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February 26, 2001

154648

Mr. Jeff Koerner
Florida Department of Environmental Regulation
Division of Air Resources Management
111 South Magnolia, Suite 4
Tallahassee, FL 32301

Subject: Class I Area Impact Analysis
Everglades National Park
Duke Energy Fort Pierce, LLC
Fort Pierce, FL

Dear Mr. Koerner:

Enclosed please a brief report entitled *Dispersion Modeling Assessment – Everglades National Park*, which summarizes the results of a dispersion modeling analysis of Duke Energy's proposed Fort Pierce power generating facility. This analysis was requested by your office and the National Park Service as a means of quantifying potential impacts attributable to the the operation of the Duke facility in the Everglades National Park. This report is intended to supplement the previously submitted application for a Permit to Construct the facility and is being submitted on behalf of our client, Duke Energy Fort Pierce, LLC. We are also sending you under separate cover two copies of a CD-ROM containing all modeling related files that were used in the analysis.

If you should have any questions concerning any aspect of this report, please do not hesitate to call Nathan Plagens of Duke Energy North America at 713-627-5985, or the undersigned at 770-604-9182, ext 355.

Sincerely,

CH2M HILL

George Howroyd

George Howroyd, Ph.D., P.E.
Principal Engineer

ATL\154648\Class I Analysis Subnittal Letter 2-26-01.doc

c: Nathan Plagens/Duke Energy
C. Holladay
NPS (2nd Ex)

Dispersion Modeling Assessment
Everglades National Park

Prepared for

Duke Energy Fort Pierce, LLC
Fort Pierce, Florida,

Prepared by

CH2M HILL, Inc.
Montgomery, Alabama

February 20, 2001
154648.01.PD

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Introduction

Duke Energy Fort Pierce, LLC (Duke), recently submitted a prevention of significant deterioration (PSD) permit application to the Florida Department of Environmental Protection (FDEP) for a proposed 640-megawatt (MW) power generating facility to be located near Fort Pierce, Florida, in St. Lucie County. The National Park Service has requested that ambient air quality, visibility, and total sulfur and nitrogen deposition screening analyses be performed to evaluate the effects of the proposed facility in the Everglades National Park, which is located approximately 180 kilometers (km) south-southwest of the project site.

As provided in Duke's permit application to FDEP dated September 2000, the proposed facility will have the following characteristics:

- 640-MW simple cycle power generating plant (8 GE 7EA turbines)
- Facility located near Fort Pierce, Florida, in St. Lucie County, north-northeast of the Everglades National Park
- Natural gas is the primary fuel, to be used up to 2,500 hours per year (per turbine)
- Low sulfur fuel oil (less than 0.05 percent) will be used only for back-up when natural gas is unavailable. Fuel oil use will be limited to 12 hours/day and 500 hours/year per turbine
- PSD Class II impact analyses demonstrated insignificant impacts for all pollutants at all locations
- Distance to nearest Class I area is approximately 180 km (Everglades National Park)

Maximum potential facility emissions (all turbines in operation) are as follows:

Pollutant	Oil Firing (lbs/hr)	Gas Firing (lbs/hr)
NOx	1,272	328
SO2	400	48
PM-10	200	88
VOC	36	11
CO	336	416

Class I Area Dispersion Modeling Methodology

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Class I Area Modeling Protocol

The Class I Area impact analysis for the Duke Energy Fort Pierce facility followed the methodology given in the 1996 *Interagency Workgroup on Air Quality Modeling Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts* (U.S. Environmental Protection Agency [EPA]-454/R-98-019) (IWAQM2). The approach used the CALPUFF model in a screening mode, as described in Section 2.1 of IWAQM2.

The Class I Area impact analysis included the calculation of concentrations of sulfur dioxide (SO_2), particulate matter (PM_{10}), and nitrogen dioxide (NO_2) for comparison to the EPA proposed Class I significance levels (Table 1); calculation of the percent change in extinction; and total sulfur and nitrogen deposition.

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EPA Proposed Class I Area Significance Levels
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Pollutant	Averaging Time	Concentration (μg/m3)
Sulfur Dioxide	Annual	0.1
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Dispersion	1. Use ISC2PUF to convert an ISC3 control input file for use by CALPUFF 2. Edit control file to use MESOPUFF II chemistry; use wet and dry deposition (use default setups for these). 3. Run CALPUFF using ISC meteorology option; horizontal domain extending 50 to 80 kilometers beyond outer receptor ring.
Processing	**For Class I Significance Levels:** Use maximum 3-hour, 24-hour, and annual SO_2; maximum 24-hour and annual PM_{10}; and maximum annual NO_2 for comparison with EPA proposed levels. **For haze:** Use maximum 24-hour sulfate, nitrate, and particulate concentrations. Calculate the percent change in extinction using the FLM supplied background extinction. **For total S and N deposition:** Convert deposition flux to kg/(hectare year) using maximum values of annual SO_2, $SO_4^=$, NO_3^-, HNO_3, and NO_2.

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Scaling Factors for Diurnal Variation in Emission Factors for CALPUFF modeling
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Pollutant	Oil Firing (lb/hr)	Gas Firing (lb/hr)	Factor (Gas/Oil)
SO_2	400	48	0.120
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For the purpose of this analysis, the diurnal variation in emissions associated with fuel oil firing was assessed by assuming that fuel oil would most likely be burned during the 12-hr period from 8 a.m. to 8 p.m. The modeling analysis was therefore based on modeling gas-fired emissions for hours 1 to 8, oil-fired emissions for hours 9 to 20, and gas-fired emissions for hours 21 to 24. All modeling was performed using the CALPUFF Screening methodology. The diurnal variation in emissions was accomplished by using the CALPUFF variable IVARY and the scaling factors given in Table 3. Base emission rates were set to those for oil firing. For hours 9 to 20 (oil firing) a scaling factor of 1 was used. For hours 1 to 8 and 21 to 24 the scaling factors in Table 10 were used. It is noted that Duke will not be restricting the hours of firing to any particular time period during the day, rather it will be resticted from firing oil for more than 12 hours in any given calendar day. The diurnal analysis performed here was based on a time period when the facility might reasonably be expected to operate on oil.

Because the facility will operate up to 2,500 hours per year (500 hours of which could be on back-up fuel oil), emission rates for the annual averaging period were conservatively derived by the following:

- Multiplying the oil-firing hourly rates listed above by 500
- Multiplying the gas-firing hourly rates by 2,000
- Summing the two results
- Dividing the sum by 8,760 (i.e., the number of hours in a year)

Specifically, the rates used for the annual averaging period were SO_2–33.79 lbs/hr, NO_x–147.5 lbs/hr, and PM_{10}–31.51 lbs/hr.

CALPUFF Settings. The CALPUFF settings used in the CALPUFF control file follow those given in Appendix B of IWAQM2. The CALPUFF control files used from the analyses are attached. The main values are summarized in Table 4.

TABLE 4
CALPUFF Settings Used in the Analysis
Proposed Power Generating Facility, Duke Energy Fort Pierce, LLC

Parameter	Setting
Pollutant Species	SO_2, SO_4, NO_X, HNO_3, NO_3, PM_{10}
Chemical Transformation	MESOPUFF II scheme with CALPUFF default
Deposition	Include both dry and wet deposition, plume
Meteorological	ISCMET.DAT (extended ISC3)
Plume Rise	Transitional, Stack-tip downwash, Partial plume penetration
Dispersion	PG/MG coefficients,
Output	Create binary file
Model Processing	Highest concentration predicted
Background Values	Ozone: 28 ppb[1]; Ammonia: 10 ppb[2]
Variable Emissions Data for Point Source	Diurnal cycle (24 scaling factors: hours 1-24)

Notes:
[1] Provided by John Notar/NPS
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CALPOST Settings. ***Visibility.*** The CALPOST control files from the analyses are attached. The main values for a visibility calculation are summarized in Table 5.

TABLE 5
CALPOST Settings Used for Visibility Calculation
Proposed Power Generating Facility, Duke Energy Fort Pierce, LLC

Parameter	Setting
Species to process	ASPEC = VISIB
Maximum relatively humidity	RHMAX = 95%[1]
Fine Particulates included	LVPMF = T
Modeled PM10 used as Fine Particulates	SPECPMF = PM10
Method used for background light extinction	MVISBK = 2
Background sulfate concentration	BKSO4 = 1.86 $\mu g/m^3$
Background soil concentration	BKSOIL = 14.91 $\mu g/m^3$
Extinction due to Rayleigh Scattering	BEXTRAY = 10 (1/Mm)
Averaging Time	L24HR = T

Note:
[1] Provided by John Notar/NPS

Total Sulfur and Nitrogen Deposition

The total depositions of sulfur and nitrogen were calculated in km per hectare per year. These values were derived from the annual wet and dry fluxes of SO_2, $SO_4^=$, NO_X, HNO_3, and NO_3^- that are available as output from CALPOST. Per direction from John Notar of the National Park Service, the fluxes were converted to sulfur and nitrogen deposited by the use of the multipliers given in Section 3.3 of IWAQM2.

Source Description

The proposed 640-MW simple cycle power generating plant (with eight GE 7EA turbines) was modeled as a single source. Table 6 summarizes the emissions source as used in the model.

Visibility

Following the IWAQM2 guidance for a screening analysis, the regional haze analysis for visibility impacts uses the maximum 24-hour sulfate, nitrate, and particulate concentrations to calculate the percent change in extinction using the FLM supplied background extinction. Table 7 summarizes the background visibility values for the Everglades National Park Class I area as provided by John Notar of the National Park Service.

TABLE 6
640-MW Simple Cycle Powering Generating Plant Source Characteristics
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Description	X UTM (km)	Y UTM (km)	Stack Height (m)	Base Elevation (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (k)
Power Plant	561.591	3028.9629	28.35	0.0	4.572	41.85	813.7

TABLE 7
Background Visibility Values for Everglades National Park
Proposed Power Generating Facility, Duke Energy Fort Pierce, LLC

Area	Hygro (1/Mm)	Non-Hygro (1/Mm)	Rayleigh (1/Mm)	f(RH)
Everglades NP	5.59	14.91	10	3.85

Results

The results of the ambient air, visibility, and deposition analyses are presented in Tables 8, 9, and 10, respectively. Table 8 shows that modeled concentrations are all less than the EPA proposed Class I area significance levels. Table 9 shows that modeled percent changes in extinction are all less than 10 percent, with only a few days per year greater than 5 percent. In general, with only two exceptions, predicted extinction values are only marginally greater than 5 percent. Table 10 shows that the maximum modeled nitrogen deposition for all years is less than or equal to 0.003 km per hectare per year, and that the maximum modeled sulfur deposited for all years is less than or equal to 0.0025 km per hectare per year.

TABLE 8
Ambient Air Quality Results
Proposed Power Generating Facility, Duke Energy Fort Pierce, LLC

Year	SO_2 Annual (μg/m3)	SO_2 24-hour (μg/m3)	SO_2 3-hour (μg/m3)	PM_{10} Annual (μg/m3)	PM_{10} 24-hour (μg/m3)	NO_x Annual (μg/m3)
1986	0.0013	0.1156	0.3669	0.0015	0.0850	0.0030
1987	0.0012	0.1207	0.4540	0.0014	0.0799	0.0028
1988	0.0011	0.1239	0.3859	0.0013	0.0880	0.0027
1989	0.0013	0.1743	0.4730	0.0015	0.1100	0.0027
1990	0.0011	0.1563	0.4762	0.0013	0.1017	0.0027
Class I Significance Level	**0.1**	**0.2**	**1.0**	**0.2**	**0.3**	**0.1**

TABLE 9
Visibility Results
Proposed Power Generating Facility, Duke Energy Fort Pierce, LLC

Year	Number of Days with Extinction Change > 5%	Days with Extinction Change ≥ 5%	Extinction Change (%)
1986	2	Day 3	5.29
		Day 51	9.00
1987	2	Day 30	5.41
		Day 51	5.74
1988	3	Day 43	5.00
		Day 44	5.06
		Day 235	5.44
1989	1	Day 356	6.89
1990	2	Day 13	5.54
		Day 355	5.06

TABLE 10
Deposition Results
Proposed Power Generating Facility, Duke Energy Fort Pierce, LLC

Year	Total N (kg/(ha*yr))	Total S (kg/(ha*yr))
1986	0.0019	0.0014
1987	0.0016	0.0011
1988	0.0016	0.0011
1989	0.0016	0.0012
1990	0.0016	0.0013

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c: Nathan Plagens/Duke Energy
D. Baldman
EPA
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Dispersion Modeling Assessment
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Background soil concentration	BKSOIL = 14.91 $\mu g/m^3$
Extinction due to Rayleigh Scattering	BEXTRAY = 10 (1/Mm)
Averaging Time	L24HR = T

Note:
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Total Sulfur and Nitrogen Deposition

The total depositions of sulfur and nitrogen were calculated in km per hectare per year. These values were derived from the annual wet and dry fluxes of SO_2, $SO_4^=$, NO_x, HNO_3, and NO_3^- that are available as output from CALPOST. Per direction from John Notar of the National Park Service, the fluxes were converted to sulfur and nitrogen deposited by the use of the multipliers given in Section 3.3 of IWAQM2.

Source Description

The proposed 640-MW simple cycle power generating plant (with eight GE 7EA turbines) was modeled as a single source. Table 6 summarizes the emissions source as used in the model.

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Results

The results of the ambient air, visibility, and deposition analyses are presented in Tables 8, 9, and 10, respectively. Table 8 shows that modeled concentrations are all less than the EPA proposed Class I area significance levels. Table 9 shows that modeled percent changes in extinction are all less than 10 percent, with only a few days per year greater than 5 percent. In general, with only two exceptions, predicted extinction values are only marginally greater than 5 percent. Table 10 shows that the maximum modeled nitrogen deposition for all years is less than or equal to 0.003 km per hectare per year, and that the maximum modeled sulfur deposited for all years is less than or equal to 0.0025 km per hectare per year.

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Year	SO_2 Annual (µg/m3)	SO_2 24-hour (µg/m3)	SO_2 3-hour (µg/m3)	PM_{10} Annual (µg/m3)	PM_{10} 24-hour (µg/m3)	NO_X Annual (µg/m3)
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1987	0.0012	0.1207	0.4540	0.0014	0.0799	0.0028
1988	0.0011	0.1239	0.3859	0.0013	0.0880	0.0027
1989	0.0013	0.1743	0.4730	0.0015	0.1100	0.0027
1990	0.0011	0.1563	0.4762	0.0013	0.1017	0.0027
Class I Significance Level	**0.1**	**0.2**	**1.0**	**0.2**	**0.3**	**0.1**

TABLE 9
Visibility Results
Proposed Power Generating Facility, Duke Energy Fort Pierce, LLC

Year	Number of Days with Extinction Change > 5%	Days with Extinction Change ≥ 5%	Extinction Change (%)
1986	2	Day 3	5.29
		Day 51	9.00
1987	2	Day 30	5.41
		Day 51	5.74
1988	3	Day 43	5.00
		Day 44	5.06
		Day 235	5.44
1989	1	Day 356	6.89
1990	2	Day 13	5.54
		Day 355	5.06

TABLE 10
Deposition Results
Proposed Power Generating Facility, Duke Energy Fort Pierce, LLC

Year	Total N (kg/(ha*yr))	Total S (kg/(ha*yr))
1986	0.0019	0.0014
1987	0.0016	0.0011
1988	0.0016	0.0011
1989	0.0016	0.0012
1990	0.0016	0.0013