of the material facts disputed by Petitioner, if any;
- (e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action;
- (f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and
- (g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any decision of the Department with regard to the application(s) have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of publication of this notice in the Office in General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under

Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

Executed in Tallahassee, Florida.

STATE OF FLORIDA DEPARTMENT  
OF ENVIRONMENTAL REGULATION



---

C. H. Fancy, P.E.  
Chief  
Bureau of Air Regulation

Copies furnished to:

Charles Collins, CD  
David Buff, P.E.  
Brian Beals, U.S. EPA  
Dennis Nester, Orange Cty.

State of Florida  
Department of Environmental Regulation  
Notice of Intent to Issue

The Department of Environmental Regulation hereby gives notice of its intent to issue a permit to Florida Gas Transmission Company, P. O. Box 1188, Houston, Texas 77251-1188, to install one natural gas fired engine. The Company's facility is located at 7990 Steer Lake Road, Orlando, Orange County, Florida. The maximum annual NO<sub>2</sub> Class II increment consumed is 4.0%. A determination of Best Available Control Technology (BACT) was required. The Department is issuing this Intent to Issue for the reasons stated in the Technical Evaluation and Preliminary Determination.

A person whose substantial interests are affected by the Department's proposed permitting decision may petition for an administrative proceeding (hearing) in accordance with Section 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received) in the Office of General Counsel of the Department at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within fourteen (14) days of publication of this notice. Petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. Failure to file a petition within this time period shall constitute a waiver of any right such person may have to request an administrative determination (hearing) under Section 120.57, Florida Statutes.

The Petition shall contain the following information:

(a) The name, address, and telephone number of each petitioner, the applicant's name and address, the Department Permit File Number and the county in which the project is proposed;

(b) A statement of how and when each petitioner received notice of the Department's action or proposed action;

(c) A statement of how each petitioner's substantial interests are affected by the Department's action or proposed action;

(d) A statement of the material facts disputed by Petitioner, if any;

(e) A statement of facts which petitioner contends warrant reversal or modification of the Department's action or proposed action;

(f) A statement of which rules or statutes petitioner contends require reversal or modification of the Department's action or proposed action; and

(g) A statement of the relief sought by petitioner, stating precisely the action petitioner wants the Department to take with respect to the Department's action or proposed action.

If a petition is filed, the administrative hearing process is designed to formulate agency action. Accordingly, the Department's final action may be different from the position taken by it in this Notice. Persons whose substantial interests will be affected by any

decision of the Department with regard to the application have the right to petition to become a party to the proceeding. The petition must conform to the requirements specified above and be filed (received) within 14 days of publication of this notice in the Office of General Counsel at the above address of the Department. Failure to petition within the allowed time frame constitutes a waiver of any right such person has to request a hearing under Section 120.57, F.S., and to participate as a party to this proceeding. Any subsequent intervention will only be at the approval of the presiding officer upon motion filed pursuant to Rule 28-5.207, F.A.C.

The application is available for public inspection during business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at:

Department of Environmental Regulation  
Bureau of Air Regulation  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400

Department of Environmental Regulation  
Central District  
3319 Maguire Blvd., Suite 232  
Orlando, Florida 32803-3767

Any person may send written comments on the proposed action to Mr. Barry Andrews at the Department's Tallahassee address. All comments mailed within 30 days of the publication of this notice will be considered in the Department's final determination. Further, a public hearing can be requested by any person. Such requests must be submitted within 30 days of this notice.

Technical Evaluation  
and  
Preliminary Determination

Florida Gas Transmission Company  
Orange County  
Orlando, Florida  
Station No. 18

Natural Gas Compressor Engine  
Permit No. AC 48-189456  
PSD-FL-163

Department of Environmental Regulation  
Division of Air Resources Management  
Bureau of Air Regulation

March 14, 1991

## SYNOPSIS OF APPLICATION

### I.1 Applicant Name and Address

Florida Gas Transmission Company  
P. O. Box 1188  
Houston, Texas 77251-1188

### I.2 Reviewing and Process Schedule

Date of Receipt of Application: November 20, 1990.

30 Days Completeness Review: December 18, 1990.

Additional Information Received: December 18, 1990.

Application Completeness Date: December 18, 1990.

## II. FACILITY INFORMATION

### II.1 Facility Location

Florida Gas Transmission Company's (FGTC) facility is located at 7990 Steer Lake Road in Orlando, Orange County, Florida. The UTM coordinates are Zone 17, 451.86 km E and 3154.79 km N.

### II.2 Standard Industrial Classification Code

This facility is classified as follows:

Major Group No. 49 - Electric, Gas and Sanitary Services

Group No. 492 - Gas Production and Distribution

Industry No. 4922 - Natural Gas Transmission

### II.3 Facility Category

The FGTC site, in Orlando, is classified as a major emitting facility for nitrogen oxides (NO<sub>x</sub>) and carbon monoxide (CO). The proposed project will increase NO<sub>x</sub> emissions by 46 tons per year and CO emissions by 49 tons per year. The total permitted emissions for this facility shall not exceed 896 tons NO<sub>x</sub> per year and 157 tons CO per year.

## III. PROJECT DESCRIPTION

The FGTC proposed to install one natural gas fired engine (Copper-Bessemer Model GMVR-12C2 integral engine compressor unit). The engine has 12 power cylinders and is rated at 2,400 bhp at 330 revolutions per minute (rpm). The engine is turbocharged,



increasing the air inlet manifold pressure, which allows the engine to operate at a high air-to-fuel ratio. This turbocharging produces more power output from the engine than would otherwise be attained without having to use a larger size engine. A flow diagram of the integral engine compressor unit is presented in the attached figure 2.2.

### III.1 Background Information

The FGTC existing compressor station consists of four 2,000 bhp natural gas fired reciprocating IC engines. All of the engines are Worthington Model SEHG-8 integral engine compressor units. These engines were installed before the CAA amendment of 1977: three engines were installed in 1959, and the fourth engine was installed in 1968. These existing engines are not being modified as part of this Phase II expansion project.

In general, the FGTC Phase II expansion project will be increasing the natural gas transport capacity of the existing Florida gas pipeline system. The scope of work for Phase II includes expansions by the addition of state-of-the-art compressor engines at light existing compressor stations and at a newly proposed compressor station. The proposed engines would be used solely for the purpose of transporting natural gas in the pipeline for distribution in Florida. The main gas pipeline and the approximate locations of the existing and proposed compressor stations along the main pipeline are shown in Figure 1-1.

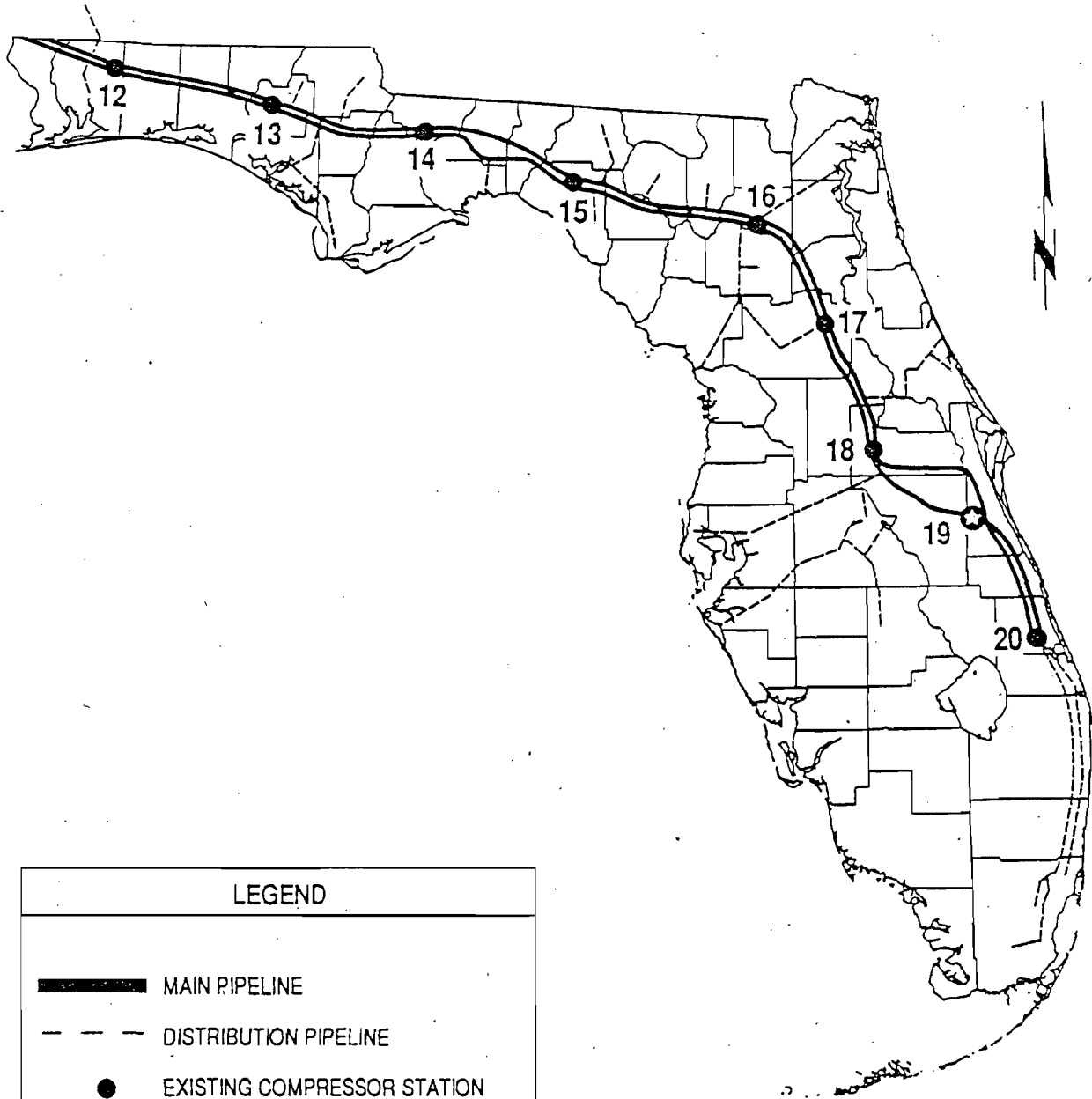
### IV. RULE APPLICABILITY

The proposed project is subject to preconstruction review under the provisions of Chapter 403, Florida Statutes, and Florida Administrative Code (F.A.C.) Chapter 17-2.

This plant is located in an area (Orange County) designated air quality maintenance for ozone pursuant to F.A.C. Rule 460 and attainment for all the other criteria pollutants in accordance with F.A.C. Rule 17-2.420.

The proposed project will be reviewed in accordance with F.A.C. Rule 17-2.500, Prevention of Significant Deterioration, because it will be a major modification to a major facility. This review consists of a determination of Best Available Control Technology (BACT) and unless otherwise exempted, an air quality impact of the increased emissions. The review also includes a review of the project's impacts on soils, vegetation, visibility and air quality impact resulting from residential and industrial growth.

The proposed facility shall comply with applicable provisions of F.A.C. Rule 17-2.700, Emission Test Procedures; F.A.C. Rule 17-2.630, Best Available Control Technology; and F.A.C. Rule 17-2.500, Prevention of Significant Deterioration.







LEGEND	
	MAIN PIPELINE
	DISTRIBUTION PIPELINE
	EXISTING COMPRESSOR STATION
	PROPOSED COMPRESSOR STATION

Figure 1-1 FGTC'S GAS TRANSMISSION SYSTEM



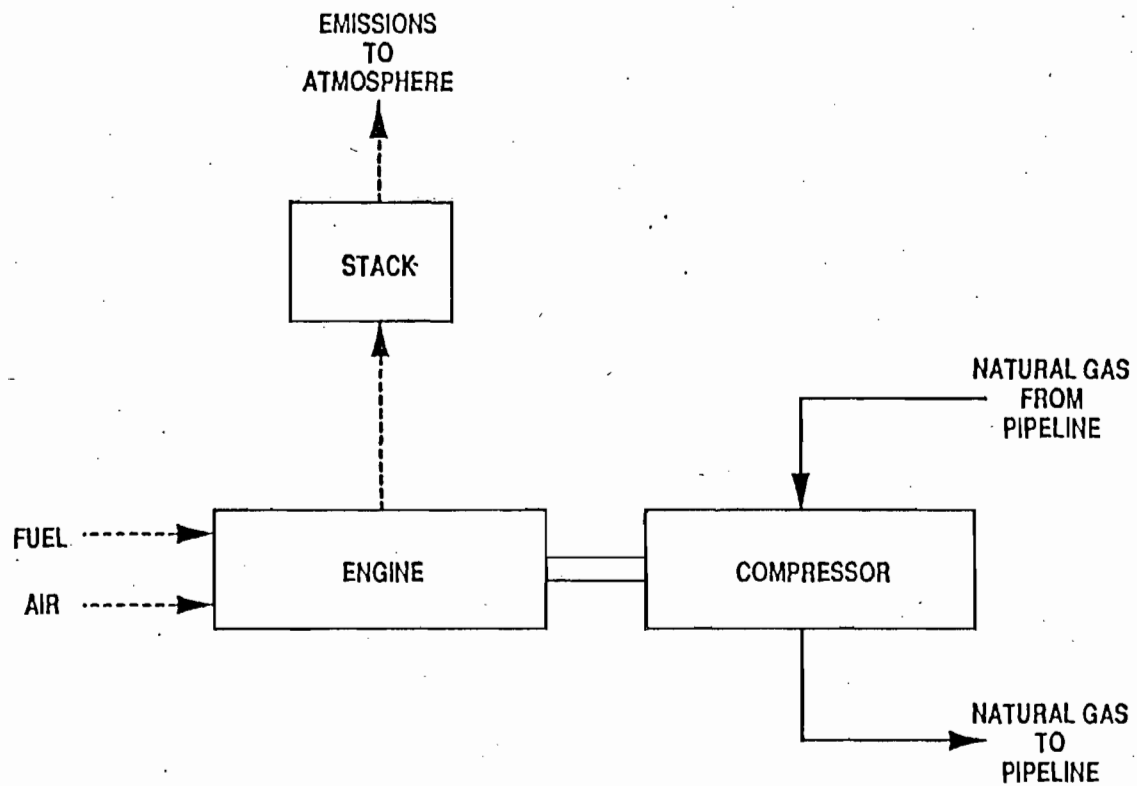


Figure 2-2 PROCESS FLOW DIAGRAM OF AN INTEGRAL ENGINE-COMPRESSOR UNIT

## V. SOURCE IMPACT ANALYSIS

### V.1 Control Technology Review

A complete BACT evaluation was submitted with the application. This evaluation included analyzing technologies involving engine modification and technologies involving exhaust gas treatment. Furthermore, the evaluation also included the feasibility of the different NO<sub>x</sub> control methods and a comparison of the technical environmental, energy and economic impacts. Based on this approach, the lean-burn engine was determined to represent BACT.

The proposed engine will incorporate "lean-burn" technology, which is state-of-the-art design for minimizing air pollutant concentration in the exhaust gases from gas-fired reciprocating IC engines. In the lean-burn design, a small, fuel-rich mixture is combusted in a preignition chamber. The hot combustion gases from the preignition then pass to the main combustion chamber, where they ignite a lean mixture of fuel. Since most of the fuel entering the engine is burned in a lean state (i.e., high ratio of air to fuel), exhaust NO<sub>x</sub> emissions are minimized. However, volatile organic compound (VOC) emissions are approximately 40 to 50 percent higher than the standard "rich-burn" engines.

### V.2 Emission Limitations

The operation of this source will produce emissions of NO<sub>x</sub>, CO, VOCs, particulates, and SO<sub>2</sub> from the burning of natural gas. Table I summarizes the proposed emissions and Table II summarizes the existing emissions from this facility.

TABLE I  
SUMMARY OF EMISSIONS  
(Unit No. 5)

Pollutant	Maximum Potential Emissions From Proposed Compressor Engine		Significant Emission Rate (TPY)
	(lbs/hr)	(TPY)	
Nitrogen Oxides	10.6	46.3	40
Carbon Monoxide	11.1	48.7	100
Volatile Organic Compounds (non-methane)	2.6	11.6	40
Particulate Matter (TSP)	0.08	0.36	25
Particulate Matter (PM <sub>10</sub> )	0.08	0.36	15
Sulfur Dioxide	0.47	2.1	40

TABLE II  
SUMMARY OF EXISTING EMISSIONS

Pollutant	Per Each Engine		Total (TPY)
	(lbs/hr)	(TPY)	
NOx	48.5	212.4	849.6
CO	6.2	27.0	108.0
VOC (non-methane)	1.9	8.5	34.0
PM	0.07	0.3	1.3
SO <sub>2</sub>	0.41	1.8	7.3

### V.3 Air Quality Analysis

#### a. Introduction

The operation of the proposed engine will result in emissions increases which are projected to be greater than the PSD significant rate for NOx. Therefore, the project is subject to the PSD review requirements contained in F.A.C. Rule 17-2.500 for NOx. Part of the requirements is an air quality impact analysis for NOx which includes:

- o An analysis of existing air quality.
- o A PSD increment analysis.
- o An Ambient Air Quality Standards (AAQS) analysis.
- o An analysis of impacts on soils, vegetation, visibility and growth-related air quality impacts.
- o A Good Engineering Practice (GEP) stack height determination.

The analysis of existing air quality generally relies on preconstruction monitoring data collected in accordance with EPA-approved methods. The PSD increment and AAQS analyses are based on air quality dispersion modeling completed in accordance with the EPA guidelines. Based on these required analyses, the Department has reasonable assurance that the proposed project, as described in this report and subject to the conditions of approval proposed herein, will not cause or contribute to a violation of any PSD increment or AAQS. A brief description of the modeling method used and results of the required analyses follow. A more complete description is contained in the permit application on file.

#### b. Analysis of the Existing Air Quality

Preconstruction ambient air quality monitoring may be required for pollutants subject to PSD review. However, an exemption to the monitoring requirement can be obtained if the maximum air quality impact resulting from the projected emissions increase, as determined through air quality modeling, is less than a pollutant-specific de minimus concentration. The predicted maximum increase for NOx is 0.99 ug/m<sup>3</sup>, annual average which is less than the de minimus concentration for NOx of 14 ug/m<sup>3</sup> annual coverage. Therefore, no preconstruction monitoring is required for NOx.

### c. Modeling Method

The EPA-approved Industrial Source Complex Long-Term (ISCLT) dispersion model was used by the applicant to predict the impact of NO<sub>x</sub> emissions from the proposed project on the surrounding ambient air. All recommended EPA default options were used. Downwash parameters were used because the proposed stack was less than the good engineering practice (GEP) stack height. Five years of surface weather observations (1982-1986) from the National Weather Service (NWS) station located at Orlando used. These data were input into the National Climatic Data Center (NCDC) stability array (STAR) preprocessor program for use as input to the ISCLT model. The STAR program converts the hourly data into the joint frequency of occurrence of wind direction, windspeed and atmospheric stability. The STAR program can produce monthly, seasonal and annual stability arrays for input into ISCLT. The highest predicted yearly impact from the proposed NO<sub>x</sub> emissions was compared with the standards.

### d. Modeling Results

The applicant evaluated the potential increase in ambient ground-level concentration associated with the project to determine if these projected ambient concentration increases would be greater than the specified PSD significant impact level for NO<sub>x</sub>. Dispersion modeling was performed with 128 receptors located on 16 radials centered on the proposed engine's stack location and at downwind differences of 100, 200, 300, 400, 500, 750, 1000, and 1250m. In addition, to account for plant boundaries in all directions, 36 discrete receptors were located along 36 radials separated by 10-degree increments. These discrete receptors were located at the nearest plant boundary in each direction. The maximum predicted annual NO<sub>2</sub> impact from this modeling was 0.99 ug/m<sup>3</sup>, which is less than the NO<sub>2</sub> significant impact level of 1 ug/m<sup>3</sup> annual average concentration. Because the maximum predicted NO<sub>2</sub> concentration is less than the significant impact level, further modeling for NO<sub>2</sub> for comparison with the AAQS and the Class II PSD increment was not required in this case.

### e. Additional Impacts Analysis

The increased emissions from the proposed project are not expected to affect the Chassahowitzka National Wilderness Area since this area is greater than 100 km from the project. Because the impacts from NO<sub>x</sub> emissions are less than the PSD significant

impact level, no harmful effects on soils and vegetation is expected. In addition, the proposed modification will not significantly change employment, population, housing or commercial/industrial development.

#### VI. CONCLUSION

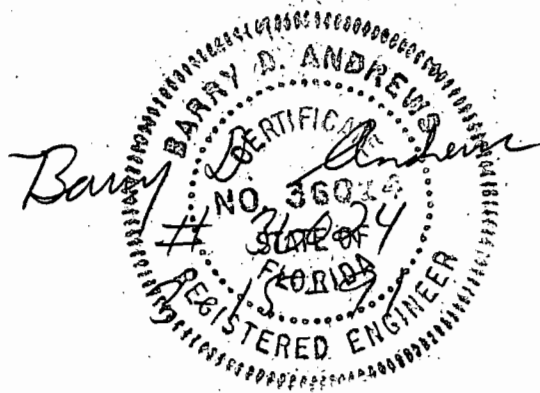
Based on the information provided by Florida Gas Transmission Company, the Department has reasonable assurance that the proposed project, as described in this evaluation, and subject to the conditions proposed herein, will not cause or contribute to a violation of any air quality standard, PSD increment, or any other technical provision of Chapter 17-2 of the Florida Administrative Code.

*Barry D. Anderson*  
# 36024  
3-15-91

impact level, no harmful effects on soils and vegetation is expected. In addition, the proposed modification will not significantly change employment, population, housing or commercial/industrial development.

VI. CONCLUSION

Based on the information provided by Florida Gas Transmission Company, the Department has reasonable assurance that the proposed project, as described in this evaluation, and subject to the conditions proposed herein, will not cause or contribute to a violation of any air quality standard, PSD increment, or any other technical provision of Chapter 17-2 of the Florida Administrative Code.





CERTIFICATE OF SERVICE

The undersigned duly designated deputy clerk hereby certifies that this NOTICE OF INTENT TO ISSUE and all copies were mailed before the close of business on 3-15-91.

FILING AND ACKNOWLEDGEMENT  
FILED, on this date, pursuant to  
§120.52(9), Florida Statutes, with  
the designated Department Clerk,  
receipt of which is hereby  
acknowledged.

Yvri Baker  
Clerk

3-15-91  
Date

HOPPING BOYD GREEN & SAMS

ATTORNEYS AND COUNSELORS

123 SOUTH CALHOUN STREET

POST OFFICE BOX 6526

TALLAHASSEE, FLORIDA 32314

(904) 222-7500

FAX (904) 224-8551

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JAMES S. ALVES  
BRIAN H. BIBEAU  
ELIZABETH C. BOWMAN  
WILLIAM L. BOYD, IV  
RICHARD S. BRIGHTMAN  
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WILLIAM D. PRESTON  
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ROBERT P. SMITH, JR.

KATHLEEN BLIZZARD  
RICHARD W. MOORE  
ANGELA R. MORRISON  
MARIBEL N. NICHOLSON  
DIANA M. PARKER  
LAURA BOYD PEARCE  
GARY V. PERKO  
MICHAEL P. PETROVICH  
DAVID L. POWELL  
DOUGLAS S. ROBERTS  
CECELIA C. SMITH  
CHERYL G. STUART  
OF COUNSEL  
W. ROBERT FOKES

January 3, 1991

**CERTIFIED MAIL**  
**RETURN RECEIPT REQUESTED**

Mr. Clair Fancy, Chief  
Bureau of Air Regulation  
Florida Department of Environmental  
Regulation  
2600 Blair Stone Road, Room 338  
Tallahassee, Florida 32399-2400

Re: Florida Gas Transmission Company  
Application for Air Operation Permit  
Compressor Station No. 18  
Orange County

Dear Clair:

As contemplated by the Consent Order entered into by DER and Florida Gas Transmission Company in OGC Case No. 90-1225, enclosed is a completed application for an air operation permit and corresponding application fee for Compressor Station No. 18 in Orange County. Also enclosed are two additional copies of the application form. As required under the Consent Order, we shall submit to the appropriate district office a copy of the application and fee voucher, as well as the signed certified mail receipt, within ten days after receiving the certified mail receipt.

Again, we sincerely appreciate DER's ongoing courtesy and cooperation in this matter.

Very truly yours,

  
James S. Alves

FlGasLtr:kkm  
Enclosures

RECEIVED  
DER - MAIL ROOM  
JAN 7 PM 12:05



December 17, 1990

RECEIVED

DEC 18 1990

DER-BAQM

Ms. Theresa Heron  
Florida Dept. of Environmental Regulation  
Twin Towers Office Bldg.  
2600 Blair Stone Road  
Tallahassee, FL 32399

RE: ENRON/FGTC Compressor Station No. 18 PSD Permit Application

Dear Ms. Heron:

As you requested, attached is the sheet of emission calculations for FGTC's Compressor Station No. 18. Please feel free to contact me at your convenience if you have further questions concerning this permit application.

Sincerely,

*David A. Buff*

David A. Buff, P.E.  
Principal Engineer

TT/tla

cc: Alan Bowman, ENRON

Attachment

*cc: J. Heron  
B. Andrews  
C. Holladay  
L. Collins, C Dist  
G. Harper, EPA*

90051A1/6

**KBN ENGINEERING AND APPLIED SCIENCES, INC.**  
1034 Northwest 57th Street Gainesville, Florida 32605 904/331-9000 FAX: 904/332-4189

EQUAL EMPLOYMENT OPPORTUNITY / AN AFFIRMATIVE ACTION EMPLOYER

**EMISSION CALCULATIONS**  
**FGTC's COMPRESSOR STATION No. 18**  
**ORANGE COUNTY, FLORIDA**

Fuel usage and emission calculations are presented below for the proposed Cooper-Bessemer Model GMVR-12C2 reciprocating IC engine at Compressor Station No. 18.

**Fuel Usage:**

$$\begin{aligned} (2,400 \text{ bhp}) \times (7,000 \text{ Btu/bhp-hr}) &= 16.80 \times 10^6 \text{ Btu/hr} \\ (16.80 \times 10^6 \text{ Btu/hr}) / (1,030 \text{ Btu/scf}) &= 16,311 \text{ scf/hr} \end{aligned}$$

**Emission Calculations:**

$$\begin{aligned} \text{NO}_x: (2.0 \text{ g/bhp-hr})(2,400 \text{ bhp})(1 \text{ lb}/453.593 \text{ g}) &= 10.582 \text{ lb/hr} \\ (10.582 \text{ lb/hr})(8,760 \text{ hr/yr})(1 \text{ ton}/2,000 \text{ lb}) &= 46.3 \text{ TPY} \end{aligned}$$

$$\begin{aligned} \text{CO: } (2.1 \text{ g/bhp-hr})(2,400 \text{ bhp})(1 \text{ lb}/453.593 \text{ g}) &= 11.111 \text{ lb/hr} \\ (11.111 \text{ lb/hr})(8,760 \text{ hr/yr})(1 \text{ ton}/2,000 \text{ lb}) &= 48.7 \text{ TPY} \end{aligned}$$

**VOCs(non-methane hydrocarbon):**

$$\begin{aligned} (0.5 \text{ g/bhp-hr})(2,400 \text{ bhp})(1 \text{ lb}/453.593 \text{ g}) &= 2.646 \text{ lb/hr} \\ (2.646 \text{ lb/hr})(8,760 \text{ hr/yr})(1 \text{ ton}/2,000 \text{ lb}) &= 11.6 \text{ TPY} \end{aligned}$$

$$\begin{aligned} \text{PM: } (5 \text{ lb}/10^6 \text{ scf})(16,311 \text{ scf/hr}) &= 0.082 \text{ lb/hr} \\ (0.082 \text{ lb/hr})(8,760 \text{ hr/yr})(1 \text{ ton}/2,000 \text{ lb}) &= 0.36 \text{ TPY} \end{aligned}$$

$$\begin{aligned} \text{SO}_2: (10 \text{ gr}/100 \text{ scf})(16,311 \text{ scf/hr})(1 \text{ lb}/7,000 \text{ gr}) &= 0.233 \text{ lb/hr of Sulfur} \\ (2 \text{ lb SO}_2/\text{lb Sulfur})(0.233 \text{ lb/hr Sulfur}) &= 0.466 \text{ lb/hr of SO}_2 \\ (0.466 \text{ lb/hr})(8,760 \text{ hr/yr})(1 \text{ ton}/2,000 \text{ lb}) &= 2.04 \text{ TPY} \end{aligned}$$



R-File

# Florida Department of Environmental Regulation

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

Bob Martinez, Governor

Dale Twachtmann, Secretary

John Shearer, Assistant Secretary

November 20, 1990

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. W. Alan Bowman  
Project Environmentalist  
Florida Gas Transmission Company  
P. O. Box 1188  
Houston, Texas 77251

Dear Mr. Bowman:

Re: Natural Gas Compressor Engine  
AC 57-188869, PSD-FL-157

The Department has reviewed your application for a permit to construct a 4000 bhp natural gas compressor engine. The engine is to be located at the Florida Gas Transmission Company site, 5 miles north of Munson, Santa Rosa County, Florida.

Based on this review, we have determined that the following information is needed:

1. Attach a derivation of the emission calculations for this source (Unit No. 12). What is the correct air to fuel ratio (60.89)? State and justify all assumptions.
2. Submit complete air construction applications and fees for each existing engine at this site.

We will resume processing your applications as soon as this information is received. If you have any questions about the data requested, please feel free to call Teresa Heron at 904-488-1344 or write to me at the above address.

Sincerely,

for C. H. Fancy, P.E.  
Chief

Bureau of Air Regulation

CHF/TH/plm

c: Jack Preece, NW Dist.  
David Buff, P.E.  
Jewell Harper, EPA



# Florida Department of Environmental Regulation

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

Bob Martinez, Governor

Dale Twachtmann, Secretary

John Shearer, Assistant Secretary

November 28, 1990

Ms. Jewell A. Harper, Chief  
Air Enforcement Branch  
U.S. EPA - Region IV  
345 Courtland Street, N.E.  
Atlanta, Georgia 30365

Dear Ms. Harper:

Re: Completeness Review

The enclosed information is being forwarded to you for completeness review.

1. Seminole Fertilizer Corp., Polk County, gas turbine cogeneration project, PSD-FL-157.
2. The following applications from Florida Gas Transmission Company:

Compressor Sta. No. 12, Santa Rosa County, PSD-FL-156  
Compressor Sta. No. 13, Washington County, PSD-FL-158  
Compressor Sta. No. 14, Gadsden County, PSD-FL-159  
Compressor Sta. No. 15, Taylor County, PSD-FL-160  
Compressor Sta. No. 16, Bradford County, PSD-FL-161  
Compressor Sta. No. 17, Marion County, PSD-FL-162  
Compressor Sta. No. 18, Orange County, PSD-FL-163  
Compressor Sta. No. 20, St. Lucie County, PSD-FL-164

If there are any questions, please call Barry Andrews at (904)488-1344 or write to me at the above address. If it is convenient to FAX a response to us, the FAX number to use is (904)922-6979.

Sincerely,

*Patricia G. Adams*

*for*  
C. H. Fancy, P.E.  
Chief

Bureau of Air Regulation

CHF/pa

**ENRON**  
**Gas Pipeline Operating Company**

RECEIVED  
DER - MAIL ROOM  
1990 NOV 20 AM 10:43

P. O. Box 1188 Houston, Texas 77251-1188 (713) 853-6161

November 17, 1990

Clair Fancy, P.E.  
Chief, Bureau of Air Regulation  
Florida Department of Environmental Regulation  
2600 Blair Stone Road  
Tallahassee, FL 32301

Dear Mr. Fancy:

RE: Construction Permit Application - Compressor Station No. 18  
Orange County, Florida - Florida Gas Transmission Company

This permit application, sent to you on behalf of Florida Gas Transmission Company (FGT), describes the expansion of FGT's Compressor Station No. 18. With net NO<sub>x</sub> emissions exceeding 40 tons per year, this addition, a 2,400 horsepower reciprocating compressor engine, constitutes a major modification. The maximum estimated NO<sub>x</sub> concentration from the proposed lean burn engine, however, is less than EPA's significant impact level.

This is the seventh of nine permit applications we plan to submit to FDER as part of FGT's Phase II expansion. We have spent a lot of time and effort to ensure that it is of highest quality. For example, the Best Available Control Technology (BACT) analysis follows EPA's (draft) top-down guideline, and capitalizes on what Enron has learned about guideline interpretation from its Northern Natural Gas Company Waterloo, Iowa station - a recently approved permit application that followed the draft guideline.

Since FGT's Phase II project is designed to bring clean fuel to Floridians by the 1991-92 heating season, and to displace foreign oil imports, we would ask that you review this permit application and issue the construction permit as soon as possible.

If you have any questions concerning this letter, please contact me at (713) 853-7303, or David Buff, KBN Engineering and Applied Sciences, Inc., Gainesville, Florida, at (904) 331-9000.

Sincerely,



W. Alan Bowman (Room 2570)  
Project Environmentalist  
Environmental Affairs Department

Enclosures: 8 Copies of Permit Application  
Construction Permit Fee

cc: Jerry Murphy, Enron  
Kevin McGlynn, Enron  
David Buff, KBN

FAN1102wab

Part of the Enron Group of Energy Companies

CHECK NO.  
0822020236

ENRON GAS PIPELINE OPERATING COMPANY  
P.O. BOX 1188  
HOUSTON, TEXAS 77251-1188

DATE OF CHECK  
10-19-90



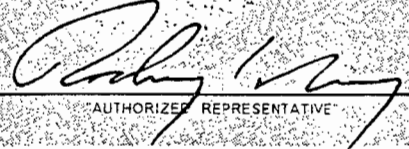
This check is VOID unless printed on BLUE background

EXACTLY \$\*\*\*\*\*500 DOLLARS 00 CENTS

AMOUNT OF CHECK  
\$\*\*\*\*\*500.00

PAY  
TO THE  
ORDER  
OF

BUREAU OF AIR REGULATION  
FLORIDA DEPARTMENT OF  
ENVIRONMENTAL REGULATION  
2600 BLAIR STONE ROAD  
TALLAHASSEE, FL  
32399-2400

BY   
AUTHORIZED REPRESENTATIVE

UNITED BANK OF GRAND JUNCTION



CHECK NO. 0822020236

REMITTANCE STATEMENT  
ENRON GAS PIPELINE OPERATING COMPANY

PAGE 001 OF 001

VOUCHER NO.	INVOICE DATE	INVOICE NUMBER	PURCHASE ORDER	AMOUNT		
				GROSS	DISCOUNT	NET
9010001572	101790	CKR10179005		500.00	0.00	500.00
					TOTAL	500.00
<i>C.S. No. 18 Construction Permit - FOT</i>						
<i>50 &lt; Q &lt; 100 tpy</i>						

Special Instructions  
CALL SUZY AT EXT 7304



**PSD PERMIT APPLICATION  
FLORIDA GAS TRANSMISSION COMPANY  
COMPRESSOR STATION NO. 18**

**Prepared For:**

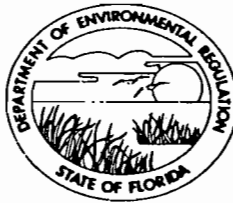
**Florida Gas Transmission Company  
1400 Smith Street  
Houston, TX 77251-1188**

**Prepared By:**

**KBN Engineering and Applied Sciences, Inc.  
1034 NW 57th Street  
Gainesville, FL 32605**

**November 1990  
90051H1/P**

## DEPARTMENT OF ENVIRONMENTAL REGULATION



AC48-189456  
PSD-FL-163

\$500 pd.  
11-20-90  
Recpt. # 151212

## APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Natural Gas Compressor Engine [X] New' [ ] Existing'

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

COMPANY NAME: Florida Gas Transmission Company COUNTY: OrangeIdentify 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) Station 18, Unit No. 5SOURCE LOCATION: Street 7990 Steer Lake Road City OrlandoUTM: East 17:451.86 km North 3154.79 kmLatitude 28 ° 31 ' 15 "N Longitude 81 ° 29 ' 31 "WAPPLICANT NAME AND TITLE: W. Alan Bowman, Project EnvironmentalistAPPLICANT ADDRESS: P.O. Box 1188, Houston, Texas 77251 Phone: (713) 853-7303

## SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

## A. APPLICANT

I am the undersigned owner or authorized representative\* of Florida Gas Transmission Co.

I certify that the statements made in this application for a 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: *C.L. Truby*C.L. Truby, Vice President

Name and Title (Please Type)

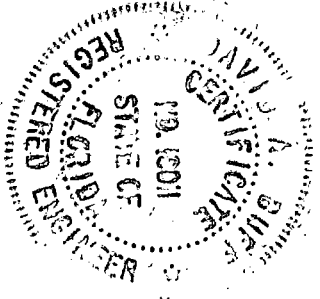
Date: 11-12-90 Telephone No. (713) 853-6161

## 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

\*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 David A. Buff

David A. Buff, P.E.  
Name (Please Type)

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

1034 NW 57th Street, Gainesville, FL 32605  
Mailing Address (Please Type)

Florida Registration No. 19011 Date: Nov. 17, 1990 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.

See PSD report, Section 1.0--Introduction, and  
Section 2.0--Project Description

B. Schedule of project covered in this application (Construction Permit Application Only)  
Start of Construction March 15, 1991 Completion of Construction 18 months after permit issuance

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.)

Not applicable

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

Not applicable

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
- 3. Does the State "Prevention of Significant Deterioration" (PSD)  
requirement apply to this source? If yes, see Sections VI and VII. Yes
- 4. Do "Standards of Performance for New Stationary Sources" (NSPS)  
apply to this source? No
- 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.

See PSD Report, Section 3.0--Air Quality Review Requirements and Applicability

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

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

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		
Not applicable				

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

- Total Process Input Rate (lbs/hr): Not applicable
- Product Weight (lbs/hr): Not applicable

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

Name of Contaminant	Emission <sup>1</sup>		Allowed <sup>2</sup> Emission Rate per Rule 17-2	Allowable <sup>3</sup> Emission lbs/hr	Potential <sup>4</sup> Emission		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/hr	T/yr	
NO <sub>x</sub>	10.6	46.3	BACT	BACT	10.6	46.3	
CO	11.1	48.7	N/A	N/A	11.1	48.7	
VOCs	2.6	11.6	N/A	N/A	2.6	11.6	
Particulates	0.08	0.36	N/A	N/A	0.08	0.36	
SO <sub>2</sub>	0.47	2.04	N/A	N/A	0.47	2.04	

<sup>1</sup>See Section V, Item 2.

<sup>2</sup>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)

<sup>3</sup>Calculated from operating rate and applicable standard.

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

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

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
Lean Burn Engine Design	NO <sub>x</sub>	80%	N/A	Design and AP-42

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max/hr	
Natural Gas	0.0163	0.0163	16.80

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

Fuel Analysis:

Percent Sulfur: 0.031 (by weight)\* Percent Ash: NA  
 Density: 0.0455 lb/ft<sup>3</sup> lbs/gal Typical Percent Nitrogen: NA  
 Heat Capacity: 22.637 (based on 1.030 Btu/scf) BTU/lb NA BTU/gal  
 Other Fuel Contaminants (which may cause air pollution): NA

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

Annual Average Not applicable Maximum                     

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

Not applicable

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\*Based on contract limit of 10 gr/100 ft<sup>3</sup> and gas at 0.0455 lb/ft<sup>3</sup>

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

Stack Height: 40 ft. Stack Diameter: 1.438 ft.  
 Gas Flow Rate: 15,627 ACFM 7,511 DSCFM Gas Exit Temperature: 550 °F.  
 Water Vapor Content: 8 % Velocity: 160.37 FPS

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) <sup>3</sup>	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 PSD Report, Section 2.0, Tables 2-1 and 2-2
3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).  
See PSD Report, Section 2.0
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.)  
Not Applicable
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).  
Not Applicable
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 PSD Report, Figure 2-2
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 PSD Report, Figure 1-2
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 PSD Report, Figure 2-1



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

**SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY**

See PSD report, Sections 3.0 and 6.0

- 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    No

Contaminant	Rate or Concentration
_____	_____
_____	_____
_____	_____

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

Contaminant	Rate or Concentration
_____	_____
_____	_____
_____	_____

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

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

\*Explain method of determining

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

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

Contaminant	Rate or Concentration

10. Stack Parameters

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

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

1.

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

<sup>1</sup>Explain method of determining efficiency.

<sup>2</sup>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:<sup>1</sup>
- d. Capital Cost:
- e. Useful Life:
- f. Operating Cost:
- g. Energy:<sup>2</sup>
- 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:<sup>1</sup>
- d. Capital Cost:
- e. Useful Life:
- f. Operating Cost:
- g. Energy:<sup>2</sup>
- 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:

- 1. Control Device:
- 2. Efficiency:<sup>1</sup>
- 3. Capital Cost:
- 4. Useful Life:
- 5. Operating Cost:
- 6. Energy:<sup>2</sup>
- 7. Maintenance Cost:
- 8. Manufacturer:
- 9. Other locations where employed on similar processes:
- a. (1) Company:
- (2) Mailing Address:
- (3) City:
- (4) State:

<sup>1</sup>Explain method of determining efficiency.

<sup>2</sup>Energy to be reported in units of electrical power - KWH design rate.

- (5) Environmental Manager:
- (6) Telephone No.:
- (7) Emissions:<sup>1</sup>

Contaminant	Rate or Concentration

(8) Process Rate:<sup>1</sup>

- b. (1) Company:
- (2) Mailing Address:
- (3) City: (4) State:
- (5) Environmental Manager:
- (6) Telephone No.:
- (7) Emissions:<sup>1</sup>

Contaminant	Rate or Concentration

(8) Process Rate:<sup>1</sup>

10. Reason for selection and description of systems:

<sup>1</sup>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**  
Refer to PSD report

A. Company Monitored Data

1. \_\_\_\_\_ no. sites \_\_\_\_\_ TSP \_\_\_\_\_ ( ) SO<sup>2</sup>\* \_\_\_\_\_ Wind spd/dir

Period of Monitoring \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ to \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_  
 day year month day year month

Other data recorded \_\_\_\_\_

Attach all data or statistical summaries to this application.

<sup>1</sup>Specify bubbler (B) or continuous (C).

2. Instrumentation, Field and Laboratory

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

b. Was instrumentation calibrated in accordance with Department procedures?

[ ] Yes [ ] No [ ] Unknown

B. Meteorological Data Used for Air Quality Modeling

1. \_\_\_\_\_ 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

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

Pollutant	Emission Rate
TSP	_____ grams/sec
SO <sup>2</sup>	_____ grams/sec

E. Emission Data Used in Modeling

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

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

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

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

**PREVENTION OF SIGNIFICANT DETERIORATION  
REPORT  
FLORIDA GAS TRANSMISSION COMPANY  
COMPRESSOR STATION NO. 18**

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## 1.0 INTRODUCTION

Florida Gas Transmission Company (FGTC), a subsidiary of ENRON Corporation of Houston, Texas, is proposing to expand its existing natural gas pipeline Compressor Station No. 18. This proposed expansion is part of FGTC's Phase II expansion project aimed at increasing the natural gas transport capacity of the existing Florida gas pipeline system. The scope of work for Phase II includes expansions by addition of state-of-the-art compressor engines at eight existing compressor stations and at a newly proposed compressor station. The main gas pipeline and the approximate locations of the existing and proposed compressor stations along the main pipeline are shown in Figure 1-1.

Compressor Station No. 18 is located at 7990 Steer Lake Road in the city of Orlando in Orange County, Florida. Figure 1-2 shows the site location of the existing compressor station.

The proposed expansion at this location consists of the addition of one new 2,400 brake horsepower (bhp) natural-gas-fired, reciprocating internal combustion (IC) engine. The proposed engine would be used solely for the purpose of transporting natural gas in the pipeline for distribution in Florida. The proposed engine is a turbocharged Cooper-Bessemer Model GMVR-12C2. Under current federal and state air quality regulations, the proposed engine will constitute a major modification at an existing major stationary source.

This report addresses the requirements of the Prevention of Significant Deterioration (PSD) review procedures pursuant to rules and regulations implementing the Clean Air Act (CAA) Amendments of 1977. The Florida Department of Environmental Regulation (FDER) has PSD review and approval authority in Florida. Based on the proposed emissions from the addition of a 2,400-bhp engine, a PSD review is required for nitrogen oxides (NO<sub>x</sub>).

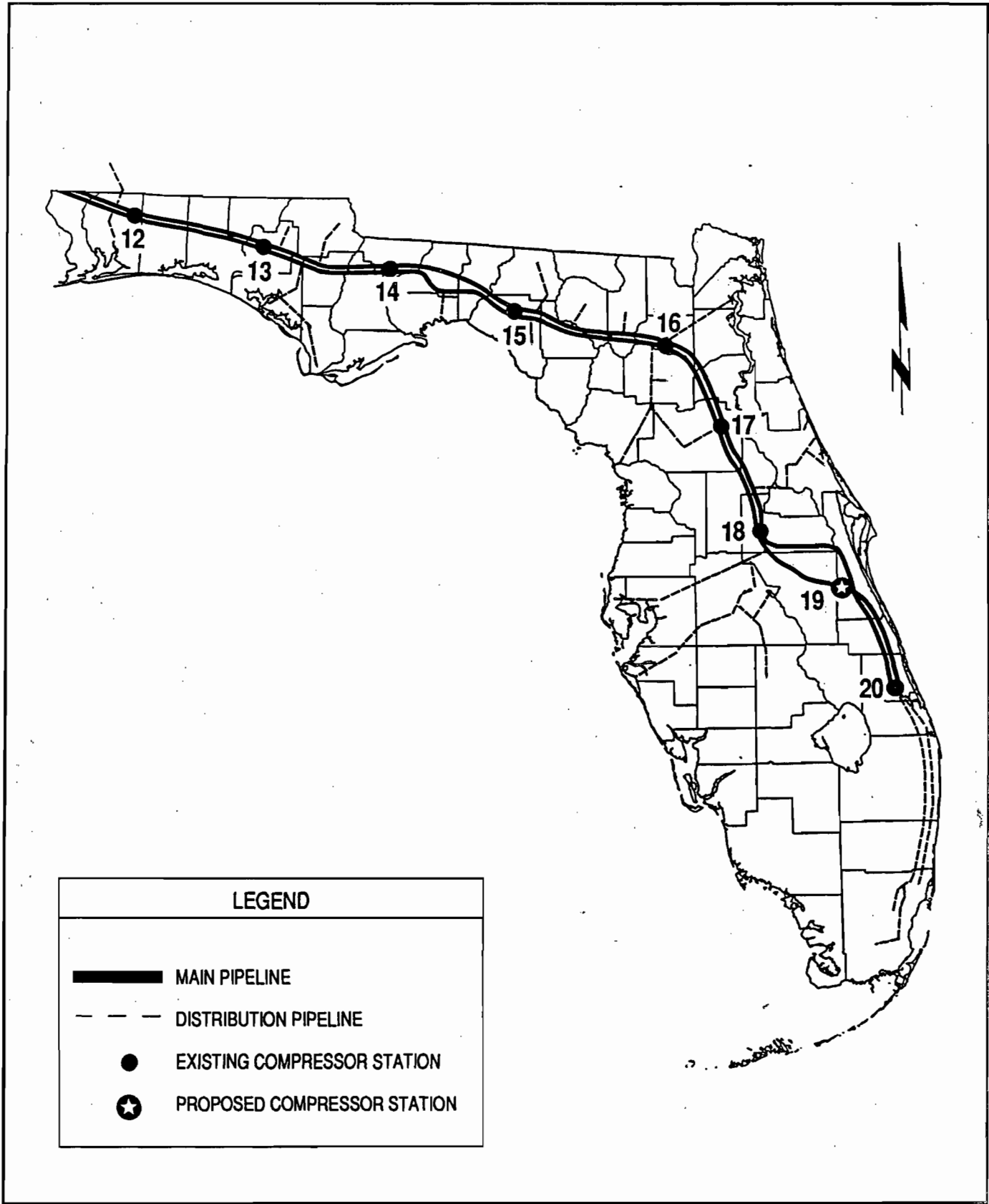
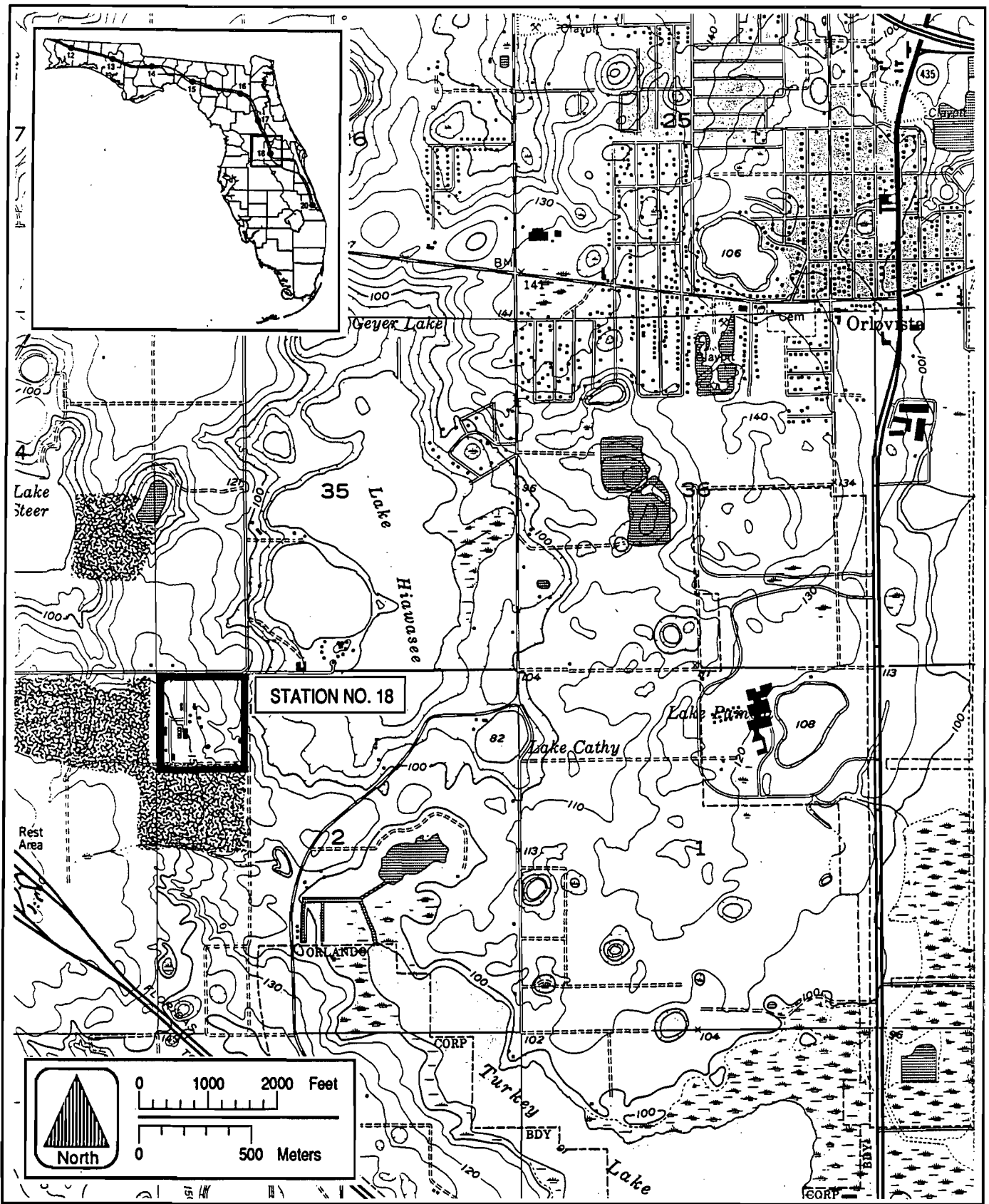


Figure 1-1 FGTC'S GAS TRANSMISSION SYSTEM





**Figure 1-2** SITE LOCATION OF ENRON'S FLORIDA GAS TRANSMISSION LINE COMPRESSOR STATION NO. 18, ORLANDO, ORANGE COUNTY, FLORIDA



Engineering designs for the proposed expansion project include selection of an engine incorporating lean-burn technology. The lean-burn technology for emission control represents best available control technology (BACT) for the proposed reciprocating IC engine.

This application contains five additional sections. Descriptions of the existing operation at FGTC's Compressor Station No. 18 and the proposed 2,400-bhp engine addition are presented in Section 2.0. The air quality review requirements and source applicability of the proposed engine to the regulations are discussed in Section 3.0. The methodology and results of the air dispersion modeling and air quality impact analysis are presented in Section 4.0, and impacts on soil, vegetation, and visibility are summarized in Section 5.0. The BACT analysis required as part of the PSD permitting process is presented in Section 6.0.



ISCLTK6L MODEL, A VERSION OF  
ISCLT (VERSION 90008)  
AN AIR QUALITY DISPERSION MODEL IN  
SECTION 1. GUIDELINE MODELS.  
IN UNAMAP (VERSION 6) JAN 1990.  
SOURCE: FILE 7 ON UNAMAP MAGNETIC TAPE FROM NTIS.

CONVERTED BY :  
KBN ENGINEERING AND APPLIED SCIENCES, INC.  
GAINESVILLE, FLORIDA  
(904)331-9000

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CARD INPUT FILE IS	ER18LT85.181	
SUMMARY OUTPUT FILE IS	ER18LT85.081	
TITLE OF RUN IS	1985 ENRON STATION 18 / 40 FT STACK	10-29-90

- ISCLT INPUT DATA (CONT.) -

NUMBER OF SOURCES = 1  
 NUMBER OF X AXIS GRID SYSTEM POINTS = 8  
 NUMBER OF Y AXIS GRID SYSTEM POINTS = 16  
 NUMBER OF SPECIAL POINTS = 36  
 NUMBER OF SEASONS = 1  
 NUMBER OF WIND SPEED CLASSES = 6  
 NUMBER OF STABILITY CLASSES = 6  
 NUMBER OF WIND DIRECTION CLASSES = 16  
 FILE NUMBER OF DATA FILE USED FOR REPORTS = 1  
 THE PROGRAM IS RUN IN RURAL MODE  
 CONCENTRATION (DEPOSITION) UNITS CONVERSION FACTOR = 0.10000000E+07  
 ACCELERATION OF GRAVITY (METERS/SEC\*\*2) = 9.800  
 HEIGHT OF MEASUREMENT OF WIND SPEED (METERS) = 10.100  
 CORRECTION ANGLE FOR GRID SYSTEM VERSUS DIRECTION DATA NORTH (DEGREES) = 0.000  
 DECAY COEFFICIENT = 0.00000000E+00  
 PROGRAM OPTION SWITCHES = 1, 2, 2, 0, 0, 3, 2, 1, 3, 2, 2, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0,

RANGE X AXIS GRID SYSTEM POINTS (METERS) =	100.00,	200.00,	300.00,	400.00,	500.00,	750.00,
1000.00,	1250.00,					
RANGE X SPECIAL DISCRETE POINTS (METERS) =	317.00,	332.00,	357.00,	402.00,	366.00,	323.00,
296.00,	283.00,	277.00,	283.00,	253.00,	171.00,	134.00,
113.00,	113.00,	98.00,	91.00,	101.00,	113.00,	137.00,
134.00,	122.00,	119.00,	122.00,	134.00,	149.00,	177.00,
229.00,	250.00,	259.00,	311.00,			
AZIMUTH BEARING Y AXIS GRID SYSTEM POINTS (DEGREES) =	22.50,	45.00,	67.50,	90.00,	112.50,	135.00,
157.50,	180.00,	202.50,	225.00,	247.50,	270.00,	292.50,
315.00,	337.50,	360.00,				
AZIMUTH BEARING Y SPECIAL DISCRETE POINTS (DEGREES) =	10.00,	20.00,	30.00,	40.00,	50.00,	60.00,
70.00,	80.00,	90.00,	100.00,	110.00,	120.00,	130.00,
140.00,	150.00,	160.00,				
170.00,	180.00,	190.00,	200.00,	210.00,	220.00,	230.00,
240.00,	250.00,	260.00,				
270.00,	280.00,	290.00,	300.00,	310.00,	320.00,	330.00,
340.00,	350.00,	360.00,				

- AMBIENT AIR TEMPERATURE (DEGREES KELVIN) -

	STABILITY	STABILITY	STABILITY	STABILITY	STABILITY	STABILITY
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
SEASON 1	300.0000	300.0000	300.0000	295.0000	290.0000	290.0000

- MIXING LAYER HEIGHT (METERS) -

	SEASON 1					
	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
STABILITY CATEGORY 10.	2.15100E+040.	2.15100E+040.	2.15100E+040.	2.15100E+040.	2.15100E+040.	2.15100E+040.
STABILITY CATEGORY 20.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.
STABILITY CATEGORY 30.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.
STABILITY CATEGORY 40.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.
STABILITY CATEGORY 50.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.
STABILITY CATEGORY 60.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 1

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00016500	0.00102701	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00015500	0.00079900	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00001000	0.00022800	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00013500	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00014500	0.00057100	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00003100	0.00068500	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00015000	0.00068500	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00002100	0.00045700	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00026900	0.00068500	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00002600	0.00057100	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00013000	0.00022800	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00014000	0.00045700	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00002100	0.00045700	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00015000	0.00068500	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00004100	0.00091300	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00012400	0.00011400	0.00000000	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 2

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00088100	0.00216901	0.00159801	0.00000000	0.00000000	0.00000000
22.500	0.00041500	0.00228301	0.00091300	0.00000000	0.00000000	0.00000000
45.000	0.00075400	0.00182601	0.00182601	0.00000000	0.00000000	0.00000000
67.500	0.00007200	0.00262601	0.00171201	0.00000000	0.00000000	0.00000000
90.000	0.00067800	0.00331102	0.00274001	0.00000000	0.00000000	0.00000000
112.500	0.00030100	0.00239701	0.00102701	0.00000000	0.00000000	0.00000000
135.000	0.00030100	0.00239701	0.00182601	0.00000000	0.00000000	0.00000000
157.500	0.00052600	0.00205501	0.00137001	0.00000000	0.00000000	0.00000000
180.000	0.00058500	0.00422402	0.00308202	0.00000000	0.00000000	0.00000000
202.500	0.00075400	0.00182601	0.00102701	0.00000000	0.00000000	0.00000000
225.000	0.00041200	0.00216901	0.00171201	0.00000000	0.00000000	0.00000000
247.500	0.00053200	0.00228301	0.00125601	0.00000000	0.00000000	0.00000000
270.000	0.00064300	0.00205501	0.00125601	0.00000000	0.00000000	0.00000000
292.500	0.00068400	0.00353902	0.00228301	0.00000000	0.00000000	0.00000000
315.000	0.00071500	0.00468002	0.00194101	0.00000000	0.00000000	0.00000000
337.500	0.00065200	0.00239701	0.00159801	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 3

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.500MPS)	WIND SPEED CATEGORY 2 ( 2.500MPS)	WIND SPEED CATEGORY 3 ( 4.300MPS)	WIND SPEED CATEGORY 4 ( 6.800MPS)	WIND SPEED CATEGORY 5 ( 9.500MPS)	WIND SPEED CATEGORY 6 (12.500MPS)
0.000	0.00032700	0.00296801	0.00593603	0.00022800	0.00000000	0.00000000
22.500	0.00008800	0.00285401	0.00456602	0.00011400	0.00000000	0.00000000
45.000	0.00022700	0.00353902	0.00502302	0.00102701	0.00000000	0.00000000
67.500	0.00024400	0.00411002	0.00867604	0.00148401	0.00000000	0.00000000
90.000	0.00024400	0.00411002	0.01095906	0.00159801	0.00000000	0.00000000
112.500	0.00076900	0.00205501	0.00502302	0.00091300	0.00000000	0.00000000
135.000	0.00030200	0.00216901	0.00194101	0.00068500	0.00000000	0.00000000
157.500	0.00017700	0.00194101	0.00422402	0.00045700	0.00000000	0.00000000
180.000	0.00032300	0.00285401	0.00799104	0.00148401	0.00000000	0.00000000
202.500	0.00005600	0.00182601	0.00411002	0.00068500	0.00000000	0.00000000
225.000	0.00032000	0.00274001	0.00388102	0.00045700	0.00022800	0.00000000
247.500	0.00004600	0.00148401	0.00285401	0.00091300	0.00022800	0.00000000
270.000	0.00004900	0.00159801	0.00559403	0.00137001	0.00011400	0.00000000
292.500	0.00033000	0.00308202	0.00684903	0.00068500	0.00000000	0.00000000
315.000	0.00020900	0.00296801	0.00627903	0.00045700	0.00000000	0.00000000
337.500	0.00028500	0.00159801	0.00342502	0.00011400	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 4

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.500MPS)	WIND SPEED CATEGORY 2 ( 2.500MPS)	WIND SPEED CATEGORY 3 ( 4.300MPS)	WIND SPEED CATEGORY 4 ( 6.800MPS)	WIND SPEED CATEGORY 5 ( 9.500MPS)	WIND SPEED CATEGORY 6 (12.500MPS)
0.000	0.00036500	0.00799104	0.00890404	0.00285401	0.00000000	0.00000000
22.500	0.00030500	0.00605003	0.00582203	0.00148401	0.00000000	0.00000000
45.000	0.00017000	0.00547903	0.00764804	0.00684903	0.00022800	0.00000000
67.500	0.00035500	0.00388102	0.01495407	0.01267106	0.00068500	0.00000000
90.000	0.00014800	0.00479502	0.01917810	0.01575308	0.00034200	0.00000000
112.500	0.00009900	0.00319602	0.01118706	0.00490902	0.00011400	0.00000000
135.000	0.00016700	0.00159801	0.00719204	0.00513703	0.00022800	0.00000000
157.500	0.00017100	0.00171201	0.00707804	0.00662103	0.00034200	0.00000000
180.000	0.00013100	0.00422402	0.01552508	0.01267106	0.00228301	0.00022800
202.500	0.00032700	0.00296801	0.00616403	0.00593603	0.00102701	0.00011400
225.000	0.00006000	0.00194101	0.00764804	0.00502302	0.00148401	0.00011400
247.500	0.00018100	0.00205501	0.00570803	0.00593603	0.00114201	0.00022800
270.000	0.00019200	0.00239701	0.00787704	0.01381307	0.00365302	0.00114201
292.500	0.00017400	0.00182601	0.00684903	0.01038805	0.00148401	0.00011400
315.000	0.00021300	0.00308202	0.00502302	0.00616403	0.00011400	0.00000000
337.500	0.00059400	0.00399502	0.00696304	0.00342502	0.00022800	0.00000000

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 5

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00000000	0.01461207	0.00411002	0.00000000	0.00000000	0.00000000
22.500	0.00000000	0.01290006	0.00182601	0.00000000	0.00000000	0.00000000
45.000	0.00000000	0.01381307	0.00228301	0.00000000	0.00000000	0.00000000
67.500	0.00000000	0.01347007	0.00399502	0.00000000	0.00000000	0.00000000
90.000	0.00000000	0.01563908	0.00468002	0.00000000	0.00000000	0.00000000
112.500	0.00000000	0.00867604	0.00331102	0.00000000	0.00000000	0.00000000
135.000	0.00000000	0.00901804	0.00251101	0.00000000	0.00000000	0.00000000
157.500	0.00000000	0.00582203	0.00365302	0.00000000	0.00000000	0.00000000
180.000	0.00000000	0.01461207	0.00605003	0.00000000	0.00000000	0.00000000
202.500	0.00000000	0.00502302	0.00148401	0.00000000	0.00000000	0.00000000
225.000	0.00000000	0.00513703	0.00159801	0.00000000	0.00000000	0.00000000
247.500	0.00000000	0.00490902	0.00411002	0.00000000	0.00000000	0.00000000
270.000	0.00000000	0.00365302	0.00844704	0.00000000	0.00000000	0.00000000
292.500	0.00000000	0.00274001	0.00616403	0.00000000	0.00000000	0.00000000
315.000	0.00000000	0.00388102	0.00353902	0.00000000	0.00000000	0.00000000
337.500	0.00000000	0.00422402	0.00388102	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 6

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.01042305	0.01769409	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00757004	0.01769409	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00831504	0.01803709	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00625303	0.01290006	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00478002	0.01301407	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00292601	0.00468002	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00312702	0.00502302	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00295401	0.00411002	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00507503	0.01027405	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00475702	0.00502302	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00285501	0.00502302	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00394602	0.00719204	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00409802	0.00799104	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00413702	0.00605003	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00345402	0.00388102	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00364102	0.00844704	0.00000000	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- VERTICAL POTENTIAL TEMPERATURE GRADIENT (DEGREES KELVIN/METER) -

	WIND SPEED CATEGORY 1	WIND SPEED CATEGORY 2	WIND SPEED CATEGORY 3	WIND SPEED CATEGORY 4	WIND SPEED CATEGORY 5	WIND SPEED CATEGORY 6
STABILITY CATEGORY 10.	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000
STABILITY CATEGORY 20.	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000
STABILITY CATEGORY 30.	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000
STABILITY CATEGORY 40.	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000	0.000000E+000
STABILITY CATEGORY 50.	0.200000E-010	0.200000E-010	0.200000E-010	0.200000E-010	0.200000E-010	0.200000E-010
STABILITY CATEGORY 60.	0.350000E-010	0.350000E-010	0.350000E-010	0.350000E-010	0.350000E-010	0.350000E-010

- WIND PROFILE POWER LAW EXPONENTS -

	WIND SPEED CATEGORY 1	WIND SPEED CATEGORY 2	WIND SPEED CATEGORY 3	WIND SPEED CATEGORY 4	WIND SPEED CATEGORY 5	WIND SPEED CATEGORY 6
STABILITY CATEGORY 10.	0.700000E-010	0.700000E-010	0.700000E-010	0.700000E-010	0.700000E-010	0.700000E-010
STABILITY CATEGORY 20.	0.700000E-010	0.700000E-010	0.700000E-010	0.700000E-010	0.700000E-010	0.700000E-010
STABILITY CATEGORY 30.	1.000000E+000	1.000000E+000	1.000000E+000	1.000000E+000	1.000000E+000	1.000000E+000
STABILITY CATEGORY 40.	1.500000E+000	1.500000E+000	1.500000E+000	1.500000E+000	1.500000E+000	1.500000E+000
STABILITY CATEGORY 50.	0.350000E+000	0.350000E+000	0.350000E+000	0.350000E+000	0.350000E+000	0.350000E+000
STABILITY CATEGORY 60.	0.550000E+000	0.550000E+000	0.550000E+000	0.550000E+000	0.550000E+000	0.550000E+000

- SOURCE INPUT DATA -

C T SOURCE SOURCE X Y EMISSION BASE /  
 A A NUMBER TYPE COORDINATE COORDINATE HEIGHT ELEV- /  
 R P (M) (M) (M) ATION /  
 D E (M) /

- SOURCE DETAILS DEPENDING ON TYPE -

X 1 STACK 0.00 0.00 12.19 0.00 GAS EXIT TEMP (DEG K)= 561.00, GAS EXIT VEL. (M/SEC)= 48.88,  
 STACK DIAMETER (M)= 0.440, HEIGHT OF ASSO. BLDG. (M)= -9.69, WIDTH OF  
 ASSO. BLDG. (M)= 74.92, WAKE EFFECTS FLAG = 0

- DIRECTION SPECIFIC BUILDING DIMENSIONS -

SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE
1	9.7,	75.0,	0	2	9.7,	75.0,	0	3	9.7,	75.0,	0	4	9.7,	75.0,	0
5	9.7,	75.0,	0	6	9.7,	75.0,	0	7	9.7,	75.0,	0	8	9.7,	75.0,	0
9	9.7,	75.0,	0	10	9.7,	75.0,	0	11	9.7,	75.0,	0	12	9.7,	75.0,	0
13	9.7,	75.0,	0	14	9.7,	75.0,	0	15	9.7,	75.0,	0	16	9.7,	75.0,	0

- SOURCE STRENGTHS ( GRAMS PER SEC ) -

SEASON 1 SEASON 2 SEASON 3 SEASON 4  
 1.33000E+00

WARNING - HW/HB > 5 FOR SOURCE 1 PROG. USES LATERAL VIRTUAL DIST. FOR UPPER BOUND OF CONCENTRATION (DEPOSITION) IN SECTOR(S):  
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.  
 IF LOWER BOUND IS DESIRED SET THE DIRECTION SPECIFIC BUILDING HEIGHT TO < 0 (WAKE EFFECTS FLAG) AND RERUN.

\*\* ANNUAL GROUND LEVEL CONCENTRATION ( MICROGRAMS PER CUBIC METER ) DUE TO SOURCE 1 \*\*

- GRID SYSTEM RECEPTORS -

- X AXIS (RANGE , METERS) -

100.000 200.000 300.000 400.000 500.000 750.000 1000.000 1250.000  
 Y AXIS (AZIMUTH BEARING, DEGREES ) - CONCENTRATION -

360.000	0.749764	0.656554	0.841737	0.906236	0.866249	0.676788	0.536186	0.440033
337.500	0.303528	0.284474	0.390332	0.431857	0.419226	0.331477	0.261319	0.212743
315.000	0.311541	0.272492	0.351106	0.382453	0.370501	0.295550	0.238536	0.199392
292.500	0.273210	0.273399	0.392898	0.451485	0.452212	0.380454	0.312860	0.260875
270.000	0.654377	0.631280	0.879482	0.989557	0.970492	0.778657	0.617506	0.504569
247.500	0.523958	0.504231	0.701788	0.792724	0.778484	0.625856	0.498872	0.410631
225.000	0.346932	0.323641	0.436849	0.488080	0.480620	0.397639	0.333218	0.288341
202.500	0.160605	0.174285	0.273264	0.319300	0.319927	0.274705	0.242657	0.219185
180.000	0.251369	0.254485	0.373819	0.429458	0.430996	0.376073	0.332071	0.296474
157.500	0.215972	0.203529	0.293971	0.337309	0.337266	0.284100	0.235799	0.198778
135.000	0.360597	0.358677	0.515544	0.560276	0.527239	0.392479	0.297489	0.234800
112.500	0.552521	0.496842	0.652292	0.694710	0.651002	0.484417	0.365059	0.286904
90.000	0.779201	0.633429	0.735081	0.749385	0.691725	0.516151	0.396658	0.317906
67.500	0.383058	0.326146	0.399078	0.418913	0.394655	0.302946	0.238543	0.195819
45.000	0.379253	0.321737	0.406429	0.443652	0.430606	0.340178	0.265367	0.213183
22.500	0.335613	0.300996	0.390668	0.422210	0.404999	0.316711	0.248580	0.201514

- DISCRETE RECEPTORS -

X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION	X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION	X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION
------------------	-----------------------------	---------------	------------------	-----------------------------	---------------	------------------	-----------------------------	---------------

317.0	10.0	0.642515	332.0	20.0	0.453121	357.0	30.0	0.414677
402.0	40.0	0.433133	366.0	50.0	0.428201	323.0	60.0	0.404226
296.0	70.0	0.426129	283.0	80.0	0.554565	277.0	90.0	0.709137
283.0	100.0	0.656647	253.0	110.0	0.580718	171.0	120.0	0.476791
134.0	130.0	0.422314	113.0	140.0	0.340100	98.0	150.0	0.248571
91.0	160.0	0.198164	88.0	170.0	0.205978	85.0	180.0	0.222259
88.0	190.0	0.184875	91.0	200.0	0.154619	101.0	210.0	0.216759
113.0	220.0	0.314945	137.0	230.0	0.400741	134.0	240.0	0.486441
122.0	250.0	0.564514	119.0	260.0	0.616230	116.0	270.0	0.688190
119.0	280.0	0.503438	122.0	290.0	0.332708	134.0	300.0	0.299474
149.0	310.0	0.304348	177.0	320.0	0.290567	229.0	330.0	0.279068
250.0	340.0	0.368960	259.0	350.0	0.560781	311.0	360.0	0.857703



\*\* ANNUAL GROUND LEVEL CONCENTRATION ( MICROGRAMS PER CUBIC METER ) DUE TO SOURCE 1 (CONT.) \*\*

- 10 CONTRIBUTING VALUES TO PROGRAM DETERMINED MAXIMUM 10 OF ALL SOURCES COMBINED -

X COORDINATE RANGE (METERS)	Y COORDINATE AZIMUTH BEARING (DEGREES)	CONCENTRATION
400.00	270.00	0.989557
500.00	270.00	0.970492
400.00	360.00	0.906236
300.00	270.00	0.879482
500.00	360.00	0.866249
311.00	360.00	0.857703
300.00	360.00	0.841737
400.00	247.50	0.792724
100.00	90.00	0.779201
750.00	270.00	0.778657

\*\*\*\*\* END OF ISCLT PROGRAM, 1 SOURCES PROCESSED \*\*\*\*\*

ISCLTK6L MODEL, A VERSION OF  
ISCLT (VERSION 90008)  
AN AIR QUALITY DISPERSION MODEL IN  
SECTION 1. GUIDELINE MODELS.  
IN UNAMAP (VERSION 6) JAN 1990.  
SOURCE: FILE 7 ON UNAMAP MAGNETIC TAPE FROM NTIS.

CONVERTED BY :  
KBN ENGINEERING AND APPLIED SCIENCES, INC.  
GAINESVILLE, FLORIDA  
(904)331-9000

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CARD INPUT FILE IS	ER18LT86.181	
SUMMARY OUTPUT FILE IS	ER18LT86.081	
TITLE OF RUN IS	1986 ENRON STATION 18 / 40 FT STACK	10-29-90

- ISCLT INPUT DATA (CONT.) -

NUMBER OF SOURCES = 1  
 NUMBER OF X AXIS GRID SYSTEM POINTS = 8  
 NUMBER OF Y AXIS GRID SYSTEM POINTS = 16  
 NUMBER OF SPECIAL POINTS = 36  
 NUMBER OF SEASONS = 1  
 NUMBER OF WIND SPEED CLASSES = 6  
 NUMBER OF STABILITY CLASSES = 6  
 NUMBER OF WIND DIRECTION CLASSES = 16  
 FILE NUMBER OF DATA FILE USED FOR REPORTS = 1  
 THE PROGRAM IS RUN IN RURAL MODE  
 CONCENTRATION (DEPOSITION) UNITS CONVERSION FACTOR =0.10000000E+07  
 ACCELERATION OF GRAVITY (METERS/SEC\*\*2) = 9.800  
 HEIGHT OF MEASUREMENT OF WIND SPEED (METERS) = 10.100  
 CORRECTION ANGLE FOR GRID SYSTEM VERSUS DIRECTION DATA NORTH (DEGREES) = 0.000  
 DECAY COEFFICIENT =0.00000000E+00  
 PROGRAM OPTION SWITCHES = 1, 2, 2, 0, 0, 3, 2, 1, 3, 2, 2, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0,

RANGE X AXIS GRID SYSTEM POINTS (METERS) =	100.00,	200.00,	300.00,	400.00,	500.00,	750.00,						
	1000.00,	1250.00,										
RANGE X SPECIAL DISCRETE POINTS (METERS) =	317.00,	332.00,	357.00,	402.00,	366.00,	323.00,						
	296.00,	283.00,	277.00,	283.00,	253.00,	171.00,	134.00,	113.00,	98.00,	91.00,		
	88.00,	85.00,	88.00,	91.00,	101.00,	113.00,	137.00,	134.00,	122.00,	119.00,		
	116.00,	119.00,	122.00,	134.00,	149.00,	177.00,	229.00,	250.00,	259.00,	311.00,		
AZIMUTH BEARING Y AXIS GRID SYSTEM POINTS (DEGREES) =	22.50,	45.00,	67.50,	90.00,	112.50,	135.00,						
	157.50,	180.00,	202.50,	225.00,	247.50,	270.00,	292.50,	315.00,	337.50,	360.00,		
AZIMUTH BEARING Y SPECIAL DISCRETE POINTS (DEGREES) =	10.00,	20.00,	30.00,	40.00,	50.00,	60.00,						
	70.00,	80.00,	90.00,	100.00,	110.00,	120.00,	130.00,	140.00,	150.00,	160.00,		
	170.00,	180.00,	190.00,	200.00,	210.00,	220.00,	230.00,	240.00,	250.00,	260.00,		
	270.00,	280.00,	290.00,	300.00,	310.00,	320.00,	330.00,	340.00,	350.00,	360.00,		

- AMBIENT AIR TEMPERATURE (DEGREES KELVIN) -

	STABILITY	STABILITY	STABILITY	STABILITY	STABILITY	STABILITY
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
SEASON 1	300.0000	300.0000	300.0000	295.0000	290.0000	290.0000

- MIXING LAYER HEIGHT (METERS) -

	SEASON 1					
	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
STABILITY CATEGORY 10	.215100E+040.	.215100E+040.	.215100E+040.	.215100E+040.	.215100E+040.	.215100E+040.
STABILITY CATEGORY 20	.143400E+040.	.143400E+040.	.143400E+040.	.143400E+040.	.143400E+040.	.143400E+040.
STABILITY CATEGORY 30	.143400E+040.	.143400E+040.	.143400E+040.	.143400E+040.	.143400E+040.	.143400E+040.
STABILITY CATEGORY 40	.143400E+040.	.143400E+040.	.143400E+040.	.143400E+040.	.143400E+040.	.143400E+040.
STABILITY CATEGORY 50	.100000E+050.	.100000E+050.	.100000E+050.	.100000E+050.	.100000E+050.	.100000E+050.
STABILITY CATEGORY 60	.100000E+050.	.100000E+050.	.100000E+050.	.100000E+050.	.100000E+050.	.100000E+050.

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 1

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00038600	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00013600	0.00022800	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00040100	0.00057100	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00029400	0.00079900	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00038600	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00055900	0.00114200	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00029400	0.00079900	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00017300	0.00079900	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00019500	0.00114200	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00004400	0.00068500	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00018000	0.00091300	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00015100	0.00045700	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00027900	0.00057100	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00005800	0.00091300	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00018700	0.00102700	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00027200	0.00045700	0.00000000	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 2

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00084300	0.00353900	0.00182600	0.00000000	0.00000000	0.00000000
22.500	0.00077500	0.00171200	0.00137000	0.00000000	0.00000000	0.00000000
45.000	0.00105800	0.00296800	0.00125600	0.00000000	0.00000000	0.00000000
67.500	0.00086800	0.00422400	0.00148400	0.00000000	0.00000000	0.00000000
90.000	0.00148600	0.00490900	0.00205500	0.00000000	0.00000000	0.00000000
112.500	0.00071200	0.00319600	0.00182600	0.00000000	0.00000000	0.00000000
135.000	0.00073700	0.00388100	0.00137000	0.00000000	0.00000000	0.00000000
157.500	0.00070300	0.00296800	0.00228300	0.00000000	0.00000000	0.00000000
180.000	0.00097800	0.00399500	0.00285400	0.00000000	0.00000000	0.00000000
202.500	0.00080900	0.00262600	0.00114200	0.00000000	0.00000000	0.00000000
225.000	0.00021700	0.00262600	0.00205500	0.00000000	0.00000000	0.00000000
247.500	0.00083400	0.00331100	0.00194100	0.00000000	0.00000000	0.00000000
270.000	0.00069500	0.00274000	0.00251100	0.00000000	0.00000000	0.00000000
292.500	0.00059300	0.00319600	0.00262600	0.00000000	0.00000000	0.00000000
315.000	0.00059300	0.00319600	0.00239700	0.00000000	0.00000000	0.00000000
337.500	0.00054200	0.00182600	0.00102700	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 3

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00013600	0.00445200	0.00627899	0.00045700	0.00000000	0.00000000
22.500	0.00029800	0.00205500	0.00422400	0.00000000	0.00000000	0.00000000
45.000	0.00024000	0.00399500	0.00570799	0.00034200	0.00000000	0.00000000
67.500	0.00036100	0.00411000	0.00582199	0.00137000	0.00000000	0.00000000
90.000	0.00073100	0.00468000	0.01107299	0.00091300	0.00000000	0.00000000
112.500	0.00031500	0.00262600	0.00525100	0.00000000	0.00000000	0.00000000
135.000	0.00018000	0.00205500	0.00376700	0.00022800	0.00000000	0.00000000
157.500	0.00020500	0.00285400	0.00422400	0.00034200	0.00000000	0.00000000
180.000	0.00023600	0.00388100	0.00981699	0.00057100	0.00000000	0.00000000
202.500	0.00021900	0.00331100	0.00365300	0.00045700	0.00000000	0.00000000
225.000	0.00019800	0.00262600	0.00353900	0.00068500	0.00000000	0.00000000
247.500	0.00031900	0.00274000	0.00399500	0.00022800	0.00000000	0.00000000
270.000	0.00052300	0.00171200	0.00502300	0.00148400	0.00000000	0.00000000
292.500	0.00032600	0.00296800	0.00570799	0.00045700	0.00000000	0.00000000
315.000	0.00020800	0.00296800	0.00399500	0.00045700	0.00000000	0.00000000
337.500	0.00041600	0.00205500	0.00353900	0.00045700	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 4

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00128000	0.01084499	0.01164399	0.00342500	0.00011400	0.00000000
22.500	0.00085200	0.00468000	0.00684899	0.00182600	0.00000000	0.00000000
45.000	0.00079100	0.00650699	0.00730599	0.00353900	0.00000000	0.00000000
67.500	0.00056300	0.00673499	0.00981699	0.00570799	0.00000000	0.00000000
90.000	0.00046700	0.00741999	0.01940598	0.00650699	0.00022800	0.00000000
112.500	0.00087000	0.00525100	0.01050199	0.00445200	0.00000000	0.00000000
135.000	0.00008200	0.00262600	0.00593599	0.00159800	0.00011400	0.00000000
157.500	0.00068500	0.00308200	0.00730599	0.00274000	0.00000000	0.00000000
180.000	0.00070900	0.00764799	0.01974898	0.00696299	0.00022800	0.00000000
202.500	0.00022800	0.00353900	0.01004599	0.00445200	0.00011400	0.00000000
225.000	0.00034200	0.00342500	0.00924699	0.00479500	0.00011400	0.00011400
247.500	0.00036700	0.00422400	0.00844699	0.00627899	0.00068500	0.00000000
270.000	0.00043900	0.00274000	0.00616399	0.00525100	0.00102700	0.00011400
292.500	0.00031700	0.00262600	0.00547899	0.00296800	0.00045700	0.00000000
315.000	0.00059200	0.00388100	0.00502300	0.00091300	0.00011400	0.00000000
337.500	0.00054900	0.00627899	0.00616399	0.00205500	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 5

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00000000	0.01209999	0.00662099	0.00000000	0.00000000	0.00000000
22.500	0.00000000	0.00993199	0.00228300	0.00000000	0.00000000	0.00000000
45.000	0.00000000	0.01095899	0.00308200	0.00000000	0.00000000	0.00000000
67.500	0.00000000	0.01221499	0.00399500	0.00000000	0.00000000	0.00000000
90.000	0.00000000	0.01483999	0.00787699	0.00000000	0.00000000	0.00000000
112.500	0.00000000	0.00719199	0.00319600	0.00000000	0.00000000	0.00000000
135.000	0.00000000	0.00867599	0.00148400	0.00000000	0.00000000	0.00000000
157.500	0.00000000	0.00844699	0.00171200	0.00000000	0.00000000	0.00000000
180.000	0.00000000	0.01404099	0.00433800	0.00000000	0.00000000	0.00000000
202.500	0.00000000	0.00878999	0.00274000	0.00000000	0.00000000	0.00000000
225.000	0.00000000	0.00650699	0.00274000	0.00000000	0.00000000	0.00000000
247.500	0.00000000	0.00833299	0.00365300	0.00000000	0.00000000	0.00000000
270.000	0.00000000	0.00468000	0.00593599	0.00000000	0.00000000	0.00000000
292.500	0.00000000	0.00502300	0.00536499	0.00000000	0.00000000	0.00000000
315.000	0.00000000	0.00216900	0.00228300	0.00000000	0.00000000	0.00000000
337.500	0.00000000	0.00331100	0.00593599	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 6

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00829799	0.01757998	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00662399	0.01324199	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00722099	0.01826498	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00742599	0.01426899	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00609599	0.01952098	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00279300	0.00844699	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00241200	0.00582199	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00363800	0.00616399	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00600499	0.01438399	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00329700	0.00741999	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00360500	0.00593599	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00313200	0.00627899	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00403000	0.00616399	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00196900	0.00456600	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00276900	0.00468000	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00477100	0.00947499	0.00000000	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- VERTICAL POTENTIAL TEMPERATURE GRADIENT (DEGREES KELVIN/METER) -

	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
STABILITY CATEGORY 10.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.
STABILITY CATEGORY 20.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.
STABILITY CATEGORY 30.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.
STABILITY CATEGORY 40.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.
STABILITY CATEGORY 50.	0.200000E-010.	0.200000E-010.	0.200000E-010.	0.200000E-010.	0.200000E-010.	0.200000E-010.
STABILITY CATEGORY 60.	0.350000E-010.	0.350000E-010.	0.350000E-010.	0.350000E-010.	0.350000E-010.	0.350000E-010.

- WIND PROFILE POWER LAW EXPONENTS -

	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
STABILITY CATEGORY 10.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.
STABILITY CATEGORY 20.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.
STABILITY CATEGORY 30.	0.100000E+000.	0.100000E+000.	0.100000E+000.	0.100000E+000.	0.100000E+000.	0.100000E+000.
STABILITY CATEGORY 40.	0.150000E+000.	0.150000E+000.	0.150000E+000.	0.150000E+000.	0.150000E+000.	0.150000E+000.
STABILITY CATEGORY 50.	0.350000E+000.	0.350000E+000.	0.350000E+000.	0.350000E+000.	0.350000E+000.	0.350000E+000.
STABILITY CATEGORY 60.	0.550000E+000.	0.550000E+000.	0.550000E+000.	0.550000E+000.	0.550000E+000.	0.550000E+000.



- SOURCE INPUT DATA -

C T SOURCE SOURCE X Y EMISSION BASE /  
 A A NUMBER TYPE COORDINATE COORDINATE HEIGHT ELEV- /  
 R P (M) (M) (M) ATION /  
 D E (M) /

- SOURCE DETAILS DEPENDING ON TYPE -

-----  
 X 1 STACK 0.00 0.00 12.19 0.00 GAS EXIT TEMP (DEG K)= 561.00, GAS EXIT VEL. (M/SEC)= 48.88,  
 STACK DIAMETER (M)= 0.440, HEIGHT OF ASSO. BLDG. (M)= -9.69, WIDTH OF  
 ASSO. BLDG. (M)= 74.92, WAKE EFFECTS FLAG = 0

- DIRECTION SPECIFIC BUILDING DIMENSIONS -

SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE
1	9.7,	75.0,	0	2	9.7,	75.0,	0	3	9.7,	75.0,	0	4	9.7,	75.0,	0
5	9.7,	75.0,	0	6	9.7,	75.0,	0	7	9.7,	75.0,	0	8	9.7,	75.0,	0
9	9.7,	75.0,	0	10	9.7,	75.0,	0	11	9.7,	75.0,	0	12	9.7,	75.0,	0
13	9.7,	75.0,	0	14	9.7,	75.0,	0	15	9.7,	75.0,	0	16	9.7,	75.0,	0

- SOURCE STRENGTHS ( GRAMS PER SEC ) -

SEASON 1 SEASON 2 SEASON 3 SEASON 4  
 1.33000E+00

WARNING - HW/HB > 5 FOR SOURCE 1 PROG. USES LATERAL VIRTUAL DIST. FOR UPPER BOUND OF CONCENTRATION (DEPOSITION) IN SECTOR(S):  
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.  
 IF LOWER BOUND IS DESIRED SET THE DIRECTION SPECIFIC BUILDING HEIGHT TO < 0 (WAKE EFFECTS FLAG) AND RERUN.

\*\* ANNUAL GROUND LEVEL CONCENTRATION ( MICROGRAMS PER CUBIC METER ) DUE TO SOURCE 1 \*\*

- GRID SYSTEM RECEPTORS -

- X AXIS (RANGE , METERS) -

100.000 200.000 300.000 400.000 500.000 750.000 1000.000 1250.000  
 Y AXIS (AZIMUTH BEARING, DEGREES ) - CONCENTRATION -

360.000	0.468692	0.463875	0.677546	0.785197	0.790353	0.666367	0.547727	0.457303
337.500	0.282777	0.264902	0.368666	0.409949	0.400722	0.321056	0.258240	0.214329
315.000	0.208333	0.210829	0.318319	0.360490	0.350829	0.275897	0.221055	0.183985
292.500	0.292856	0.289127	0.428794	0.493518	0.489766	0.403362	0.329469	0.274177
270.000	0.395375	0.425244	0.671043	0.806253	0.824677	0.705903	0.585039	0.492401
247.500	0.348816	0.351246	0.509812	0.581274	0.574448	0.472955	0.391447	0.332171
225.000	0.228046	0.242040	0.378339	0.447382	0.450696	0.380204	0.321006	0.277807
202.500	0.157832	0.161541	0.249474	0.297267	0.304666	0.267947	0.233484	0.206673
180.000	0.268095	0.275909	0.429580	0.517838	0.533725	0.476989	0.418393	0.366929
157.500	0.170817	0.172392	0.254890	0.295839	0.299358	0.265967	0.233266	0.203337
135.000	0.279979	0.258046	0.347407	0.373253	0.355394	0.276280	0.217060	0.174936
112.500	0.356141	0.328752	0.439978	0.468572	0.441627	0.338133	0.265408	0.215872
90.000	0.461718	0.403958	0.500813	0.517655	0.480551	0.363458	0.285174	0.232744
67.500	0.349417	0.317333	0.437882	0.491804	0.483234	0.393061	0.318884	0.264777
45.000	0.339694	0.306604	0.406617	0.448121	0.437258	0.353600	0.284718	0.234740
22.500	0.246003	0.239733	0.350935	0.415904	0.426260	0.365395	0.301508	0.252413

- DISCRETE RECEPTORS -

X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION	X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION	X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION
------------------	-----------------------------	---------------	------------------	-----------------------------	---------------	------------------	-----------------------------	---------------

317.0	10.0	0.538878	332.0	20.0	0.410048	357.0	30.0	0.400955
402.0	40.0	0.434091	366.0	50.0	0.443128	323.0	60.0	0.435925
296.0	70.0	0.434870	283.0	80.0	0.440826	277.0	90.0	0.480026
283.0	100.0	0.444198	253.0	110.0	0.387566	171.0	120.0	0.323564
134.0	130.0	0.305910	113.0	140.0	0.262573	98.0	150.0	0.198531
91.0	160.0	0.163143	88.0	170.0	0.194004	85.0	180.0	0.231970
88.0	190.0	0.189450	91.0	200.0	0.153073	101.0	210.0	0.176803
113.0	220.0	0.222109	137.0	230.0	0.277127	134.0	240.0	0.332840
122.0	250.0	0.378751	119.0	260.0	0.395207	116.0	270.0	0.425496
119.0	280.0	0.367563	122.0	290.0	0.320739	134.0	300.0	0.280024
149.0	310.0	0.241510	177.0	320.0	0.230457	229.0	330.0	0.249857
250.0	340.0	0.331194	259.0	350.0	0.453311	311.0	360.0	0.697108

\*\* ANNUAL GROUND LEVEL CONCENTRATION ( MICROGRAMS PER CUBIC METER ) DUE TO SOURCE 1 (CONT.) \*\*

- 10 CONTRIBUTING VALUES TO PROGRAM DETERMINED MAXIMUM 10 OF ALL SOURCES COMBINED -

X COORDINATE RANGE (METERS)	Y COORDINATE AZIMUTH BEARING (DEGREES)	CONCENTRATION
500.00	270.00	0.824677
400.00	270.00	0.806253
500.00	360.00	0.790353
400.00	360.00	0.785197
750.00	270.00	0.705903
311.00	360.00	0.697108
300.00	360.00	0.677546
300.00	270.00	0.671043
750.00	360.00	0.666367
1000.00	270.00	0.585039

\*\*\*\*\* END OF ISCLT PROGRAM, 1 SOURCES PROCESSED \*\*\*\*\*

**APPENDIX B**

## APPENDIX B

### ECONOMIC IMPACT ANALYSIS METHODOLOGY

In the "top-down" approach, the economic impact along with environmental and energy impacts is one of three main criteria for BACT evaluation in considering any emission control method. The economic analysis determines the cost effectiveness of each applicable emission control alternative.

The economic analysis is based on the cost estimating procedure outlined in EPA's control cost manual (EPA, 1990b). An overall description of this cost estimating methodology is given as follows:

1. The total capital investment consists of direct capital and indirect capital costs. The direct capital cost includes the purchased equipment cost and the direct installation cost. The indirect capital cost accounts for other indirect expenses pertaining to the installation of the emission control device, such as engineering, construction and field expenses, contractor fee, contingencies, and startup and testing.
2. The annualized cost consists of the direct operating cost, the indirect operating cost, and the capital recovery cost. The direct operating cost includes both annual operating and maintenance costs, cost of replacement parts, and fuel costs. The indirect annual operating cost accounts for items such as overhead, property taxes, insurance, and administration. The capital recovery cost is calculated from the total capital investment cost using a capital recovery factor.
3. The total annual operating cost is divided by the total emission reduction of the control system to result in dollars per ton of pollutant removed (i.e., dollars per ton of  $\text{NO}_x$  in this case). This value is defined as the cost effectiveness of the control method. Incremental cost effectiveness of one control method over

another is also calculated based on the incremental annual cost and incremental emission reduction.

Detailed descriptions of the cost estimates are presented in the following three sections for the SCR system being evaluated as an add-on control device for the lean-burn engine. The discussion includes economic analyses of the lean-burn engine and the NSCR system for the rich-burn engine. The baseline cost estimate is based on the rich-burn engine since it has been defined as the baseline engine on which all emission calculations are based.

#### SECTION I TOTAL CAPITAL INVESTMENT (TCI)

The TCI cost for the SCR converter covers a complete turn-key system. The basic purchased equipment costs consist of the differential reciprocating IC engine cost and the SCR system cost. The differential engine cost accounts for the difference in cost between the higher cost lean-burn and the lower cost rich-burn engines as quoted by Cooper Industries, Inc. The cost of the SCR system is either a printed cost quotation or a "ball park" estimate of unit cost per brake horsepower obtained directly from the equipment vendors. Subsequently, other direct and indirect capital cost items are estimated from cost factors based on standard cost estimating guidelines (EPA, 1990b). The estimating method provides accuracies on the order of plus or minus 20 percent.

The direct capital costs (DCC) for the SCR converter are comprised of purchased equipment costs and direct installation costs. Purchased equipment costs represent the free on board (FOB) delivery costs of the differential lean-burn engine, the emission control basic equipment, ammonia auxiliary system, exhaust reheat duct burner system, emission monitoring equipment, structure support, instrumentation, freight, and sales tax. The differential engine cost accounts for the difference in costs of the lean-burn engine and an equivalent rich-burn engine (i.e., equivalent in terms of output). Emission control basic equipment consists of all catalyst structure, and mechanical and electrical components

required for efficient operation of the device. These include such items as internal piping and exhaust gas ductwork.

The storage tank and delivery equipment costs for the ammonia system were obtained from the ammonia supplier. The ammonia system was designed for a typical 3-month supply of anhydrous ammonia and its auxiliary equipment such as ammonia vaporizer/injection components.

The cost of the auxiliary equipment for reheating the exhaust gas accounts for the duct burner system required to bring the exhaust temperature from 495°F to 700°F. Without raising the temperature, the SCR system would not work properly.

Emission monitoring costs include the cost of NO<sub>x</sub> and O<sub>2</sub> continuous monitors, which are not included in the basic equipment costs. These monitors are tied to the ammonia injection system to ensure proper NO<sub>x</sub> reduction. These costs are estimated at 15 percent of the SCR basic equipment cost.

Structure support costs account for miscellaneous external piping, auxiliary support, independent flow controllers and indicators for the connection between the basic equipment and the ammonia system. Costs are estimated at 10 percent of the overall equipment cost. Overall equipment includes the engine, emission control device, exhaust reheating heater, monitoring equipment, and any other auxiliary system.

Plant instrumentation and controls are usually not included in the basic equipment cost; typical cost factors range from 10 to 15 percent of the overall equipment cost, depending on the specific application.

The purchased equipment costs are then the basis for determining the direct and indirect installation costs. The installation costs are based on standard cost factors (EPA, 1990b).



The direct installation costs consist of the direct expenditures for materials and labor for site preparation, foundations, structural steel, erection, piping, electrical, painting, and insulation. Direct installation costs are expressed as a percentage of the total basic equipment costs for standard industrial installations.

The indirect capital costs (ICC) typically cover several areas, such as: engineering and supervision, construction and field expenses, construction contractor fee, contingencies, start-up and testing, and working capital. Each of the above items is based on a percentage of the DCC; except for the working capital which is based on the direct operating cost (DOC).

For the proposed lean-burn engine, the TCI cost estimate is also calculated by summing the purchased equipment costs, direct installation costs, and indirect capital costs. In this case, the itemized basic purchased equipment costs only include the differential engine cost, instrumentation, freight, and sales tax. Other direct and indirect installation costs are estimated by multiplying the sum of the basic purchased equipment costs by the standard cost factors.

The TCI cost estimate for the NSCR converter was based on a similar cost estimating procedure. Basic purchased equipment costs for the NSCR system include the basic converter, emission monitoring, structural support, instrumentation, freight, and sales tax. The direct and indirect installation costs follow a similar procedure to the one described above.

## SECTION II ANNUALIZED COST (AC)

The AC estimates for each SCR system are comprised of the direct operating costs (DOC), the indirect operating costs (IOC) and the capital recovery cost (CRC). The DOC includes the operating labor, maintenance, replacement catalyst and parts, utilities, and ammonia supply. The IOC includes plant overhead, property taxes, insurance, and administration. The CRC accounts for the annualized cost of the initial capital investment for the emission control system.

## 2.0 PROJECT DESCRIPTION

A plot plan of FGTC's Compressor Station No. 18, showing the location of the plant boundaries, the existing engines, and the proposed additional engine, is presented in Figure 2-1. The following sections describe the existing operations at this location, as well as a description of the proposed project.

### 2.1 EXISTING OPERATIONS

FGTC's existing Compressor Station No. 18 consists of four 2,000-bhp natural-gas-fired reciprocating IC engines. All of the engines are Worthington Model SEHG-8. These engines were installed prior to the CAA amendments of 1977: three engines were installed in 1959; and the fourth engine was installed in 1968. These existing engines are not being modified as part of this expansion project; therefore, they are not subject to PSD review.

### 2.2 PROPOSED COMPRESSOR STATION ADDITION

The proposed engine will be used to drive a gas compressor that is a part of the mechanical prime mover of the main gas transmission line that transports natural gas from source wells in Texas and Louisiana. The proposed engine will play a critical part in recompressing the natural gas for delivery throughout Florida. Without the proposed engine, it would not be possible to increase the volumetric delivery capacity in order to meet both short-term and long-term demands for natural gas in Florida.

FGTC proposes to install one natural-gas-fired engine at the Compressor Station No. 18. The expansion plan currently calls for installation of a Cooper-Bessemer Model GMVR-12C2 integral engine-compressor unit. The engine has 12 power cylinders and is rated at 2,400 bhp at 330 revolutions per minute (rpm). The engine is turbocharged, increasing the air inlet manifold pressure, which allows the engine to operate at a high air-to-fuel ratio. This turbocharging provides more power output from the engine than would otherwise be attained without having to use a larger size engine. A

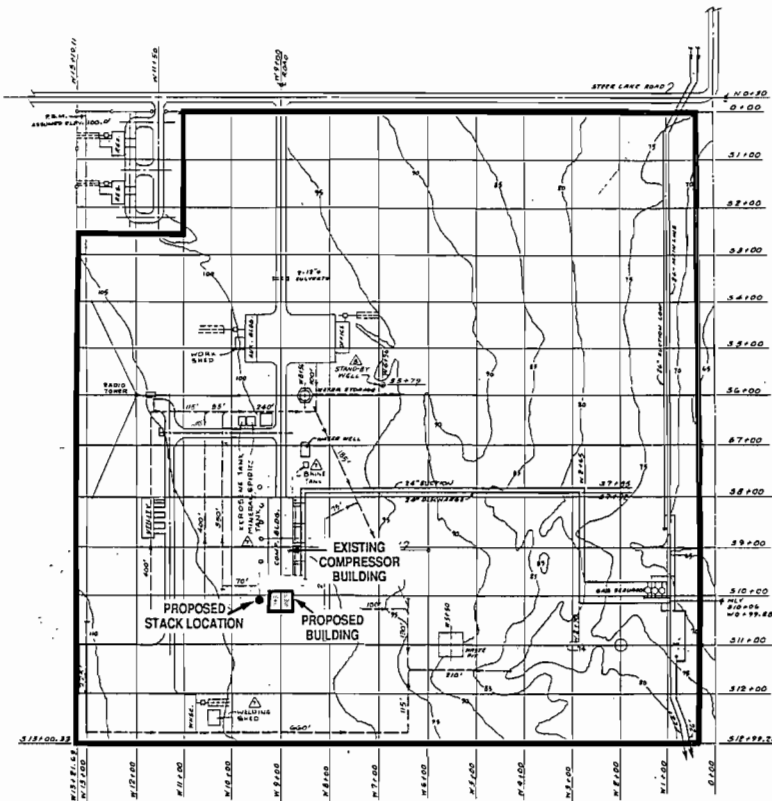


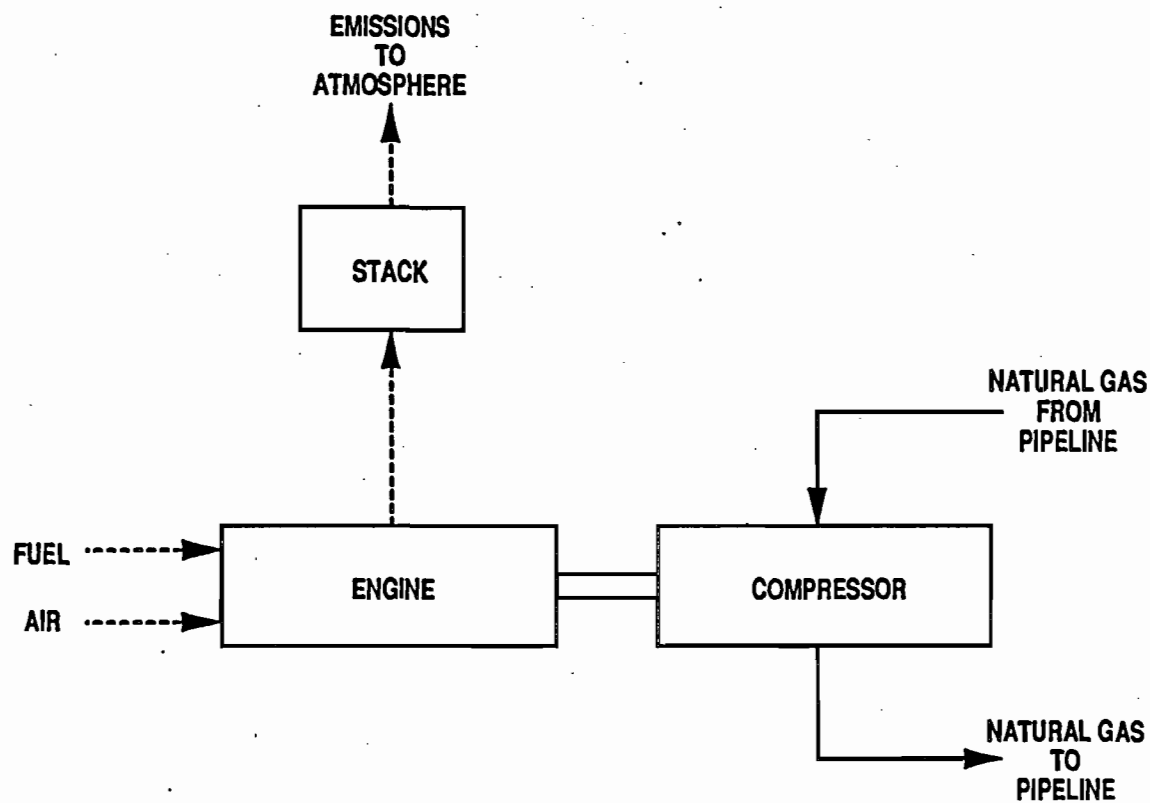
Figure 2-1 PLOT PLAN OF COMPRESSOR STATION NO. 18

flow diagram of the integral engine compressor unit is presented in Figure 2-2. Fuel fired will be exclusively natural gas, supplied from the FGTC's gas pipeline. Based on the operating characteristics and design, this engine is classified as a high-power, large-bore, slow-speed reciprocating IC engine according to the U.S. Environmental Protection Agency's (EPA's) documented classification (EPA, 1979). Engine specifications and stack parameters for the proposed engine are presented in Table 2-1.

The proposed engine will incorporate "lean-burn" technology, which is state-of-the-art design for minimizing air pollutant concentration in the exhaust gases from gas-fired reciprocating IC engines. In the lean-burn design, a small, fuel-rich mixture is combusted in a pre-ignition chamber. The hot combustion gases from the pre-ignition chamber then pass to the main combustion chamber, where they ignite a lean mixture of fuel. Since most of the fuel entering the engine is burned in a lean state (i.e., high ratio of air to fuel), exhaust  $\text{NO}_x$  emissions are minimized. However, volatile organic compound (VOC) emissions are approximately 40 to 50 percent higher than standard "rich-burn" engines.

Maximum hourly and annual emissions of regulated pollutants from the proposed engine are presented in Table 2-2. Emissions of  $\text{NO}_x$ , carbon monoxide (CO), and VOC are based on the engine manufacturer's guarantee. Particulate matter (PM) emissions are based upon EPA publication AP-42 (EPA, 1988d) emission factors for natural gas combustion in boilers. Emissions of sulfur dioxide ( $\text{SO}_2$ ) are based on ENRON's natural gas specification. According to EPA's publication entitled Toxic Air Pollutant Emission Factors--A Compilation for Selected Air Toxic Compounds and Sources, there are no emission factors for other regulated pollutants due to natural gas combustion in stationary IC engines (EPA, 1988a).

In order to accommodate the new engine at the existing compressor station site, a new 40-ft by 53-ft compressor building will be built at approximately 40 ft from the south end of the existing compressor building.



2-4

Figure 2-2 PROCESS FLOW DIAGRAM OF AN INTEGRAL ENGINE-COMPRESSOR UNIT



Florida Gas  
Transmission Company

Table 2-1. Engine Specifications and Stack Parameters for the Proposed Project

Parameter	Design Specification
<u>Engine-Compressor</u>	
Manufacturer	Cooper-Bessemer
Model	GMVR-12C2
Air Charging	Turbocharged
Unit Size	2,400 bhp
Number of Power Cylinders	12 cylinders
Number of Compressor Cylinders	6 cylinders
Power Cylinder Data	
Bore Size	14 inches
Stroke	14 inches
Cylinder Power	200 bhp/cylinder
Specific Heat Input	7,000 Btu/bhp-hr
Maximum Fuel Consumption	16,311 scf/hr <sup>a</sup>
Speed	330 rpm
<u>Stack Parameters</u>	
Stack Height	40 ft
Stack Diameter	17.25 inches
Exhaust Gas FLOW	36,860 lb/hr
	15,627 acfm
Exhaust Temperature	550°F
Exhaust Gas Velocity	160.37 ft/sec

Note:

- acfm = actual cubic feet per minute.
- bhp = brake horsepower.
- Btu/bhp-hr = British thermal units per brake horsepower per hour.
- °F = degrees fahrenheit.
- ft = feet.
- ft/sec = feet per second.
- lb/hr = pounds per hour.
- scf = standard cubic feet.
- rpm = revolutions per minute.

<sup>a</sup>Based on heating value for natural gas of 1,030 British thermal units per standard cubic foot (Btu/scf).

Source: Cooper Industries, 1990.  
ENRON Corporation, 1990.

Table 2-2. Maximum Emissions From FGTC's Proposed Compressor Engine

Pollutant	Emission Factor	Reference	Maximum Emissions	
			lb/hr	TPY
Nitrogen Oxides	2.0 g/bhp-hr	Manufacturer's guarantee	10.6	46.3
Carbon Monoxide	2.1 g/bhp-hr	Manufacturer's guarantee	11.1	48.7
Volatile Organic Compounds (non-methane)	0.5 g/bhp-hr	Manufacturer's guarantee	2.6	11.6
Particulate Matter	5 lb/MMscf	AP-42, Table 1.4-1	0.08	0.36
Sulfur Dioxide	10 gr/100 scf	ENRON Specification	0.47	2.04

Note: Maximum natural gas consumption is 16,311 standard cubic feet per hour (scf/hr).

g/bhp-hr - grams per brake horsepower per hour.  
 gr/100scf - grains per one hundred standard cubic feet.  
 lb/hr - pounds per hour.  
 lb/MMscf - pounds per million standard cubic feet.  
 TPY - tons per year.

The footprint of the newly proposed compressor housing with respect to the current existing plot plan is shown in Figure 2-1. The new engine will be housed inside the newly proposed building. The location of the exhaust stack for the new engine is also shown in Figure 2-1.



### 3.0 AIR QUALITY REVIEW REQUIREMENTS AND APPLICABILITY

The following discussion pertains to the federal and state air regulatory requirements and their applicability to FGTC's proposed compressor station expansion. These regulations must be satisfied before construction can begin on the proposed source.

#### 3.1 NATIONAL AND STATE AAQS

The existing applicable national and Florida ambient air quality standards (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

Federal PSD requirements are contained in the Code of Federal Regulations (CFR), 40, 52.21, Prevention of Significant Deterioration of air quality. The state of Florida has adopted PSD regulations [Chapter 17-2.510, Florida Administrative Code (F.A.C.)] that are essentially identical to the federal regulations. PSD regulations require that all new major stationary sources or major modifications to existing major sources of air pollutants regulated under CAA be reviewed and a construction permit issued. Florida's State Implementation Plan (SIP), which contains PSD regulations, has been approved by EPA, and, therefore, PSD approval authority in Florida has been granted to FDER.

A "major facility" is defined under PSD as any one of 28 named source categories which has the potential to emit 100 TPY or more, or any other

Table 3-1. National and State AAQS, Allowable PSD Increments, and Significance Levels ( $\mu\text{g}/\text{m}^3$ )

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

<sup>a</sup>Maximum concentration not to be exceeded more than once per year.

<sup>b</sup>Achieved when the expected number of exceedances per year is less than 1.

<sup>c</sup>Proposed by EPA in the Federal Register on October 5, 1989.

<sup>d</sup>Achieved when the expected number of days per year with concentrations above the standard is less 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.

$\mu\text{g}/\text{m}^3$  = micrograms per cubic meter.

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.

stationary facility that has the potential to emit 250 TPY or more of any pollutant regulated under CAA. A "source" is defined as an identifiable piece of process equipment or emissions unit. "Potential to emit" means the capability, at maximum design capacity, to emit a pollutant considering the application of control equipment and any other federally enforceable limitations on the source's capacity. A "major modification" is defined under PSD regulations as a change at an existing major stationary facility which 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. Major new facilities and major modifications are required to undergo the following analyses 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 must also be reviewed with respect to good engineering practices (GEP) stack height regulations. If the proposed new source or modification is located in a nonattainment area for any pollutant, the source may be subject to nonattainment new source review requirements. Discussions concerning each of these requirements are presented in the following sections.

### 3.2.2 INCREMENTS/CLASSIFICATIONS

The 1977 Clean Air Act (CAA) amendments address PSD of air quality. The law specifies that certain increases in air quality concentrations above the baseline concentration level of sulfur dioxide (SO<sub>2</sub>) and particulate matter--total suspended particulates [PM(TSP)]--would constitute

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

Pollutant	Regulated Under	Significant Emission Rate (TPY)	<u>De Minimis</u> Monitoring Concentration ( $\mu\text{g}/\text{m}^3$ )
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 <sup>a</sup>
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	b	NM
Radionuclides	NESHAP	b	NM
Inorganic Arsenic	NESHAP	b	NM

<sup>a</sup>No de minimis concentration; an increase in VOC emissions of 100 TPY or more will require monitoring analysis for ozone.

<sup>b</sup>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.

NSPS - New Source Performance Standards.

NESHAP - National Emission Standards for Hazardous Air Pollutants.

$\mu\text{g}/\text{m}^3$  - micrograms per cubic meter.

Sources: 40 CFR 52.21.

Chapter 17-2, F.A.C.

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 will have an impact. Congress also directed EPA to evaluate PSD increments for other criteria pollutants and, if appropriate, promulgate PSD increments for such pollutants.

Three classifications were designated, based on criteria established in the CAA Amendments. Certain types of areas (international parks, national wilderness areas, and memorial parks larger than 5,000 acres, and national parks larger than 6,000 acres) were designated as Class I areas. All other areas of the country were designated as Class II. PSD increments for Class III areas were defined, but no areas were designated as Class III. However, Congress made provisions in the law to allow the redesignation of Class II areas to Class III areas.

In 1977, EPA promulgated PSD regulations related to the requirements for classifications, increments, and area designations as set forth by Congress. PSD increments were initially set for only SO<sub>2</sub> and PM(TSP). However, in 1988, EPA promulgated final PSD regulations for nitrogen oxides (NO<sub>x</sub>) and established PSD increments for nitrogen dioxide (NO<sub>2</sub>).

The current federal PSD increments are shown in Table 3-1. As shown, Class I increments are the most stringent, allowing the smallest amount of air quality deterioration, while the Class III increments allow the greatest amount of deterioration. FDER has adopted the EPA class designations and allowable PSD increments for PM(TSP), SO<sub>2</sub>, and NO<sub>2</sub>.

On October 5, 1989, EPA proposed PSD increments for PM<sub>10</sub>. Those proposed increments are shown in Table 3-1. The PM<sub>10</sub> increments as proposed are somewhat lower in magnitude than the current PM(TSP) increments.

The term "baseline concentration" evolves from federal and state PSD regulations and refers to a fictitious concentration level corresponding

to a specified baseline date and certain additional baseline sources. By definition in the PSD regulations, 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 sources in existence on the applicable baseline date; and
2. The allowable emissions of major stationary sources that began construction before January 6, 1975, for SO<sub>2</sub> and PM(TSP) sources, or February 8, 1988, for NO<sub>x</sub> sources; but which 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 source on which construction began after January 6, 1975, for SO<sub>2</sub> and PM(TSP) sources, and after February 8, 1988, for NO<sub>x</sub> sources; and
2. Actual emission increases and decreases at any stationary source occurring after the baseline date.

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

1. The major source baseline date, which is January 6, 1975, in the cases of SO<sub>2</sub> and PM(TSP), and February 8, 1988, in the case of NO<sub>2</sub>;
2. The minor source baseline date, which is the earliest date after the trigger date on which a major stationary source or major modification subject to PSD regulations submits a complete PSD application; and
3. The trigger date, which is August 7, 1977, for SO<sub>2</sub> and PM(TSP), and February 8, 1988, for NO<sub>2</sub>.

The minor source baseline date for SO<sub>2</sub> and PM(TSP) has been set as December 27, 1977, for the entire state of Florida (Chapter 17-2.450, F.A.C.). The minor source baseline date for NO<sub>2</sub> has been set as March 28, 1988, for all of Florida.

### 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 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.

The requirements for BACT were promulgated within the framework of PSD in the 1977 amendments of the CAA [Public Law 95-95; Part C, Section 165(a)(4)]. The primary purpose of BACT is to optimize consumption of PSD air quality 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 decision making.

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, 1990a).

#### 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 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 would potentially 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 is generally 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 utilized if the data meet certain quality assurance requirements; otherwise, additional data may need to be gathered. Guidance in designing a PSD monitoring network is provided in EPA's Ambient Monitoring Guidelines for Prevention of Significant Deterioration (EPA, 1987a).

Under the exemption rule, 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 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 analysis, estimating baseline and future air quality levels, and determining compliance with AAQS and allowable PSD increments. Designated EPA models must normally be used in performing the impact analysis. Specific applications for other than EPA-approved models require EPA's consultation and prior approval. Guidance for the use and application of dispersion models is presented in the EPA publication Guideline on Air Quality Models (EPA, 1987b). The source impact analysis for criteria pollutants may be limited to only the new or modified source if the net increase in impacts due to the new or modified source is below significance levels, as presented in Table 3-1.

Various lengths of record for meteorological data can be utilized for impact analysis. A 5-year period can be used with corresponding evaluation of highest, second-highest short-term concentrations for comparison to AAQS or PSD increments. The term "highest, second-

highest" (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 must normally be used for comparison to air quality standards.

### 3.2.6 ADDITIONAL IMPACT ANALYSES

In addition to air quality impact analyses, federal and state of Florida PSD regulations require analysis 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 due to general commercial, residential, industrial, and other growth associated with the source must also be addressed. These analyses are required for each pollutant emitted in significant amounts (Table 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, 1985). 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:

$$H_g = H + 1.5L$$

where:  $H_g$  = 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 kilometers (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.

### 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 if the proposed pieces of equipment have the potential to emit 100 TPY or more of the nonattainment pollutant, or if the modification results in a significant net emission increase of the nonattainment pollutant.

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 which 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 which are located within an area of influence are exempt from the provisions of new source review for nonattainment areas. Sources which 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 PSD REVIEW

##### 3.4.1.1 Pollutant Applicability

FGTC's Compressor Station No. 18 is located in Orange County, which has been designated by EPA and FDER as an attainment area for all criteria pollutants. The nearest nonattainment area is located more than 100 km from the compressor station site. Orange County and surrounding counties are designated as PSD Class II areas for SO<sub>2</sub>, PM(TSP), and NO<sub>2</sub>. The site is also located more than 100 km from the nearest PSD Class I area.

FGTC's existing Compressor Station No. 18 is considered to be an existing major facility because total potential emissions of any regulated pollutant from the existing facility exceed 250 TPY. As a result, PSD review is required for the proposed expansion for each pollutant for which the net increase in emissions exceeds the PSD significant emission rates presented in Table 3-2 (i.e., major modification).

Table 3-3 presents the maximum hourly and annual emissions from the proposed new compressor engine. As shown, potential NO<sub>x</sub> emissions from the engine will exceed the PSD significant emission rate for this regulated pollutant. Therefore, the proposed expansion project is subject to PSD review for NO<sub>x</sub>.

##### 3.4.1.2 Ambient Monitoring

Based upon the increase in emissions from FGTC's proposed expansion at Compressor Station No. 18, presented in Table 3-3, a PSD preconstruction ambient monitoring analysis is required for NO<sub>x</sub>. However, if the increase in impacts of a pollutant is less than the de minimis monitoring concentration, then an exemption from the preconstruction ambient monitoring requirement may be granted for that pollutant. In addition, if an acceptable ambient monitoring method for the pollutant has not been established by EPA, monitoring is not required.

Table 3-3. Maximum Potential Emissions Due to Proposed Engine at Compressor Station No. 18

Pollutant	Maximum Potential Emissions From Proposed Compressor Engine		Significant Emission Rate (TPY)	PSD Review Applies?
	(lb/hr)	(TPY)		
Nitrogen Oxides	10.6	46.3	40	Yes
Carbon Monoxide	11.1	48.7	100	No
Volatile Organic Compounds (non-methane)	2.6	11.6	40	No
Particulate Matter (TSP)	0.08	0.36	25	No
Particulate Matter (PM10)	0.08	0.36	15	No
Sulfur Dioxide	0.47	2.04	40	No

The maximum annual impact associated with the potential NO<sub>x</sub> emissions from the proposed IC engine is 0.99 μg/m<sup>3</sup>. The methodology used to predict this value is presented in Section 4.0, along with the impact analysis result. The de minimis concentration level for NO<sub>x</sub> is 14 μg/m<sup>3</sup> annual average. Since the maximum impact of NO<sub>x</sub> is less than its de minimis concentration level, the proposed expansion project is exempted from the PSD preconstruction ambient monitoring requirement for NO<sub>x</sub>.

#### 3.4.1.3 GEP Stack Height Analysis

The GEP stack height regulations allow any stack to be at least 65 m (213 ft) high. The proposed stack for the new compressor engine will be 40 ft high (12.19 m) and, therefore, does not exceed the GEP stack height. The potential for downwash of the engines' emissions due to nearby structures is discussed in Section 4.0, Source Impact Analysis.

#### 3.4.2 NONATTAINMENT REVIEW

FGTC's Compressor Station No. 18 is not located in any nonattainment area or in any area of influence of a nonattainment area. As a result, nonattainment review does not apply to the proposed expansion project.

## 4.0 SOURCE IMPACT ANALYSIS

### 4.1 ANALYSIS APPROACH AND ASSUMPTIONS

#### 4.1.1 GENERAL MODELING APPROACH

The general modeling approach follows EPA and FDER modeling guidelines for determining compliance with AAQS and PSD increments. In general, when model predictions are used to determine compliance with AAQS and PSD increments, current EPA and FDER policies stipulate that the highest annual average concentration and highest, second-highest short-term (i.e., 24 hours or less) concentration can be compared to the applicable standard.

Model predictions for annual average NO<sub>x</sub> concentrations were performed using the Industrial Source Complex Long-Term (ISCLT) model (Version 90008). A brief description of the Industrial Source Complex (ISC) model is given in Section 4.1.2.

#### 4.1.2 MODEL SELECTION

The ISC dispersion model (EPA, 1988b) was used to evaluate the NO<sub>x</sub> emissions from the proposed compressor engine. This model is contained in the EPA User's Network for Applied Modeling of Air Pollution (UNAMAP), Version 6 (EPA, 1988c). The ISC model was selected primarily for the following reasons:

1. EPA and FDER have approved the general use of the model for air quality dispersion analysis because the model assumptions and methods are consistent with those in the Guideline on Air Quality Models (EPA, 1987b);
2. The ISC model is capable of predicting the impacts from stack, area, and volume sources that are spatially distributed over large areas and located in flat or gently rolling terrain; and
3. The results from the ISC model are appropriate for addressing compliance with AAQS and PSD increments.

The ISCLT model is an extension of the Air Quality Display Model (AQDM) and the Climatological Dispersion Model (CDM). The ISCLT model uses joint



frequencies of wind direction, windspeed, 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.

Major features of the ISCLT model are presented in Table 4-1. Concentrations due to stack and volume sources are calculated by the model using the steady-state Gaussian plume equation for a continuous source. The area source equation in the ISC model is based on the equation for a continuous and finite crosswind line source.

The ISC model has rural and urban options which affect the windspeed 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 is selected. Otherwise, the rural option is used.

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 ISC model:

1. Final plume rise at all receptor locations,
2. Stack-tip downwash,
3. Buoyancy-induced dispersion,
4. Default windspeed profile coefficients for rural or urban option,
5. Default vertical potential temperature gradients, and

Table 4-1. Major Features of the ISCLT Model

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ISCLT Model Features

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- Polar or Cartesian coordinate systems for receptor locations
- Rural or one of three urban options that affect windspeed 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)
- Procedures suggested by Huber and Snyder (1976), Huber (1977), Schulmann and Hanna (1986), and Schulmann and Scire (1980) for evaluating building downwash and wake effects
- Procedures suggested by Briggs 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 windspeed with height (windspeed-profile exponent law)
- Concentration estimates for 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)

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Source: EPA, 1988a.

6. Reducing calculated SO<sub>2</sub> concentrations in urban areas by using a decay half-life of 4 hours (i.e., reduce the SO<sub>2</sub> concentration 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 based on the degree of residential, industrial, and commercial development within 3 km of the plant site.

#### 4.1.3 METEOROLOGICAL DATA

EPA (1987b) recommends the use of 5 years of representative meteorological data for use in air quality modeling. The most recent, readily available 5-year period is preferred. The meteorological data may be collected either onsite or at the nearest National Weather Service (NWS) station.

Meteorological data used in the analysis were selected based on the recommendations of the FDER for the area in which the project is located. The data consisted of a 5-year record of surface weather observations (1982-1986) from the NWS station located at the Orlando International Airport. The database consists of hourly surface data (i.e., windspeed, wind direction, etc.) that are recorded and then sent to the National Climatic Data Center (NCDC) in Asheville, North Carolina. The NCDC digitizes the recorded data onto magnetic tape for sale to the public.

The NWS station in Orlando, located 20 km east-southeast of the site, is the nearest weather station that routinely records the hourly surface data required by the air dispersion models. Because of the proximity of the Orlando NWS station to the plant site, the Orlando meteorological data are considered to be representative of weather conditions occurring at FGTC's Compressor Station No. 18 site.

The ISCLT model requires annual/seasonal mixing height data and ambient air temperatures. The appropriate values for Orlando for input to the model were obtained from FDER. The Orlando hourly surface data were input into

the National Climatic Data Center (NCDC) stability array (STAR) preprocessor program. The STAR program converts the hourly data into the joint frequency of occurrence of wind direction, windspeed and atmospheric stability. The program can produce monthly, seasonal and annual stability arrays.

#### 4.1.4 SOURCE DATA

The model parameters for the proposed compressor engine are given in Table 4-2. The location of the proposed engine stack within the FGTC's Compressor Station No. 18 site are presented in Figure 2-1.

#### 4.1.5 RECEPTOR LOCATIONS

The locations of the receptors were based on identifying the areas in which maximum concentrations would be expected due to the proposed compressor engine. A description of the receptor locations for determining maximum predicted concentrations is as follows:

1. For the ISCLT model, 128 receptors were located on 16 radials centered on the proposed engine's stack location and at downwind distances of 100, 200, 300, 400, 500, 750, 1,000, and 1,250 m.
2. To account for plant boundaries in all directions, 36 discrete receptors were located along 36 radials separated by 10-degree increments. These discrete receptors were located at the nearest plant boundary in each direction. The locations of the discrete receptors are given in Table 4-3.

Only those receptors located outside FGTC's Compressor Station No. 18 plant property were used in the determination of maximum impacts.

#### 4.1.6 BUILDING DOWNWASH CONSIDERATIONS

Based on the dimensions of the compressor building that will house the proposed engine, the stack for the proposed engine will be less than GEP height. Also, based on the location of the proposed engine's exhaust stack in relation to the compressor building, the stack will be in the influence

Table 4-2. Summary of Source Parameters Used in the Modeling Analysis

Modeled Source Number	<u>Stack Dimensions (m)</u>		<u>Operating Parameters</u>		<u>Emissions (g/s)</u>
	Height	Diameter	Temperature (K)	Velocity (m/s)	NO <sub>2</sub>
1	12.19	0.44	561	48.88	1.33

Table 4-3. Discrete Plant Boundary Receptors, Compressor Station No. 18<sup>a</sup>

Direction	Distance (km)	Direction	Distance (km)
10	0.317	190	0.088
20	0.332	200	0.091
30	0.357	210	0.101
40	0.402	220	0.113
50	0.366	230	0.137
60	0.323	240	0.134
70	0.296	250	0.122
80	0.283	260	0.119
90	0.277	270	0.116
100	0.283	280	0.119
110	0.253	290	0.122
120	0.171	300	0.134
130	0.134	310	0.149
140	0.113	320	0.177
150	0.098	330	0.229
160	0.091	340	0.250
170	0.088	350	0.259
180	0.085	360	0.311

<sup>a</sup>Relative to the proposed stack located at (0,0) meters.

of the compressor building. Therefore, the potential for building downwash must be considered in the modeling analysis.

The procedures used for addressing the effects of building downwash are those recommended in the ISC Dispersion Model User's Guide. In the ISCLT model, the building height and width are input to the model, which are used to modify the dispersion parameters if the Huber-Snyder building downwash routine is used. The effective width used by the program is the diameter of a circle of equal area to the square of the width input to the model. If a specific width is to be modeled, then the value input to the model must be calculated according to the following formula:

$$M_w = \sqrt{\pi \left(\frac{H_w}{2}\right)^2} = 0.886 H_w$$

where:  $M_w$  = building width input to the model to produce a building width of  $H_w$  used in the dispersion calculation.  
 $H_w$  = the actual building width for which dispersion calculations are desired.

If the Schulman-Scire wake effects method is used, the user inputs the building height and projected width associated with each 22.5-degree wind sector. These building heights and projected widths are the same used for GEP stack height calculations.

Although the proposed engine building (40 ft by 53 ft) is not physically connected to the existing engine housing (160 ft by 55 ft), the close proximity of these two buildings was taken into consideration by assuming a single building of 240 ft by 55 ft (or 73.2 m by 16.8 m) for a conservative prediction. A summary of actual and modeled building dimensions is presented in Table 4-4. Because of the proximity of the proposed stack to the compressor building (approximately 17 ft) and the low ratio of stack height to building height, potential downwash from this structure was assumed to occur. Because the stack-to-building height ratio is less than 1.5, the Schulman-Scire downwash method was used in the analysis. Therefore, directional-specific building height and width for each

Table 4-4. Building Dimensions used in the ISCLT Modeling, Compressor Station No. 18

Building	<u>Building Dimensions</u>			<u>Modeled Building Dimensions</u>	
	Height (m)	Length (m)	Width (m)	Height (m)	Projected Width <sup>a</sup> (m)
Compressor Building <sup>b</sup>	9.69	73.2	16.8	9.69	75.0

<sup>a</sup>Maximum projected building width was assumed to be applicable in all wind sectors.

<sup>b</sup>Dimensions are for an assumed footprint area that includes the 460 ft by 55 ft area of the existing building, the 40 ft by 53 ft area of the proposed building, and the 40 ft by 55 ft area between the two buildings.



22.5-degree wind sector was determined for use as input values in this algorithm. In order to be conservative, the diagonal of the projected building (240 ft by 55 ft) was used as the input value for width in all 16 wind sectors.

#### 4.2 MODEL RESULTS

A summary of the five-year maximum annual NO<sub>2</sub> impact concentrations predicted for the proposed compressor engine is presented in Table 4-5. As shown in this table, the maximum annual average NO<sub>2</sub> impact concentration is 0.99  $\mu\text{g}/\text{m}^3$ . This maximum concentration is predicted to occur in a direction of 270° and at a distance of 0.400 km from the proposed engine's stack. Further modeling refinement was not necessary to verify the reported maximum concentration value and the associated receptor location because of the accuracy of the sector-averaging feature in the ISCLT model and the 100 m or less separation distances between all receptors. Since the predicted maximum NO<sub>2</sub> concentration is less than the significant impact level of 1  $\mu\text{g}/\text{m}^3$  annual average concentration, further modeling for potential NO<sub>2</sub> impacts to the local surroundings of the compressor station is not required. The computer modeling printouts are provided in Appendix C.

Table 4-5. Maximum Predicted Annual Average NO<sub>2</sub> Concentrations  
Due to the Proposed Station 18 Compressor Engine for  
Comparison to Significant Impact Levels

Year Modeled	Maximum Concentration (µg/m <sup>3</sup> )	Receptor Location		NO <sub>2</sub> Significant Impact Level (µg/m <sup>3</sup> )
		Direction (°)	Distance (km)	
1982	0.96	360	0.400	1
1983	0.90	360	0.400	
1984	0.97	270	0.400	
1985	0.99	270	0.400	
1986	0.82	270	0.500	

## 5.0 SOILS, VEGETATION, VISIBILITY AND ASSOCIATED POPULATION GROWTH IMPACTS

### 5.1 IMPACTS UPON SOILS AND VEGETATION

As demonstrated in Section 4.0, FGTC's proposed IC engine will have a very minimal impact upon ambient air quality in the vicinity of the Compressor Station No. 18 site. Maximum predicted impact of NO<sub>x</sub> is below EPA significance level, and emissions of CO and VOC are low. Based on these considerations, there is expected to be no significant impact to soils or vegetation from the proposed engine.

### 5.2 IMPACTS UPON VISIBILITY

The visibility analysis required by PSD regulations is directed primarily towards Class I areas. Since there are no Class I areas located within 100 km of the site, there will be no impact upon visibility due to this proposed small source. With regard to local visibility impacts, the proposed source will meet Florida visible emission requirement of 20 percent opacity [Chapter 17-2.610(2), F.A.C.]. During normal operations, the expected actual opacity from the IC engine will be much less than 20 percent.

### 5.3 IMPACTS DUE TO ASSOCIATED POPULATION GROWTH

There will be a small increase in temporary construction workers during construction; however, there will be no increase in permanent employment at Compressor Station No. 18 as a result of adding the new engine. As a result, there will be no permanent impacts on air quality caused by associated population growth.

## 6.0 BEST AVAILABLE CONTROL TECHNOLOGY EVALUATION

The potential emissions of NO<sub>x</sub> from the proposed engine exceed the PSD significant emission rate of 40-TPY; therefore, BACT analysis for NO<sub>x</sub> is required. The complete "top-down" BACT evaluation of NO<sub>x</sub> includes a description of natural gas prime movers (Section 6.1), the identification of NO<sub>x</sub> control technologies for reciprocating internal combustion engines (Section 6.2), the environmental, energy and economic impact evaluations of all technically feasible methods (Section 6.3), and the BACT analysis summary (Section 6.4).

### 6.1 NATURAL GAS PRIME MOVERS

The prime movers in the natural gas industry are generally heavy duty natural-gas-fired stationary internal combustion (IC) engines. These engines are applied to power compressors used for pipeline transmission, field collection of gas from wells, underground storage, and gas processing plant activities. Stationary IC engines used include both gas turbines and reciprocating IC engines.

The use of gas turbines at new natural gas pipeline compression stations has increased in recent years for a wide variety of reasons. Their primary benefit is that gas turbines typically emit fewer pollutants than reciprocating IC engines (i.e., on g/bhp-hr basis); however, gas turbines are generally 10 to 15 percent less fuel efficient, requiring higher specific heat input rate (i.e., on Btu/bhp/hr basis). Also, gas turbines have been found to use more fuel to produce the same compression efficiency.

A primary limitation of gas turbines is related to their inability to respond quickly and efficiently to varying load changes in service demand. This often precludes the use of turbines when supplemental compression is required at a given compressor station. Furthermore, the use of gas turbines in conjunction with reciprocating IC engines at existing compressor stations is hindered by operating limitations. The mechanical

operation of reciprocating IC engines generates a pulse vibration that can be transferred to adjacent equipment through physical connection to the pipeline. Gas turbines are sensitive to this type of vibration due to the destructive interference nature of this vibrational frequency; therefore, their operation and reliability can be adversely effected. Based on the above discussion, the use of gas turbines for FGTC's proposed expansion is not considered further.

The use of reciprocating IC engines has been more widespread in terms of the number of installations at natural gas pipeline compressor stations. A recent Gas Research Institute research study (GRI, 1990) reports that the number of such engines is five times that of gas turbines. Advantages of using reciprocating IC engines are primarily better fuel and compression efficiencies and their capability to operate at variable loads to meet the fluctuating consumptive demands.

Reciprocating IC engines used in gas pipeline transmission are generally integral engine-compressor units designed specifically for such application. The integral units provide greater gas-moving efficiency than separable compressors and offer greater operating flexibility than gas turbines. The engines are either two-cycle or four-cycle and are rated between 900 to 13,500 bhp. Old existing engines include four-cycle rich-burn or two- and four-cycle lean-burn. New engines installed in pipeline compressor stations are generally of lean-burn combustion design, which can achieve 80 percent or greater NO<sub>x</sub> emission reduction compared to the older, rich-burn models.

## 6.2 IDENTIFICATION OF NO<sub>x</sub> CONTROL TECHNOLOGIES FOR RECIPROCATING IC ENGINES

In this section, the control technologies capable of reducing NO<sub>x</sub> emissions produced by reciprocating IC engines will be evaluated relative to their potential application as BACT for the proposed 2,400-bhp engine. This BACT analysis follows EPA's most recent draft guideline for the top-down approach (EPA, 1990a).

All potentially applicable control technologies for reciprocating IC engines are reviewed. The technologies can be separated into two major groups:

1. Reducing pollutant emissions by process modification (i.e., "low-NO<sub>x</sub>" engine design), and
2. Converting NO<sub>x</sub> in the exhaust gas by add-on catalytic exhaust gas treatment devices.

The discussion of each potential NO<sub>x</sub> control technology includes a description of the technology and the potential NO<sub>x</sub> emission reduction, if the technology is concluded to be technically feasible.

#### 6.2.1 TECHNOLOGIES INVOLVING ENGINE MODIFICATION

The concept of low-NO<sub>x</sub> reciprocating IC engines is described in the NSPS Background Information Document (BID) for stationary reciprocating IC engines issued by EPA in July 1979 (EPA, 1979). Five types of engine or process modifications have been recognized by EPA as technically viable for reducing NO<sub>x</sub> emissions from such engines:

1. Steam injection,
2. Air-to-fuel ratio changes,
3. Retarded ignition timing,
4. Derating power output, and
5. Exhaust gas recirculation.

Each of these is discussed in the following sections.

##### 6.2.1.1 Steam Injection

The concept of designing a low-NO<sub>x</sub> reciprocating IC engine focuses on controlling the combustion temperature, since thermal NO<sub>x</sub> generally increases as combustion temperature increases. Favorable conditions for thermal oxidation of molecular nitrogen can be reduced by quenching the flame temperature with low quality steam or water. In this method, water or steam is injected at a location downstream from the combustion zone inside each firing cylinder.

However, water or steam injection to reduce NO<sub>x</sub> formation does not work well at the high water injection rate required for reciprocating IC engines. Reciprocating IC engines are typically designed with high gas flow rates and operate at high excess air. Also, experiments with large-bore engines have concluded that steam injection for controlling NO<sub>x</sub> emissions can cause irreversible structural damage to the engine block (EPA, 1979). Thus, water or steam injection technology for reciprocating IC engines is considered technically infeasible. As a result, this method will not be discussed further.

#### Potential NO<sub>x</sub> Emission Reduction

Not applicable for a technically infeasible process.

#### 6.2.1.2 Air-to-Fuel Ratio Changes

The state-of-the-art concept in designing a low-NO<sub>x</sub> reciprocating IC engine involves raising the air-to-fuel ratio to create a lean fuel mixture for the combustion process. The peak combustion temperature is lowered due to lower heat of combustion from burning less fuel, and by the high excess air, which tends to dilute the combustion gases. Such combustion results in less pollutants being emitted (i.e., a cleaner burning process). Cooper-Bessemer was the first original equipment manufacturer of reciprocating IC engines to incorporate this concept into engine design, which was appropriately named CleanBurn<sup>®</sup> technology.

In general, the high air-to-fuel ratio design is referred to as lean-burn technology (LBT) for gas-fired reciprocating IC engines. The name is derived from the lean mixture of air-to-fuel in the main combustion cylinder. The air-to-fuel ratio can reach as high as 200 for some IC engine designs and operating conditions, according to one of the major reciprocating IC engine suppliers (Dresser-Rand, 1990).

LBT is primarily accomplished by increasing the stoichiometric air-to-fuel ratio over the conventional rich-burn engine. In general, small increases

in the air-to-fuel ratio (approximately 10 percent) cause a significant reduction in NO<sub>x</sub> (approximately 30 percent) with less than 5 percent fuel penalty (EPA, 1979). On turbocharged engines, this can be accomplished by operating at high manifold pressures, which results in lower combustion temperatures and reduces NO<sub>x</sub> formation. However, misfiring and erratic combustion can occur at very lean mixtures. The limits to which the air-to-fuel ratio can be increased are related to three major engine design factors:

1. The capability of the turbocharger to produce higher air manifold pressures for rated engine loading,
2. The ability of the ignition system to light-off the leaner mixtures, and
3. The combustion chamber characteristics to maintain efficient combustion with leaner combustible gaseous mixtures.

With current state-of-the-art engine and turbocharger designs coupled with advanced control technology, all of these three factors can be sufficiently achieved.

Potential NO<sub>x</sub> Emission Reduction:

<u>Pollutant</u>	<u>Uncontrolled Emission Level</u>	<u>Guaranteed Emission Level</u>	<u>Potential Percentage Reduction</u>
NO <sub>x</sub>	11.0 g/bhp-hr <sup>a</sup>	1.5-2.0 g/bhp-hr	82-86%

Note: <sup>a</sup> Represents emission level for the baseline rich-burn engine.

6.2.1.3 Retarded Ignition Timing

Retarding the spark ignition timing of the reciprocating IC engine reduces the peak combustion pressure and temperature, thereby lowering thermal NO<sub>x</sub> formation. The timing delay is measured in degrees in reference to the engine's crankshaft rotation. There are limits to how much the ignition timing can be retarded. In general, retard values range from 2 to 6 degrees, depending on engine, and NO<sub>x</sub> reduction per degree of retard decreases for increasing levels of retard.



A study by the American Gas Association showed that the NO<sub>x</sub> emissions from 10 different gas-fired naturally aspirated engine models ranged from a 7 percent reduction to a 2 percent increase per degree of ignition retardation (Urban and Springer, 1975). EPA's research (1979) reported the percent of NO<sub>x</sub> reduction per degree of retard ranged from 0.6 to 8.5 for turbocharged engines. Overall, EPA's report concluded that retarding ignition timing reduced NO<sub>x</sub> emissions 15 percent for gas-fired engines.

Potential NO<sub>x</sub> Emission Reduction:

<u>Pollutant</u>	<u>Uncontrolled Emission Level</u>	<u>Achievable Emission Level</u>	<u>Potential Percentage Reduction</u>
NO <sub>x</sub>	11.0 g/bhp-hr <sup>a</sup>	9.4 g/bhp-hr	15%
	2.0 g/bhp-hr <sup>b</sup>	1.7 g/bhp-hr	15%

Note: <sup>a</sup> Represents emission level for the baseline rich-burn engine.  
<sup>b</sup> Represents emission level for a typical lean-burn engine.

6.2.1.4 Derating Power Output

A reciprocating IC engine can be derated by operating at less than full or 100-percent rated power. The effect of derating on an engine is to reduce peak combustion cylinder temperatures and pressures, thus lowering NO<sub>x</sub> formation rates.

Reported NO<sub>x</sub> reduction levels achieved by derating vary greatly for different reciprocating IC engines primarily as a result of air charging. Data compiled by EPA (1979) show that non-turbocharged engines achieve the largest reduction because derating has a greater effect on air-to-fuel ratios. In contrast, turbocharged engines operate at an already high air-to-fuel ratio and, therefore, very little NO<sub>x</sub> reduction is achieved by derating. Normalized NO<sub>x</sub> reduction from derating (i.e., percent of NO<sub>x</sub> reduction per percent derate) is reported from 0.25 to 6.2 for normally aspirated or blower-charged engines, and 0.01 to 2.6 for turbocharged engines. The EPA report showed that NO<sub>x</sub> reduction ranged from 10 percent

increase to 90 percent reduction, and averaged approximately 40 percent reduction at a derating of 75 percent of rated torque.

Potential NO<sub>x</sub> Emission Reduction:

<u>Pollutant</u>	<u>Uncontrolled Emission Level</u>	<u>Achievable Emission Level</u>	<u>Potential Percentage Reduction</u>
NO <sub>x</sub>	11.0 g/bhp-hr <sup>a</sup>	6.6 g/bhp-hr	40%
	2.0 g/bhp-hr <sup>b</sup>	1.2 g/bhp-hr	40%

Note: <sup>a</sup> Represents emission level for the baseline rich-burn engine.

<sup>b</sup> Represents emission level for a typical lean-burn engine.

6.2.1.5 Exhaust Gas Recirculation

Exhaust gas recirculation (EGR) reduces peak combustion temperatures in a reciprocating IC engine by replacing a fraction of the combustion air with exhaust gases. The recirculated exhaust gases serve to absorb heat without providing as much additional oxygen for the oxidation of nitrogen.

EGR can be accomplished by either introducing exhaust gases into the intake manifold or restricting the exit of gases from the cylinder by internal recirculation. Externally recirculated gases must be cooled prior to being reintroduced into the combustion cylinder in order to provide greater heat absorption per charge.

EGR is most effective in reducing NO<sub>x</sub> emission from conventional rich-burn engines because its application can increase the air-to-fuel ratio. EPA's research (1979) reported a NO<sub>x</sub> reduction of 34 percent for a gas-fired, blower-charged engine with 6 percent EGR rate. Excessive EGR rates can result in increased fuel consumption, high CO emissions, and misfiring (GRI, 1990).

EGR is not effective for a lean-burn engine with a high air intake flow rate since it cannot significantly further dilute the air/fuel mixture. In

addition, no system has been developed to date for the complex control system needed to regulate the recirculation of the exhaust gases. As a result, EGR for lean-burn engines is not considered further.

Potential NO<sub>x</sub> Emission Reduction:

<u>Pollutant</u>	<u>Uncontrolled Emission Level</u>	<u>Achievable Emission Level</u>	<u>Potential Percentage Reduction</u>
NO <sub>x</sub>	11.0 g/bhp-hr <sup>a</sup>	7.3 g/bhp-hr	34%
	2.0 g/bhp-hr <sup>b</sup>	Not applicable	--

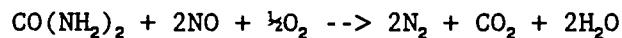
Note: <sup>a</sup> Represents emission level for the baseline rich-burn engine.

<sup>b</sup> Represents emission level for a typical lean-burn engine.

6.2.2 TECHNOLOGIES INVOLVING EXHAUST GAS TREATMENT

6.2.2.1 NO<sub>x</sub>OUT Process

The NO<sub>x</sub>OUT process originated from the initial research by the Electric Power Research Institute (EPRI) in 1976 on the use of urea to reduce NO<sub>x</sub>. EPRI licensed the proprietary process to Fuel Tech, Inc., for commercialization. In the NO<sub>x</sub>OUT 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 occurs:



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<sub>x</sub>. 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 1,000°F and 1,950°F. Advantages of the system are:

1. Low capital and operating costs due to utilization of urea injection, and
2. The proprietary catalysts used are nontoxic and nonhazardous, thus eliminating potential disposal problems.

Disadvantages of the system are:

1. Formation of ammonia from excess urea treatment rates and/or improper use of reagent catalysts, and
2.  $\text{SO}_3$ , 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  $\text{NO}_x$ OUT 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  $\text{NO}_x$  reduction,
2. A 600-million-British-thermal-unit (MMBtu) CO boiler with 60 to 70 percent  $\text{NO}_x$  reduction, and
3. A 75-megawatt (MW) pulverized coal-fired boiler with 65 percent  $\text{NO}_x$  reduction.

The  $\text{NO}_x$ OUT system has not been demonstrated on any stationary IC engine.

The  $\text{NO}_x$ OUT process is not technically feasible for the proposed lean-burn engine due to the high application temperature of 1,000°F to 1,950°F. The exhaust gas temperature of a lean-burn engine is typically between 495°F to 700°F. Raising the exhaust temperature to the required temperature level would essentially require the installation of an auxiliary 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  $\text{NO}_x$ .

#### 6.2.2.2 THERMAL DeNO<sub>x</sub>

Thermal DeNO<sub>x</sub> is Exxon Research and Engineering Company's patented process for  $\text{NO}_x$  reduction. The process is a high temperature selective noncatalytic reduction (SNCR) of  $\text{NO}_x$  using ammonia as the reducing agent. Thermal DeNO<sub>x</sub> 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 prior to ammonia injection.

The only known commercial applications of Thermal DeNO<sub>x</sub> are on industrial boilers, large furnaces, and incinerators which consistently produce exhaust gas temperatures above 1,800°F. There are no known applications or experience in the reciprocating IC engine industry. Temperatures of 1,800°F require alloy materials of construction with very large size piping and components since the exhaust gas volume would be increased by several times. As with the NO<sub>x</sub>OUT process, high capital, operating, and maintenance costs are expected due to material of construction specification, additional duct burner system, and fuel consumption. Uncontrolled emissions would increase because of the additional fuel burning.

Thus, the Thermal DeNO<sub>x</sub> process will not be considered for the proposed project because it is technically infeasible due to its high application temperature.

#### 6.2.2.3 Combination of Lean-Burn Engine and Nonselective Catalytic Reduction (NSCR)

Certain manufacturers, such as Engelhard and Johnson-Matthey, market a non-selective catalytic reduction system for NO<sub>x</sub> control on reciprocating IC 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. Rich-burn engines typically achieve low oxygen levels of less than 4 percent and the required temperature and, therefore, can use the NSCR process. Lean-burn engines, on the other hand, have a high air-to-fuel ratio, typical exhaust gas oxygen content of 12 to 15 percent, and the exhaust gas temperature is less than 700°F. As a result, NSCR is not a technically feasible add-on NO<sub>x</sub> control device for FGTC's proposed lean-burn engine. Therefore, the combination of a lean-burn engine and NSCR was not considered further in the BACT analysis.

#### 6.2.2.4 Selective Catalytic Reduction with Ammonia Injection

The NO<sub>x</sub> abatement technology for oil- and gas-fired combustion sources that is currently receiving considerable attention is the selective catalytic reduction (SCR) process with ammonia injection. Engelhard Corporation's discovery in 1957 that ammonia reacts selectively with NO<sub>x</sub> in the presence of a catalyst and excess oxygen has led to the commercialization of SCR technology for industrial boilers of various sizes. The technology has been well developed and applied in Japan, especially for control of emissions from gas-, oil-, and coal-fired utility boilers. It has been applied domestically on combustion sources which generate large quantities of NO<sub>x</sub>, such as gas turbines.

SCR catalysts consist of two types: metal oxides and zeolite. In the metal oxides catalytic system, either vanadium or titanium is embedded into a ceramic matrix structure; the zeolite catalysts are ceramic molecular sieves extruded into modules of honeycomb shape. The all-ceramic zeolite catalysts are durable, and less susceptible to catalyst masking or poisoning than the noble metal/ceramic base catalysts. All catalysts exhibit advantages and disadvantages in terms of exhaust gas temperatures, ammonia/NO<sub>x</sub> ratio, and optimum exhaust gas oxygen concentrations. A common disadvantage for all catalyst systems is the narrow window of temperature between 600°F and 900°F within which the NO<sub>x</sub> reduction process takes place (Schorr, 1989; Steuler, 1990; Engelhard, 1990; Johnson-Matthey, 1990). Operating outside this temperature range results in catastrophic harm to the catalyst system. Chemical poisoning occurs at lower temperature conditions, while thermal degradation occurs at higher temperatures. Reactivity can only be restored through catalyst replacement.

Catalysts are subject to loss of activity over time. Since the catalyst is the most costly component of the SCR system, applications require servicing and cleaning of the catalyst surface every 2,000 to 3,000 hours of operation. The cleaning normally consists of blowing the catalyst surfaces with a compressed air gun or water jet. Most catalyst suppliers guarantee a catalyst life of 3 years, assuming certain operating conditions.

Technically, SCR is potentially applicable to further reduce the already low NO<sub>x</sub> emissions (2 g/bhp-hr) from the proposed lean-burn reciprocating engine. SCR is capable of achieving NO<sub>x</sub> reduction of 70 to 90 percent. For the proposed lean-burn engine, with already low NO<sub>x</sub> concentration in the exhaust gases, vendors guarantee a removal rate of 80 percent. This would result in NO<sub>x</sub> emissions of 0.4 g/bhp-hr. This represents an overall NO<sub>x</sub> reduction of 96 percent compared to a rich-burn engine (at 11.0 g/bhp-hr).

#### 6.2.2.5 Combination of Rich-Burn Engine and NSCR

Although the draft top-down BACT guideline document dated March 15, 1990, does not require an evaluation of processes that have inherently higher emission rates than the proposed process, the option of using a rich-burn engine equipped with NSCR also was considered in the BACT analysis.

Rich-burn reciprocating IC engines are defined as those which contain less than 4 percent oxygen concentration in the exhaust gas. Rich-burn engines typically are naturally aspirated engines with near stoichiometric air-to-fuel ratios and produce exhaust gas temperatures in the range of 1,200°F to 1,300°F.

NSCR technology uses a precious metal to catalyze the reactions of NO<sub>x</sub> with CO and unburned hydrocarbon fuel in the exhaust gas streams to form nitrogen, carbon dioxide, and water vapor. A complete NSCR system includes exhaust gas oxygen sensor, exhaust gas monitor, hydrocarbon fuel injector, automatic air/fuel controller, and temperature sensor for automatic shut-down of the engine if overheating occurs. The engine exhaust entering the catalyst bed is maintained slightly fuel-rich to maximize NO<sub>x</sub> reduction. The hydrocarbon fuel injector automatically controls an adjustable valve that supplies a small amount of hydrocarbon fuel to compensate for the changes in engine load or ambient conditions.

Technically, NSCR is potentially applicable to reduce 90 percent or more of the NO<sub>x</sub> emissions in the exhaust gas of the rich-burn reciprocating IC

engine. In general, vendors guarantee a removal rate of 90 percent for an equivalent NO<sub>x</sub> emission level of 1.1 g/bhp-hr (i.e., 10 percent of the rich-burn engine NO<sub>x</sub> emission rate of 11.0 g/bhp-hr).

### 6.2.3 SUMMARY OF TECHNICALLY FEASIBLE NO<sub>x</sub> CONTROL METHODS

In summary, there are two basic alternatives for reduction of NO<sub>x</sub> emissions from reciprocating IC engines: engine modification and add-on control technology. Presented in Table 6-1 is a summary of the technical evaluation of NO<sub>x</sub> emission control methods applicable to reciprocating IC engines.

In the engine modification category, only the alternatives of air-to-fuel ratio change, retard ignition timing, derating power output, and EGR are applicable. EGR is applicable to rich-burn engines only. Steam/water injection and EGR (for lean-burn engines) are considered technically infeasible. In the add-on control technology category, only the lean-burn engine/SCR combination and rich-burn engine/NSCR combination are considered technically feasible. Other methods such as the NO<sub>x</sub>OUT process, Thermal DeNO<sub>x</sub>, and the lean-burn engine/NSCR combination are considered technically infeasible.

### 6.3 EVALUATION OF TECHNICALLY FEASIBLE NO<sub>x</sub> CONTROL METHODS

This section examines all of the technically feasible NO<sub>x</sub> control methods identified in the previous discussion. First, all five remaining control alternatives are ranked according to their total removal effectiveness. Each alternative is then examined further in regards to technical issues, environmental effects, energy requirements and impacts, and economic impacts.

The discussion also reviews current permitting practices for applications similar to FGTC's proposed project. Presented in Table 6-2 is a summary of BACT determinations for NO<sub>x</sub> emissions from gas-fired stationary reciprocating IC engines issued since 1985. The information was obtained from BACT/Lowest Achievable Emission Rate (LAER) Clearinghouse documents



Table 6-1 Summary of Technical Feasibility of NOx Emission Controls for Reciprocating Engine

Control Technology	NOx Controlled Emission Rate	Technical Feasibility	Comments
<b><u>Engine Modification Alternatives</u></b>			
Steam Injection	Not Applicable	NO	Technically infeasible due to irreversible structural damage to engine block.
Air-to-fuel Ratio Change (or Lean-Burn Technology)	1.5-2.0 g/bhp-hr	YES	Lowest emission rate achievable by engine modification, at least 80% control efficiency.
Retarding Ignition Timing			
Rich-burn Engine	9.4 g/bhp-hr	YES	Engine timing retard between 2° and 6°; average 15% NOx reduction.
Lean-burn Engine	1.7 g/bhp-hr	YES	
Derating Power Output			
Rich-burn Engine	6.6 g/bhp-hr	YES	Average 40% NOx reduction at 25% of engine power derated for gas-fired engines.
Lean-burn Engine	1.2 g/bhp-hr	YES	
Exhaust Gas Recirculation			
Rich-burn Engine	7.3 g/bhp-hr	YES	Maximum 34% NOx reduction for standard engine. Ineffective for lean-burn engine.
Lean-burn Engine	Not Applicable	NO	
<b><u>Add-on Control Technology*</u></b>			
NOxOUT Process	Not Applicable	NO	Technically infeasible (1000-1600°F), cost prohibitive for high temperature auxiliary equipment.
THERMAL DeNOx	Not Applicable	NO	Technically infeasible (above 1000°F), cost prohibitive for high temperature auxiliary equipment.
Lean-Burn Engine/NSCR	Not Applicable	NO	Technically infeasible for lean-burn engine, required <4% O2 conc. in the exhaust stream.
Lean-Burn Engine/SCR	0.4 g/bhp-hr	YES	Applicable to lean-burn engine with control efficiency of 80 percent.
Rich-Burn Engine/NSCR	1.1 g/bhp-hr	YES	Applicable to rich-burn engine only, required greater than 4% O2 conc. in exhaust gas stream. control efficiency of 90%.

\* Except for the rich-burn engine/NSCR option, all add-on control technologies are for lean-burn engines.

Table 6-2 Summary of BACT Determinations for NOx Emissions from Gas-fired Reciprocating Engines

Company Name	State	Permit Number	Date of Permit	Engine Specifications			NOx Emission Limit**			Control Method	Comments
				Fuel* Type	Make	Model	Size (Bhp)	(g/Bhp-hr)	(lb/hr)		
<b>Source Type: Natural Gas Compressor Station</b>											
Northern Natural Gas Company	IA		05-Sep-90	N.G.	Cooper		4,000	1.8	15.9		Lean burn engine
same as above	IA		05-Sep-90	N.G.	Cooper		2,000	1.8	7.9		Lean burn engine
National Fuel Gas Supply Corp.	PA	53-329-001	13-Jun-89	N.G.	Cooper	8015JHC2	3,000	2.0	13.2		Lean burn engine
Natural Gas Pipeline Company	IL	85100014	01-Mar-89	N.G.	Worthington	MLV-10	4,000	9.0	79.4		Design & oper. practice
Tennessee Gas Pipeline Company	PA	53-339-002	21-Jun-88	N.G.	Cooper	GMVH-10C	2,250	3.0	14.9		Lean burn engine
Consolidated Gas Transmission Corp.	PA	59-399-008	10-May-88	N.G.	Dresser-Rand	TCV-10	4,200	3.0	27.8		Lean burn engine Air to fuel ratio is 4.5:1
ANR Production Company	VA	11064	03-Mar-88	N.G.	Caterpillar	G398TAA	600	1.2	1.6		Catalytic converter N.G. Compressor Sta.
Southern Natural Gas Company	AL	406-0003-X	19-Feb-88	N.G.	Dresser-Rand	TCVD-10	4,160	2.2	20.2		Lean burn engine Per. cond.: stack test
National Fuel Gas Supply Corp.	PA	53-399-002	01-Feb-88	N.G.	Dresser-Rand	412 KEV-1	2,850	3.0	18.8		Lean burn engine
Shell California Production Co.	CA	147853	14-Oct-86	N.G.			600	3.2	4.2		SCR 70% reduction
Northern Natural Gas Company	IA		04-Feb-86	N.G.			4,000			250	Engine design
Consolidated Gas Transmission Corp.	PA	18-399-009	11-Dec-85	N.G.	Cooper	12W-330-C2	6,000	3.0	39.7		Lean burn engine
Shell California Production	CA	0041-6	02-Dec-85	N.G.	Caterpillar		225	0.805	0.4	50	NSCR, rich burn engine 90% reduction
<b>Source Type: Power Cogeneration and Other Uses</b>											
University of Illinois, Ch. Cir. Camp.	IL	applying	1990	N.G.	Cooper	LSVB-GDC	8,000	1.9	33.5		Lean burn engine
Northeast Landfill Power	Ri	999-1014	12-Dec-89	L.G.	Waukesha	12V-AT25GL	2,400	1.3	6.6		Lean burn engine High-speed (900 rpm)
Worcester Company	Ri	988-990	27-Sep-89	N.G.	Superior	12-SGTB	2,000	1.5	6.6		Lean burn engine High-speed (900 rpm)
City of Ventura	CA	1379-1	31-Dec-86	D.G.			773	2.0	3.4		Engine design Digestive gas
State of Utah Natural Resources	UT		01-Sep-86	N.G.			4,630	3.5	36.0		Lean burn engine Turbocharger ups fuel eff.
Tricounty Sun Energy Sheraton Hotel	CA	1369-1	07-Aug-86	N.G.	Caterpillar		200			50	NSCR, rich burn engine 90% reduction
Genstar Gas Recovery Systems	CA	30970	29-Aug-85	L.G.			2,650	1.5	8.8		Lean burn engine Landfilled gas
same as above	CA	30893	29-Aug-85	L.G.			1,100	1.5	3.6		Lean burn engine Landfilled gas
Pacific Lighting Energy	CA	30336	01-Mar-85	N.G.	Superior	16-SGTA	2,650	1.5	8.8		Lean burn engine High-speed (900 rpm)

\* N.G. = Natural Gas; L.G. = Landfilled Gas; and D.G. = Digestive Gas.

\*\* for a single engine.

from 1985 to 1990, as well as from actual permit applications, issued permits, and personal conversations with personnel of air permitting agencies from various states.

#### 6.3.1 RANKING OF FEASIBLE CONTROL TECHNOLOGIES

The top-down BACT approach requires the ranking of the NO<sub>x</sub> emission control alternatives in terms of achievable emission level. The five options, in order of removal effectiveness, are as follows: first, the lean-burn engine equipped with SCR; second, the rich-burn engine equipped with NSCR; third, the lean-burn engine with derating; fourth, the lean-burn engine with retard ignition timing; and fifth, the lean-burn engine.

A baseline condition must be established for BACT ranking and economic analysis purposes. The baseline is defined as the uncontrolled rate of the process being reviewed. Therefore, the baseline condition for the control technologies involving stationary reciprocating IC engine would be a conventional rich-burn engine with a NO<sub>x</sub> emission level of 11 g/bhp-hr (EPA, 1988d).

Presented in Table 6-3 is the BACT top-down hierarchy of technically feasible NO<sub>x</sub> control technologies, their corresponding NO<sub>x</sub> emission rates, and their control efficiencies calculated from the baseline emission level. Only control options that result in an NO<sub>x</sub> emission rate lower than the proposed lean-burn engine (2.0 g/bhp-hr) are shown in the table. Only these options are evaluated further for BACT.

#### 6.3.2 ANALYSIS OF LEAN-BURN ENGINE WITH SCR

##### Technical Issues

As the most effective NO<sub>x</sub> abatement process in terms of removal efficiency, SCR has been a more frequently attempted technology for state-of-the-art reciprocating IC engines. However, the reliability of SCR's performance on reciprocating IC engines has not been consistently demonstrated. Data on sustained NO<sub>x</sub> reduction performance for reciprocating IC engines are very limited.

Table 6-3 BACT "Top-Down" Hierarchy of NOx Control Technologies

BACT Ranking	Technology	Brake Emission Rate (g/bhp-hr)	Annual Emissions (TPY)	Total Emission Reduction (TPY)*	Total Control Efficiency (%)*
First	Lean-burn Engine with SCR	0.4	9.3	245.7	96%
Second	Rich-burn Engine with NSCR	1.1	25.5	229.4	90%
Third	Lean-burn Engine/Derating Power+	1.2	27.8	227.1	89%
Fourth	Lean-burn Engine/Retard Timing	1.7	39.4	215.5	85%
Fifth	Lean-burn Engine	2.0	46.3	208.6	82%
Baseline	Rich-burn Engine	11.0	254.9	----	----

- \* Total emission reduction and total control efficiency are calculated from baseline emission level.
- + The range of control effectiveness is dependent on the percent of engine's rated torque. The calculated values are based on 40% NOx reduction at 25% derated power (or at 75% rated torque).

Technical issues involved in the use of SCR are the narrow operating temperature range and the possible damage to the catalyst and downstream equipment. A stack gas reheat system would be required to heat the exhaust gases up to the operating temperature of the SCR (see further discussion under Energy Requirements and Impacts). This further complicates an already complicated system consisting of SCR components and ammonia handling system. The use of ammonia as a reactant for the NO<sub>x</sub> reduction reactions may allow excess ammonia to form ammonium bisulfate compounds under irregular operating conditions. These compounds can serve as catalyst poisoning agents and also cause damage to metal ductwork downstream. Thus, SCR application requires a strict maintenance service schedule. It is expected that the SCR system may require manual cleaning every 2,000 to 2,500 hours of operation (Steuler, 1990). Cleaning consists of blowing the catalyst surfaces with a compressed air gun and vacuuming any soot.

In California, the South Coast Air Quality Management District (SCAQMD, 1984) reported SCR demonstration tests on seven reciprocating engines. The report indicated that only one SCR system was able to complete the 4,000 hours of continuous testing operation; the other six engine/SCR units failed because of various reasons attributed to either poor catalyst performance and/or problematic ammonia injection operation. A recent survey report by the Gas Research Institute on SCR (GRI, 1990) states:

A total of 13 SCR units are currently installed on reciprocating engines. Only one unit involves gas transmission. A number of operational problems impacting SCR performance and engine operation have been documented. At least three SCR units applied to reciprocating engines are scheduled to be replaced with alternative controls...

In addition, a review of the BACT determinations made to date on gas-fired reciprocating IC engines (Table 6-2) reveals that SCR has never been applied specifically to any large-bore (i.e., greater than 1,000 bhp) and low-speed (i.e., 300 rpm) lean-burn engine due to the already low NO<sub>x</sub>

emission rate. The economic consideration is also a significant factor for not using SCR in such applications.

Application of SCR on gas-fired engines has been limited to small-bore, high-speed engines typically less than 1,000 bhp, at 900 rpm or greater (i.e., ANR Production Company's 600-bhp engine, and Shell California Production's 600-bhp engine; see Table 6-2). The only SCR application to a large-bore reciprocating IC engine was reported for Pfizer, Inc.'s cogeneration facility in Massachusetts. This project was for a 6,710-bhp engine with estimated uncontrolled emission rates between 5 and 12 g/bhp-hr for dual-fuel (94 percent natural gas, 6 percent diesel) and diesel fuel, respectively (see Appendix A). However, Pfizer's engine is different than FGTC's proposed engine in both fuel-type and application. Furthermore, the reliability of Pfizer's operation is still in question pending its performance verification based on upcoming stack testing.

The most recent PSD permit for a reciprocating IC engine used in natural gas compression application was issued on September 5, 1990. This permit was issued to Northern Natural Gas Company for a gas-fired 4,000-bhp gas compressor engine in Iowa. It was determined by the permitting agency, the Iowa Department of Natural Resources (IDNR), that "application of SCR systems to the engine as applied for would represent a transfer of technology since none are known to be operational." They further found such "technology transfer to be unreliable at best with a high percentage of down time likely." Therefore, SCR was rejected as BACT by IDNR due to its uncertain reliability.

#### Environmental Effects

The add-on SCR technology for NO<sub>x</sub> control will pose other potential adverse environmental impacts such as accidental spills and emissions of ammonia, and solid waste disposal for the non-inert spent catalyst. These issues are briefly described in the following discussion.

The SCR system requires the use of ammonia as reagent to convert NO<sub>x</sub> to nitrogen gas and water. The main environmental impact centers around the issue of delivery, handling, and storage of ammonia, which poses inherent safety and health risks in the event of accidental releases. In proposing NO<sub>x</sub> abatement regulations for stationary gas turbines, California's South Coast Air Quality Management District (SCAQMD) has performed a risk assessment study on spill handling and storage of ammonia. The study has concluded that this aspect of SCR operation could realistically present serious consequences, and recommended further consideration of potential impacts and mitigation measures (SCAQMD, 1979). The current practice is to use an aqueous ammonia system (normally between 25 to 29 percent ammonia concentration) at installations located in populated areas. However, such practice increases the complexity, size, and the cost of the ammonia system. Furthermore, ammonia slippage is a normal occurrence during operation of SCR control equipment. NO<sub>x</sub> abatement system suppliers generally report an ammonia slippage level of 10 ppm.

Spent catalysts of the metal oxides pellet-type system must be disposed of properly. Ceramic-based honeycomb-shaped catalysts can be landfilled due to the inert intrinsic properties of ceramic materials.

#### Energy Requirements and Impacts

The add-on technology of SCR imposes further energy penalties. The additional energy requirements are caused by power loss due to additional back pressure from the SCR, electrical requirements for heating the ammonia solution and operating the injection system, and additional energy necessary for reheating the proposed engine exhaust gases from 550°F up to the SCR operating range of 700°F. [SCR manufacturers specify a typical operating temperature window between 600°F to 900°F (Engelhard, 1990; and Steuler, 1990)]. A minimum of 1.80 MMBtu/hr is required for stack gas reheating or 15,768 MMBtu/yr. However, using the lean-burn engine will result in better fuel economy than the baseline rich-burn engine. The heat input savings amounts to 2.4 MMBtu/hr or 21,024 MMBtu/yr. Thus, the net

fuel savings is 5,256 MMBtu/yr. Also, an addition of 5.1 megawatt-hour is required for the operation of the ammonia vaporizer and injection system.

#### Economic Analysis

This section presents the total capital investment (TCI) and the annualized cost (AC) of the SCR NO<sub>x</sub> control system for the proposed lean-burn engine. The analysis uses the cost of the conventional rich-burn engine as the baseline cost. The detailed economic analysis procedure is given in Appendix B.

Capital and annualized cost estimates were prepared for two SCR systems:

1. Kleenaire system from Nitrogen Nergas Corporation, which uses the metal oxide-based catalyst and can achieve an 80 percent NO<sub>x</sub> reduction on the proposed lean-burn engine; and
2. Engelhard NO<sub>x</sub> abatement system which uses the all-ceramic honeycomb catalyst and can achieve an NO<sub>x</sub> reduction efficiency of 80 percent on the proposed lean-burn engine.

Capital costs for both systems are tabulated in Table 6-4. In the purchased equipment costs for both SCR systems, the differential engine cost of \$50,000 (i.e., Item 1a in Table 6-4) is added to account for the extra cost of the lean-burn engine. The vendor's equipment quote for the Kleenaire system is \$137,000. The direct capital cost of the system is calculated to be \$405,627, and the indirect capital cost is calculated to be \$230,362. The total capital investment is \$635,989. The basic equipment cost for the Engelhard System is \$168,000. Direct capital cost is \$472,727 and the indirect capital cost is \$264,309 for a total capital investment of \$737,036.

The annualized costs for these two NO<sub>x</sub> abatement systems are given in Table 6-5. The calculation basis for cost items are also given in the table. The annualized costs are \$406,225 and \$409,321 for the Kleenaire system and the Engelhard system, respectively. Current application trend favors the use of the all-ceramic system due to its advantages of higher



Table 6-4 Capital Cost Estimates for SCR Systems for NOx Emission Control

Cost Items	Cost Factors	Costs	
		Kleenaire System+	Engelhard System++
<b>DIRECT CAPITAL COSTS (DCC):</b>			
<b>(1) Purchased Equipment</b>			
(a) Differential Engine Cost	See Note 1	\$50,000	\$50,000
(b) SCR Basic Equipment	Vendor Quote	\$137,000	\$168,000
(c) Ammonia System	See Note 2	\$13,000	\$13,000
(d) Auxiliary Equipment (Reheat)*	0.10 x (1b)	\$13,700	\$16,800
(e) Emission Monitoring	0.15 x (1b)	\$20,550	\$25,200
(f) Structure Support	0.10 x (1a-1e)	\$23,425	\$27,300
(g) Instrumentation & controls <sup>1</sup>	0.10 x (1a-1e)	\$23,425	\$27,300
(h) Freight <sup>1</sup>	0.05 x (1a-1g)	\$14,055	\$16,380
(i) Sales Tax (Florida)	0.06 x (1a-1g)	\$16,866	\$19,656
(j) Subtotal	(1a-1i)	\$312,021	\$363,636
(2) Direct Installation <sup>1</sup>	0.30 x (1j)	\$93,606	\$109,091
<b>Total DCC:</b>	<b>(1) + (2)</b>	<b>\$405,627</b>	<b>\$472,727</b>
<b>INDIRECT CAPITAL COSTS (ICC):</b>			
<b>(3) Indirect Installation</b>			
(a) Engineering & Supervision <sup>1</sup>	0.10 x (DCC)	\$40,563	\$47,273
(b) Construction & Field Expenses <sup>1</sup>	0.05 x (DCC)	\$20,281	\$23,636
(c) Construction Contractor Fee <sup>1</sup>	0.10 x (DCC)	\$40,563	\$47,273
(d) Contingencies <sup>2</sup>	0.25 x (DCC)	\$101,407	\$118,182
<b>(4) Other Indirect Costs</b>			
(a) Startup & Testing <sup>1</sup>	0.03 x (DCC)	\$12,169	\$14,182
(b) Working Capital	30-day DOC**	\$15,379	\$13,763
<b>Total ICC:</b>	<b>(3) + (4)</b>	<b>\$230,362</b>	<b>\$264,309</b>
<b>TOTAL CAPITAL INVESTMENT (TCI):</b>	<b>DCC + ICC</b>	<b>\$635,989</b>	<b>\$737,036</b>

+ Represents a typical first generation catalyst which is metal oxides embedded in ceramic matrix.

++ Represents second generation all ceramic catalyst extruded into honeycomb-shape.

\* Duct burner system to reheat the exhaust gas from 550°F up to 700°F.

\*\* 30 days of direct operating costs, calculated from the annualized cost Table 6-5 (i.e., total DOC/12 months).

<sup>1</sup> Based on catalytic incinerators, from OAQPS Control Cost Manual, Fourth Edition.

<sup>2</sup> Guaranteed efficiency and operation for the installation of SCR on large-bore and low-speed lean-burn engine. Such application is not considered as well-proven technology.

Note 1: Differential engine cost is calculated from vendor's price quotation for a lean-burn engine minus vendor's price quotation for the rich-burn engine being used as baseline.

Note 2: Ammonia vendor's quotation from LaRoche Industries, Inc. for a 2,000-gallon anhydrous ammonia tank, an ammonia evaporator, and a dual-valve pressure regulator.

Table 6-5 Annualized Cost Estimates for SCR Systems for NOx Emission Control

Cost Items	Basis	Costs	
		Kleenair System+	Engelhard System++
<b>DIRECT OPERATING COSTS (DOC):</b>			
(1) Operating Labor			
Operator <sup>2</sup>	5,840 hr/yr @ \$20/hr	\$116,800	\$116,800
Supervisor <sup>1</sup>	15% of operator cost	\$17,520	\$17,520
(2) Maintenance <sup>2</sup>	5% of direct capital cost	\$20,281	\$23,636
(3) Replacement Parts (include freight & tax)			
(a) Catalyst	(Part+Labor)xCRF; See Note 1	\$31,507	\$13,297
(b) Guard Bed	(Part+Labor)xCRF; See Note 2	\$4,544	\$0
(4) Utilities			
(a) Electricity	0.30 MW-hr/ton NH <sub>3</sub> ; \$85/MW-hr	\$437	\$437
(b) Fuel for stack reheat	\$2.06/MMBtu; See Note 3	\$32,482	\$32,482
(c) Fuel credit	\$2.06/MMBtu; See Note 4	-\$43,309	-\$43,309
(5) Ammonia	0.37 lb NH <sub>3</sub> /lb NO <sub>x</sub> ; \$250/ton NH <sub>3</sub>	\$4,287	\$4,287
Total DOC		\$184,549	\$165,150
<b>INDIRECT OPERATING COSTS (IOC):</b>			
(7) Overhead <sup>1</sup>	60% of operating labor & maintenance	\$92,761	\$94,774
(8) Property Taxes <sup>1</sup>	1% of total capital investment	\$6,360	\$7,370
(9) Insurance <sup>1</sup>	1% of total capital investment	\$6,360	\$7,370
(10) Administration <sup>1</sup>	2% of total capital investment	\$12,720	\$14,741
Total IOC		\$118,201	\$124,255
CAPITAL RECOVERY COST (CRC)	CRF of 0.1627 times TCI	\$103,475	\$119,916
<b>ANNUALIZED COST (AC):</b>	<b>DOC + IOC + CRC</b>	<b>\$406,225</b>	<b>\$409,321</b>

+ Represents a typical first generation catalyst which is metal oxides embeded in ceramic matrix.

++ Represents second generation all ceramic catalyst extruded in honeycomb shape.

<sup>1</sup> Based on catalytic incinerators, from OAQPS Control Cost Manual, Fourth Edition.

<sup>2</sup> Based on no existing installation of SCR on large-bore and low-speed lean-burn engine: 5.33 hours per shift are devoted to the emission control system operation and maintenance.

Note 1: Catalyst replacement part cost for the Kleenair System is \$69,870 with a service life of 3 years.

Catalyst replacement part cost for the Engelhard system is \$29,070 with a service life of 3 years.

Combined freight and tax factor is 11%; and CRF for a 3-year recovery period and 10% interest rate is 0.4021.

Replacement labor cost is \$50 per hour for two 8-hour days. Total cost includes both material and labor costs.

Note 2: The Kleenair system includes a guard bed which works as a pre-filter upstream from the metal oxides catalyst; the replacement part cost is \$10,000 with an estimated service life of 3 years. Required labor is for 4 hours.

Note 3: Assumed heat transfer efficiency of 80%, heat input required to raise exhaust temperature to 700°F is:

$$Q = (36,860 \text{ lb/hr})(0.26 \text{ Btu/lb}^\circ\text{F for air})(700^\circ\text{F}-550^\circ\text{F})/(0.8) = 1.80 \text{ MMBtu/hr.}$$

$$\text{Annual heat input equals } 1.80 \text{ MMBtu/hr times } 8,760 \text{ hr/yr} = 15,768 \text{ MMBtu/yr.}$$

Note 4: Heat input for lean-burn engine is calculated from 7,000 Btu/bhp-hr times 2,400 bhp = 16.8 MMBtu/hr.

Heat input for rich-burn, naturally aspirated engine is calculated from 8,000 Btu/bhp-hr times 2,400 bhp = 19.2 MMBtu/hr.

Therefore, using a better fuel efficient engine results in saving an annual heat input of:

$$(19.2 - 16.8) \text{ MMBtu/hr} \times 8,760 \text{ hr/yr} = 21,024 \text{ MMBtu/yr.}$$

removal rates and more reliable catalyst component. In general, the all-ceramic catalyst system is considered the better system since it is less susceptible to catalyst damage and results in less operating costs.

Therefore, subsequent economic cost effectiveness analysis uses the cost values computed for the Engelhard system.

### 6.3.3 ANALYSIS OF RICH-BURN ENGINE WITH NSCR

#### Technical Issues

Rich-burn engines operate at near stoichiometric air-to-fuel ratios and, therefore, generate high engine cylinder temperatures in the range of 1,200°F to 1,300°F. Engine manufacturers have found that such high temperatures do not allow loading the engine very high. For greater power output, engine manufacturers have found that engine modifications (i.e., turbocharged engines which can produce more power enhancements with lower emission levels) are the better choice than building larger engine blocks. In the current U.S. market, rich-burn engines over 2,000 bhp are not standard off-the-shelf items; however, a 2,400-bhp engine can be obtained by special order.

All known rich-burn engine/NSCR combination applications are found for small engines of approximately 1,000 bhp or less (i.e., a 600-bhp engine for ANR Production Company, Virginia; a 225-bhp engine for Shell California Production, California; and a 200-bhp engine for Tricounty Sheraton Hotel, California; see Table 6-2).

A significant technical consideration in the use of the rich-burn engine with NSCR is the NSCR's effect upon maintenance, operation, and reliability of the overall system. Any add-on technology requires substantially more maintenance, controls, monitors, and operating personnel compared to a system without add-on technology (i.e., lean-burn engine). The system will have a much greater frequency of downtime and malfunctioning such that the system will have far less operating reliability. Reliability is an extremely important consideration for a compressor station engine, which

must be operated nearly continuously throughout the year and usually is located in a remote area.

#### Environmental Effects

Catalyst disposal may be required when using NSCR, depending on the catalyst type. Most vendors guarantee a service life of 3 years for the catalyst system. Environmental impacts are expected to be minimal for the rich-burn engine/NSCR option since no toxic or hazardous reagents are required. Rich-burn/NSCR technology generally produces lower CO and VOC emissions as compared to a lean-burn engine.

#### Energy Requirements and Impacts

The NSCR converter does not require any additional fuel other than a small amount of hydrocarbon fuel used for injection into the exhaust gas mixture to ensure fuel rich conditions. However, the fuel economy of the rich-burn, naturally aspirated engine is approximately 8,000 Btu/bhp-hr (EPA, 1979) compared to the 7,000 Btu/bhp-hr for the proposed lean-burn engine. For a 2,400-bhp output, an additional 2.4 MMBtu/hr heat input is required, or approximately 21,024 MMBtu per year for an annual cost of \$43,309.

#### Economic Analysis

Capital and annualized cost estimates were prepared for a NSCR converter. Cost of the NSCR converter was provided by Johnson-Matthey as \$48,000. The NSCR can achieve 90 percent NO<sub>x</sub> reduction. The resulting NO<sub>x</sub> emission rate is 1.1 g/bhp-hr.

The total capital investment cost for a NSCR converter designed for a 2,400-bhp rich-burn engine is tabulated in Table 6-6. The direct capital cost is calculated to be \$95,584, and the indirect capital cost is calculated to be \$58,453. The total capital investment is \$154,037. Also shown in the table is the differential cost of the lean-burn engine over that of the baseline rich-burn engine.

Table 6-6 Capital Cost Estimates for Lean-burn Engine and Rich-burn Engine/NSCR System.

Cost Items	Cost Factors	Costs	
		Lean-Burn Engine	Johnson-Matthey NSCR System
<b>DIRECT CAPITAL COSTS (DCC):</b>			
(1) Purchased Equipment			
(a) Differential Engine Cost	See Note 1	\$50,000	\$0
(b) NSCR Converter	Vendor Quote	\$0	\$48,000
(c) Emission Monitoring	0.15 x (1b)	\$0	\$7,200
(d) Structural Support	0.10 x (1b-1c)	\$0	\$5,520
(e) Instrumentation <sup>1</sup>	0.10 x (1a-1c)	\$5,000	\$5,520
(f) Freight <sup>1</sup>	0.05 x (1a-1e)	\$2,750	\$3,312
(g) Sales Tax (Florida)	0.06 x (1a-1e)	\$3,300	\$3,974
(h) Subtotal	(1a-1g)	\$61,050	\$73,526
(2) Direct Installation <sup>1</sup>	0.30 x (1h)	\$18,315	\$22,058
Total DCC:	(1) + (2)	\$79,365	\$95,584
<b>INDIRECT CAPITAL COSTS (ICC):</b>			
(3) Indirect Installation			
(a) Engineering & Supervision <sup>1</sup>	0.10 x (DCC)	\$7,937	\$9,558
(b) Construction & Field Expenses <sup>1</sup>	0.05 x (DCC)	\$3,968	\$4,779
(c) Construction Contractor Fee <sup>1</sup>	0.10 x (DCC)	\$7,937	\$9,558
(d) Contingencies	See Note 2	\$11,905	\$23,896
(4) Other Indirect Costs			
(a) Startup & Testing <sup>1</sup>	0.03 x (DCC)	\$2,381	\$2,868
(b) Working Capital	30-day DOC*	\$0	\$7,794
Total ICC:	(3) + (4)	\$34,128	\$58,453
<b>TOTAL CAPITAL INVESTMENT (TCI):</b>	<b>DCC + ICC</b>	<b>\$113,493</b>	<b>\$154,037</b>

\* 30 days of direct operating costs, calculated from the annualized cost Table 6-7 (i.e., total DOC/12 months).

<sup>1</sup> Based on catalytic incinerators, from OAQPS Control Cost Manual, Fourth Edition.

Note 1: Differential engine cost is calculated from vendor's price quotation for a lean-burn engine minus vendor's price quotation for the rich-burn engine being designated as baseline.

Note 2: For lean-burn engine, 15 percent of DCC is used for a guaranteed efficiency and operation. For NSCR application, 25 percent of DCC is used for contingency based on no existing installation of NSCR on large-bore rich-burn engine.

Table 6-7 Annualized Cost Estimates for Lean-Burn Engine and Rich-Burn/NSCR System

Cost Items	Basis	Costs	
		Lean-Burn Engine	Johnson-Matthey NSCR System
<b>DIRECT OPERATING COSTS (DOC):</b>			
(1) Operating Labor			
Operator <sup>2</sup>	\$20/hr (2,920 hr/yr for NSCR)	\$0	\$58,400
Supervisor <sup>1</sup>	15% of operator cost	\$0	\$8,760
(2) Maintenance <sup>2</sup>	5% of direct capital cost	\$3,968	\$4,779
(3) Replacement Parts (include freight & tax)			
Catalyst	(Part+Labor)xCRF; See Note 1	\$0	\$21,585
(4) Fuel			
Fuel credit (gas)	\$2.06/MMBtu; See Note 2	-\$43,309	\$0
Total DOC		-\$39,341	\$93,524
<b>INDIRECT OPERATING COSTS (IOC):</b>			
(7) Overhead <sup>1</sup>	60% of operating labor & maintenance	\$2,381	\$43,163
(8) Property Taxes <sup>1</sup>	1% of total capital investment	\$1,135	\$1,540
(9) Insurance <sup>1</sup>	1% of total capital investment	\$1,135	\$1,540
(10) Administration <sup>1</sup>	2% of total capital investment	\$2,270	\$3,081
Total IOC		\$6,921	\$49,324
CAPITAL RECOVERY COST (CRC)	CRF of 0.1627 times TCI	\$18,465	\$25,062
<b>ANNUALIZED COST (AC):</b>	<b>DOC + IOC + CRC</b>	<b>-\$13,955</b>	<b>\$167,910</b>

<sup>1</sup> Based on catalytic incinerators, from OAQPS Control Cost Manual, Fourth Edition.

<sup>2</sup> Based on no existing installation of NSCR on high-load rich-burn engine: 2.667 hours per shift are devoted to the emission control system operation and maintenance.

Note 1: For NSCR, the catalyst accounts for 95% of the basic cost and has a service life of 3 year; therefore, catalyst replacement part cost is \$48,000 times 0.95 plus 11% for the combined freight and tax cost. Replacement labor cost is \$50 per hour for one 8-hour day. Total cost includes both material and labor costs. Thus, the annualized catalyst replacement cost is equal to the total replacement cost multiplied by the CRF for a 3-year recovery period and an interest rate of 10%. CRF = 0.4021.

Note 2: Heat input for lean-burn engine is calculated from 7,000 Btu/bhp-hr times 2,400 bhp = 16.8 MMBtu/hr. Heat input for rich-burn, naturally aspirated engine is calculated from 8,000 Btu/bhp-hr times 2,400 bhp = 19.2 MMBtu/hr. Therefore, using a better fuel efficient engine results in saving an annual heat input of: (19.2 - 16.8) MMBtu/hr x 8,760 hr/yr = 21,024 MMBtu/yr.

The annualized cost for the NSCR converter is given in Table 6-7. The calculation basis for cost items are also given in the table. The resulting annualized cost is \$167,910. In comparison, the annualized differential cost of the lean-burn engine itself is -\$13,955. As computed from Table 6-7, this negative value of the annualized cost for the lean-burn engine resulted from the fuel credit generated by using the proposed fuel-efficient engine.

#### 6.3.4 ANALYSIS OF LEAN-BURN ENGINE WITH DERATING POWER OUTPUT

##### Technical Issues

Derating power output does not require additional equipment. Derating is accomplished by restricting the engine torque to a level below its normal operating design rate. This is done by making adjustment to the throttle valve setting in order to change the power output. Although a derated engine produces less NO<sub>x</sub> emissions, such practice will also reduce the overall engine's efficiency and shorten its service life as much as 25 percent (Dresser-Rand, 1990). In addition, continuous derating operation would require a bigger, more expensive engine to meet the overall power requirement.

Derating power output is not considered BACT for the proposed lean-burn engine because of potential engine reliability problems, shortened engine life, and increased emissions of hydrocarbons.

##### Environmental Effects

Application of this technology would result in lower NO<sub>x</sub> and carbon monoxide (CO) emissions, but emissions of hydrocarbons would increase. For instance, Cooper Industries, Inc., has reported a 23.2 TPY emissions reduction of NO<sub>x</sub> and 2.3 TPY decrease in CO with a corresponding emissions increase of 7.0 TPY total hydrocarbons based on a 30 percent derating of the proposed 2,400-bhp lean-burn engine.

#### Energy Requirements and Impacts

In general, derating an engine will result in less fuel economy. EPA (1979) reported a fuel penalty of 8 percent based on derating power output on a dual-fuel engine by 25 percent. Manufacturers of gas-fired reciprocating engines state that approximately an 8 percent increase in fuel consumption will occur for a derating of 30 percent.

#### Economic Analysis

If derating is employed, a larger engine would be necessary to meet the FGTC power requirement of 2,400 bhp at Compressor Station No. 18. This will increase both the capital cost and annual operating cost for the engine. A detailed economic analysis was not performed for this technology.

### 6.3.5 ANALYSIS OF LEAN-BURN ENGINE WITH RETARD IGNITION TIMING

#### Technical Issues

EPA's research (1979) has reported that retard ignition timing is only effective for dual-fuel and diesel fuel burning engines. Retarding the spark for lean-burn engines will result in misfiring because spark-ignited engines are designed to be sensitive to any small deviation in timing changes. The summary of previous BACT determinations (Appendix A) shows that all ignition timing changes were exclusively applied to diesel burning reciprocating IC engines.

Ignition timing retardation increases exhaust temperatures above the engine's normal operating temperature. The increased engine operating temperature will result in additional maintenance, shorter engine life, and higher initial cost for high temperature exhaust components. Thus, retarding ignition timing for a lean-burn engine is not considered further.

#### Environmental Effects

Retarding ignition timing can increase the emission level of CO and VOC. This is due to less efficient combustion as the engine timing is changed



from the optimal setting. In the event of misfiring, unburned hydrocarbons and CO emissions may increase significantly.

Energy Requirements and Impacts

Not performed--inapplicable technology.

Economic Analysis

Not performed--inapplicable technology. The expected capital cost is equal to the cost of the lean-burn engine.

6.3.6 ANALYSIS OF LEAN-BURN ENGINE

Technical Issues

The proposed turbocharged reciprocating IC engine will operate according to the manufacturer's specified operating parameters listed in Table 6-8. The engine's state-of-the-art design includes small pre-ignition chambers in which a rich fuel mixture is spark-ignited. The hot gases then enter the main combustion chambers and create spontaneous combustion of the lean fuel mixture. As a result, the overall combustion process is conducted under very lean fuel conditions. Operations on the lean side of the air-to-fuel ratio allow the proposed engine to obtain peak fuel economy.

In general, NO<sub>x</sub> formation is directly proportional to the combustion temperature and residence time of the combustion gases (EPA, 1988d). The high mass flow rate at full-load, as indicated by the 36,860 pounds per hour of exhaust mass flow rate, reduces the residence time of the combustion gases compared to a rich-burn engine, which operates at an air-to-fuel ratio near unity. High mass flow rate also means the engine operates below the peak temperature region for thermal NO<sub>x</sub> formation. The exhaust temperature for the proposed engine is 550°F, which is lower than the exhaust temperature of between 1,200°F and 1,300°F for an equivalent rich-burn engine. Thus, the rate of thermal NO<sub>x</sub> formation is lower compared to the conventional rich-burn engine (i.e., 2 g/bhp-hr compared to 11 g/bhp-hr, respectively).

**Table 6-8 Summary of the Operating Parameters for the Proposed Engine, Station No. 18**

<b>Parameter</b>	<b>Design Specification</b>
<b>Make and Model</b>	<b>Cooper-Bessemer GMVR-12C2</b>
<b>Air/Fuel Ratio</b>	<b>Variable</b>
<b>Exhaust Mass Flow</b>	<b>36,860 lb/hr</b>
<b>Ignition Timing</b>	<b>Variable</b>
<b>Air Manifold Pressure</b>	<b>Variable</b>
<b>Air Ambient Air Temperature</b>	<b>80 °F</b>
<b>Exhaust Temperature</b>	<b>550 °F</b>
<b>Maximum Allowed Back Pressure</b>	<b>3 inches of water</b>
<b>Specific Fuel Consumption</b>	<b>7,000 Btu/bhp-hr</b>

Source: Cooper Industries, Inc. (1990).

The lean-burn engine-compressor has become the most effective method of transporting natural gas in a pipeline system judging by recent construction permits issued by several states (see Page 1 of Appendix A). The engine itself is very reliable and durable in continuous operation without requiring excessive maintenance attention as would be required in the case of additional add-on control technology.

#### Environmental Effects

There are no adverse environmental impacts expected for using the lean-burn engine, since there is no wastewater or solid waste created.

#### Energy Requirements and Impacts

The lean-burn engine is more fuel efficient than a comparable rich-burn engine. The fuel saved is 2.4 MMBtu/hr, for a total savings of 21,024 MMBtu/yr.

#### Economic Analysis

Capital and annualized cost estimates were prepared for the lean-burn engine. The differential engine cost of the lean-burn engine compared to the baseline rich-burn engine was provided by ENRON for the proposed 2,400-bhp Cooper-Bessemer GMVR-12C2 model. The engine has a guaranteed NO<sub>x</sub> emission limit of 2 g/bhp-hr.

The differential capital cost of the integral engine-compressor unit is tabulated in Table 6-6. The differential engine cost for the Cooper-Bessemer engine is \$50,000, from which the differential direct capital cost is calculated to be \$79,365, and the indirect capital cost is calculated to be \$34,128. The differential total capital investment is \$113,493.

The annualized cost is given in Table 6-7. The calculation basis for cost items is also given. The direct operating cost consists of normal maintenance cost of the lean-burn technology parts for \$3,968 and a fuel credit of \$43,309 for better fuel efficiency operation. The differential annualized cost is -\$13,955 for the lean-burn engine.

#### 6.4 BACT SUMMARY AND CONCLUSION

The BACT analysis for NO<sub>x</sub> control has identified three feasible control alternatives: the lean-burn engine with SCR, the rich-burn engine with NSCR, and the lean-burn engine. Elimination of a control technology as BACT will be based on comparison of the overall environmental, energy, and economic impacts. The most effective control alternative not eliminated will be selected as BACT.

##### 6.4.1 COMPARISON OF TECHNICAL ISSUES

Of the three alternatives, the lean-burn engine is the most reliable option for pipeline transmission application. SCR and NSCR require significant routine maintenance and scheduled downtime for replacement service but also may cause unscheduled downtime because of malfunction or failure of SCR/NSCR components. Conversely, the lean-burn engine is highly reliable and requires low maintenance over unattended continuous operation. The lean-burn engine also has the capability of operating under variable load conditions. Since most compressor stations are located in rural areas, the lean-burn engine by itself without any add-on control device is most suitable for such operation.

##### 6.4.2 COMPARISON OF ENVIRONMENTAL EFFECTS

Of the three alternatives, SCR poses the greatest potential for toxic impacts as a result of ammonia handling and storage, and ammonia slip. Comparing potential adverse environmental impacts: the lean-burn engine with SCR option is the worst due to potential ammonia release and disposal of catalysts; the rich-burn engine with NSCR is the next worse option due to disposal of catalyst. The lean-burn engine does not create any waste; therefore, it is the best alternative in terms of the environmental impact analysis.

##### 6.4.3 COMPARISON OF ENERGY IMPACTS

The lean-burn engine equipped with SCR shows a net fuel credit of 5,256 MMBtu/yr for using the fuel-efficient lean-burn engine. In addition, an annual 5.1 MW-hr of electrical power is required for the ammonia

vaporizer and injection system. The highest energy requirement is for the rich-burn/NSCR combination. This alternative does not use any additional fuel or energy for the operation of the control device. However, the rich-burn engine is less fuel efficient than the proposed lean-burn engine, making the rich-burn engine/NSCR option the worst ranking in terms of energy impacts. The lean-burn engine shows a savings of 21,024 MMBtu/yr in heat input over the rich-burn engine because of its inherent fuel efficient design. Thus, the lean-burn engine is the best alternative in view of the energy impact analysis.

#### 6.4.4 COMPARISON OF ECONOMIC ANALYSIS

Economic analysis is based on the cost effectiveness of the control method. Economic impact is determined by the total and incremental cost effectiveness values. The detailed cost estimating procedure is presented in Appendix B. Results of the economic impact analysis are summarized in Table 6-9 for all three technically feasible NO<sub>x</sub> control methods. Comparing the total cost effectiveness of these three NO<sub>x</sub> control alternatives: the lean-burn engine/SCR technology has the highest cost effectiveness value of \$1,666 per ton of NO<sub>x</sub> removed; the rich-burn engine/NSCR technology is the next highest with \$732 per ton of NO<sub>x</sub> removed. The lean-burn engine has a total cost effectiveness value of -\$67 per ton of NO<sub>x</sub> removed.

The incremental cost effectiveness values for the lean-burn engine/SCR technology and the rich-burn engine/NSCR technology are \$14,810 and \$8,744 per ton of NO<sub>x</sub> removed, respectively. The lean-burn engine has an incremental cost effectiveness of -\$67 per ton of NO<sub>x</sub> removed. Therefore, the lean-burn engine is the most cost effective control option.

#### 6.4.5 SUMMARY AND CONCLUSION

The top-down BACT analysis in terms of environmental, energy and economic impacts for the FGTC's proposed project is summarized in Table 6-9. Both the lean-burn engine/SCR and the rich-burn engine/NSCR control options are eliminated primarily based on the high total and incremental cost

Table 6-9 Summary of Top-Down BACT Impact Analysis Results for NOx

Control Alternative	Environmental Impacts				Energy Impacts		Economic Impacts			
	Total Emission Reduction (TPY)*	Incremental Emission Reduction (TPY)**	Potential toxic air impact?	Potential adverse environmental impacts?	Incremental increase over baseline		Total Annualized Cost (\$/yr)	Incremental Annualized Cost (\$/yr)	Total Cost Effectiveness (\$/ton)	Incremental Cost Effectiveness (\$/ton)
					Natural gas (MMBtu/yr)	Electricity (MW-hr/yr)				
Lean-Burn Engine with SCR	245.7	16.3	Yes	Yes	-5,256	5.1	\$409,321	\$241,409	\$1,666	\$14,810
Rich-Burn Engine with NSCR	229.4	20.8	No	Yes	0	0	\$167,910	\$181,865	\$732	\$8,744
Lean-Burn Engine	208.6	208.6	No	No	-21,024	0	-\$13,955	-\$13,955	-\$67	-\$67
Baseline (rich-burn engine)	----	----	--	--	----	--	----	----	----	----

\* Total emission reduction, total annualized cost, and total cost effectiveness are calculated based on similar baseline parameter values.

\*\* Incremental values are based on the next lower control technology's parameter values.

effectiveness for NO<sub>x</sub> control. Recently, FDER has determined that incremental cost effectiveness values of \$4,000 to \$5,000 per ton of NO<sub>x</sub> removed are unreasonable. These values were established for much larger sources of NO<sub>x</sub>, such as utility gas turbine combined-cycle projects. In addition, add-on control technologies have significant energy penalties along with potential adverse environmental impacts, and these systems are not fully proven on IC engines of the size proposed by FGTC. On the other hand, lean-burn engines are the proven method for pipeline transmission application in which minimum maintenance and unattended operation are essential. Currently, lean-burn engines are the state-of-the-art application of reciprocating IC engines capable of achieving low emission without add-on control.

By eliminating lean-burn/SCR and rich-burn/NSCR options, the lean-burn engine is BACT. This is consistent with current BACT determinations shown in Table 6-2 for similar source applications. In the most recent top-down BACT analysis, IDNR has concluded that the inherently low NO<sub>x</sub> emitting lean-burn engine is BACT for Northern Natural Gas Company. In its BACT summary, IDNR rejected SCR on the grounds of uncertain reliability and unreasonable cost effectiveness (i.e., total cost effectiveness of \$1,600 and incremental cost effectiveness of \$12,000 per ton NO<sub>x</sub> removed).

No other stationary internal combustion sources, whether in natural-gas-related applications or other industrial processes, which use similar fuel and equivalent engines (i.e., natural-gas-fired and 2,400-bhp lean-burn engine) have been required to bear a high incremental cost effectiveness to reduce NO<sub>x</sub> emissions. Furthermore, the FGTC's proposed lean-burn engine has low NO<sub>x</sub> emissions of 46.3 TPY, and modeling results show an insignificant NO<sub>x</sub> impact (less than 1.0 µg/m<sup>3</sup>). In conclusion, the FGTC's proposed Cooper-Bessemer GMVR-12C2 lean-burn engine is BACT.

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**APPENDIX A**

Appendix A Summary of BACT Determinations for NOx Emissions from Stationary Reciprocating Engines (page 1 of 2)

Company Name	State	Permit Number	Date of Permit	Total Capacity	Engine Specifications			Load (Bhp)	NOx Emission Limit*			Control Method	Comments
					Fuel Type	Make	Model		(g/Bhp-hr)	(lb/hr)	(ppm)		
<u>Source Type: Natural Gas Compressor Station</u>													
Northern Natural Gas Company	IA		05-Sep-90	4,000 Bhp	N.G.	Cooper		4,000	1.8	15.9		Lean burn engine	
same as above	IA		05-Sep-90	4,000 Bhp	N.G.	Cooper		2,000	1.8	7.9		Lean burn engine	
National Fuel Gas Supply Corp.	PA	53-329-001	13-Jun-89	6,000 Bhp	N.G.	Cooper	8015JHC2	3,000	2.0	13.2		Lean burn engine	
Natural Gas Pipeline Company	IL	85100014	01-Mar-89	1,600 Bhp	N.G.	Worthington	MLV-10	4,000	9.0	79.4		Design & oper. practice	
Tennessee Gas Pipeline Company	PA	53-339-002	21-Jun-88	2,250 Bhp	N.G.	Cooper	GMVH-10C	2,250	3.0	14.9		Lean burn engine	
Consolidated Gas Transmission Corp.	PA	59-399-008	10-May-88	8,400 Bhp	N.G.	Dresser-Rand	TCV-10	4,200	3.0	27.8		Lean burn engine	Air to fuel ratio is 4.5:1
ANR Production Company	VA	11064	03-Mar-88	1,800 Bhp	N.G.	Caterpillar	G398TAA	600	1.2	1.6		Catalytic converter	N.G. Compressor Sta.
Southern Natural Gas Company	AL	406-0003-X0	19-Feb-88	4,160 Bhp	N.G.	Dresser-Rand	TCVD-10	4,160	2.2	20.2		Lean burn engine	Per. cond.: stack test
National Fuel Gas Supply Corp.	PA	53-399-002	01-Feb-88	2,850 Bhp	N.G.	Dresser-Rand	412 KEV-1	2,850	3.0	18.8		Lean burn engine	
Shell California Production Co.	CA	147853	14-Oct-86	600 Bhp				600	3.2	4.2		SCR	70% reduction
Northern Natural Gas Company	IA		04-Feb-86	8,000 Bhp	N.G.			4,000			250	Engine design	
Consolidated Gas Transmission Corp.	PA	18-399-009	11-Dec-85	6,000 Bhp	N.G.	Cooper	12W-330-C2	6,000	3.0	39.7		Lean burn engine	
Shell California Production	CA	0041-6	02-Dec-85	225 Bhp	N.G.	Caterpillar		225	0.805	0.4	50	NSCR, rich burn engine	90% reduction

\* for a single engine.

N.G. = Natural Gas.

Appendix A Summary of BACT Determinations for NOx Emissions from Stationary Reciprocating Engines (page 2 of 2)

Company Name	State	Permit Number	Date of Permit	Total Capacity	Engine Specifications			Load (Bhp)	NOx Emission Limit*			Control Method	Comments
					Fuel Type	Make	Model		(g/Bhp-hr)	(lb/hr)	(ppm)		
<b>Source Type: Power Cogeneration and Other Uses</b>													
University of Illinois, Ch. Cir. Camp.	IL	applying	1990	16,000 Bhp	N.G.	Cooper	LSVB-GDC	8,000	1.9	33.5		Lean burn engine	
Northeast Landfill Power	RI	999-1014	12-Dec-89	19,200 Bhp	L.G.	Waukesha	12V-AT25GL	2,400	1.3	6.6		Lean burn engine	High-speed (900 rpm)
Pfizer, Inc.	MA	B-87-C-006	16-Nov-89	6,710 Bhp	Dual/Diesel	Cooper	LSVB-16-GDT	6,710	0.7	10.1		SCR	90% reduction
Cogentrix (formerly Xiox)	PA	33-399-004	31-Oct-89	20,904 Bhp	Dual	Wartsila	16V32GD	6,968	5.0	76.8		Engine retardation	
Worcester Company	RI	988-990	27-Sep-89	6,000 Bhp	N.G.	Superior	12-SGTB	2,000	1.5	6.6		Lean burn engine	High-speed (900 rpm)
Citizens Utilities	HI	HI 88-04	19-Sep-89	42,000 Bhp	Diesel			10,500			605	Engine design	
Key West Electric System	FL	PSD-FL-135	05-Jun-89	26,532 Bhp	Diesel			13,266	6.0	175.5		Engine timing retard	
Maul Electric Company, Inc.	HI	HI 87-01	30-Dec-88	33,400 Bhp	Diesel			16,700	7.0	256.1	595	5° Ignition retard	20% reduction
Power Ventures	FL	PSD-FL-120	05-Dec-88	8,800 Bhp	Dual	Undetermined			5.0			Engine design	
same as above	FL	PSD-FL-120	05-Dec-88	8,800 Bhp	Diesel	Undetermined			12.0			Engine design	
Maul Pineapple Co., Ltd.	HI	HI 87-02	17-May-88	4,020 Bhp	Diesel			2,010	5.2	23.0	536	2° Ignition retard	
same as above	HI	HI 87-02	17-May-88	6,040 Bhp	Diesel			3,020	5.3	35.0	520	2° Ignition retard	
Maul Electric Company, Inc.	HI	HI 86-02	17-Nov-87	6,700 Bhp	Diesel			3,350	9.3	68.4	600	4° Ignition retard	20% reduction
Hawaii Electric Light Co., Inc.	HI	HI 85-03	17-Nov-87	10,050 Bhp	Diesel			3,350	9.3	68.4	600	4° engine retard	20% reduction
City of Ventura	CA	1379-1	31-Dec-86	773 Bhp	D.G.			773	2.0	3.4		Engine design	Digestive gas
State of Utah Natural Resources	UT		01-Sep-86	18,000 Bhp	N.G.			4,630	3.5	36.0		Lean burn engine	Turbocharger ups fuel eff.
Tricounty Sun Energy Sheraton Hotel	CA	1369-1	07-Aug-86	200 Bhp	N.G.	Caterpillar		200			50	NSCR, rich burn engine	90% reduction
LaJet Energy Company	CA	85096	17-Jul-86	1,385 Bhp	Diesel	Cummins	KTTA-50CC	1,385	5.4	16.5		Engine design	
3M	TX	PSD-TX-674	30-May-86	8,386 Bhp	Dual	Cooper	LSVG-20-GDT	8,386	5.0	92.4		Engine design	
Genstar Gas Recovery Systems	CA	30970	29-Aug-85	2,650 Bhp	L.G.			2,650	1.5	8.8		Lean burn engine	Landfilled gas
same as above	CA	30893	29-Aug-85	1,100 Bhp	L.G.			1,100	1.5	3.6		Lean burn engine	Landfilled gas
Pacific Lighting Energy	CA	30336	01-Mar-85	2,650 Bhp	N.G.	Superior	16-SGTA	2,650	1.5	8.8		Lean burn engine	High-speed (900 rpm)

\* for a single engine. Note: N.G. = Natural Gas; L.G. = Landfilled Gas; D.G. = Digestive Gas.

In the DOC category, the annual operating labor includes the operator and supervisor costs for continuous operation. The operator cost for the SCR system was calculated based on 5.33 hours per shift devoted to regular maintenance and safety assurance procedure for the emission control system, which include the operation of the ammonia system. The maintenance requirement is 5 percent of the DCC.

Catalyst replacement cost was calculated using a capital recovery factor (CRF) computed for a three-year recovery period and a 10 percent interest rate. The CRF equation is given below. The total catalyst replacement cost includes the replacement part cost and the labor cost for technical supervision by the catalyst supplier.

The utility costs are the sum of the itemized costs for electricity, natural gas for exhaust stack gas reheat, and a fuel credit for using the more efficient lean-burn engine. Electricity cost is based on the estimated total annual consumption for the ammonia vaporizer/injection system. The unit cost for electrical power is current standard cost value. The price of natural gas is based on current natural gas pricing (DOE/EIA, 1989). The total tonnage of ammonia is calculated by the ammonia molar equivalent required to convert the total estimated NO<sub>x</sub> emissions.

Indirect operating costs include the cost of plant overhead, property taxes, insurance, administration, and capital recovery cost. These costs are typically either one or two percent of the total capital investment; except the overhead which is sixty percent of the operating labor and maintenance costs. The capital recovery cost (CRC) is based on the service life of the control system, interest rate, capital depreciation rate, and total capital investment. The CRC is calculated by multiplying the TCI by the capital recovery factor (CRF), which is defined as:

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

where:  $i$  = annual interest rate (in percent), and  
 $n$  = equipment service life (in years).



The standard estimated equipment service life for each alternative is 10 years, and the average interest rate is assumed to be 10 percent.

The annualized cost is the sum of the DOC, IOC, and CRC.

The annualized cost estimates for the lean-burn engine and the NSCR converter use similar cost estimating procedure as shown for the SCR system, with the exception of the ammonia supply in the DOC category. The DOC of the NSCR system includes the costs of the operating labor, maintenance, and catalyst replacement.

### SECTION III COST EFFECTIVENESS

In general, the cost effectiveness of SCR, lean-burn engine, or rich-burn engine/NSCR option is based on the annualized cost of each system and the associated annual pollutant emission reduction. This is determined by dividing the annualized cost by the tonnage of pollutant removed per year.

This cost effectiveness value is presented in terms of total cost effectiveness and incremental cost effectiveness. The total cost effectiveness values are based on the differences in costs and tonnages of NO<sub>x</sub> emitted between a given emission control option and the baseline. The incremental cost effectiveness values are based on the difference in costs and tonnages of NO<sub>x</sub> emitted between a given emission control option and the next most effective control option.

**APPENDIX C**

**ISCLT PRINTOUTS  
FLORIDA GAS TRANSMISSION COMPANY  
COMPRESSOR STATION NO. 18**

ISCLTK6L MODEL, A VERSION OF  
ISCLT (VERSION 90008)  
AN AIR QUALITY DISPERSION MODEL IN  
SECTION 1. GUIDELINE MODELS.  
IN UNAMAP (VERSION 6) JAN 1990.  
SOURCE: FILE 7 ON UNAMAP MAGNETIC TAPE FROM NTIS.

CONVERTED BY :  
KBN ENGINEERING AND APPLIED SCIENCES, INC.  
GAINESVILLE, FLORIDA  
(904)331-9000

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CARD INPUT FILE IS	ER18LT82.I81	
SUMMARY OUTPUT FILE IS	ER18LT82.O81	
TITLE OF RUN IS	1982 ENRON STATION 18 / 40 FT STACK	10-29-90

- ISCLT INPUT DATA -

NUMBER OF SOURCES = 1  
 NUMBER OF X AXIS GRID SYSTEM POINTS = 8  
 NUMBER OF Y AXIS GRID SYSTEM POINTS = 16  
 NUMBER OF SPECIAL POINTS = 36  
 NUMBER OF SEASONS = 1  
 NUMBER OF WIND SPEED CLASSES = 6  
 NUMBER OF STABILITY CLASSES = 6  
 NUMBER OF WIND DIRECTION CLASSES = 16  
 FILE NUMBER OF DATA FILE USED FOR REPORTS = 1  
 THE PROGRAM IS RUN IN RURAL MODE  
 CONCENTRATION (DEPOSITION) UNITS CONVERSION FACTOR = 0.10000000E+07  
 ACCELERATION OF GRAVITY (METERS/SEC\*\*2) = 9.800  
 HEIGHT OF MEASUREMENT OF WIND SPEED (METERS) = 10.100  
 CORRECTION ANGLE FOR GRID SYSTEM VERSUS DIRECTION DATA NORTH (DEGREES) = 0.000  
 DECAY COEFFICIENT = 0.00000000E+00  
 PROGRAM OPTION SWITCHES = 1, 2, 2, 0, 0, 3, 2, 1, 3, 2, 2, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0,

RANGE X AXIS GRID SYSTEM POINTS (METERS )=	100.00,	200.00,	300.00,	400.00,	500.00,	750.00,				
	1000.00,	1250.00,								
RANGE X SPECIAL DISCRETE POINTS (METERS )=	317.00,	332.00,	357.00,	402.00,	366.00,	323.00,				
	296.00,	283.00,	277.00,	283.00,	253.00,	171.00,	134.00,	113.00,	98.00,	91.00,
	88.00,	85.00,	88.00,	91.00,	101.00,	113.00,	137.00,	134.00,	122.00,	119.00,
	116.00,	119.00,	122.00,	134.00,	149.00,	177.00,	229.00,	250.00,	259.00,	311.00,
AZIMUTH BEARING Y AXIS GRID SYSTEM POINTS (DEGREES)=	22.50,	45.00,	67.50,	90.00,	112.50,	135.00,				
	157.50,	180.00,	202.50,	225.00,	247.50,	270.00,	292.50,	315.00,	337.50,	360.00,
AZIMUTH BEARING Y SPECIAL DISCRETE POINTS (DEGREES)=	10.00,	20.00,	30.00,	40.00,	50.00,	60.00,				
	70.00,	80.00,	90.00,	100.00,	110.00,	120.00,	130.00,	140.00,	150.00,	160.00,
	170.00,	180.00,	190.00,	200.00,	210.00,	220.00,	230.00,	240.00,	250.00,	260.00,
	270.00,	280.00,	290.00,	300.00,	310.00,	320.00,	330.00,	340.00,	350.00,	360.00,

- AMBIENT AIR TEMPERATURE (DEGREES KELVIN) -

	STABILITY	STABILITY	STABILITY	STABILITY	STABILITY	STABILITY
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
SEASON 1	300.0000	300.0000	300.0000	295.0000	290.0000	290.0000

- MIXING LAYER HEIGHT (METERS) -

	SEASON 1					
	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
STABILITY CATEGORY 10.	2.15100E+040.	2.15100E+040.	2.15100E+040.	2.15100E+040.	2.15100E+040.	2.15100E+040.
STABILITY CATEGORY 20.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.
STABILITY CATEGORY 30.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.
STABILITY CATEGORY 40.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.	1.43400E+040.
STABILITY CATEGORY 50.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.
STABILITY CATEGORY 60.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.	1.00000E+050.

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 1

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00001500	0.00045701	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00000400	0.00011400	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00013300	0.00045701	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00001100	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00001500	0.00045701	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00002200	0.00068501	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00001100	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00001100	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00003400	0.00102701	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00001900	0.00057101	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00012900	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00012500	0.00022800	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00000700	0.00022800	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00001900	0.00057101	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00000400	0.00011400	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00024000	0.00011400	0.00000000	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 2

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00031500	0.00171202	0.00102701	0.00000000	0.00000000	0.00000000
22.500	0.00006100	0.00137002	0.00137002	0.00000000	0.00000000	0.00000000
45.000	0.00008200	0.00182602	0.00125602	0.00000000	0.00000000	0.00000000
67.500	0.00043901	0.00182602	0.00137002	0.00000000	0.00000000	0.00000000
90.000	0.00063501	0.00353904	0.00308204	0.00000000	0.00000000	0.00000000
112.500	0.00035100	0.00251103	0.00159802	0.00000000	0.00000000	0.00000000
135.000	0.00020600	0.00194102	0.00216903	0.00000000	0.00000000	0.00000000
157.500	0.00008200	0.00182602	0.00182602	0.00000000	0.00000000	0.00000000
180.000	0.00049601	0.00308204	0.00433805	0.00000000	0.00000000	0.00000000
202.500	0.00025200	0.00296804	0.00274003	0.00000000	0.00000000	0.00000000
225.000	0.00049601	0.00308204	0.00194102	0.00000000	0.00000000	0.00000000
247.500	0.00069801	0.00228303	0.00182602	0.00000000	0.00000000	0.00000000
270.000	0.00072401	0.00285403	0.00182602	0.00000000	0.00000000	0.00000000
292.500	0.00046001	0.00228303	0.00068501	0.00000000	0.00000000	0.00000000
315.000	0.00031500	0.00171202	0.00068501	0.00000000	0.00000000	0.00000000
337.500	0.00043901	0.00182602	0.00045701	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 3

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.500MPS)	WIND SPEED CATEGORY 2 ( 2.500MPS)	WIND SPEED CATEGORY 3 ( 4.300MPS)	WIND SPEED CATEGORY 4 ( 6.800MPS)	WIND SPEED CATEGORY 5 ( 9.500MPS)	WIND SPEED CATEGORY 6 (12.500MPS)
0.000	0.00012200	0.00399505	0.00547907	0.00057101	0.00000000	0.00000000
22.500	0.00053701	0.00216903	0.00411005	0.00068501	0.00000000	0.00000000
45.000	0.00021500	0.00319604	0.00867610	0.00057101	0.00011400	0.00000000
67.500	0.00009800	0.00319604	0.00662108	0.00159802	0.00011400	0.00000000
90.000	0.00021200	0.00308204	0.00742009	0.00159802	0.00000000	0.00000000
112.500	0.00010500	0.00342504	0.00787709	0.00079901	0.00000000	0.00000000
135.000	0.00010100	0.00331104	0.00353904	0.00034200	0.00000000	0.00000000
157.500	0.00004900	0.00159802	0.00456605	0.00057101	0.00000000	0.00000000
180.000	0.00058201	0.00365304	0.01016012	0.00182602	0.00000000	0.00000000
202.500	0.00031200	0.00251103	0.00365304	0.00045701	0.00011400	0.00000000
225.000	0.00005600	0.00182602	0.00456605	0.00045701	0.00000000	0.00000000
247.500	0.00018700	0.00228303	0.00319604	0.00022800	0.00000000	0.00000000
270.000	0.00015300	0.00114201	0.00331104	0.00057101	0.00000000	0.00000000
292.500	0.00018400	0.00216903	0.00353904	0.00045701	0.00000000	0.00000000
315.000	0.00002800	0.00091301	0.00296804	0.00057101	0.00000000	0.00000000
337.500	0.00002800	0.00091301	0.00296804	0.00011400	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 4

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.500MPS)	WIND SPEED CATEGORY 2 ( 2.500MPS)	WIND SPEED CATEGORY 3 ( 4.300MPS)	WIND SPEED CATEGORY 4 ( 6.800MPS)	WIND SPEED CATEGORY 5 ( 9.500MPS)	WIND SPEED CATEGORY 6 (12.500MPS)
0.000	0.00086901	0.00799110	0.01769421	0.01187214	0.00045701	0.00000000
22.500	0.00031300	0.00559407	0.01232915	0.01084513	0.00091301	0.00011400
45.000	0.00064701	0.00502306	0.01655320	0.01586819	0.00079901	0.00000000
67.500	0.00027700	0.00456605	0.01392717	0.01860722	0.00034200	0.00000000
90.000	0.00013900	0.00399505	0.01815122	0.01563919	0.00034200	0.00000000
112.500	0.00037900	0.00411005	0.01118714	0.01073113	0.00011400	0.00000000
135.000	0.00038700	0.00433805	0.01084513	0.00536506	0.00068501	0.00000000
157.500	0.00046201	0.00308204	0.00981712	0.00570807	0.00102701	0.00011400
180.000	0.00041500	0.00513706	0.01518318	0.01255715	0.00148402	0.00022800
202.500	0.00041400	0.00171202	0.00605007	0.00468006	0.00022800	0.00022800
225.000	0.00020600	0.00251103	0.00650708	0.00353904	0.00068501	0.00000000
247.500	0.00009900	0.00285403	0.00456605	0.00331104	0.00022800	0.00022800
270.000	0.00031200	0.00216903	0.00582207	0.00456605	0.00079901	0.00022800
292.500	0.00018200	0.00182602	0.00399505	0.00547907	0.00022800	0.00022800
315.000	0.00040200	0.00137002	0.00490906	0.00559407	0.00022800	0.00000000
337.500	0.00054801	0.00216903	0.00365304	0.00605007	0.00011400	0.00011400

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 5

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00000000	0.01369916	0.01210015	0.00000000	0.00000000	0.00000000
22.500	0.00000000	0.01004612	0.00399505	0.00000000	0.00000000	0.00000000
45.000	0.00000000	0.01210015	0.00547907	0.00000000	0.00000000	0.00000000
67.500	0.00000000	0.00913211	0.00605007	0.00000000	0.00000000	0.00000000
90.000	0.00000000	0.01141614	0.00936111	0.00000000	0.00000000	0.00000000
112.500	0.00000000	0.00799110	0.00445205	0.00000000	0.00000000	0.00000000
135.000	0.00000000	0.00764809	0.00251103	0.00000000	0.00000000	0.00000000
157.500	0.00000000	0.00901811	0.00182602	0.00000000	0.00000000	0.00000000
180.000	0.00000000	0.01621019	0.00125602	0.00000000	0.00000000	0.00000000
202.500	0.00000000	0.00388105	0.00102701	0.00000000	0.00000000	0.00000000
225.000	0.00000000	0.00365304	0.00182602	0.00000000	0.00000000	0.00000000
247.500	0.00000000	0.00388105	0.00137002	0.00000000	0.00000000	0.00000000
270.000	0.00000000	0.00376705	0.00319604	0.00000000	0.00000000	0.00000000
292.500	0.00000000	0.00388105	0.00353904	0.00000000	0.00000000	0.00000000
315.000	0.00000000	0.00182602	0.00228303	0.00000000	0.00000000	0.00000000
337.500	0.00000000	0.00342504	0.00342504	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 6

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.01031612	0.02488630	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00553207	0.01575319	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00540307	0.01369916	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00347904	0.01153014	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00515006	0.01449817	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00391605	0.01027412	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00415305	0.00799110	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00525206	0.00593607	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00652308	0.01244315	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00328104	0.00422405	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00198802	0.00319604	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00229803	0.00547907	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00435605	0.00833310	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00388505	0.00662108	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00262903	0.00228303	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00238703	0.00593607	0.00000000	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- VERTICAL POTENTIAL TEMPERATURE GRADIENT (DEGREES KELVIN/METER) -

	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
STABILITY CATEGORY 10.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.
STABILITY CATEGORY 20.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.
STABILITY CATEGORY 30.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.
STABILITY CATEGORY 40.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.	0.00000E+000.
STABILITY CATEGORY 50.	0.20000E-010.	0.20000E-010.	0.20000E-010.	0.20000E-010.	0.20000E-010.	0.20000E-010.
STABILITY CATEGORY 60.	0.35000E-010.	0.35000E-010.	0.35000E-010.	0.35000E-010.	0.35000E-010.	0.35000E-010.

- WIND PROFILE POWER LAW EXPONENTS -

	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
STABILITY CATEGORY 10.	0.70000E-010.	0.70000E-010.	0.70000E-010.	0.70000E-010.	0.70000E-010.	0.70000E-010.
STABILITY CATEGORY 20.	0.70000E-010.	0.70000E-010.	0.70000E-010.	0.70000E-010.	0.70000E-010.	0.70000E-010.
STABILITY CATEGORY 30.	0.10000E+000.	0.10000E+000.	0.10000E+000.	0.10000E+000.	0.10000E+000.	0.10000E+000.
STABILITY CATEGORY 40.	0.15000E+000.	0.15000E+000.	0.15000E+000.	0.15000E+000.	0.15000E+000.	0.15000E+000.
STABILITY CATEGORY 50.	0.35000E+000.	0.35000E+000.	0.35000E+000.	0.35000E+000.	0.35000E+000.	0.35000E+000.
STABILITY CATEGORY 60.	0.55000E+000.	0.55000E+000.	0.55000E+000.	0.55000E+000.	0.55000E+000.	0.55000E+000.



- SOURCE INPUT DATA -

C T SOURCE SOURCE X Y EMISSION BASE /  
 A A NUMBER TYPE COORDINATE COORDINATE HEIGHT ELEV- /  
 R P (M) (M) (M) ATION /  
 D E (M) /

- SOURCE DETAILS DEPENDING ON TYPE -

X 1 STACK 0.00 0.00 12.19 0.00 GAS EXIT TEMP (DEG K)= 561.00, GAS EXIT VEL. (M/SEC)= 48.88,  
 STACK DIAMETER (M)= 0.440, HEIGHT OF ASSO. BLDG. (M)= -9.69, WIDTH OF  
 ASSO. BLDG. (M)= 74.92, WAKE EFFECTS FLAG = 0

- DIRECTION SPECIFIC BUILDING DIMENSIONS -

SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE
1	9.7,	75.0,	0	2	9.7,	75.0,	0	3	9.7,	75.0,	0	4	9.7,	75.0,	0
5	9.7,	75.0,	0	6	9.7,	75.0,	0	7	9.7,	75.0,	0	8	9.7,	75.0,	0
9	9.7,	75.0,	0	10	9.7,	75.0,	0	11	9.7,	75.0,	0	12	9.7,	75.0,	0
13	9.7,	75.0,	0	14	9.7,	75.0,	0	15	9.7,	75.0,	0	16	9.7,	75.0,	0

- SOURCE STRENGTHS ( GRAMS PER SEC ) -  
 SEASON 1 SEASON 2 SEASON 3 SEASON 4  
 1.33000E+00

WARNING - HW/HB > 5 FOR SOURCE 1 PROG. USES LATERAL VIRTUAL DIST. FOR UPPER BOUND OF CONCENTRATION (DEPOSITION) IN SECTOR(S):  
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.  
 IF LOWER BOUND IS DESIRED SET THE DIRECTION SPECIFIC BUILDING HEIGHT TO < 0 (WAKE EFFECTS FLAG) AND RERUN.

\*\* ANNUAL GROUND LEVEL CONCENTRATION ( MICROGRAMS PER CUBIC METER ) DUE TO SOURCE 1 \*\*  
 - GRID SYSTEM RECEPTORS -  
 - X AXIS ( RANGE , METERS ) -  
 100.000 200.000 300.000 400.000 500.000 750.000 1000.000 1250.000  
 Y AXIS (AZIMUTH BEARING, DEGREES ) - CONCENTRATION -

360.000	0.812837	0.717730	0.904979	0.956981	0.905309	0.697688	0.547515	0.446699
337.500	0.366571	0.321990	0.417142	0.455667	0.443245	0.357349	0.288777	0.240132
315.000	0.337802	0.294080	0.389781	0.444805	0.448525	0.381356	0.314326	0.262546
292.500	0.425540	0.421463	0.599478	0.673364	0.656437	0.522891	0.413944	0.337779
270.000	0.654363	0.601861	0.806904	0.896787	0.878024	0.710924	0.569347	0.468945
247.500	0.592706	0.553524	0.741779	0.824615	0.803831	0.644018	0.511166	0.417420
225.000	0.529629	0.508194	0.715059	0.815471	0.806053	0.658485	0.530670	0.438954
202.500	0.417062	0.369030	0.485866	0.547798	0.545405	0.461805	0.386170	0.328758
180.000	0.396845	0.377756	0.541985	0.648547	0.672120	0.604588	0.525282	0.459336
157.500	0.189615	0.188037	0.277098	0.311691	0.300320	0.233761	0.185619	0.153400
135.000	0.215377	0.206923	0.287555	0.318221	0.306667	0.238227	0.183520	0.145985
112.500	0.252208	0.241144	0.334297	0.366922	0.350950	0.270990	0.212173	0.173137
90.000	0.333114	0.289839	0.372374	0.396874	0.376837	0.290952	0.227756	0.185704
67.500	0.254245	0.226882	0.305172	0.335979	0.325518	0.257034	0.202665	0.164574
45.000	0.304265	0.280301	0.383019	0.418214	0.400311	0.308182	0.237458	0.188830
22.500	0.378343	0.328786	0.418885	0.442829	0.417057	0.313994	0.238228	0.188122

- DISCRETE RECEPTORS -  
 X Y CONCENTRATION X Y CONCENTRATION X Y CONCENTRATION  
 RANGE AZIMUTH RANGE AZIMUTH RANGE AZIMUTH  
 (METERS) (DEGREES) (METERS) (DEGREES) (METERS) (DEGREES)

317.0	10.0	0.688392	332.0	20.0	0.482779	357.0	30.0	0.423370
402.0	40.0	0.418067	366.0	50.0	0.390827	323.0	60.0	0.335655
296.0	70.0	0.305411	283.0	80.0	0.318733	277.0	90.0	0.353678
283.0	100.0	0.330006	253.0	110.0	0.289557	171.0	120.0	0.241294
134.0	130.0	0.234170	113.0	140.0	0.215540	98.0	150.0	0.185947
91.0	160.0	0.181022	88.0	170.0	0.254538	85.0	180.0	0.335125
88.0	190.0	0.341531	91.0	200.0	0.363033	101.0	210.0	0.444513
113.0	220.0	0.516663	137.0	230.0	0.566557	134.0	240.0	0.593268
122.0	250.0	0.624800	119.0	260.0	0.642280	116.0	270.0	0.681379
119.0	280.0	0.568594	122.0	290.0	0.474666	134.0	300.0	0.413952
149.0	310.0	0.356507	177.0	320.0	0.317316	229.0	330.0	0.307950
250.0	340.0	0.402311	259.0	350.0	0.609252	311.0	360.0	0.919768

\*\* ANNUAL GROUND LEVEL CONCENTRATION ( MICROGRAMS PER CUBIC METER ) DUE TO SOURCE 1 (CONT.) \*\*

- 10 CONTRIBUTING VALUES TO PROGRAM DETERMINED MAXIMUM 10 OF ALL SOURCES COMBINED -

X COORDINATE RANGE (METERS)	Y COORDINATE AZIMUTH BEARING (DEGREES)	CONCENTRATION
400.00	360.00	0.956981
311.00	360.00	0.919768
500.00	360.00	0.905309
300.00	360.00	0.904979
400.00	270.00	0.896787
500.00	270.00	0.878024
400.00	247.50	0.824615
400.00	225.00	0.815471
100.00	360.00	0.812837
300.00	270.00	0.806904

\*\*\*\*\* END OF ISCLT PROGRAM, 1 SOURCES PROCESSED \*\*\*\*\*

ISCLTK6L MODEL, A VERSION OF  
ISCLT (VERSION 90008)  
AN AIR QUALITY DISPERSION MODEL IN  
SECTION 1. GUIDELINE MODELS.  
IN UNAMAP (VERSION 6) JAN 1990.  
SOURCE: FILE 7 ON UNAMAP MAGNETIC TAPE FROM NTIS.

CONVERTED BY :  
KBN ENGINEERING AND APPLIED SCIENCES, INC.  
GAINESVILLE, FLORIDA  
(904)331-9000

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CARD INPUT FILE IS	ER18LT83.181	
SUMMARY OUTPUT FILE IS	ER18LT83.081	
TITLE OF RUN IS	1983 ENRON STATION 18 / 40 FT STACK	10-29-90

- ISCLT INPUT DATA (CONT.) -

NUMBER OF SOURCES = 1  
 NUMBER OF X AXIS GRID SYSTEM POINTS = 8  
 NUMBER OF Y AXIS GRID SYSTEM POINTS = 16  
 NUMBER OF SPECIAL POINTS = 36  
 NUMBER OF SEASONS = 1  
 NUMBER OF WIND SPEED CLASSES = 6  
 NUMBER OF STABILITY CLASSES = 6  
 NUMBER OF WIND DIRECTION CLASSES = 16  
 FILE NUMBER OF DATA FILE USED FOR REPORTS = 1  
 THE PROGRAM IS RUN IN RURAL MODE  
 CONCENTRATION (DEPOSITION) UNITS CONVERSION FACTOR =0.10000000E+07  
 ACCELERATION OF GRAVITY (METERS/SEC\*\*2) = 9.800  
 HEIGHT OF MEASUREMENT OF WIND SPEED (METERS) = 10.100  
 CORRECTION ANGLE FOR GRID SYSTEM VERSUS DIRECTION DATA NORTH (DEGREES) = 0.000  
 DECAY COEFFICIENT =0.00000000E+00  
 PROGRAM OPTION SWITCHES = 1, 2, 2, 0, 0, 3, 2, 1, 3, 2, 2, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0,

RANGE X AXIS GRID SYSTEM POINTS (METERS )=	100.00,	200.00,	300.00,	400.00,	500.00,	750.00,
1000.00,	1250.00,					
RANGE X SPECIAL DISCRETE POINTS (METERS )=	317.00,	332.00,	357.00,	402.00,	366.00,	323.00,
296.00,	283.00,	277.00,	283.00,	253.00,	171.00,	134.00,
113.00,	113.00,	137.00,	134.00,	122.00,	119.00,	116.00,
119.00,	122.00,	134.00,	149.00,	177.00,	229.00,	250.00,
259.00,	311.00,	22.50,	45.00,	67.50,	90.00,	112.50,
135.00,	157.50,	180.00,	202.50,	225.00,	247.50,	270.00,
292.50,	315.00,	337.50,	360.00,	10.00,	20.00,	30.00,
40.00,	50.00,	60.00,	70.00,	80.00,	90.00,	100.00,
110.00,	120.00,	130.00,	140.00,	150.00,	160.00,	170.00,
180.00,	190.00,	200.00,	210.00,	220.00,	230.00,	240.00,
250.00,	260.00,	270.00,	280.00,	290.00,	300.00,	310.00,
320.00,	330.00,	340.00,	350.00,	360.00,		

- AMBIENT AIR TEMPERATURE (DEGREES KELVIN) -

STABILITY	STABILITY	STABILITY	STABILITY	STABILITY	STABILITY
CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
SEASON 1	300.0000	300.0000	300.0000	295.0000	290.0000

- MIXING LAYER HEIGHT (METERS) -

	SEASON 1					
	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
STABILITY CATEGORY 10.	215100E+040.	215100E+040.	215100E+040.	215100E+040.	215100E+040.	215100E+040.
STABILITY CATEGORY 20.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.
STABILITY CATEGORY 30.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.
STABILITY CATEGORY 40.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.
STABILITY CATEGORY 50.	100000E+050.	100000E+050.	100000E+050.	100000E+050.	100000E+050.	100000E+050.
STABILITY CATEGORY 60.	100000E+050.	100000E+050.	100000E+050.	100000E+050.	100000E+050.	100000E+050.

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 1

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00011400	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00011400	0.00045700	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00000000	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00000000	0.00137001	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00011400	0.00079901	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00000000	0.00022800	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00011400	0.00057100	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00011400	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00011400	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00000000	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00000000	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00011400	0.00045700	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00000000	0.00045700	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00000000	0.00045700	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00000000	0.00045700	0.00000000	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 2

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00076301	0.00251102	0.00148401	0.00000000	0.00000000	0.00000000
22.500	0.00027800	0.00182601	0.00068501	0.00000000	0.00000000	0.00000000
45.000	0.00028900	0.00228302	0.00182601	0.00000000	0.00000000	0.00000000
67.500	0.00030900	0.00308202	0.00194102	0.00000000	0.00000000	0.00000000
90.000	0.00018600	0.00285402	0.00296802	0.00000000	0.00000000	0.00000000
112.500	0.00039500	0.00182601	0.00205502	0.00000000	0.00000000	0.00000000
135.000	0.00015900	0.00171201	0.00274002	0.00000000	0.00000000	0.00000000
157.500	0.00004200	0.00171201	0.00216902	0.00000000	0.00000000	0.00000000
180.000	0.00003900	0.00159801	0.00308202	0.00000000	0.00000000	0.00000000
202.500	0.00028400	0.00205502	0.00137001	0.00000000	0.00000000	0.00000000
225.000	0.00025100	0.00068501	0.00068501	0.00000000	0.00000000	0.00000000
247.500	0.00038400	0.00137001	0.00057100	0.00000000	0.00000000	0.00000000
270.000	0.00027300	0.00159801	0.00114201	0.00000000	0.00000000	0.00000000
292.500	0.00049300	0.00102701	0.00194102	0.00000000	0.00000000	0.00000000
315.000	0.00016100	0.00182601	0.00125601	0.00000000	0.00000000	0.00000000
337.500	0.00014700	0.00125601	0.00079901	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 3

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00019800	0.00274002	0.00833307	0.00114201	0.00000000	0.00000000
22.500	0.00005100	0.00171201	0.00502304	0.00057100	0.00000000	0.00000000
45.000	0.00019200	0.00251102	0.00616405	0.00114201	0.00000000	0.00000000
67.500	0.00019800	0.00274002	0.00684905	0.00194102	0.00011400	0.00000000
90.000	0.00020900	0.00308202	0.00753406	0.00137001	0.00011400	0.00000000
112.500	0.00005100	0.00171201	0.00684905	0.00091301	0.00000000	0.00000000
135.000	0.00004400	0.00148401	0.00513704	0.00091301	0.00000000	0.00000000
157.500	0.00003700	0.00125601	0.00422403	0.00102701	0.00000000	0.00000000
180.000	0.00030900	0.00251102	0.00776306	0.00114201	0.00011400	0.00000000
202.500	0.00002000	0.00068501	0.00319603	0.00057100	0.00000000	0.00000000
225.000	0.00005400	0.00182601	0.00296802	0.00068501	0.00000000	0.00000000
247.500	0.00016100	0.00148401	0.00331103	0.00114201	0.00011400	0.00000000
270.000	0.00005700	0.00194102	0.00468004	0.00148401	0.00057100	0.00000000
292.500	0.00017800	0.00205502	0.00490904	0.00137001	0.00011400	0.00000000
315.000	0.00014400	0.00091301	0.00445204	0.00057100	0.00000000	0.00000000
337.500	0.00003700	0.00125601	0.00525104	0.00079901	0.00011400	0.00000000

SEASON 1

STABILITY CATEGORY 4

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00070701	0.00833307	0.02111917	0.01038808	0.00057100	0.00000000
22.500	0.00031100	0.00456604	0.01506812	0.00821907	0.00057100	0.00011400
45.000	0.00022000	0.00525104	0.01038808	0.00947508	0.00137001	0.00000000
67.500	0.00029600	0.00422403	0.01164409	0.01175809	0.00068501	0.00000000
90.000	0.00043400	0.00468004	0.01735214	0.01506812	0.00125601	0.00011400
112.500	0.00012900	0.00308202	0.01073109	0.01073109	0.00102701	0.00011400
135.000	0.00045700	0.00239702	0.01130109	0.00730606	0.00068501	0.00000000
157.500	0.00011500	0.00274002	0.00981708	0.00810506	0.00068501	0.00011400
180.000	0.00052900	0.00411003	0.01735214	0.01643813	0.00285402	0.00022800
202.500	0.00024800	0.00308202	0.00673505	0.00433803	0.00045700	0.00011400
225.000	0.00012900	0.00308202	0.00901807	0.00559404	0.00114201	0.00000000
247.500	0.00012500	0.00296802	0.00616405	0.00970308	0.00171201	0.00022800
270.000	0.00012000	0.00285402	0.00856207	0.01290010	0.00411003	0.00068501
292.500	0.00008100	0.00194102	0.00662105	0.01175809	0.00319603	0.00011400
315.000	0.00062901	0.00365303	0.00696306	0.00707806	0.00102701	0.00000000
337.500	0.00026300	0.00342503	0.00730606	0.00627905	0.00022800	0.00000000



- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 5

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00000000	0.01187210	0.01004608	0.00000000	0.00000000	0.00000000
22.500	0.00000000	0.00970308	0.00593605	0.00000000	0.00000000	0.00000000
45.000	0.00000000	0.00684905	0.00445204	0.00000000	0.00000000	0.00000000
67.500	0.00000000	0.00616405	0.00662105	0.00000000	0.00000000	0.00000000
90.000	0.00000000	0.00844707	0.00799106	0.00000000	0.00000000	0.00000000
112.500	0.00000000	0.00742006	0.00593605	0.00000000	0.00000000	0.00000000
135.000	0.00000000	0.00639305	0.00445204	0.00000000	0.00000000	0.00000000
157.500	0.00000000	0.00753406	0.00239702	0.00000000	0.00000000	0.00000000
180.000	0.00000000	0.01278510	0.00239702	0.00000000	0.00000000	0.00000000
202.500	0.00000000	0.00559404	0.00079901	0.00000000	0.00000000	0.00000000
225.000	0.00000000	0.00433803	0.00159801	0.00000000	0.00000000	0.00000000
247.500	0.00000000	0.00525104	0.00433803	0.00000000	0.00000000	0.00000000
270.000	0.00000000	0.00593605	0.00742006	0.00000000	0.00000000	0.00000000
292.500	0.00000000	0.00399503	0.00593605	0.00000000	0.00000000	0.00000000
315.000	0.00000000	0.00216902	0.00319603	0.00000000	0.00000000	0.00000000
337.500	0.00000000	0.00468004	0.00559404	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 6

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00586605	0.02397319	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00418803	0.01255710	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00223402	0.00947508	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00149201	0.00593605	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00293702	0.01141609	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00238002	0.00844707	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00291902	0.00879007	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00199202	0.00468004	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00512404	0.01187210	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00215402	0.00502304	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00136301	0.00468004	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00294702	0.00662105	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00286302	0.00947508	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00349303	0.00947508	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00190702	0.00262602	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00214502	0.00616405	0.00000000	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- VERTICAL POTENTIAL TEMPERATURE GRADIENT (DEGREES KELVIN/METER) -

	WIND SPEED CATEGORY 1	WIND SPEED CATEGORY 2	WIND SPEED CATEGORY 3	WIND SPEED CATEGORY 4	WIND SPEED CATEGORY 5	WIND SPEED CATEGORY 6
STABILITY CATEGORY 10.	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000
STABILITY CATEGORY 20.	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000
STABILITY CATEGORY 30.	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000
STABILITY CATEGORY 40.	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000	0.00000E+000
STABILITY CATEGORY 50.	2.00000E-010	2.00000E-010	2.00000E-010	2.00000E-010	2.00000E-010	2.00000E-010
STABILITY CATEGORY 60.	3.50000E-010	3.50000E-010	3.50000E-010	3.50000E-010	3.50000E-010	3.50000E-010

- WIND PROFILE POWER LAW EXPONENTS -

	WIND SPEED CATEGORY 1	WIND SPEED CATEGORY 2	WIND SPEED CATEGORY 3	WIND SPEED CATEGORY 4	WIND SPEED CATEGORY 5	WIND SPEED CATEGORY 6
STABILITY CATEGORY 10.	7.00000E-010	7.00000E-010	7.00000E-010	7.00000E-010	7.00000E-010	7.00000E-010
STABILITY CATEGORY 20.	7.00000E-010	7.00000E-010	7.00000E-010	7.00000E-010	7.00000E-010	7.00000E-010
STABILITY CATEGORY 30.	1.00000E+000	1.00000E+000	1.00000E+000	1.00000E+000	1.00000E+000	1.00000E+000
STABILITY CATEGORY 40.	1.50000E+000	1.50000E+000	1.50000E+000	1.50000E+000	1.50000E+000	1.50000E+000
STABILITY CATEGORY 50.	3.50000E+000	3.50000E+000	3.50000E+000	3.50000E+000	3.50000E+000	3.50000E+000
STABILITY CATEGORY 60.	5.50000E+000	5.50000E+000	5.50000E+000	5.50000E+000	5.50000E+000	5.50000E+000

- SOURCE INPUT DATA -

C T SOURCE SOURCE X Y EMISSION BASE /  
 A A NUMBER TYPE COORDINATE COORDINATE HEIGHT ELEV- /  
 R P (M) (M) (M) ATION /  
 D E (M) /

- SOURCE DETAILS DEPENDING ON TYPE -

-----  
 X 1 STACK 0.00 0.00 12.19 0.00 GAS EXIT TEMP (DEG K)= 561.00, GAS EXIT VEL. (M/SEC)= 48.88,  
 STACK DIAMETER (M)= 0.440, HEIGHT OF ASSO. BLDG. (M)= -9.69, WIDTH OF  
 ASSO. BLDG. (M)= 74.92, WAKE EFFECTS FLAG = 0

- DIRECTION SPECIFIC BUILDING DIMENSIONS -

SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE
1	9.7,	75.0,	0	2	9.7,	75.0,	0	3	9.7,	75.0,	0	4	9.7,	75.0,	0
5	9.7,	75.0,	0	6	9.7,	75.0,	0	7	9.7,	75.0,	0	8	9.7,	75.0,	0
9	9.7,	75.0,	0	10	9.7,	75.0,	0	11	9.7,	75.0,	0	12	9.7,	75.0,	0
13	9.7,	75.0,	0	14	9.7,	75.0,	0	15	9.7,	75.0,	0	16	9.7,	75.0,	0

- SOURCE STRENGTHS ( GRAMS PER SEC ) -  
 SEASON 1 SEASON 2 SEASON 3 SEASON 4  
 1.33000E+00

WARNING - HW/HB > 5 FOR SOURCE 1 PROG. USES LATERAL VIRTUAL DIST. FOR UPPER BOUND OF CONCENTRATION (DEPOSITION) IN SECTOR(S):  
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.  
 IF LOWER BOUND IS DESIRED SET THE DIRECTION SPECIFIC BUILDING HEIGHT TO < 0 (WAKE EFFECTS FLAG) AND RERUN.

\*\* ANNUAL GROUND LEVEL CONCENTRATION ( MICROGRAMS PER CUBIC METER ) DUE TO SOURCE 1 \*\*

- GRID SYSTEM RECEPTORS -

- X AXIS (RANGE , METERS) -

Y AXIS (AZIMUTH BEARING, DEGREES )	100.000	200.000	300.000	400.000	500.000	750.000	1000.000	1250.000
360.000	0.800801	0.676451	0.836270	0.900519	0.867198	0.686077	0.541318	0.440961
337.500	0.430682	0.376227	0.475118	0.508169	0.486105	0.381555	0.301998	0.246590
315.000	0.453821	0.398169	0.504720	0.541395	0.519717	0.411634	0.326698	0.267767
292.500	0.495269	0.448697	0.588390	0.638310	0.612396	0.482210	0.381757	0.312158
270.000	0.714086	0.634083	0.818446	0.891971	0.863029	0.689791	0.548111	0.447049
247.500	0.596274	0.549492	0.709701	0.755800	0.716114	0.555184	0.435261	0.351492
225.000	0.486514	0.437759	0.570900	0.621046	0.598793	0.478648	0.383931	0.315665
202.500	0.320811	0.307912	0.441201	0.520270	0.531725	0.461499	0.387141	0.328683
180.000	0.441654	0.434331	0.629032	0.743582	0.762877	0.670718	0.568243	0.485615
157.500	0.278209	0.273121	0.375437	0.412487	0.398864	0.322115	0.262425	0.218816
135.000	0.353700	0.318881	0.415732	0.444440	0.421222	0.328075	0.258071	0.207867
112.500	0.673407	0.550196	0.634218	0.643157	0.592976	0.442165	0.339365	0.272473
90.000	0.781865	0.625069	0.704860	0.715154	0.661676	0.499585	0.389942	0.317002
67.500	0.441258	0.376365	0.457522	0.481548	0.454894	0.353610	0.280774	0.230642
45.000	0.285114	0.247999	0.316869	0.357287	0.358750	0.303307	0.246667	0.202610
22.500	0.254585	0.230431	0.309083	0.340115	0.329446	0.262774	0.210780	0.173896

- DISCRETE RECEPTORS -

X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION	X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION	X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION
317.0	10.0	0.603245	332.0	20.0	0.378632	357.0	30.0	0.330432
402.0	40.0	0.348728	366.0	50.0	0.371789	323.0	60.0	0.414926
296.0	70.0	0.474822	283.0	80.0	0.563963	277.0	90.0	0.682760
283.0	100.0	0.640426	253.0	110.0	0.591816	171.0	120.0	0.513051
134.0	130.0	0.425081	113.0	140.0	0.342912	98.0	150.0	0.285201
91.0	160.0	0.257863	88.0	170.0	0.309751	85.0	180.0	0.372952
88.0	190.0	0.325701	91.0	200.0	0.289873	101.0	210.0	0.367478
113.0	220.0	0.457890	137.0	230.0	0.520800	134.0	240.0	0.576149
122.0	250.0	0.633180	119.0	260.0	0.673606	116.0	270.0	0.736384
119.0	280.0	0.625333	122.0	290.0	0.532859	134.0	300.0	0.488554
149.0	310.0	0.459090	177.0	320.0	0.416589	229.0	330.0	0.375226
250.0	340.0	0.447635	259.0	350.0	0.601814	311.0	360.0	0.851240

\*\* ANNUAL GROUND LEVEL CONCENTRATION ( MICROGRAMS PER CUBIC METER ) DUE TO SOURCE 1 (CONT.) \*\*

- 10 CONTRIBUTING VALUES TO PROGRAM DETERMINED MAXIMUM 10 OF ALL SOURCES COMBINED -

X COORDINATE RANGE (METERS)	Y COORDINATE AZIMUTH BEARING (DEGREES)	CONCENTRATION
400.00	360.00	0.900519
400.00	270.00	0.891971
500.00	360.00	0.867198
500.00	270.00	0.863029
311.00	360.00	0.851240
300.00	360.00	0.836270
300.00	270.00	0.818446
100.00	360.00	0.800801
100.00	90.00	0.781865
500.00	180.00	0.762877

\*\*\*\*\* END OF ISCLT PROGRAM, 1 SOURCES PROCESSED \*\*\*\*\*

ISCLTK6L MODEL, A VERSION OF  
ISCLT (VERSION 90008)  
AN AIR QUALITY DISPERSION MODEL IN  
SECTION 1. GUIDELINE MODELS.  
IN UNAMAP (VERSION 6) JAN 1990.  
SOURCE: FILE 7 ON UNAMAP MAGNETIC TAPE FROM NTIS.

CONVERTED BY :  
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GAINESVILLE, FLORIDA  
(904)331-9000

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CARD INPUT FILE IS	ER18LT84.I81	
SUMMARY OUTPUT FILE IS	ER18LT84.O81	
TITLE OF RUN IS	1984 ENRON STATION 18 / 40 FT STACK	10-29-90

- ISCLT INPUT DATA (CONT.) -

NUMBER OF SOURCES = 1  
 NUMBER OF X AXIS GRID SYSTEM POINTS = 8  
 NUMBER OF Y AXIS GRID SYSTEM POINTS = 16  
 NUMBER OF SPECIAL POINTS = 36  
 NUMBER OF SEASONS = 1  
 NUMBER OF WIND SPEED CLASSES = 6  
 NUMBER OF STABILITY CLASSES = 6  
 NUMBER OF WIND DIRECTION CLASSES = 16  
 FILE NUMBER OF DATA FILE USED FOR REPORTS = 1  
 THE PROGRAM IS RUN IN RURAL MODE  
 CONCENTRATION (DEPOSITION) UNITS CONVERSION FACTOR = 0.10000000E+07  
 ACCELERATION OF GRAVITY (METERS/SEC\*\*2) = 9.800  
 HEIGHT OF MEASUREMENT OF WIND SPEED (METERS) = 10.100  
 CORRECTION ANGLE FOR GRID SYSTEM VERSUS DIRECTION DATA NORTH (DEGREES) = 0.000  
 DECAY COEFFICIENT = 0.00000000E+00  
 PROGRAM OPTION SWITCHES = 1, 2, 2, 0, 0, 3, 2, 1, 3, 2, 2, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0,

RANGE X AXIS GRID SYSTEM POINTS (METERS) =	100.00,	200.00,	300.00,	400.00,	500.00,	750.00,					
	1000.00,	1250.00,									
RANGE X SPECIAL DISCRETE POINTS (METERS) =	317.00,	332.00,	357.00,	402.00,	366.00,	323.00,					
	296.00,	283.00,	277.00,	283.00,	253.00,	171.00,	134.00,	113.00,	98.00,	91.00,	
	88.00,	85.00,	88.00,	91.00,	101.00,	113.00,	137.00,	134.00,	122.00,	119.00,	
	116.00,	119.00,	122.00,	134.00,	149.00,	177.00,	229.00,	250.00,	259.00,	311.00,	
AZIMUTH BEARING Y AXIS GRID SYSTEM POINTS (DEGREES) =	22.50,	45.00,	67.50,	90.00,	112.50,	135.00,					
	157.50,	180.00,	202.50,	225.00,	247.50,	270.00,	292.50,	315.00,	337.50,	360.00,	
AZIMUTH BEARING Y SPECIAL DISCRETE POINTS (DEGREES) =	10.00,	20.00,	30.00,	40.00,	50.00,	60.00,					
	70.00,	80.00,	90.00,	100.00,	110.00,	120.00,	130.00,	140.00,	150.00,	160.00,	
	170.00,	180.00,	190.00,	200.00,	210.00,	220.00,	230.00,	240.00,	250.00,	260.00,	
	270.00,	280.00,	290.00,	300.00,	310.00,	320.00,	330.00,	340.00,	350.00,	360.00,	

- AMBIENT AIR TEMPERATURE (DEGREES KELVIN) -

	STABILITY	STABILITY	STABILITY	STABILITY	STABILITY	STABILITY
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
SEASON 1	300.0000	300.0000	300.0000	295.0000	290.0000	290.0000

- MIXING LAYER HEIGHT (METERS) -

	SEASON 1					
	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED	WIND SPEED
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4	CATEGORY 5	CATEGORY 6
STABILITY CATEGORY 10.	215100E+040.	215100E+040.	215100E+040.	215100E+040.	215100E+040.	215100E+040.
STABILITY CATEGORY 20.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.
STABILITY CATEGORY 30.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.
STABILITY CATEGORY 40.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.	143400E+040.
STABILITY CATEGORY 50.	100000E+050.	100000E+050.	100000E+050.	100000E+050.	100000E+050.	100000E+050.
STABILITY CATEGORY 60.	100000E+050.	100000E+050.	100000E+050.	100000E+050.	100000E+050.	100000E+050.



- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 1

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.500MPS)	WIND SPEED CATEGORY 2 ( 2.500MPS)	WIND SPEED CATEGORY 3 ( 4.300MPS)	WIND SPEED CATEGORY 4 ( 6.800MPS)	WIND SPEED CATEGORY 5 ( 9.500MPS)	WIND SPEED CATEGORY 6 (12.500MPS)
0.000	0.00023500	0.00113800	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.00001100	0.00011400	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00019100	0.00068300	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00022400	0.00102500	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00030500	0.00056900	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00015800	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00003300	0.00034200	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00027200	0.00022800	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00037000	0.00125200	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00005500	0.00056900	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00018000	0.00056900	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00011000	0.00113800	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00020200	0.00079700	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00023500	0.00113800	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00008800	0.00091100	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00018000	0.00056900	0.00000000	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 2

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.500MPS)	WIND SPEED CATEGORY 2 ( 2.500MPS)	WIND SPEED CATEGORY 3 ( 4.300MPS)	WIND SPEED CATEGORY 4 ( 6.800MPS)	WIND SPEED CATEGORY 5 ( 9.500MPS)	WIND SPEED CATEGORY 6 (12.500MPS)
0.000	0.00102600	0.00307401	0.00193501	0.00000000	0.00000000	0.00000000
22.500	0.00058300	0.00170801	0.00068300	0.00000000	0.00000000	0.00000000
45.000	0.00102600	0.00307401	0.00148000	0.00000000	0.00000000	0.00000000
67.500	0.00076400	0.00273201	0.00125200	0.00000000	0.00000000	0.00000000
90.000	0.00081100	0.00352901	0.00296001	0.00000000	0.00000000	0.00000000
112.500	0.00070400	0.00375701	0.00170801	0.00000000	0.00000000	0.00000000
135.000	0.00107900	0.00193501	0.00250501	0.00000000	0.00000000	0.00000000
157.500	0.00095800	0.00193501	0.00284601	0.00000000	0.00000000	0.00000000
180.000	0.00032900	0.00352901	0.00296001	0.00000000	0.00000000	0.00000000
202.500	0.00074400	0.00239101	0.00045500	0.00000000	0.00000000	0.00000000
225.000	0.00056300	0.00136600	0.00102500	0.00000000	0.00000000	0.00000000
247.500	0.00049000	0.00216301	0.00113800	0.00000000	0.00000000	0.00000000
270.000	0.00063000	0.00250501	0.00113800	0.00000000	0.00000000	0.00000000
292.500	0.00138700	0.00307401	0.00193501	0.00000000	0.00000000	0.00000000
315.000	0.00079100	0.00318801	0.00193501	0.00000000	0.00000000	0.00000000
337.500	0.00052300	0.00273201	0.00068300	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 3

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.500MPS)	WIND SPEED CATEGORY 2 ( 2.500MPS)	WIND SPEED CATEGORY 3 ( 4.300MPS)	WIND SPEED CATEGORY 4 ( 6.800MPS)	WIND SPEED CATEGORY 5 ( 9.500MPS)	WIND SPEED CATEGORY 6 (12.500MPS)
0.000	0.00036100	0.00330101	0.00569202	0.00068300	0.00000000	0.00000000
22.500	0.00022200	0.00273201	0.00546402	0.00079700	0.00000000	0.00000000
45.000	0.00050100	0.00387101	0.00535102	0.00079700	0.00000000	0.00000000
67.500	0.00016400	0.00432601	0.00831102	0.00204901	0.00000000	0.00000000
90.000	0.00029900	0.00478101	0.01013203	0.00204901	0.00000000	0.00000000
112.500	0.00008600	0.00227701	0.00785502	0.00125200	0.00000000	0.00000000
135.000	0.00020900	0.00239101	0.00523702	0.00079700	0.00000000	0.00000000
157.500	0.00005200	0.00136600	0.00478101	0.00056900	0.00000000	0.00000000
180.000	0.00034400	0.00284601	0.00603402	0.00102500	0.00000000	0.00000000
202.500	0.00018700	0.00182101	0.00204901	0.00056900	0.00000000	0.00000000
225.000	0.00008200	0.00216301	0.00216301	0.00045500	0.00011400	0.00000000
247.500	0.00020000	0.00216301	0.00227701	0.00045500	0.00011400	0.00000000
270.000	0.00031000	0.00193501	0.00398501	0.00216301	0.00000000	0.00000000
292.500	0.00009900	0.00261801	0.00421201	0.00068300	0.00000000	0.00011400
315.000	0.00022200	0.00273201	0.00626102	0.00068300	0.00000000	0.00000000
337.500	0.00007800	0.00204901	0.00421201	0.00045500	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 4

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.500MPS)	WIND SPEED CATEGORY 2 ( 2.500MPS)	WIND SPEED CATEGORY 3 ( 4.300MPS)	WIND SPEED CATEGORY 4 ( 6.800MPS)	WIND SPEED CATEGORY 5 ( 9.500MPS)	WIND SPEED CATEGORY 6 (12.500MPS)
0.000	0.00092700	0.00592002	0.01707705	0.01001803	0.00125200	0.00000000
22.500	0.00048400	0.00489501	0.00865203	0.00694402	0.00034200	0.00000000
45.000	0.00048400	0.00489501	0.00967703	0.00876603	0.00034200	0.00000000
67.500	0.00057700	0.00284601	0.01070103	0.01536905	0.00068300	0.00000000
90.000	0.00067400	0.00580602	0.01821505	0.01434404	0.00022800	0.00000000
112.500	0.00030800	0.00250501	0.01081503	0.00842403	0.00022800	0.00000000
135.000	0.00044700	0.00273201	0.00683102	0.00352901	0.00045500	0.00011400
157.500	0.00016000	0.00216301	0.00466801	0.00307401	0.00034200	0.00022800
180.000	0.00056500	0.00432601	0.01161203	0.00637502	0.00113800	0.00034200
202.500	0.00013500	0.00182101	0.00341501	0.00421201	0.00102500	0.00011400
225.000	0.00014300	0.00193501	0.00614802	0.00523702	0.00182101	0.00022800
247.500	0.00024000	0.00159400	0.00580602	0.00375701	0.00079700	0.00022800
270.000	0.00055200	0.00250501	0.00660302	0.01070103	0.00216301	0.00056900
292.500	0.00038800	0.00193501	0.00500902	0.00626102	0.00068300	0.00000000
315.000	0.00026500	0.00193501	0.00648902	0.00296001	0.00034200	0.00000000
337.500	0.00048000	0.00318801	0.00740002	0.00592002	0.00056900	0.00000000

- ISCLT INPUT DATA (CONT.) -

- FREQUENCY OF OCCURRENCE OF WIND SPEED, DIRECTION AND STABILITY -

SEASON 1

STABILITY CATEGORY 5

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.00000000	0.01149803	0.00466801	0.00000000	0.00000000	0.00000000
22.500	0.00000000	0.01070103	0.00227701	0.00000000	0.00000000	0.00000000
45.000	0.00000000	0.01195404	0.00330101	0.00000000	0.00000000	0.00000000
67.500	0.00000000	0.01275004	0.00512302	0.00000000	0.00000000	0.00000000
90.000	0.00000000	0.01320604	0.00819702	0.00000000	0.00000000	0.00000000
112.500	0.00000000	0.00774102	0.00512302	0.00000000	0.00000000	0.00000000
135.000	0.00000000	0.00694402	0.00341501	0.00000000	0.00000000	0.00000000
157.500	0.00000000	0.00671702	0.00056900	0.00000000	0.00000000	0.00000000
180.000	0.00000000	0.01206704	0.00159400	0.00000000	0.00000000	0.00000000
202.500	0.00000000	0.00500902	0.00056900	0.00000000	0.00000000	0.00000000
225.000	0.00000000	0.00603402	0.00045500	0.00000000	0.00000000	0.00000000
247.500	0.00000000	0.00557802	0.00136600	0.00000000	0.00000000	0.00000000
270.000	0.00000000	0.00421201	0.00466801	0.00000000	0.00000000	0.00000000
292.500	0.00000000	0.00284601	0.00193501	0.00000000	0.00000000	0.00000000
315.000	0.00000000	0.00239101	0.00284601	0.00000000	0.00000000	0.00000000
337.500	0.00000000	0.00352901	0.00671702	0.00000000	0.00000000	0.00000000

SEASON 1

STABILITY CATEGORY 6

DIRECTION (DEGREES)	WIND SPEED CATEGORY 1 ( 1.5000MPS)	WIND SPEED CATEGORY 2 ( 2.5000MPS)	WIND SPEED CATEGORY 3 ( 4.3000MPS)	WIND SPEED CATEGORY 4 ( 6.8000MPS)	WIND SPEED CATEGORY 5 ( 9.5000MPS)	WIND SPEED CATEGORY 6 (12.5000MPS)
0.000	0.01320504	0.02060606	0.00000000	0.00000000	0.00000000	0.00000000
22.500	0.01089603	0.01992306	0.00000000	0.00000000	0.00000000	0.00000000
45.000	0.00727002	0.01457204	0.00000000	0.00000000	0.00000000	0.00000000
67.500	0.00806702	0.01377504	0.00000000	0.00000000	0.00000000	0.00000000
90.000	0.00799902	0.01593805	0.00000000	0.00000000	0.00000000	0.00000000
112.500	0.00427601	0.00694402	0.00000000	0.00000000	0.00000000	0.00000000
135.000	0.00533302	0.00888003	0.00000000	0.00000000	0.00000000	0.00000000
157.500	0.00355401	0.00512302	0.00000000	0.00000000	0.00000000	0.00000000
180.000	0.00660702	0.00865203	0.00000000	0.00000000	0.00000000	0.00000000
202.500	0.00326101	0.00466801	0.00000000	0.00000000	0.00000000	0.00000000
225.000	0.00380101	0.00352901	0.00000000	0.00000000	0.00000000	0.00000000
247.500	0.00434701	0.00717202	0.00000000	0.00000000	0.00000000	0.00000000
270.000	0.00566102	0.00944903	0.00000000	0.00000000	0.00000000	0.00000000
292.500	0.00439601	0.00637502	0.00000000	0.00000000	0.00000000	0.00000000
315.000	0.00301101	0.00387101	0.00000000	0.00000000	0.00000000	0.00000000
337.500	0.00485501	0.00831102	0.00000000	0.00000000	0.00000000	0.00000000

- ISCLT INPUT DATA (CONT.) -

- VERTICAL POTENTIAL TEMPERATURE GRADIENT (DEGREES KELVIN/METER) -

	WIND SPEED CATEGORY 1	WIND SPEED CATEGORY 2	WIND SPEED CATEGORY 3	WIND SPEED CATEGORY 4	WIND SPEED CATEGORY 5	WIND SPEED CATEGORY 6
STABILITY CATEGORY 10.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.
STABILITY CATEGORY 20.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.
STABILITY CATEGORY 30.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.
STABILITY CATEGORY 40.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.	0.000000E+000.
STABILITY CATEGORY 50.	0.200000E-010.	0.200000E-010.	0.200000E-010.	0.200000E-010.	0.200000E-010.	0.200000E-010.
STABILITY CATEGORY 60.	0.350000E-010.	0.350000E-010.	0.350000E-010.	0.350000E-010.	0.350000E-010.	0.350000E-010.

- WIND PROFILE POWER LAW EXPONENTS -

	WIND SPEED CATEGORY 1	WIND SPEED CATEGORY 2	WIND SPEED CATEGORY 3	WIND SPEED CATEGORY 4	WIND SPEED CATEGORY 5	WIND SPEED CATEGORY 6
STABILITY CATEGORY 10.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.
STABILITY CATEGORY 20.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.	0.700000E-010.
STABILITY CATEGORY 30.	0.100000E+000.	0.100000E+000.	0.100000E+000.	0.100000E+000.	0.100000E+000.	0.100000E+000.
STABILITY CATEGORY 40.	0.150000E+000.	0.150000E+000.	0.150000E+000.	0.150000E+000.	0.150000E+000.	0.150000E+000.
STABILITY CATEGORY 50.	0.350000E+000.	0.350000E+000.	0.350000E+000.	0.350000E+000.	0.350000E+000.	0.350000E+000.
STABILITY CATEGORY 60.	0.550000E+000.	0.550000E+000.	0.550000E+000.	0.550000E+000.	0.550000E+000.	0.550000E+000.

- SOURCE INPUT DATA -

C T SOURCE SOURCE X Y EMISSION BASE /  
 A A NUMBER TYPE COORDINATE COORDINATE HEIGHT ELEV- /  
 R P (M) (M) (M) ATION /  
 D E (M) /

- SOURCE DETAILS DEPENDING ON TYPE -

-----  
 X 1 STACK 0.00 0.00 12.19 0.00 GAS EXIT TEMP (DEG K)= 561.00, GAS EXIT VEL. (M/SEC)= 48.88,  
 STACK DIAMETER (M)= 0.440, HEIGHT OF ASSO. BLDG. (M)= -9.69, WIDTH OF  
 ASSO. BLDG. (M)= 74.92, WAKE EFFECTS FLAG = 0

- DIRECTION SPECIFIC BUILDING DIMENSIONS -

SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE	SECTOR	DSBH	DSBW	IWAKE
1	9.7,	75.0,	0	2	9.7,	75.0,	0	3	9.7,	75.0,	0	4	9.7,	75.0,	0
5	9.7,	75.0,	0	6	9.7,	75.0,	0	7	9.7,	75.0,	0	8	9.7,	75.0,	0
9	9.7,	75.0,	0	10	9.7,	75.0,	0	11	9.7,	75.0,	0	12	9.7,	75.0,	0
13	9.7,	75.0,	0	14	9.7,	75.0,	0	15	9.7,	75.0,	0	16	9.7,	75.0,	0

- SOURCE STRENGTHS ( GRAMS PER SEC ) -

SEASON 1 SEASON 2 SEASON 3 SEASON 4  
 1.33000E+00

WARNING - HW/HB > 5 FOR SOURCE 1 PROG. USES LATERAL VIRTUAL DIST. FOR UPPER BOUND OF CONCENTRATION (DEPOSITION) IN SECTOR(S):  
 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.  
 IF LOWER BOUND IS DESIRED SET THE DIRECTION SPECIFIC BUILDING HEIGHT TO < 0 (WAKE EFFECTS FLAG) AND RERUN.

\*\* ANNUAL GROUND LEVEL CONCENTRATION ( MICROGRAMS PER CUBIC METER ) DUE TO SOURCE 1 \*\*

- GRID SYSTEM RECEPTORS -

- X AXIS ( RANGE , METERS ) -

100.000 200.000 300.000 400.000 500.000 750.000 1000.000 1250.000  
 Y AXIS (AZIMUTH BEARING, DEGREES ) - CONCENTRATION -

360.000	0.555114	0.485193	0.617707	0.658492	0.625931	0.486231	0.386275	0.318323
337.500	0.341902	0.298540	0.378019	0.393915	0.367460	0.273378	0.210321	0.170092
315.000	0.346429	0.310278	0.401536	0.433397	0.418386	0.333207	0.266715	0.221042
292.500	0.406243	0.407726	0.585436	0.654172	0.633107	0.494311	0.385241	0.311154
270.000	0.653110	0.624407	0.860049	0.965636	0.948231	0.768115	0.616146	0.508146
247.500	0.604840	0.577261	0.776979	0.848854	0.811780	0.624741	0.487107	0.397536
225.000	0.387622	0.370730	0.521663	0.592267	0.585079	0.477941	0.389692	0.327545
202.500	0.268761	0.270708	0.394122	0.457264	0.458325	0.384766	0.321068	0.276523
180.000	0.516282	0.465401	0.627573	0.713231	0.713849	0.599237	0.492416	0.414234
157.500	0.270188	0.263866	0.380506	0.431200	0.423625	0.343968	0.278255	0.230927
135.000	0.317860	0.309841	0.432153	0.470884	0.449405	0.342487	0.259677	0.203598
112.500	0.411911	0.368810	0.477098	0.505490	0.475017	0.352613	0.263781	0.206374
90.000	0.619419	0.522121	0.617547	0.631785	0.583410	0.433241	0.332166	0.266852
67.500	0.314758	0.269181	0.334203	0.355174	0.338921	0.263160	0.206980	0.169701
45.000	0.367567	0.296365	0.350945	0.373792	0.359503	0.282148	0.221566	0.179737
22.500	0.255660	0.225913	0.293391	0.316472	0.301746	0.230825	0.179376	0.145495

- DISCRETE RECEPTORS -

X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION	X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION	X RANGE (METERS)	Y AZIMUTH BEARING (DEGREES)	CONCENTRATION
------------------	-----------------------------	---------------	------------------	-----------------------------	---------------	------------------	-----------------------------	---------------

317.0	10.0	0.473932	332.0	20.0	0.338726	357.0	30.0	0.325367
402.0	40.0	0.356655	366.0	50.0	0.362417	323.0	60.0	0.341914
296.0	70.0	0.356844	283.0	80.0	0.464687	277.0	90.0	0.594718
283.0	100.0	0.522864	253.0	110.0	0.433756	171.0	120.0	0.370572
134.0	130.0	0.354230	113.0	140.0	0.316774	98.0	150.0	0.273058
91.0	160.0	0.260510	88.0	170.0	0.350631	85.0	180.0	0.451968
88.0	190.0	0.347537	91.0	200.0	0.255285	101.0	210.0	0.301237
113.0	220.0	0.371969	137.0	230.0	0.454911	134.0	240.0	0.558005
122.0	250.0	0.640820	119.0	260.0	0.652554	116.0	270.0	0.686789
119.0	280.0	0.563827	122.0	290.0	0.459182	134.0	300.0	0.407040
149.0	310.0	0.365104	177.0	320.0	0.324827	229.0	330.0	0.297779
250.0	340.0	0.351234	259.0	350.0	0.451383	311.0	360.0	0.628502

\*\* ANNUAL GROUND LEVEL CONCENTRATION ( MICROGRAMS PER CUBIC METER ) DUE TO SOURCE 1 (CONT.) \*\*

- 10 CONTRIBUTING VALUES TO PROGRAM DETERMINED MAXIMUM 10 OF ALL SOURCES COMBINED -

X COORDINATE RANGE (METERS)	Y COORDINATE AZIMUTH BEARING (DEGREES)	CONCENTRATION
400.00	270.00	0.965636
500.00	270.00	0.948231
300.00	270.00	0.860049
400.00	247.50	0.848854
500.00	247.50	0.811780
300.00	247.50	0.776979
750.00	270.00	0.768115
500.00	180.00	0.713849
400.00	180.00	0.713231
116.00	270.00	0.686789

\*\*\*\*\* END OF ISCLT PROGRAM, 1 SOURCES PROCESSED \*\*\*\*\*



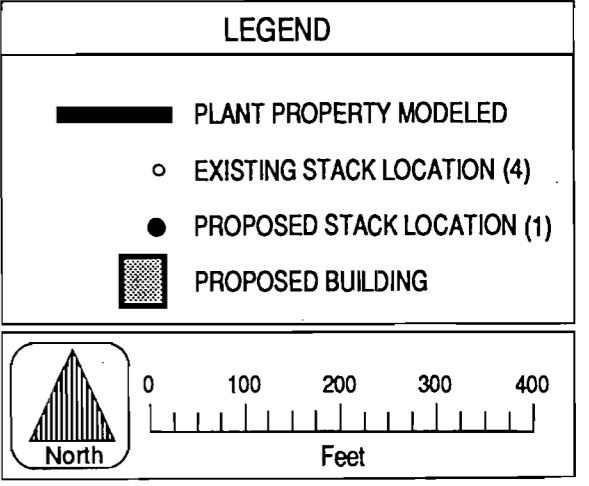
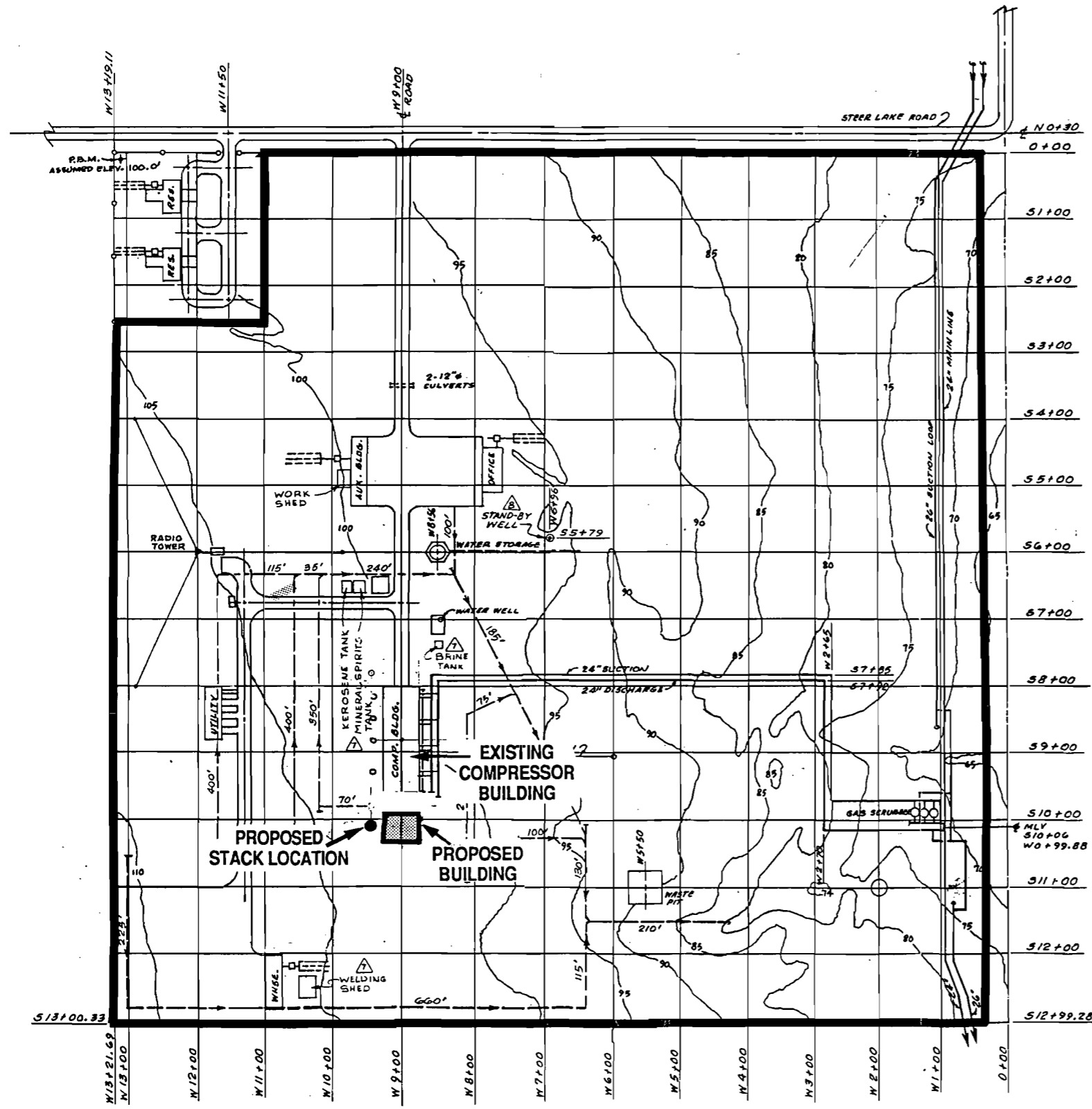


Figure 2-1 PLOT PLAN OF COMPRESSOR STATION NO. 18

**The Orlando Sentinel**

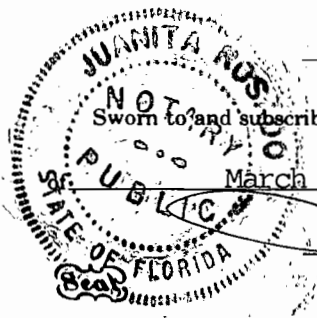
Published Daily  
Orlando, Orange County, Florida

State of Florida ) ss.  
COUNTY OF ORANGE

Before the undersigned authority personally appeared \_\_\_\_\_  
Noemi R. Lucero \_\_\_\_\_, who on oath says that  
she is the Legal Advertising Representative of the Orlando Sentinel, a Daily newspaper  
published at Orlando, in Orange County, Florida; that the attached copy of ad-  
vertisement, being a intent to issue \_\_\_\_\_ in the matter of  
ONE NATURAL GAS FIRED ENGINE  
\_\_\_\_\_ in the \_\_\_\_\_ Court,  
was published in said newspaper in the issues of \_\_\_\_\_  
March 21, 1991

Affiant further says that the said Orlando Sentinel is a newspaper published at Orlando, in  
said Orange County, Florida, and that the said newspaper has heretofore been continuously  
published in said Orange County, Florida, each Week Day and has been entered as second-  
class mail matter at the post office in Orlando, in said Orange County, Florida for a period of  
one year next preceding the first publication of the attached copy of advertisement; and af-  
fiant further says that he/she has neither paid nor promised any person, firm or corporation  
any discount, rebate, commission or refund for the purpose of securing this advertisement for  
publication in the said newspaper.

*Noemi R. Lucero*



Sworn to and subscribed before me this 21st \_\_\_\_\_ day  
March \_\_\_\_\_ A.D., 1991

*Juanita Rosado*  
Notary Public

Notary Public  
State of Florida at Large  
My Commission Expires  
June 18, 1994  
FORM NO. AD-262

RECEIVED

APR 4 - 1991 ADVERTISING CHARGE \$173.20

DER - BAQM

State of Florida  
Department of Environmental  
Regulation  
Notice of Intent to Issue  
The Department of Environ-  
mental Regulation hereby gives  
notice of its intent to issue a per-  
mit to Florida Gas Transmission  
Company, P.O. Box 1188, Hous-  
ton, Texas 77251-1188, to install  
one natural gas fired engine.  
The Company's facility is locat-  
ed at 7990 Steer Lake Road, Or-  
lando, Orange County, Florida.  
The maximum annual NO 2  
Class II increment consumed is  
4.0%. A determination of Best  
Available Control Technology  
(BACT) was required. The De-  
partment is issuing this Intent to  
Issue for the reasons stated in  
the Technical Evaluation and  
Preliminary Determination.  
A person whose substantial  
interests are affected by the De-  
partment's proposed permitting  
decision may petition for an ad-  
ministrative proceeding (hear-  
ing) in accordance with Section  
120.57, Florida Statutes. The pe-  
tition must contain the informa-  
tion set forth below and must be  
filed (received) in the Office of  
General Counsel of the Depart-  
ment at 2600 Blair Stone Road,  
Tallahassee, Florida 32399-2400,  
within fourteen (14) days of pub-  
lication of this notice. Petitioner  
shall mail a copy of the petition  
to the applicant at the address  
indicated above at the time of fil-  
ing. Failure to file a petition with-  
in this time period shall consti-  
tute a waiver of any right such  
person may have to request an  
administrative determination  
(hearing) under Section 120.57,  
Florida Statutes.  
The Petition shall contain the  
following information:  
(a) The name, address, and  
telephone number of each peti-  
tioner, the applicant's name and  
address, the Department Permit  
File Number and the county in  
which the project is proposed;  
(b) A statement of how and  
when each petitioner received  
notice of the Department's ac-  
tion or proposed action;  
(c) A statement of how each  
petitioner's substantial interests  
are affected by the Department's  
action or proposed action;  
(d) A statement of the material  
facts disputed by Petitioner, if  
any;  
(e) A statement of facts which  
petitioner contends warrant re-  
versal or modification of the De-  
partment's action or proposed  
action;  
(f) A statement of which rules  
or statutes petitioner contends  
require reversal or modification  
of the Department's action or  
proposed action; and  
(g) A statement of the relief  
sought by petitioner, stating pre-  
cisely the action petitioner wants  
the Department to take with re-  
spect to the Department's action  
or proposed action.  
If a petition is filed, the adminis-  
trative hearing process is de-  
signed to formulate agency ac-  
tion. Accordingly, the Depart-  
ment's final action may be differ-  
ent from the position taken by it  
in this Notice. Persons whose  
substantial interests will be af-  
fected by any decision of the  
Department with regard to the  
application have the right to pe-  
tition to become a party to the  
proceeding. The petition must  
conform to the requirements  
specified above and be filed (re-  
ceived) within 14 days of publi-  
cation of this notice in the Office  
of General Counsel at the above  
address of the Department. Fail-  
ure to petition within the allowed  
time frame constitutes a waiver  
of any right such person has to  
request a hearing under Section  
120.57, F.S., and to participate  
as a party to this proceeding.  
Any subsequent intervention will  
only be at the approval of the  
presiding officer upon motion  
filed pursuant to Rule 28-5.207,  
F.A.C.  
The application is available for  
public inspection during busi-  
ness hours, 8:00 a.m. to 5:00  
p.m., Monday through Friday,  
except legal holidays, at:  
Department of Environmental  
Regulation  
Bureau of Air Regulation  
2600 Blair Stone Road  
Tallahassee, Florida 32399-2400  
Department of Environmental  
Regulation  
Central District  
3319 Maguire Blvd., Suite 232  
Orlando, Florida 32803-3767  
Any person may send written  
comments on the proposed ac-  
tion to Mr. Barry Andrews at the  
Department's Tallahassee ad-  
dress. All comments mailed  
within 30 days of the publication  
of this notice will be considered  
in the Department's final deter-  
mination. Further, a public hear-  
ing can be requested by any  
person. Such requests must be  
submitted within 30 days of this  
notice.  
CL-160 Mar. 21, 1991