Florida Power & Light Company
9700 SW 344 Street, Homestead, FL 33035
Turkey Point Fossil Plant

FPL

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May 2, 2007

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BUREAU OF AIR REGULATION

Alvaro Linero, P.E. – Program Administrator
Permitting South Section
Bureau of Air Regulation
Florida Department of Environmental Protection
2600 Blair Stone /Road
Tallahassee, Fl
32399-2400

RE: Turkey Point Fossil Power Plant Units 1 & 2; 0250003-008-AC BART Determination Application – Response to Request for Additional Information

Dear Al,

FPL provides the following responses to the FDEP's Request for Additional Information [Feb 26, 2007] referenced above.

Question 1. On page 5-2 of the Application you state "ESPs have been added to FPL's Port Everglades Plant including the 400 MW class units that are very similar to Units 1 and 2 at PTF." Please explain why the same rationale used to implement these controls at the Port Everglades Plant cannot be economically employed at the Turkey Point Fossil Power Plant.

Response:
Units 1&2 at Turkey Point Fossil Plant are similar to the 400 MW class units (3&4) at Port Everglades. However, there are significant differences in the economic employment of ESPs at PTF versus PPE which are answered, for the most part, by the responses to Questions #2 and #9 below.

Further, other significant differences exist between the two facilities. First, the rationale to install ESPs at Port Everglades was driven by local concerns over the visible emissions in the immediate vicinity of the plant. However the Clean Air Visibility Rule is not based on that criteria. In fact, the basis is very different and the Rule's metric for improvement is distinct from the Port Everglades situation. Further, the BART Determination process requires that a control option be evaluated on 5 criteria; Cost of Compliance, Energy Impacts, Non-Air Quality Environmental Impacts, Remaining Useful Life, and Visibility Impacts. The Cost of Compliance on page 5-3 of the BART Determination indicates an annualized cost of about $13.4 million, resulting in a cost effectiveness of over $10,000 per ton removed. The change in visibility impacts as indicated on page 5-4 is 0.1 dv.

This equates to $134 million per dv. in visibility improvement. FPL believes, for Turkey Point, the Cost of Compliance to install ESPs, compared to the visibility impacts as determined by the Rule, is unreasonable.

Question 2. According to Public Service Commission (PSC) Docket Item No. 0600007-EI (August 4, 2006), the projected net investment in the Port Everglades ESPs (December 2006) is approximately $60,000,000 for the four units. Please reconcile the estimate of $94,000,000 for the two Turkey Point units with the $60,000,000 investment in the four Port Everglades units.

Response:
The Port Everglades ESP project cost from Docket Item No. 030007-EI dated September 8, 2003 is $92,100,000 for the four Port Everglades Units. FPL believes that the cost quoted in the question is actually the projected net investment through December 2006 which was approximately $60,000,000 from the July through December 2006 forecast. Further, since the initiation of the project at Port Everglades, the cost for installation at Turkey Point 1 & 2 is projected to be higher due to market conditions such as material cost escalation, labor cost escalation, and increased market competition to obtain equipment and construction services. Also, the economy of scale for the larger project is diluted by performing only two units versus four. An example would be that the cost of common facilities that can be shared by four units must now be borne by two. Finally, site differences also contribute to the increased estimated cost for installation at Turkey Point, in particular, the location of the nuclear units immediately adjacent to the fossil units.

Question 3. The Department experts have noted much improved stack opacity and general visibility in the vicinity of the Port Everglades Plant. Please explain whether such improvements could be expected by a similar effort at Turkey Point Fossil Plant.

Response:
The installation of control technology with similar design and operating characteristics as Port Everglades could be expected to yield similar improvements in stack opacity and general visibility in the local area adjacent to Turkey Point. However, the Clean Air Visibility Rule measure of visibility impairment in Class 1 Areas, the Deciview, is substantially different than the eye's perception of general visibility in a locale such as Port Everglades. Modeling consistent with the requirements of the Rule has shown that upon using a like technology installation as Port Everglades, Turkey Point's visibility impacts within the Everglades National Park Class 1 Area, some 21 kilometers distant, would result only in a 0.1 dv. improvement in visibility.

Question No. 4. According to information submitted in support of Title V fees, Turkey Point Units 1 and 2 combined used 23,600,000 and 6,500,000 MM Btu of fuel oil and natural gas respectively in 2005. Therefore the plant used natural gas for nearly 25 percent of its fuel requirement in 2005.

Please estimate the costs of using 50, 75 and 100% natural gas to reduce particulate matter (PM/PM_{10}), sulfur dioxide (SO_2) and nitrogen oxide (NO_X) emissions from the two units.

Response:
The existing natural gas infrastructure to Turkey Point, as well as FPL's contractual transportation rights on Florida Gas Transmission (FGT), would not allow FPL to routinely deliver natural gas to Turkey Point Units 1 and 2 in the quantities described in this question. This limitation applies to both pre- and post-Turkey Point Unit 5. Please see the response to Question 6 for a more detailed description.

Assuming FPL had the ability to routinely deliver natural gas to Turkey Point Units 1 and 2 in the quantities described in this question, the following estimates utilizing 2005 actual fuel volume and price data would apply:

FPL's 2005 total fuel cost for Turkey Point Units 1 and 2 was $203.3 million. This fuel cost relates to an actual MMBtu consumption that was composed of 21.7% natural gas and 78.3% fuel oil. If Turkey Point Units 1 and 2 had consumed natural gas in sufficient quantities to represent 50%, 75% and 100% of the actual total MMBtu consumption for Turkey Point Units 1 and 2, total fuel costs would have increased by approximately $25.2 million, $47.5 million and $69.7 million respectively.

Question No. 5. Provide information on the sulfur contained in the fuel oil combusted or co-fired with natural gas on Units 1 and 2. Estimate the costs for using lower sulfur fuel than presently used (e.g. 0.5% or 0.1% sulfur fuel oil).

Response:
FPL's total fuel oil consumption at Turkey Point Units 1 and 2 during 2005 was 23,649,249 MMBtu. The average sulfur content of all heavy fuel oil delivered to Turkey Point in 2005 was 0.968 wt. %. The total cost of the fuel oil consumed in Turkey Point Units 1 and 2 was $144.1 million. Applying current market conditions for 0.7%, 0.5% and 0.3% sulfur grade fuel oil to Turkey Point Units 1 and 2 2005 fuel oil consumption would yield higher total fuel costs of $21.8 million, $37.2 million and $53.1 million respectively. However, it is important to recognize that these figures only project the impact of increased commodity costs associated with lower sulfur grade fuel oil. FPL assumes there could be additional costs/issues associated with lower sulfur grade fuels relative to FPL's current 1% grade fuel oil.

In general, moving to lower sulfur grades would eliminate approximately 95% of Gulf Coast fuel oil production as blending stock for FPL. This would limit FPL to significant dependency on New York Harbor and foreign production for these sulfur grades. This reduction in the diversity of FPL's fuel oil supply could negatively impact FPL's ability to maintain adequate fuel inventory at Turkey Point, thereby reducing reliability. In particular, 0.3% sulfur grade fuel oil is generally produced in the first quarter of each year for northeast utility plants. After the first quarter, refiners change the crude slate back to heavy crude for the asphalt and bunker fuel markets. Additionally, foreign market barrels are generally consumed in the foreign marketplace. Furthermore, 0.5% sulfur grade fuel oil is typically not a refined product. This sulfur grade is usually a blend of 0.3% and 0.7% grades. Although FPL believes that the availability of 0.7% would be adequate for Turkey Point, the limiting factor would be the availability of 0.3% sulfur grade fuel oil to make the 0.5% sulfur grade blend. Lastly, specifications for these lower sulfur grades vary from FPL's current specifications for 1.0% fuel oil. Lower sulfur grade fuel oil has a higher API gravity and a reduced BTU content. A lower BTU content will result in increased costs. Specification variances may also result in compatibility issues with FPL's current plant equipment leading to additional costs for increased maintenance, modifications or even replacement to allow these lower sulfur grades to be burned.

Question No. 6. How will the new Turkey Point Combined Cycle Unit 5 affect natural gas availability for Units 1 and 2? It was understood during the permitting of Unit 5 that there would be no effect on natural gas supplies.

Response:
In order to accommodate the natural gas volume and pressure requirements of Turkey Point Combined Cycle Unit 5, FGT has added a new compressor station in Dade County. Additionally, FPL's contractual rights to deliver natural gas into Broward and Dade Counties, as well as into Turkey Point, are increasing to accommodate the incremental requirements of the new unit. The quantities of natural gas available for consumption in Turkey Point Units 1 and 2, as well as FPL's other dual-fired units, will continue to be determined by numerous factors that are taken into consideration each day during the planning process. FPL's overall natural gas requirements are driven by the relative price relationship between heavy oil and natural gas, unit efficiencies, unit availability and FPL's system load. FPL's ability to deliver natural gas to its generation fleet is a function of FPL's contractual delivery rights (at both the plant and system-wide level), natural gas pipeline conditions, overall natural gas supply availability, unit availability, alternate fuel availability and overall system conditions. After Turkey Point Unit 5 goes into commercial operation, as in the past, there will be times when FPL determines that natural gas is available to Turkey Point Units 1 and 2 and other times when FPL determines that natural gas is not available to these units after all of the above-mentioned factors have been taken into account. Post Turkey Point Unit 5, FPL will continue to allocate natural gas to its system within the framework of its contractual transportation rights in order to produce the most reliable, lowest cost electricity possible.

Question 7. Please advise the status of the projects described in Docket No. 060007-EI with respect to the Turkey Point Fossil Plant. The submittal to the PSC described Low NO_X burners for the Turkey Point Fossil Units 1 and 2.

Response:
In his August 4, 2006 and October 13, 2006 prepared testimony to the Public Service Commission, FPL witness R.R. LaBauve discusses the comprehensive evaluation that FPL undertook at the time to determine the most cost-effective strategies to comply with CAIR and CAMR. Since that time, FPL has not performed any further evaluation of comparable scope, so the discussion in Mr. LaBauve's testimony still generally applies. However, FPL is continually reviewing and updating its compliance strategies using the most current information, and that process has led to certain revisions to the strategies, as well as updated compliance cost estimates. The discussion below describes the revisions to the CAIR and CAMR compliance strategies and cost estimates that pertain to Turkey Point.

Reburn and Low NOx Burner projects at Cape Canaveral, Port Everglades, Turkey Point, and Putnam plants are on hold. The evaluation of recent projections of future FPL generating unit operations and the estimated NOx reductions from the implementation of the 800 MW unit cycling project indicate that the purchase of NOx allowances for annual and ozone season compliance may be a preferred compliance alternative, depending on allowance availability and price, as compared to the cost of the Reburn and Low NOx Burner projects. FPL will continue to monitor the relative economics of these NOx controls versus the cost of purchasing NOx allowances. Putting the Reburn and Low NOx Burner projects on hold for now will reduce FPL's 2007 CAIR compliance capital expenditures by $46 million. If FPL does not proceed with the Reburn and Low NOx Burner projects, total CAIR compliance capital costs may be reduced by $139 million.

Question 8. Provide control strategies including costs and modeling results to minimize the higher emitting modes including startups, shutdowns, soot blowing and any other such conditions during which opacity limits greater than 40% are allowed. Measures to avoid or minimize the high opacity emission modes will logically benefit visibility in the Everglades National Park Class I Area.

Response:
The Turkey Point Fossil Plant uses Best Operating Practices and good combustion techniques to minimize opacity during startup, shutdown and other operating scenarios such as sootblowing and load changing. Startups and shutdowns are conducted with natural gas firing, pending its availability. The modeling, which was performed consistent with the Rule, is based on emissions generated during the highest 24 hours in a three-year period. The modeled conditions include periods of sootblowing.

Question 9. Please provide the basis for the equipment costs noted in Table 5-1 (the table) of the Application. The estimates of both Direct Capital Cost items and the Indirect Capital Cost items need justification based on contractors' bids.

Response:
The basis for the equipment costs provided is from the costs for Port Everglades 3 and 4 with application of escalation for market conditions described in the response to Question 2. The current state of the market for pollution control equipment is robust, which makes it difficult to obtain an accurate response to inquiries for potential projects. It is premature to solicit bids from contractors for work that would take place for a project that would be placed in service in 2013.

Question 10. The Direct Operating Cost part of the table includes operator labor cost information. Do the cited values include benefits and overhead? Please provide further justification for the given labor estimates, preferably from the Company's own cost factors.

Response:
The labor cost was based on raw labor costs from engineering study estimates from FPL. The benefits and overhead are included in the Overhead category under Indirect Operating Costs which are based on 60 percent of labor costs using the OAQPS Control Cost Manual (EPA 2002).

Question 11. Please provide the details (formulas, algorithms, etc.) of the energy loss estimates due to the electrostatic precipitator (ESP) operation noted in the table.

Response:
The energy loss estimates due to the ESP were based on the formula provided in the OAQPS Control Cost Manual for estimating annual electricity use for the ESP fan. The formula and assumptions used in this analysis are as follows.

<u>Energy Requirement for ESP Fan Power (FP)</u>

FP (kWh/yr) = 0.000181 (System flow rate, acfm)(Pressure drop, inches)(Annual operating hours, hr/yr)

0.000181=	Conversion factor based on average fan efficiency of 65 percent		
System flow rate =	1,956,026	acfm	
Pressure drop =	2	inches H_2O	(lower value from range in OAQPS)
Annual operation =	4,488.5	hr/yr	
FP =	3,178,233	kWh/yr	
FP cost=	$190,694	$/yr	[$0.06/kWh (nominal cost)]

System flow rate is based on total flow rates from Units 1 and 2 with exit velocities of 63.8 and 62.7 ft/s, respectively. Each unit has a stack diameter of 18.1 ft. Annual operating hours were estimated based on the average hourly heat input rates for both units for 2001 to 2003 divided by the maximum heat input rates for the units.
Similarly the energy due to the transformer-rectifier sets and rapper systems was based on the formula presented in the OAQPS Cost Control Manual for estimating the operating power for these items. The formula and assumptions are as follows.

Operating Power (OP) for Transformer-Rectifier Sets and Rapper Systems

OP (kWh/yr) = 0.00194 (ESP plate area, m^2)(Annual operating hours, hr/yr)

0.00194 =	Conversion factor		
Plate area =	136,921.79	ft^2	Estimated based on design efficiency of 70% and particle migration velocity of 8.4 cm/sec (see Figure 3.4 of Section 6, OAQPS Cost Manual; 70 ft^2 per 1,000 ft^3/min flow rate)
Annual operation =	4488.5	hr/yr	
TR=	1,192,276.4	kWh/yr	
TR cost =	$35,768	$/yr	[$0.03/kWh (nominal cost)]

Question 12. Please provide the details of the estimates of the maintenance materials and labor costs, and ash disposal cost noted in the table.

Response:
The estimates of the maintenance materials and labor costs are based on engineering estimates. The ash disposal costs are based on Golder's estimate for development and disposal of ash in a typical Class I landfill. The costs are based on $50/ton times the PM emissions of 1,257 tons per year that would be disposed. These costs are conservatively low since transportation costs are not included

Question 13. It appears that the "Historical Maximum Emissions (TPY)" entry in the table is based on the Title V permit limit for particulate matter (PM) of 0.1 lb/MMBtu heat input. Please provide stack test data for the two units for PM emissions for the last five years. We note that Department Annual Operating Report data reveals PM emissions in the 470 – 510 tons per year range for each unit for the last two years.

Response:
The "Historical Maximum Emissions (TPY)" entry in the table is based on the Title V permit limit for particulate matter (PM) of 0.1 lb/MMBtu heat input. PM emission test data for 2001, 2002, and 2003 were provided to the Department as Appendix "B" in the *Bart Determination Analysis for Turkey Point Power Plant – UPDATE April 2007.* Included in this response as Attachment "A" is the PM test data for 2004, 2005, and 2006.

Question 14. Please consider replacement or modification of the existing multiple cyclone system to the latest high efficiency design as part of the BART determination analysis.

Response:
Turkey Point Fossil Plant's impact on visibility within the Everglades National Park Class 1 Area was modeled consistent with 40 CFR 51, Subpart P, and the BART Determination analysis was conducted consistent with Rule FAC 62-296.340, F.A.C. The requirement for analysis of BART control options' first step is to identify all available retrofit control technologies. In identifying "all" options, the most stringent option and a reasonable set of options must be identified. This was done in Section 5 - BART Analysis for PM Emissions of the Bart Determination Analysis for Turkey Point Power Plant.

The units are currently equipped with multi-cyclones which were included as part of the technology evaluation. This control technology consists of two banks of 695 tubes with a range of efficiency from 99% for particles with an aerodynamic diameter of 20 microns and greater to 30% for particles with an aerodynamic diameter of 5 microns and less. Replacement or modification of these units as cyclone systems would not provide substantial greater removal efficiencies for the small particle sizes. In contrast, Electrostatic Precipitators (ESPs) and fabric filters were evaluated and have higher removal efficiencies, especially for the smaller particle sizes. Consequently, the visibility impacts using the most stringent control option, ESPs, were modeled. The reduction in visibility impairment within the Everglades National Park Class 1 Area with ESPs installed on the Turkey Point units was 0.1dv. Although high efficiency design multiple cyclones may provide a slight improvement over the currently installed multi cyclones at PTF, they are unable to achieve the collection efficiency of ESPs and are, therefore, not considered a viable control option in the BART Determination analysis.

Thank you for your consideration in this matter, and if you should have any questions, please feel free to contact me at (305) 242-3822, or Kevin Washington at (561) 691-2877.

Sincerely yours,

H.O. Nunez
Turkey Point Plant General Manager/Responsible Official

Attachments: 2

Cc: Tom Cascio
Ken Kosky – Golder Assoc.

FLORIDA POWER AND LIGHT COMPANY

ATTACHMENT "A"

PRODUCTION ASSURANCE EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 1
TEST: STEADY STATE
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	1/14/04	1/14/04	1/14/04
GROSS LOAD (AVG MMBTU/HR)	3632	3632	3632
START TIME (24-HR CLOCK)	1032	1152	1312
END TIME (24-HR CLOCK)	1141	1306	1421
VOL DRY GAS SAMPLED METER COND (DCF)	49.009	52.631	52.082
BAROMETRIC PRESSURE (IN. HG)	30.18	30.18	30.18
AVG ORIFICE PRESSURE DROP (IN. H20)	2.201	2.550	2.490
AVG GAS METER TEMP (F)	93.5	93.3	91.6
GAS METER CALIBRATION FACTOR	0.9399	0.9399	0.9399
VOL GAS SAMPLED STD COND (DSCF)	44.541	47.895	47.528
TOTAL WATER COLLECTED (G)	111.6	100.8	111.3
VOL WATER COLLECTED STD COND (SCF)	5.26	4.75	5.25
MOISTURE IN STACK GAS (% VOL)	10.57	9.03	9.94
MOLE FRACTION DRY GAS	0.894	0.910	0.901
CO2 VOL PERCENT DRY	14.1	14.1	14.1
O2 VOL PERCENT DRY	3.3	3.3	3.3
N2 VOL PERCENT DRY	82.56	82.54	82.55
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.39	30.39	30.40
MOL. WT. WET STACK GAS (LB/LB-MOLE)	29.08	29.28	29.16
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-1.70	-1.70	-1.70
STACK GAS STATIC PRESSURE (IN. HG ABS.)	30.06	30.06	30.06
AVERAGE SQUARE ROOT VELOCITY HEAD	0.875	0.939	0.932
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	297.6	299.8	301.9
STACK GAS VELOCITY STACK COND (FT/SEC)	58.48	62.65	62.38
CROSS SECTION STACK AREA (SQ FT)	320.1	320.1	320.1
STACK GAS FLOW RATE STD COND (DSCFM)	703297.9	764146.0	751121.5
STACK GAS FLOW RATE STACK COND (ACFM)	1123312.9	1203296.4	1198161.1
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	99.17	98.15	99.09
PARTICULATE COLLECTED (MG)	53.6	53.2	54.4
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.019	0.017	0.018
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.029	0.027	0.028

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.03

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
PRODUCTION ASSURANCE EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 1
TEST: SOOT BLOW
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	1/14/04	1/14/04	1/14/04
GROSS LOAD (AVG MMBTU/HR)	3632	3632	3632
START TIME (24-HR CLOCK)	909	1430	1544
END TIME (24-HR CLOCK)	1018	1539	1650
VOL DRY GAS SAMPLED METER COND (DCF)	47.083	47.509	45.901
BAROMETRIC PRESSURE (IN. HG)	30.18	30.18	30.18
AVG ORIFICE PRESSURE DROP (IN. H20)	2.051	2.019	1.950
AVG GAS METER TEMP (F)	80.6	89.9	88.9
GAS METER CALIBRATION FACTOR	0.9399	0.9399	0.9399
VOL GAS SAMPLED STD COND (DSCF)	43.796	43.445	42.044
TOTAL WATER COLLECTED (G)	102.2	96.0	91.9
VOL WATER COLLECTED STD COND (SCF)	4.82	4.53	4.33
MOISTURE IN STACK GAS (% VOL)	9.91	9.44	9.34
MOLE FRACTION DRY GAS	0.901	0.906	0.907
CO2 VOL PERCENT DRY	14.1	14.4	14.3
O2 VOL PERCENT DRY	3.2	3.0	3.3
N2 VOL PERCENT DRY	82.62	82.63	82.44
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.39	30.42	30.41
MOL. WT. WET STACK GAS (LB/LB-MOLE)	29.16	29.25	29.25
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-1.70	-1.70	-1.70
STACK GAS STATIC PRESSURE (IN. HG ABS.)	30.06	30.06	30.06
AVERAGE SQUARE ROOT VELOCITY HEAD	0.850	0.844	0.828
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	293.9	303.2	303.7
STACK GAS VELOCITY STACK COND (FT/SEC)	56.62	56.44	55.41
CROSS SECTION STACK AREA (SQ FT)	320.1	320.1	320.1
STACK GAS FLOW RATE STD COND (DSCFM)	689245.7	682316.2	670100.7
STACK GAS FLOW RATE STACK COND (ACFM)	1087535.8	1084136.3	1064338.1
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	99.50	99.71	98.25
PARTICULATE COLLECTED (MG)	69.3	60.7	65.9
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.024	0.022	0.024
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.038	0.033	0.038

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.04

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
TECHNICAL SERVICES EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 2
TEST: STEADY STATE
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	06/02/04	06/02/04	06/02/04
GROSS LOAD (AVG MMBTU/HR)	3579	3579	3579
START TIME (24-HR CLOCK)	1001	1115	1227
END TIME (24-HR CLOCK)	1108	1221	1333
VOL DRY GAS SAMPLED METER COND (DCF)	58.184	57.647	56.417
BAROMETRIC PRESSURE (IN. HG)	30.04	30.04	30.04
AVG ORIFICE PRESSURE DROP (IN. H20)	2.743	2.658	2.593
AVG GAS METER TEMP (F)	98.0	99.7	99.3
GAS METER CALIBRATION FACTOR	0.9279	0.9279	0.9279
VOL GAS SAMPLED STD COND (DSCF)	51.615	50.976	49.910
TOTAL WATER COLLECTED (G)	118.1	130.0	140.6
VOL WATER COLLECTED STD COND (SCF)	5.57	6.13	6.63
MOISTURE IN STACK GAS (% VOL)	9.74	10.73	11.73
MOLE FRACTION DRY GAS	0.903	0.893	0.883
CO2 VOL PERCENT DRY	14.4	14.5	14.4
O2 VOL PERCENT DRY	3.3	3.2	3.1
N2 VOL PERCENT DRY	82.35	82.33	82.48
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.43	30.45	30.43
MOL. WT. WET STACK GAS (LB/LB-MOLE)	29.22	29.11	28.97
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-0.80	-0.80	-0.80
STACK GAS STATIC PRESSURE (IN. HG ABS.)	29.98	29.98	29.98
AVERAGE SQUARE ROOT VELOCITY HEAD	0.975	0.959	0.948
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	295.5	296.5	297.6
STACK GAS VELOCITY STACK COND (FT/SEC)	65.02	64.13	63.59
CROSS SECTION STACK AREA (SQ FT)	305.1	305.1	305.1
STACK GAS FLOW RATE STD COND (DSCFM)	752328.9	732908.6	717572.8
STACK GAS FLOW RATE STACK COND (ACFM)	1190323.3	1173955.9	1164093.1
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	102.40	103.81	103.81
PARTICULATE COLLECTED (MG)	100.6	64.1	70.3
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.030	0.019	0.022
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.047	0.030	0.034

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.04

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
TECHNICAL SERVICES EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 2
TEST: SOOT BLOW
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	6/2/2004	6/2/2004	6/2/2004
GROSS LOAD (AVG MMBTU/HR)	3579	3579	3579
START TIME (24-HR CLOCK)	844	1445	1500
END TIME (24-HR CLOCK)	952	1552	1607
VOL DRY GAS SAMPLED METER COND (DCF)	54.501	56.441	56.119
BAROMETRIC PRESSURE (IN. HG)	30.04	30.04	30.04
AVG ORIFICE PRESSURE DROP (IN. H20)	2.536	2.608	2.583
AVG GAS METER TEMP (F)	87.3	98.0	99.7
GAS METER CALIBRATION FACTOR	0.9279	0.9279	0.9279
VOL GAS SAMPLED STD COND (DSCF)	49.269	50.054	49.615
TOTAL WATER COLLECTED (G)	118.6	120.8	141.9
VOL WATER COLLECTED STD COND (SCF)	5.59	5.70	6.69
MOISTURE IN STACK GAS (% VOL)	10.19	10.22	11.88
MOLE FRACTION DRY GAS	0.898	0.898	0.881
CO2 VOL PERCENT DRY	14.2	14.6	14.7
O2 VOL PERCENT DRY	3.1	3.0	2.9
N2 VOL PERCENT DRY	82.71	82.41	82.41
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.39	30.45	30.46
MOL. WT. WET STACK GAS (LB/LB-MOLE)	29.13	29.18	28.98
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-0.80	-0.80	-0.80
STACK GAS STATIC PRESSURE (IN. HG ABS.)	29.98	29.98	29.98
AVERAGE SQUARE ROOT VELOCITY HEAD	0.946	0.954	0.947
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	294.0	299.6	298.8
STACK GAS VELOCITY STACK COND (FT/SEC)	63.10	63.85	63.56
CROSS SECTION STACK AREA (SQ FT)	305.1	305.1	305.1
STACK GAS FLOW RATE STD COND (DSCFM)	727819.8	730912.2	714885.4
STACK GAS FLOW RATE STACK COND (ACFM)	1155084.4	1168887.6	1163594.2
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	101.04	102.21	103.59
PARTICULATE COLLECTED (MG)	109.2	90.8	132.1
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.034	0.028	0.041
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.053	0.043	0.063

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.05

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
PRODUCTION ASSURANCE EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 1
TEST: STEADY STATE
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	2/01/05	2/01/05	2/01/05
GROSS LOAD (AVG MMBTU/HR)	3587	3587	3587
START TIME (24-HR CLOCK)	1215	1350	1512
END TIME (24-HR CLOCK)	1342	1456	1618
VOL DRY GAS SAMPLED METER COND (DCF)	60.455	61.384	57.985
BAROMETRIC PRESSURE (IN. HG)	30.08	30.08	30.08
AVG ORIFICE PRESSURE DROP (IN. H20)	2.658	2.711	2.429
AVG GAS METER TEMP (F)	89.2	92.3	90.6
GAS METER CALIBRATION FACTOR	0.9046	0.9046	0.9046
VOL GAS SAMPLED STD COND (DSCF)	53.183	53.702	50.853
TOTAL WATER COLLECTED (G)	114.4	123.1	119
VOL WATER COLLECTED STD COND (SCF)	5.39	5.80	5.61
MOISTURE IN STACK GAS (% VOL)	9.21	9.75	9.94
MOLE FRACTION DRY GAS	0.908	0.902	0.901
CO2 VOL PERCENT DRY	13.7	13.7	13.8
O2 VOL PERCENT DRY	3.9	3.9	3.8
N2 VOL PERCENT DRY	82.37	82.41	82.43
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.35	30.35	30.35
MOL. WT. WET STACK GAS (LB/LB-MOLE)	29.21	29.15	29.13
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-1.60	-1.60	-1.60
STACK GAS STATIC PRESSURE (IN. HG ABS.)	29.96	29.96	29.96
AVERAGE SQUARE ROOT VELOCITY HEAD	1.026	1.035	0.978
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	304.9	305.3	306.9
STACK GAS VELOCITY STACK COND (FT/SEC)	68.84	69.60	65.82
CROSS SECTION STACK AREA (SQ FT)	320.1	320.1	320.1
STACK GAS FLOW RATE STD COND (DSCFM)	829808.5	833378.7	784952.3
STACK GAS FLOW RATE STACK COND (ACFM)	1322207.4	1336725.1	1264221.0
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	100.36	100.91	101.45
PARTICULATE COLLECTED (MG)	89.0	115.2	78.5
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.026	0.033	0.024
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.042	0.053	0.038

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.04

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
PRODUCTION ASSURANCE EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 1
TEST: SOOT BLOW
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	2/01/05	2/01/05	2/01/05
GROSS LOAD (AVG MMBTU/HR)	3587	3587	3587
START TIME (24-HR CLOCK)	1046	1623	1733
END TIME (24-HR CLOCK)	1155	1729	1840
VOL DRY GAS SAMPLED METER COND (DCF)	61.312	59.08	60.654
BAROMETRIC PRESSURE (IN. HG)	30.08	30.08	30.08
AVG ORIFICE PRESSURE DROP (IN. H20)	2.843	2.498	2.708
AVG GAS METER TEMP (F)	83.4	92.6	91.6
GAS METER CALIBRATION FACTOR	0.9046	0.9046	0.9046
VOL GAS SAMPLED STD COND (DSCF)	54.530	51.628	53.131
TOTAL WATER COLLECTED (G)	115.5	113.9	121.4
VOL WATER COLLECTED STD COND (SCF)	5.45	5.37	5.72
MOISTURE IN STACK GAS (% VOL)	9.08	9.42	9.73
MOLE FRACTION DRY GAS	0.909	0.906	0.903
CO2 VOL PERCENT DRY	13.8	13.8	13.7
O2 VOL PERCENT DRY	3.8	3.8	3.8
N2 VOL PERCENT DRY	82.38	82.43	82.53
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.36	30.36	30.34
MOL. WT. WET STACK GAS (LB/LB-MOLE)	29.24	29.20	29.14
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-1.60	-1.60	-1.60
STACK GAS STATIC PRESSURE (IN. HG ABS.)	29.96	29.96	29.96
AVERAGE SQUARE ROOT VELOCITY HEAD	1.065	0.991	1.030
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	303.8	309.0	306.7
STACK GAS VELOCITY STACK COND (FT/SEC)	71.38	66.75	69.34
CROSS SECTION STACK AREA (SQ FT)	320.1	320.1	320.1
STACK GAS FLOW RATE STD COND (DSCFM)	862864.5	798438.5	829031.3
STACK GAS FLOW RATE STACK COND (ACFM)	1371068.6	1282100.9	1331723.2
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	98.96	101.26	100.36
PARTICULATE COLLECTED (MG)	178.9	109.2	116.8
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.051	0.033	0.034
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.081	0.052	0.054

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.06

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
PRODUCTION ASSURANCE EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 2
TEST: STEADY STATE
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	04/19/05	04/19/05	04/19/05
GROSS LOAD (AVG MMBTU/HR)	3629	3629	3629
START TIME (24-HR CLOCK)	1039	1151	1304
END TIME (24-HR CLOCK)	1145	1257	1410
VOL DRY GAS SAMPLED METER COND (DCF)	54.833	54.855	54.661
BAROMETRIC PRESSURE (IN. HG)	30.1	30.1	30.1
AVG ORIFICE PRESSURE DROP (IN. H20)	2.173	2.226	2.220
AVG GAS METER TEMP (F)	92.4	94.5	93.3
GAS METER CALIBRATION FACTOR	0.9046	0.9046	0.9046
VOL GAS SAMPLED STD COND (DSCF)	47.927	47.774	47.710
TOTAL WATER COLLECTED (G)	110.9	106.0	109.1
VOL WATER COLLECTED STD COND (SCF)	5.23	5.00	5.14
MOISTURE IN STACK GAS (% VOL)	9.84	9.47	9.73
MOLE FRACTION DRY GAS	0.902	0.905	0.903
CO2 VOL PERCENT DRY	14.6	14.6	14.6
O2 VOL PERCENT DRY	2.9	2.8	2.8
N2 VOL PERCENT DRY	82.51	82.58	82.60
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.45	30.45	30.45
MOL. WT. WET STACK GAS (LB/LB-MOLE)	29.23	29.27	29.24
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-0.60	-0.60	-0.60
STACK GAS STATIC PRESSURE (IN. HG ABS.)	30.06	30.06	30.06
AVERAGE SQUARE ROOT VELOCITY HEAD	0.923	0.935	0.936
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	279.7	282.7	284.4
STACK GAS VELOCITY STACK COND (FT/SEC)	60.83	61.70	61.87
CROSS SECTION STACK AREA (SQ FT)	305.1	305.1	305.1
STACK GAS FLOW RATE STD COND (DSCFM)	719983.4	730249.6	728415.6
STACK GAS FLOW RATE STACK COND (ACFM)	1113663.2	1129599.3	1132566.5
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	99.35	97.65	97.76
PARTICULATE COLLECTED (MG)	51.9	52.5	49
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.017	0.017	0.016
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.025	0.026	0.024

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.03

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
PRODUCTION ASSURANCE EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 2
TEST: SOOT BLOW
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	4/19/2005	4/19/2005	4/19/2005
GROSS LOAD (AVG MMBTU/HR)	3629	3629	3629
START TIME (24-HR CLOCK)	916	1429	1547
END TIME (24-HR CLOCK)	1022	1537	1658
VOL DRY GAS SAMPLED METER COND (DCF)	56.152	54.901	53.844
BAROMETRIC PRESSURE (IN. HG)	30.10	30.10	30.10
AVG ORIFICE PRESSURE DROP (IN. H20)	2.335	2.180	2.079
AVG GAS METER TEMP (F)	84.3	90.5	90.0
GAS METER CALIBRATION FACTOR	0.9046	0.9046	0.9046
VOL GAS SAMPLED STD COND (DSCF)	49.836	48.160	47.262
TOTAL WATER COLLECTED (G)	111.0	100.2	115.3
VOL WATER COLLECTED STD COND (SCF)	5.23	4.72	5.44
MOISTURE IN STACK GAS (% VOL)	9.50	8.93	10.32
MOLE FRACTION DRY GAS	0.905	0.911	0.897
CO2 VOL PERCENT DRY	14.6	14.7	14.7
O2 VOL PERCENT DRY	2.7	2.5	2.6
N2 VOL PERCENT DRY	82.73	82.78	82.76
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.44	30.46	30.45
MOL. WT. WET STACK GAS (LB/LB-MOLE)	29.26	29.34	29.17
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-0.60	-0.60	-0.60
STACK GAS STATIC PRESSURE (IN. HG ABS.)	30.06	30.06	30.06
AVERAGE SQUARE ROOT VELOCITY HEAD	0.960	0.926	0.904
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	280.1	285.2	284.6
STACK GAS VELOCITY STACK COND (FT/SEC)	63.23	61.11	59.82
CROSS SECTION STACK AREA (SQ FT)	305.1	305.1	305.1
STACK GAS FLOW RATE STD COND (DSCFM)	750645.7	725106.7	699580.6
STACK GAS FLOW RATE STACK COND (ACFM)	1157467.0	1118780.6	1095115.8
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	99.09	99.13	100.83
PARTICULATE COLLECTED (MG)	146.2	69.5	56.4
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.045	0.022	0.018
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.068	0.033	0.028

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.04

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
PRODUCTION ASSURANCE EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 1
TEST: STEADY STATE
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	1/10/06	1/10/06	1/10/06
GROSS LOAD (AVG MMBTU/HR)	3528	3528	3528
START TIME (24-HR CLOCK)	1157	1313	1429
END TIME (24-HR CLOCK)	1306	1421	1535
VOL DRY GAS SAMPLED METER COND (DCF)	53.987	56.521	57.114
BAROMETRIC PRESSURE (IN. HG)	30.16	30.16	30.16
AVG ORIFICE PRESSURE DROP (IN. H20)	2.721	2.924	3.016
AVG GAS METER TEMP (F)	87.8	92.0	93.5
GAS METER CALIBRATION FACTOR	0.9807	0.9807	0.9807
VOL GAS SAMPLED STD COND (DSCF)	51.758	53.801	54.230
TOTAL WATER COLLECTED (G)	114.6	136.6	123.9
VOL WATER COLLECTED STD COND (SCF)	5.40	6.44	5.84
MOISTURE IN STACK GAS (% VOL)	9.45	10.69	9.72
MOLE FRACTION DRY GAS	0.905	0.893	0.903
CO2 VOL PERCENT DRY	13.0	13.1	13.2
O2 VOL PERCENT DRY	4.5	4.5	4.4
N2 VOL PERCENT DRY	82.49	82.46	82.47
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.27	30.27	30.28
MOL. WT. WET STACK GAS (LB/LB-MOLE)	29.11	28.96	29.09
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-1.60	-1.60	-1.60
STACK GAS STATIC PRESSURE (IN. HG ABS.)	30.04	30.04	30.04
AVERAGE SQUARE ROOT VELOCITY HEAD	1.032	1.065	1.080
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	288.0	289.5	290.0
STACK GAS VELOCITY STACK COND (FT/SEC)	68.53	71.00	71.88
CROSS SECTION STACK AREA (SQ FT)	320.1	320.1	320.1
STACK GAS FLOW RATE STD COND (DSCFM)	844707.5	861398.8	880935.4
STACK GAS FLOW RATE STACK COND (ACFM)	1316219.4	1363723.3	1380563.0
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	95.95	97.80	96.40
PARTICULATE COLLECTED (MG)	65.2	66.5	65.9
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.019	0.019	0.019
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.032	0.032	0.031

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.03

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
PRODUCTION ASSURANCE EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 1
TEST: SOOT BLOW
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	1/10/06	1/10/06	1/10/06
GROSS LOAD (AVG MMBTU/HR)	3528	3528	3528
START TIME (24-HR CLOCK)	1033	1541	1653
END TIME (24-HR CLOCK)	1142	1648	1759
VOL DRY GAS SAMPLED METER COND (DCF)	53.665	55.416	57.115
BAROMETRIC PRESSURE (IN. HG)	30.16	30.16	30.16
AVG ORIFICE PRESSURE DROP (IN. H20)	2.701	2.813	2.946
AVG GAS METER TEMP (F)	84.4	92.7	93.7
GAS METER CALIBRATION FACTOR	0.9807	0.9807	0.9807
VOL GAS SAMPLED STD COND (DSCF)	51.776	52.669	54.208
TOTAL WATER COLLECTED (G)	158.4	134.8	140.6
VOL WATER COLLECTED STD COND (SCF)	7.47	6.36	6.63
MOISTURE IN STACK GAS (% VOL)	12.61	10.77	10.90
MOLE FRACTION DRY GAS	0.874	0.892	0.891
CO2 VOL PERCENT DRY	13.1	13.1	13.1
O2 VOL PERCENT DRY	4.4	4.4	4.5
N2 VOL PERCENT DRY	82.49	82.44	82.39
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.27	30.28	30.27
MOL. WT. WET STACK GAS (LB/LB-MOLE)	28.73	28.96	28.93
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-1.60	-1.60	-1.60
STACK GAS STATIC PRESSURE (IN. HG ABS.)	30.04	30.04	30.04
AVERAGE SQUARE ROOT VELOCITY HEAD	1.026	1.040	1.064
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	287.9	290.9	291.1
STACK GAS VELOCITY STACK COND (FT/SEC)	68.56	69.42	71.04
CROSS SECTION STACK AREA (SQ FT)	320.1	320.1	320.1
STACK GAS FLOW RATE STD COND (DSCFM)	815753.3	839977.9	858039.9
STACK GAS FLOW RATE STACK COND (ACFM)	1316823.2	1333319.1	1364413.0
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	99.39	98.19	98.93
PARTICULATE COLLECTED (MG)	96.3	73.7	81.8
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.029	0.022	0.023
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.048	0.036	0.039

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.04

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
PRODUCTION ASSURANCE EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 2
TEST: STEADY STATE
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	1/17/06	1/17/06	1/17/06
GROSS LOAD (AVG MMBTU/HR)	3625	3625	3625
START TIME (24-HR CLOCK)	1215	1329	1443
END TIME (24-HR CLOCK)	1321	1436	1549
VOL DRY GAS SAMPLED METER COND (DCF)	48.122	48.431	47.719
BAROMETRIC PRESSURE (IN. HG)	29.98	29.98	29.98
AVG ORIFICE PRESSURE DROP (IN. H20)	2.096	2.096	2.069
AVG GAS METER TEMP (F)	90.3	90.9	90.9
GAS METER CALIBRATION FACTOR	0.9807	0.9807	0.9807
VOL GAS SAMPLED STD COND (DSCF)	45.587	45.833	45.151
TOTAL WATER COLLECTED (G)	113.8	117.1	117.7
VOL WATER COLLECTED STD COND (SCF)	5.37	5.52	5.55
MOISTURE IN STACK GAS (% VOL)	10.53	10.75	10.95
MOLE FRACTION DRY GAS	0.895	0.892	0.891
CO2 VOL PERCENT DRY	14.4	14.3	14.3
O2 VOL PERCENT DRY	2.8	2.8	2.7
N2 VOL PERCENT DRY	82.79	82.96	82.97
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.41	30.40	30.40
MOL. WT. WET STACK GAS (LB/LB-MOLE)	29.10	29.06	29.04
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-1.60	-1.60	-1.60
STACK GAS STATIC PRESSURE (IN. HG ABS.)	29.86	29.86	29.86
AVERAGE SQUARE ROOT VELOCITY HEAD	0.904	0.904	0.898
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	289.5	290.0	290.8
STACK GAS VELOCITY STACK COND (FT/SEC)	60.25	60.33	59.98
CROSS SECTION STACK AREA (SQ FT)	305.1	305.1	305.1
STACK GAS FLOW RATE STD COND (DSCFM)	693825.8	692492.9	686392.6
STACK GAS FLOW RATE STACK COND (ACFM)	1103064.8	1104403.8	1098100.6
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	98.07	98.79	98.18
PARTICULATE COLLECTED (MG)	45.0	49.5	50.7
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.015	0.017	0.017
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.023	0.025	0.026

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.02

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

FLORIDA POWER AND LIGHT COMPANY
PRODUCTION ASSURANCE EMISSION TEST GROUP
700 UNIVERSE BLVD.
JUNO BEACH, FLORIDA 33408

PARTICULATE EMISSION TEST

PLANT: TURKEY POINT
UNIT: 2
TEST: SOOT BLOW
METHOD: 17

	RUN 1	RUN 2	RUN 3
DATE OF RUN	1/17/06	1/17/06	1/17/06
GROSS LOAD (AVG MMBTU/HR)	3625	3625	3625
START TIME (24-HR CLOCK)	830	946	1100
END TIME (24-HR CLOCK)	939	1054	1207
VOL DRY GAS SAMPLED METER COND (DCF)	48.291	47.904	47.317
BAROMETRIC PRESSURE (IN. HG)	29.98	29.98	29.98
AVG ORIFICE PRESSURE DROP (IN. H20)	2.156	2.069	2.076
AVG GAS METER TEMP (F)	79.7	88.2	89.2
GAS METER CALIBRATION FACTOR	0.9807	0.9807	0.9807
VOL GAS SAMPLED STD COND (DSCF)	46.651	45.549	44.911
TOTAL WATER COLLECTED (G)	138.8	120.2	125.6
VOL WATER COLLECTED STD COND (SCF)	6.54	5.67	5.92
MOISTURE IN STACK GAS (% VOL)	12.30	11.07	11.65
MOLE FRACTION DRY GAS	0.877	0.889	0.883
CO2 VOL PERCENT DRY	14.7	14.3	14.5
O2 VOL PERCENT DRY	2.6	2.8	2.8
N2 VOL PERCENT DRY	82.75	82.84	82.77
MOL. WT. DRY STACK GAS (LB/LB-MOLE)	30.45	30.41	30.43
MOL. WT. WET STACK GAS (LB/LB-MOLE)	28.92	29.03	28.98
ELEV. DIFF. FROM MANOM. TO BAROM. (FT)	0.00	0.00	0.00
STACK GAS STATIC PRESSURE (IN. H2O GAGE)	-1.60	-1.60	-1.60
STACK GAS STATIC PRESSURE (IN. HG ABS.)	29.86	29.86	29.86
AVERAGE SQUARE ROOT VELOCITY HEAD	0.921	0.898	0.899
PITOT TUBE COEFFICIENT	0.84	0.84	0.84
AVG STACK TEMP (F)	285.1	289.3	290.9
STACK GAS VELOCITY STACK COND (FT/SEC)	61.41	59.93	60.13
CROSS SECTION STACK AREA (SQ FT)	305.1	305.1	305.1
STACK GAS FLOW RATE STD COND (DSCFM)	697244.7	686164.4	682486.7
STACK GAS FLOW RATE STACK COND (ACFM)	1124233.4	1097082.3	1100800.5
NET TIME OF RUN (MIN)	60	60	60
NOZZLE DIAMETER (IN)	0.250	0.250	0.250
PERCENT ISOKINETIC	99.86	99.08	98.22
PARTICULATE COLLECTED (MG)	61.3	59.0	51.8
WEIGHTED AVERAGE F FACTOR (DSCF/MILL. BTU)	9190	9190	9190
HEAT INPUT OIL (%)	100.0	100.0	100.0
HEAT INPUT GAS (%)	0.0	0.0	0.0
PARTICULATE EMISSIONS (GRAINS/SCF)	0.020	0.020	0.018
PARTICULATE EMISSIONS (LB/MILL. BTU)	0.030	0.030	0.027

AVERAGE PARTICULATE EMISSIONS (LB/MMBTU) 0.03

NOTE: STANDARD CONDITIONS -- 68F, 29.92 in. Hg

Professional Engineer Certification

1. Professional Engineer Name: Edward Preast
   Registration Number: 33225
2. Professional Engineer Mailing Address...
   Organization/Firm: Florida Power & Light Company
   Street Address: 700 Universe Blvd.
   City: Juno Beach State: Fl Zip Code: 33408
3. Professional Engineer Telephone Numbers...
   Telephone: (561) 691-2679 ext. Fax: (561) 691-7049
4. Professional Engineer Email Address: ed_preast@fpl.com
5. Professional Engineer Statement:

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

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

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

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

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

(5) If the purpose of this application is to obtain an initial air operation permit or operation permit revision or renewal for one or more newly constructed or modified emissions units (check here ☐, if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with all provisions contained in such permit. **This Certification is in reply to a Request for Additional Information regarding FPL's BART Determination for Turkey Point Units 1&2**

Edward Preast 4/30/07

Signature Date

(seal)

Department of Environmental Protection

Division of Air Resource Management

APPLICATION FOR AIR PERMIT - LONG FORM

I. APPLICATION INFORMATION

Air Construction Permit – Use this form to apply for an air construction permit at a facility operating under a federally enforceable state air operation permit (FESOP) or Title V air permit. Also use this form to apply for an air construction permit:

- For a proposed project subject to prevention of significant deterioration (PSD) review, nonattainment area (NAA) new source review, or maximum achievable control technology (MACT) review; or
- Where the applicant proposes to assume a restriction on the potential emissions of one or more pollutants to escape a federal program requirement such as PSD review, NAA new source review, Title V, or MACT; or
- Where the applicant proposes to establish, revise, or renew a plantwide applicability limit (PAL).

Air Operation Permit – Use this form to apply for:

- an initial federally enforceable state air operation permit (FESOP); or
- an initial/revised/renewal Title V air operation permit.

Air Construction Permit & Title V Air Operation Permit (Concurrent Processing Option) – Use this form to apply for both an air construction permit and a revised or renewal Title V air operation permit incorporating the proposed project.

To ensure accuracy, please see form instructions.

Identification of Facility

1. Facility Owner/Company Name: Florida Power & Light Company	
2. Site Name: Turkey Point Fossil Plant (PTF)	
3. Facility Identification Number: 0250003	
4. Facility Location...:9.5 miles east of Florida City on SW 344 Street Street Address or Other Locator: 9700 SW 344 Street City: Homesread County: Miami-Dade Zip Code: 33035	
5. Relocatable Facility? ☐ Yes X No	6. Existing Title V Permitted Facility? X Yes ☐ No

Application Contact

1. Application Contact Name: John C. Hampp
2. Application Contact Mailing Address... P.O. Box 14000 Juno Beach, Fl. 33408 Organization/Firm: Florida Power & Light Co. Environmental Services Dept. Street Address: 700 Universe Blvd. City: Juno Beach State: FL Zip Code: 33408
3. Application Contact Telephone Numbers... Telephone: (561) 691-2894 ext. Fax: (561) 691-7049
4. Application Contact Email Address: john_hampp@fpl.com

Application Processing Information (DEP Use)

1. Date of Receipt of Application: 1/31/07	3. PSD Number (if applicable):
2. Project Number(s): 0250003-008-AC	4. Siting Number (if applicable):

Facility Information

Purpose of Application

This application for air permit is submitted to obtain: (Check one)

Air Construction Permit

Air construction permit.

Air construction permit to establish, revise, or renew a plantwide applicability limit (PAL).

Air construction permit to establish, revise, or renew a plantwide applicability limit (PAL), and separate air construction permit to authorize construction or modification of one or more emissions units covered by the PAL.

Air Operation Permit

Initial Title V air operation permit.

Title V air operation permit revision.

Title V air operation permit renewal.

Initial federally enforceable state air operation permit (FESOP) where professional engineer (PE) certification is required.

Initial federally enforceable state air operation permit (FESOP) where professional engineer (PE) certification is not required.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit (Concurrent Processing)

Air construction permit and Title V permit revision, incorporating the proposed project.

Air construction permit and Title V permit renewal, incorporating the proposed project.

Note: By checking one of the above two boxes, you, the applicant, are requesting concurrent processing pursuant to Rule 62-213.405, F.A.C. In such case, you must also check the following box:

I hereby request that the department waive the processing time requirements of the air construction permit to accommodate the processing time frames of the Title V air operation permit.

Application Comment

This application is for the purpose of obtaining a BART determination for the BART-eligible emissions units at the Turkey Point Power Plant.

Facility Information

Scope of Application

Emissions Unit ID Number	Description of Emissions Unit	Air Permit Type	Air Permit Proc. Fee
001	Unit No. 1	AC1F	
002	Unit No. 2	AC1F	

Application Processing Fee

Check one: ☐ Attached - Amount: $__________________ ☒ Not Applicable

APPLICATION INFORMATION

Owner/Authorized Representative Statement

Complete if applying for an air construction permit or an initial FESOP.

1. Owner/Authorized Representative Name : H.O. Nunez – Plant Manager	
2. Owner/Authorized Representative Mailing Address... Organization/Firm: Florida Power & Light Company Turkey Point Fossil Plant (PTF) Street Address: 9700 SW 344 Street City: Homestead State: FL Zip Code: 33035	
3. Owner/Authorized Representative Telephone Numbers... Telephone: (305) 242-3822 ext. Fax: (305) 242-3821	
4. Owner/Authorized Representative Email Address: ed_nunez@fpl.com	
5. Owner/Authorized Representative Statement: *I, the undersigned, am the owner or authorized representative of the facility addressed in this air permit application. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof and all other requirements identified in this application to which the facility is subject. I understand that a permit, if granted by the department, cannot be transferred without authorization from the department, and I will promptly notify the department upon sale or legal transfer of the facility or any permitted emissions unit.* [signature] Signature 1/31/2007 Date	

Facility Information

Application Responsible Official Certification

Complete if applying for an initial/revised/renewal Title V permit or concurrent processing of an air construction permit and a revised/renewal Title V permit. If there are multiple responsible officials, the "application responsible official" need not be the "primary responsible official."

1. Application Responsible Official Name:
2. Application Responsible Official Qualification (Check one or more of the following options, as applicable): ☐ For a corporation, the president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or a duly authorized representative of such person if the representative is responsible for the overall operation of one or more manufacturing, production, or operating facilities applying for or subject to a permit under Chapter 62-213, F.A.C. ☐ For a partnership or sole proprietorship, a general partner or the proprietor, respectively. ☐ For a municipality, county, state, federal, or other public agency, either a principal executive officer or ranking elected official. ☐ The designated representative at an Acid Rain source.
3. Application Responsible Official Mailing Address... Organization/Firm: Street Address City: State: Zip Code:
4. Application Responsible Official Telephone Numbers... Telephone: ( ) - ext. Fax: ( ) -
5. Application Responsible Official Email Address:
6. Application Responsible Official Certification: *I, the undersigned, am a responsible official of the Title V source addressed in this air permit application. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof and all other applicable requirements identified in this application to which the Title V source is subject. I understand that a permit, if granted by the department, cannot be transferred without authorization from the department, and I will promptly notify the department upon sale or legal transfer of the facility or any permitted emissions unit. Finally, I certify that the facility and each emissions unit are in compliance with all applicable requirements to which they are subject, except as identified in compliance plan(s) submitted with this application.* ______________________ ______________________ Signature Date

Facility Information

Professional Engineer Certification

1. Professional Engineer Name: **Kennard F. Kosky**
   Registration Number: **14996**
2. Professional Engineer Mailing Address...
   Organization/Firm: **Golder Associates Inc.****
   Street Address: **6241 NW 23rd Street, Suite 500**
   City: **Gainesville** State: **FL** Zip Code: **32653**
3. Professional Engineer Telephone Numbers...
   Telephone: **(352) 336-5600** ext.**545** Fax: **(352) 336-6603**
4. Professional Engineer Email Address: **kkosky@golder.com**
5. Professional Engineer Statement:

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

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

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

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

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

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

Kennard F. Kosky — Signature 1-31-07 — Date

(seal)

* Attach any exception to certification statement.
** Board of Professional Engineers Certificate of Authorization #00001670

```
      -------      -----------      ----------      ----------     ---------------
-----     -----------------------

!          SO2 =     0.1509,          1000,              8,                    0,
0.04 !
!          NOX =     0.1656,             1,              8,                    5,
3.5 !
!         HNO3 =     0.1628,             1,             18,                    0,
0.00000008 !

!END!
```

INPUT GROUP: 8 -- Size parameters for dry deposition of particles
----

For SINGLE SPECIES, the mean and standard deviation are used to compute a deposition velocity for NINT (see group 9) size-ranges, and these are then averaged to obtain a mean deposition velocity.

For GROUPED SPECIES, the size distribution should be explicitly specified (by the 'species' in the group), and the standard deviation for each should be entered as 0. The model will then use the deposition velocity for the stated mean diameter.

```
        SPECIES       GEOMETRIC MASS MEAN        GEOMETRIC STANDARD
         NAME              DIAMETER                   DEVIATION
                           (microns)                  (microns)
        -------       -------------------        ------------------
!          SO4 =            0.48,                      2.    !
!          NO3 =            0.48,                      2.    !
!       PM0063 =            0.63,                      0.    !
!       PM0100 =            1.00,                      0.    !
!       PM0125 =            1.25,                      0.    !
!       PM0250 =            2.50,                      0.    !
!       PM0600 =            6.00,                      0.    !
!       PM1000 =           10.00,                      0.    !

!END!
```

0 for Source Group

INPUT GROUP: 9 -- Miscellaneous dry deposition parameters

```
     Reference cuticle resistance (s/cm)
     (RCUTR)                           Default: 30     !  RCUTR = 30.0 !
     Reference ground resistance  (s/cm)
     (RGR)                             Default: 10     !    RGR = 10.0 !
     Reference pollutant reactivity
     (REACTR)                          Default: 8      ! REACTR = 8.0 !
```

Turkey Point

2001 Puff PTF1

2001 FL02.dat

Met2001-Dom2-01A.DAT

→ Background O_3 - 50ppb

Source unit 12 lb/hr

SO4	68
Pm0063	87.3
Pm0100	83.2
Pm0125	16.3
Pm0250	36.6
Pm0600	24.4
Pm1000	52.8

20011010
Hour Not Found

BART DETERMINATION ANALYSIS
FOR
TURKEY POINT POWER PLANT

Prepared For:
Florida Power & Light Company
700 Universe Boulevard
Juno Beach, Florida 33408

Prepared By:
Golder Associates Inc.
6241 NW 23rd Street, Suite 500
Gainesville, Florida 32653-1500

January 2007
0637549

DISTRIBUTION:

1 Copy	FDEP
1 Copy	Florida Power and Light Co.
1 Copy	Golder Associates Inc.

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LIST OF ACRONYMS AND ABBREVIATIONS

AOR	annual operating report
BACT	Best Available Control Technology
Btu/gal	British thermal units per gallon
Btu/lb	British thermal units per pound
CAA	Clean Air Act
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
ESP	electrostatic precipitator
°F	degrees Fahrenheit
ft/s	feet per second
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
GEP	Good Engineering Practice
km	kilometer
LAER	lowest achievable emission rate
lbs/hr	pounds per hour
lb/MMBtu	pounds per million British thermal units
m	meter
MMBtu/hr	million British thermal units per hour
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NSPS	New Source Performance Standards
OAQPS	Office of Air Quality Planning and Standards
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter equal to or less than 10 micrometers
PSD	prevention of significant deterioration
RBLC	RACT, BACT, LAER Clearinghouse
SAM	sulfuric acid mist
SO_2	sulfur dioxide
TPD	tons per day
TPH	tons per hour
TPY	tons per year

1.0 INTRODUCTION

Pursuant to Section 403.061(35), Florida Statutes, the federal Clean Air Act (CAA), and the regional haze regulations contained in Title 40, Part 51 of the Code of Federal Regulations (40 CFR 51), Subpart P – Protection of Visibility, the Florida Department of Environmental Protection (FDEP) is required to ensure that certain sources of visibility impairing pollutants in Florida use Best Available Retrofit Technology (BART) to reduce the impact of their emissions on regional haze in federal Class I areas. Requirements for individual source BART control technology determinations and for BART exemptions are proposed in Rule 62-296.340 of the Florida Administrative Code (F.A.C.). Rule 62-296.340(5)(c), F.A.C., states that a BART-eligible source may demonstrate that it is exempt from the requirement for BART determination for all pollutants by performing an individual source attribution analysis in accordance with the procedures contained in 40 CFR 51, Appendix Y. A BART-eligible source is exempt from BART determination requirements if its contribution to visibility impairment, as determined below, does not exceed 0.5 deciview (dv) above natural conditions in any Class I area.

Based on FDEP guidelines, the 98th percentile, i.e., the 8th highest 24-hour average visibility impairment value in any year or the 22nd highest 24-hour average visibility impairment value over 3 years combined, whichever is higher, is compared to 0.5 dv in the source attribution analysis.

Based on Rule 62-296.340(5)(c), F.A.C., if the owner or operator of a BART-eligible source requests exemption from the requirement for BART determination for all pollutants by submitting its source attribution analysis to the FDEP by January 31, 2007, and the FDEP ultimately grants such exemption, the requirement for submission of an air construction permit application pursuant to 62-296.340(3)(b)1., F.A.C., shall not apply.

This report is submitted to the FDEP to present the source attribution analysis, BART evaluation, and proposed BART determination(s) for the BART-eligible emissions units at the Florida Power and Light Company's (FPL) Turkey Point Power Plant (PTF). A description of the BART-eligible emissions units is presented in Section 2.0. Results of the BART exemption analysis are presented in Section 3.0. Regulatory requirements for the BART determination (control options) analysis are presented in Section 4.0. The BART determination analysis is presented in Section 5.0.

The source information and methodologies used for the BART exemption analysis and the control technology determination are the same as those presented in the document entitled "Air Modeling determination. The predicted impacts from this option are given in the table and show reductions of 0.10 dv for the 8th highest impairment, 0.09 dv for 22nd highest three year impairment and 4 for the number of days with impairment over 0.50 dv.

2.0 DESCRIPTION OF BART-ELIGIBLE EMISSIONS UNITS

PTF has two oil-fired and natural gas-fired conventional steam electric generating units, designated as Unit No. 1 and Unit No. 2, which are BART-eligible emission units. Each fossil steam unit is a nominal 400 megawatt (MW) class (electric) steam generator which drives a single reheat turbine generator. PTF also has a combined cycle unit, Unit No. 5, which is not a BART-eligible unit. This unit is a nominal 1,150 MW unit that recently began operation and consists of four combustion turbine/heat recovery steam generator sets and a nominal 470 MW steam turbine electric generator. Two nuclear units, designated as Unit No. 3 and Unit No. 4 (PTN), are located on the site immediately adjacent to Unit No. 1 and Unit No. 2.

PTF is located 9.5 miles east of Florida City on SW 344 Street, Florida City, Dade County. The general location of this plant, in Universal Transverse Mercator (UTM) coordinates, is 567.4 km, East; 2,813.5 km, North; Zone 17. An area map showing PTF and prevention of significant deterioration (PSD) Class I areas located within 300 kilometers (km) of the plant is presented in Figure 1-1 of the Protocol. The only PSD Class I area located within 300 km of the plant is the Everglades National Park (NP), located about 21 km to the west of the plant.

The stack, operating, and PM emission data, including PM speciation, for the BART-eligible emissions units are presented in detail in the Protocol. The plant is currently operating under the Title V Permit No. 0250003-005-AV, effective January 1, 2004.

The emissions units are regulated under Acid Rain-Phase II, Fossil Fuel Steam Generators with more than 250 million Btu per Hour Heat Input (Rule 62-296.405, F.A.C.) and Reasonable Achievable Control Technology (RACT) Requirements for Major volatile organic compounds (VOC)- and NO_x-Emitting Facilities (Rule 62-296.570, F.A.C.).

On March 10, 2005, EPA issued the CAIR requiring affected electric generating units (EGUs) in the eastern U.S. to reduce emissions of NO_x and SO_2. Some issues regarding how the CAIR emission reductions would affect BART-eligible units pursued, and based on a proposed settlement agreement between the EPA and the Utility Air Regulatory (UARG), EGUs would have to model only particulate matter (PM) and primary sulfate emissions for either BART. Both units are subject to CAIR. As a result, only PM and primary sulfate emissions are included in the modeling for the source attribution analysis.

The stacks for Unit No. 1 and No. 2 at PTF are at Good Engineering Practice (GEP) height with no or minimal downwash effects. Therefore, building downwash effects are expected to be minimal and were not included in the analysis. Because there are minimal fugitive PM emissions with these units (the plant fires residual fuel oil), fugitive PM emissions from this plant were not addressed in the BART evaluation.

For both units, PM emissions shall not exceed 0.1 pound per million British thermal units (lb/MMBtu) heat input during normal operations. During soot blowing and load change, PM emissions shall not exceed an average of 0.3 lb/MMBtu heat input during the 3 hours in any 24-hour period of excess emissions allowed for boiler cleaning (soot blowing) and load change.

3.0 BART EXEMPTION ANALYSIS AND RESULTS

A BART modeling protocol for PTF was submitted to the FDEP in September 2006 and a revised protocol was submitted in January 2007. Initial visibility modeling was conducted to determine if the BART-eligible source could be exempt from BART based on its impacts. The baseline emissions used for the exemption modeling and the exemption modeling results are presented in the following sections.

3.1 Emission Rates

Emission rates used in the PTF BART analysis are presented in the BART protocol (see Appendix A). The EPA BART guidelines indicate that the emission rate to be used for BART modeling is the highest 24-hour actual emission rate representative of normal operations for the modeling period. Depending on the availability of the source data, the source emissions information should be based on the following, in order of priority based on the BART common protocol:

- 24-hour maximum emissions based on continuous emission monitoring (CEM) data for the period 2001-2003,
- Facility stack test emissions,
- Potential to emit,
- Allowable permit limits, and
- AP-42 emission factors.

The PM emissions rates are based on stack test data. A summary of PM speciation for PTF is presented in Table 2-4A of the Protocol. These species categories were generally based on the speciation profile provided by VISTAS for Uncontrolled Utility Residual Oil Boiler. The PM condensable emission rates were estimated based on emission factors for oil combustion presented in Table 1.3-2 in AP-42 while the different PM particle size categories were determined from particle size distribution for utility boilers firing residual oil provided in Table 1.3-4 in AP-42. When considering PM emission control with electrostatic precipitator (ESP), the particle size distribution for the units was based on information provided for a unit with an ESP. The PM elemental carbon emission rates were based on data provided in EPA's January 2002 DRAFT "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon".

3.2 Modeling Methodology

The CALPUFF model, Version 5.756, was used to predict the maximum visibility impairment at the PSD Class I area located within 300 km of PTF. Recent technical enhancements, including changes to the over-water boundary layer formulation and coastal effects modules (sponsored by the Minerals Management Service), are included in this version. The methods and assumptions used in the CALPUFF model are presented in the Protocol. The 4-km spacing Florida domain was used for the BART exemption. The refined CALMET domain, used for the BART modeling analysis has been provided by the FDEP. The major features used in preparing these CALMET data have also been described in Section 4.0 of the Protocol.

Currently, the atmospheric light extinction is estimated by an algorithm developed by the Interagency Monitoring of Protected Visual Environments (IMPROVE) committee, which was adopted by the EPA under the 1999 Regional Haze Rule (RHR) and referred to as the "1999 IMPROVE algorithm". This algorithm for estimating light extinction from particle speciation data tends to underestimate light extinction for the highest haze conditions and overestimate it for the lowest haze conditions and does not include light extinction due to sea salt, which is important at sites near the seacoasts. As a result of these limitations, the IMPROVE Steering Committee recently developed a new algorithm (the "new IMPROVE algorithm") for estimating light extinction from PM component concentrations, which provides a better correspondence between measured visibility and that calculated from PM component concentrations. A detailed description of the new IMPROVE algorithm and its implementation is presented in Section 3.4 of the Protocol.

Both the 1999 IMPROVE algorithm and the new IMPROVE algorithm were used to calculate the natural background light extinction at the Class I area for the BART modeling analysis. Visibility impacts were predicted at the PSD Class I area using receptors provided by the National Park Service and are represented in Figure 4-1 of the Protocol.

3.3 BART Exemption Modeling Results

Summaries of the maximum visibility impairment values for the PTF BART-eligible emission units estimated using the 1999 IMPROVE algorithm, are presented in Tables 3-1 and 3-2. The 98th percentile 24-hour average visibility impairment values (i.e., 8th highest) for the years 2001, 2002 and 2003; and the 22nd highest 24-hour average visibility impairment value over the three years are presented in Table 3-1. This table also presents the number of days and receptors for which the visibility impairment was predicted to be greater than 0.5 dv. The eight highest visibility impairment values predicted at the PSD Class I areas are presented in Table 3-2.

As shown in Tables 3-1 and 3-2, the 8th highest visibility impairment values predicted for each year at the Everglades NP PSD Class I area using the 1999 IMPROVE algorithm are greater than 0.5 dv. The 22nd highest visibility impairment value predicted over the 3-year period at this PSD Class I area is also greater than 0.5 dv. As a result, the new IMPROVE algorithm was used to estimate visibility impacts for these units.

The 8th highest visibility impairment values predicted at the Everglades NP PSD Class I area using new IMPROVE algorithm are presented in Tables 3-3 and 3-4. These results also show that the 8th highest visibility impairment value for each year and the 22nd highest visibility impairment value predicted over the 3-year period at this PSD Class I area are also greater than 0.5 dv.

Based on these results, the PTF is subject to the BART requirements and a BART determination analysis for PM is required for each of the BART-eligible emissions units at the plant.

TABLE 3-1
SUMMARY OF BART EXEMPTION MODELING RESULTS
FPL TURKEY POINT POWER PLANT, UNITS 1 AND 2

PSD Class I Area	Distance (km) of Source to Nearest Class I Area Boundary	Number of Days and Receptors with Impact >0.5 dv									22nd Highest Impact (dv) Over 3-Yr Period
		2001			2002			2003			
		No. of Days	No. of Receptors	8th Highest Impact (dv)	No. of Days	No. of Receptors	8th Highest Impact (dv)	No. of Days	No. of Receptors	8th Highest Impact (dv)	
Everglades NP	21	228	893	1.891	251	890	1.441	211	845	1.577	1.690

TABLE 3-2
VISIBILITY IMPACT RANKINGS AT PSD CLASS I AREA
FPL TURKEY POINT POWER PLANT, UNITS 1 AND 2

PSD Class I Area	Rank	Predicted Impact (dv)		
		2001	2002	2003
Everglades NP	1	2.466	2.018	1.952
	2	2.443	1.883	1.776
	3	2.364	1.851	1.768
	4	2.075	1.840	1.691
	5	2.025	1.646	1.690
	6	1.906	1.637	1.629
	7	1.898	1.442	1.600
	8	1.891	1.441	1.577

TABLE 3-3
SUMMARY OF BART EXEMPTION MODELING RESULTS WITH NEW IMPROVE EQUATION
FPL TURKEY POINT POWER PLANT, UNITS 1 AND 2

		Number of Days and Receptors with Impact >0.5 dv [a]								
	Distance (km) of Source	2001			2002			2003			22nd Highest Impact (dv)
PSD Class I Area	to Nearest Class I Area Boundary	No. of Days	No. of Receptors	8th Highest Impact (dv)	No. of Days	No. of Receptors	8th Highest Impact (dv)	No. of Days	No. of Receptors	8th Highest Impact (dv)	Over 3-Yr Period
Everglades NP	21	NA	NA	1.450	NA	NA	1.123	NA	NA	1.230	1.307

NA= not available

[a] No. of days and receptors are not readily available from the spreadsheet developed by VISTAS to estimate visbility impairment with the new IMPROVE equation.

TABLE 3-4
VISIBILITY IMPACT RANKINGS AT PSD CLASS I AREA
WITH NEW IMPROVE EQUATION
FPL TURKEY POINT POWER PLANT, UNITS 1 AND 2

PSD Class I Area	Rank	Predicted Impact (dv)		
		2001	2002	2003
Everglades NP	1	1.961	1.584	1.530
	2	1.945	1.473	1.376
	3	1.867	1.448	1.347
	4	1.614	1.442	1.322
	5	1.575	1.298	1.306
	6	1.516	1.286	1.248
	7	1.464	1.141	1.247
	8	1.450	1.123	1.230

4.0 REQUIREMENTS FOR ANALYSIS OF BART CONTROL OPTIONS

The visibility regulations define BART as follows:

> *Best Available Retrofit Technology (BART)* means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant which is emitted by . . . [a BART-eligible source]. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

The BART analysis identifies the best system of continuous emission reduction taking into account:

1. The available retrofit control options,
2. Any pollution control equipment in use at the source (which affects the availability of options and their impacts),
3. The costs of compliance with control options,
4. The remaining useful life of the facility,
5. The energy and non-air quality environmental impacts of control options, and
6. The visibility impacts analysis.

Once it is determined that a source is subject to BART for a particular pollutant, then for each affected emission unit, BART must be established for that pollutant. The BART determination must address air pollution control measures for each emissions unit or pollutant emitting activity subject to review.

For VOC and PM sources subject to maximum achievable control technology (MACT) standards under 40 CFR 63, the analysis may be streamlined (at the discretion of the State) by including a discussion of the MACT controls and whether any major new technologies have been developed subsequent to the MACT standards. There are many VOC and PM sources that are well controlled because they are regulated by the MACT standards, which EPA developed under CAA Section 112. For a few MACT standards, this may also be true for SO_2. Any source subject to MACT standards must meet a level that is as stringent as the best-controlled 12 percent of sources in the industry. The EPA believes that, in many cases, it will be unlikely that States will identify emission controls more stringent than the MACT standards without identifying control options that would cost many thousands of dollars per ton. Unless there are new technologies subsequent to the MACT standards which would lead to cost-effective increases in the level of control, EPA believes the State may rely on the MACT standards for purposes of BART.

The EPA believes that the same rationale also holds true for emissions standards developed for municipal waste incinerators under the CAA Section 111(d), and for many new source review(NSR)/PSD determinations and NSR/PSD settlement agreements. However, EPA does not believe that technology determinations from the 1970s or early 1980s, including new source performance standards (NSPS), should be considered to represent best control for existing sources, as best control levels for recent plant retrofits are more stringent than these older levels.

Where the source is relying on these standards to represent a BART level of control, a discussion of whether any new technologies have subsequently become available should be provided.

The five basic steps of a case-by-case BART analysis are:

STEP 1—Identify All Available Retrofit Control Technologies,

STEP 2—Eliminate Technically Infeasible Options,

STEP 3—Evaluate Control Effectiveness of Remaining Control Technologies,

STEP 4—Evaluate Impacts and Document the Results, and

STEP 5—Evaluate Visibility Impacts.

Each of these steps is described briefly in the following sections.

STEP 1—Identify All Available Retrofit Control Technologies

Available retrofit control options are those air pollution control technologies with a practical potential for application to the emissions unit and the regulated pollutant under evaluation. In identifying "all" options, the most stringent option and a reasonable set of options for analysis that reflects a comprehensive list of available technologies must be identified. It is not necessary to list all permutations of available control levels that exist for a given technology—the list is complete if it includes the maximum level of control each technology is capable of achieving.

Air pollution control technologies can include a wide variety of available methods, systems, and techniques for control of the affected pollutant. Technologies required as BACT or lowest achievable emission rate (LAER) are available for BART purposes and must be included as control alternatives. The control alternatives can include not only existing controls for the source category in question but also take into account technology transfer of controls that have been applied to similar source categories and gas streams. Technologies which have not yet been applied to (or permitted for) full scale operations are not needed to be considered and purchase or construction of a process or control device that has not already been demonstrated in practice is not expected.

Where a NSPS exists for a source category (which is the case for most of the categories affected by BART), a level of control equivalent to the NSPS as one of the control options, should be included. The NSPS standards are codified in 40 CFR 60.

Potentially applicable retrofit control alternatives can be categorized in three ways.

- Pollution prevention: use of inherently lower-emitting processes/practices, including the use of control techniques (e.g. low-NO_x burners) and work practices that prevent emissions and result in lower "production-specific" emissions (note that it is not our intent to direct States to switch fuel forms, *e.g.* from coal to gas),
- Use of (and where already in place, improvement in the performance of) add-on controls, such as scrubbers, fabric filters, thermal oxidizers and other devices that control and reduce emissions after they are produced, and
- Combinations of inherently lower-emitting processes and add-on controls.

In the course of the BART review, one or more of the available control options may be eliminated from consideration because they are demonstrated to be technically infeasible or to have unacceptable energy, cost, or non-air quality environmental impacts on a case-by-case (or site-specific) basis.

EPA does not consider BART as a requirement to redesign the source when considering available control alternatives. For example, where the source subject to BART is a coal-fired electric generator, EPA does not require the BART analysis to consider building a natural gas-fired electric turbine although the turbine may be inherently less polluting on a per unit basis.

For emission units subject to a BART review, there will often be control measures or devices already in place. For such emission units, it is important to include control options that involve improvements to existing controls and not to limit the control options only to those measures that involve a complete replacement of control devices.

If a BART source has controls already in place which are the most stringent controls available (note that this means that all possible improvements to any control devices have been made), then it is not necessary to comprehensively complete each following step of the BART analysis. As long these most stringent controls available are made federally enforceable for the purpose of implementing BART for that source, the remaining analyses may be skipped, including the visibility analysis in Step 5. Likewise, if a source commits to a BART determination that consists of the most stringent controls available, then there is no need to complete the remaining analyses.

STEP 2— Eliminate Technically Infeasible Options

In Step 2, the source evaluates the technical feasibility of the control options identified in Step 1. The source should document a demonstration of technical infeasibility and should explain, based on physical, chemical, or engineering principles, why technical difficulties would preclude the successful use of the control option on the emissions unit under review. The source may then eliminate such technically infeasible control options from further consideration in the BART analysis.

Control technologies are technically feasible if either (1) they have been installed and operated successfully for the type of source under review under similar conditions, or (2) the technology could be applied to the source under review. Two key concepts are important in determining whether a technology could be applied: "availability" and "applicability." A technology is considered "available" if the source owner may obtain it through commercial channels, or it is otherwise available within the common sense meaning of the term. An available technology is "applicable" if it can reasonably be installed and operated on the source type under consideration. A technology that is available and applicable is technically feasible.

Where it is concluded that a control option identified in Step 1 is technically infeasible, the source should demonstrate that the option is either commercially unavailable, or that specific circumstances preclude its application to a particular emission unit. Generally, such a demonstration involves an evaluation of the characteristics of the pollutant-bearing gas stream and the capabilities of the technology. Alternatively, a demonstration of technical infeasibility may involve a showing that there are un-resolvable technical difficulties with applying the control to the source (*e.g.*, size of the unit, location of the proposed site, operating problems related to specific circumstances of the source, space constraints, reliability, and adverse side effects on the rest of the facility). Where the resolution of technical difficulties is merely a matter of increased cost, the technology should be considered as technically feasible. The cost of a control alternative is considered later in the process.

STEP 3— Evaluate Control Effectiveness of Remaining Control Technologies

Step 3 involves evaluating the control effectiveness of all the technically feasible control alternatives identified in Step 2 for the pollutant and emissions unit under review. Two key issues in this process include:

1. Ensure that the degree of control is expressed using a metric that ensures an "apples to apples" comparison of emissions performance levels among options, and
2. Giving appropriate treatment and consideration of control techniques that can operate over a wide range of emission performance levels.

This issue is especially important when comparing inherently lower-polluting processes to one another or to add-on controls. In such cases, it is generally most effective to express emissions performance as an average steady state emissions level per unit of product produced or processed. Examples of common metrics are:

- Pounds of SO_2 emissions per million Btu heat input, and
- Pounds of NO_x emissions per ton of cement produced.

Many control techniques, including both add-on controls and inherently lower polluting processes, can perform at a wide range of levels. Scrubbers and high and low efficiency ESPs are two of the many examples of such control techniques that can perform at a wide range of levels. It is important, that in analyzing the technology one take into account the most stringent emission control level that the technology is capable of achieving. The recent regulatory decisions and performance data (e.g., manufacturer's data, engineering estimates and the experience of other sources) should be considered when identifying an emissions performance level or levels to evaluate.

For retrofitting existing sources in addressing BART, one should consider ways to improve the performance of existing control devices, particularly when a control device is not achieving the level of control that other similar sources are achieving in practice with the same device. For example, one should consider improving performance when sources with ESPs are performing below currently achievable levels.

STEP 4— Evaluate Impacts and Document the Results

After identifying the available and technically feasible control technology options, the following analyses should be conducted when making the BART determination:

1. Costs of compliance,
2. Energy impacts,
3. Non-air quality environmental impacts, and
4. Remaining useful life.

The source should discuss and, where possible, quantify both beneficial and adverse impacts. In general, the analysis should focus on the direct impact of the control alternative.

Costs of Compliance

To conduct a cost analysis, the following steps are used:

1. Identify the emissions units being controlled,
2. Identify design parameters for emission controls, and
3. Develop cost estimates based upon those design parameters.

It is important to identify clearly the emission units being controlled, that is, to specify a well-defined area or process segment within the plant. In some cases, multiple emission units can be controlled jointly. Then, the control system design parameters should be specified. The value selected for the design parameter should ensure that the control option will achieve the level of emission control being evaluated. The source should include in the analysis documentation of the assumptions regarding design parameters. Examples of supporting references include the EPA Office of Air Quality Planning and Standards (OAQPS) *Control Cost Manual* and background information documents used for NSPS and hazardous pollutant emission standards.

Once the control technology alternatives and achievable emissions performance levels have been identified, then the source must develop estimates of capital and annual costs. The basis for equipment cost estimates also should be documented, either with data supplied by an equipment vendor (i.e., budget estimates or bids) or by a referenced source (such as the *OAQPS Control Cost Manual,* Fifth Edition, February 1996, EPA 453/B–96–001). To maintain and improve consistency, cost estimates should be based on the *OAQPS Control Cost Manual,* where possible. The *Control Cost Manual* addresses most control technologies in sufficient detail for a BART analysis. The cost analysis should also take into account any site-specific design or other conditions identified above that affect the cost of a particular BART technology option.

Cost effectiveness, in general, is a criterion used to assess the potential for achieving an objective in the most economical way. For purposes of air pollutant analysis, "effectiveness" is measured in terms of tons of pollutant emissions removed, and "cost" is measured in terms of annualized control costs. The EPA recommends two types of cost-effectiveness calculations—average cost effectiveness, and incremental cost effectiveness.

Average cost effectiveness means the total annualized costs of control divided by annual emissions reductions (the difference between baseline annual emissions and the estimate of emissions after controls). Because costs are calculated in (annualized) dollars per year ($/yr) and emission rates are calculated in TPY, the result is an average cost-effectiveness number in (annualized) dollars per ton ($/ton) of pollutant removed.

The baseline emissions rate should represent a realistic depiction of anticipated annual emissions for the source. In general, for the existing sources subject to BART, the anticipated annual emissions will be estimated based upon actual emissions from a baseline period.

When future operating parameters (e.g., limited hours of operation or capacity utilization, type of fuel, raw materials or product mix or type) are projected to differ from past practice, and if this projection has a deciding effect in the BART determination, then these parameters or assumptions are to be translated into enforceable limitations. In the absence of enforceable limitations, baseline emissions are calculated based upon continuation of past practice.

In addition to the average cost effectiveness of a control option, the incremental cost effectiveness should also be calculated. The incremental cost effectiveness calculation compares the costs and performance level of a control option to those of the next most stringent option, as shown in the following formula (with respect to cost per emissions reduction):

Incremental Cost Effectiveness (dollars per incremental ton removed) =

[(Total annualized costs of control option) − (Total annualized costs of next control option)] ÷ [(Control option annual emissions) − (Next control option annual emissions)]

Energy Impacts

The energy requirements of the control technology should be analyzed to determine whether the use of that technology results in energy penalties or benefits. If such benefits or penalties exist, they should be quantified to the extent practicable. Because energy penalties or benefits can usually be quantified in terms of additional cost or income to the source, the energy impacts analysis can, in most cases, simply be factored into the cost impacts analysis.

The energy impact analysis should consider only direct energy consumption and not indirect energy impacts. The energy requirements of the control options should be shown in terms of total (and in certain cases, also incremental) energy costs per ton of pollutant removed. Then these units can be converted into dollar costs and, where appropriate, can be factored into the control cost analysis. Indirect energy impacts (such as energy to produce raw materials for construction of control equipment) are generally not considered.

The energy impact analysis may also address concerns over the use of locally scarce fuels. The designation of a scarce fuel may vary from region to region. However, in general, a scarce fuel is one which is in short supply locally and can be better used for alternative purposes, or one which may not be reasonably available to the source either at the present time or in the near future.

Non-Air Quality Environmental Impacts

In the non-air quality related environmental impacts portion of the BART analysis, environmental impacts other than air quality due to emissions of the pollutant in question are addressed. Such environmental impacts include solid or hazardous waste generation and discharges of polluted water from a control device.

Any significant or unusual environmental impacts associated with a control alternative that has the potential to affect the selection or elimination of a control alternative should be identified. Some control technologies may have potentially significant secondary environmental impacts. Scrubber effluent, for example, may affect water quality and land use. Alternatively, water availability may affect the feasibility and costs of wet scrubbers. Other examples of secondary environmental impacts could include hazardous waste discharges, such as spent catalysts or contaminated carbon.

In general, the analysis need only address those control alternatives with any significant or unusual environmental impacts that have the potential to affect the selection of a control alternative, or elimination of a more stringent control alternative. Thus, any important relative environmental impacts (both positive and negative) of alternatives can be compared with each other.

Remaining Useful Life

The requirement to consider the source's "remaining useful life" of the source for BART determinations may be treated as one element of the overall cost analysis. The "remaining useful life" of a source, if it represents a relatively short time period, may affect the annualized costs of retrofit controls. For example, the methods for calculating annualized costs in EPA's *OAQPS Control Cost Manual* require the use of a specified time period for amortization that varies based upon the type of control. If the remaining useful life will clearly not exceed this time period, the remaining useful life has an effect on control costs and on the BART determination process. Where the remaining useful life is less than the time period for amortizing costs, this shorter time period should be considered in the cost calculations.

The remaining useful life is the difference between:

1. The date that controls will be put in place (capital and other construction costs incurred before controls are put in place can be rolled into the first year, as suggested in EPA's *OAQPS Control Cost Manual*); and
2. The date the facility permanently stops operations. Where this affects the BART determination, this date should be assured by a federally- or State-enforceable restriction preventing further operation.

EPA recognizes that there may be situations where a source operator intends to shut down a source by a given date, but wishes to retain the flexibility to continue operating beyond that date in the event, for example, that market conditions change. Where this is the case, the BART analysis may account for this, but it must maintain consistency with the statutory requirement to install BART within 5 years. Where the source chooses not to accept a federally enforceable condition requiring the source to shut down by a given date, it is necessary to determine whether a reduced time period for the remaining useful life changes the level of controls that would have been required as BART.

STEP 5—Evaluate Visibility Impacts

The following is an approach EPA suggests to determine visibility impacts (the degree of visibility improvement for each source subject to BART) for the BART determination. Once it is determined that a source is subject to BART, a visibility improvement determination for the source must be conducted as part of the BART determination.

The permitting agency has flexibility in making this determination, i.e., in setting absolute thresholds, target levels of improvement, or *de minimis* levels since the deciview improvement must be weighed among the five factors, and the agency is free to determine the weight and significance to be assigned to each factor. For example, a 0.3 dv improvement may merit a stronger weighting in one case versus another, so one "bright line" may not be appropriate.

CALPUFF or other appropriate dispersion model must be used to determine the visibility improvement expected at a Class I area from the potential BART control technology applied to the source. Modeling should be conducted for SO_2, NO_x, and direct PM emissions ($PM_{2.5}$ and/or PM_{10}). There are several steps for determining the visibility impacts from an individual source using a dispersion model:

- Develop a modeling protocol.
- For each source, run the model, at pre-control and post-control emission rates according to the accepted methodology in the protocol. Use the 24-hour average actual emission rate from the highest emitting day of the meteorological period modeled (for the pre-control scenario). Calculate the model results for each receptor as the change in deciviews compared against natural visibility conditions. Post-control emission rates are calculated as a percentage of pre-control emission rates. For example, if the 24-hour pre-control emission rate is 100 lb/hr of SO_2, then the post control rate is 5 lb/hr if the control efficiency being evaluated is 95 percent.
- Make the net visibility improvement determination. Assess the visibility improvement based on the modeled change in visibility impacts for the pre-control and post-control emission scenarios. The assessment of visibility improvements due to BART controls is flexible and can be done by one or more methods. The frequency, magnitude, and duration components of impairment may be considered. Suggestions for making the determination are:

- Use of a comparison threshold, as is done for determining if BART-eligible sources should be subject to a BART determination. Comparison thresholds can be used in a number of ways in evaluating visibility improvement (e.g. the number of days or hours that the threshold was exceeded, a single threshold for determining whether a change in impacts is significant, or a threshold representing an x percent change in improvement).
- Compare the 98th percent days for the pre- and post-control runs.

Each of the modeling options may be supplemented with source apportionment data or source apportionment modeling.

Selecting the "Best" Alternative

From the alternatives evaluated in Step 3, EPA recommends developing a chart (or charts) displaying for each of the alternatives the following:

1. Expected emission rate (tons per year, pounds per hour);
2. Emissions performance level (e.g., percent pollutant removed, emissions per unit product, lb/MMBtu, ppm);
3. Expected emissions reductions (tons per year);
4. Costs of compliance—total annualized costs ($), cost effectiveness ($/ton), and incremental cost effectiveness ($/ton), and/or any other cost-effectiveness measures (such as $/dv);
5. Energy impacts;
6. Non-air quality environmental impacts; and
7. Modeled visibility impacts.

The source has the discretion to determine the order in which you should evaluate control options for BART. The source should provide a justification for adopting the technology selected as the "best" level of control, including an explanation of the CAA factors that led you to choose that option over other control levels.

In the case where the source is conducting a BART determination for two regulated pollutants on the same source, if the result is two different BART technologies that do not work well together, then a different technology or combination of technologies can be substituted.

Even if the control technology is cost effective, there may be cases where the installation of controls would affect the viability of continued plant operations. There may be unusual circumstances that justify taking into consideration the conditions of the plant and the economic effects of requiring the use of a given control technology. These effects would include effects on product prices, the market share, and profitability of the source. Where there are such unusual circumstances that are judged to affect plant operations, the conditions of the plant and the economic effects of requiring the use of a control technology may be taken into consideration. Where these effects are judged to have a severe impact on plant operations, they may be considered in the selection process, but an economic analysis that demonstrates, in sufficient detail for public review, the specific economic effects, parameters, and reasoning may have to be provided. Any analysis may also consider whether other competing plants in the same industry have been required to install BART controls if this information is available.

5.0 BART ANALYSIS FOR PM EMISSIONS

5.1 Available Retrofit Technologies

Unit No. 1 and Unit No. 2 at the PTF currently have multi-cyclones for particulate control. The multi-cyclones consist of two UOP tubular mechanical dust collector with 695 tubes per collector. The collection efficiency for these multi-cyclones is high (about 90 percent) for particles that are 20 microns in diameter and larger. For particles with a mean diameter of 7.5 micron, the collection efficiency is 66.2 percent. The collection efficiency of the multi-cyclones for particles with a mean diameter of 2.5 microns is about 30 percent. As a result, ESPs and fabric filters would be the most effective PM-control devices that could be applied to reduce low diameter particles that contribute to visibility. PM removal efficiencies of these devices can be greater than 99 percent. Both devices are also highly effective in controlling PM_{10} emissions. Other technologies, such as wet scrubbers, have not demonstrated equivalent levels of control for PM.

ESP

In an ESP, a high-voltage electric field is produced to impart an electric charge to the solid particles in the flue gas stream. The pulsating direct current voltage in the range of 20,000- to 100,000- volts is used to ionize the gas stream, known as corona. The ions, usually produced using a negative corona, are attracted to the particles while traveling in the ionized gas stream. These particles are then removed from the gas stream by migrating toward the oppositely charged collecting electrodes. Rapping mechanisms, that are operated intermittently, dislodge the collected particles, which subsequently fall into a hopper. ESP performance is highly dependent on the electrical characteristics or resistivity of the particle or aerosol to be collected.

ESP performance is dependent on a number of factors, which influence the resistivity of the particle. These factors include the particle composition, flue gas characteristics, particle size distribution, and particle loading. These parameters can vary during normal operation and can influence ESP performance when gas streams come directly from the boiler.

Fabric Filters

In a fabric filter, PM is removed from the flue gas as it passes through a fabric filter media such as woven cloths or felts a nylon, fiberglass, or composition fabric; hence the term "fabric filter." The filters are normally arranged as a number of cylinders or tubes (commonly referred to a "bags"), through which the flue gas is directed. The filters are contained in a housing which has gas inlets and outlets. The flue gas enters the cylindrical filter from the bottom and flows upward, from either the inside of the cylinder to the outside or the opposite depending upon the design. Particulate collection occurs through several mechanisms, including gravitational settling, direct impaction, inertial impaction, diffusion, and electrostatic attraction. When the pressure drop reaches a predefined level, a section of the filters the bag is taken offline for cleaning. Various methods are used to clean the bags in the fabric filter. The three general types of cleaning are shaker cleaning, pulse-jet cleaning, and reverse-air cleaning. All three types of cleaning methods can achieve the same low emission rates.

The shaker cleaning is accomplished by taking the bags off-line, shaking the bags of the fabric filter, and then deflating the bag by inducing a vacuum. The PM collected on the bags is dislodged and then falls into the collection hoppers at the bottom of the fabric filter.

In the pulse-jet method of cleaning, cleaning is accomplished off-line by directing a short burst of compressed air inside the filter bags. This burst produces a shock wave, which travels down the length of the bag, dislodging the accumulated dust cake. The collected PM then falls into the hoppers located below the bags. This is currently the best practice for cleaning.

In reverse air fabric filters, the PM is collected on the inside of the filter bags. Cleaning is accomplished by introducing a reverse flow of air through the bags. This causes the bag to collapse, thereby dislodging the filter cake. The dislodged PM falls into the collection hoppers for disposal.

Control Technology Feasibility

ESPs are available, technically feasible and demonstrated as effective PM control devices for oil fired units. ESPs have been added to FPL's Port Everglades Plant, including the 400 MW class units that are very similar to Units 1 and 2 at PTF. Fabric filters have not been applied to oil-fired units. The particles generated by oil-fired units may limit the ability of fabric filters to be effective control. Studies conducted during the full-scale Orimulsion tests in the late 1980s at the FPL Sanford Plant found particles generated with an oil-based fuel caused considerable plugging of bags in pilot scale tests. The similarity of residual oil and Orimulsion suggest that fabric filters would not be an effective control for Turkey Point Units 1 and 2. As a result, ESPs are considered the appropriate control technology to achieve an emissions rate potentially applicable as BART for these units.

5.2 Impacts of Control Technology Options

Cost of Compliance

The total estimated capital, annualized, and incremental costs for an ESP are summarized in Table 5-1. The capital cost for two 400-MW units is estimated to be $94 million with an annualized cost of about $13.4 million. The cost effectiveness is over $10,000 per ton of PM removed. The improvement in visibility impact is about 0.1 dv for each of the years evaluated using the new IMPROVE algorithm. The cost effectiveness for ESPs would be about $134 million per dv improvement. It should be noted that the estimated cost does not include any changes in construction associated with the close proximity of the nuclear units (i.e., Turkey Point Units 3 and 4). The location of the ESP construction for Units 1 and 2 in close proximity to the nuclear units would increase security and potentially require Nuclear Regulatory Commission approval. This would likely increase costs as well as approval times when construction could begin.

Energy Impacts

Energy losses will occur with the ESP. The energy loses are due to the pressure drop and energy used in the transformer rectifier sets.

The energy required to operate an ESP would be about 4,370 MW-hr per year for both units. This is about 0.5 MW per unit of 0.13 percent of the gross generation.

Non-Air Quality Environmental Impacts

The ESP would collect ash that would have to be either recycled or placed in a land fill. Ash from residual oil is sometimes recycled for its vanadium content. Otherwise the ash would have to be put in a landfill. About 1,257 tons of ash would be generated from the ESPs. This ash would have to be trucked from the site. About 50 trucks per year would be required.

Remaining Useful Life

FPL has no plans to shutdown either unit in the near future. However, Units 1 and 2 are typically operated as cycling units.

Salt Concentrations for Class I Areas of VISTAS and Nearby States *

Class I Area	State	bRay Mm-1	Sea Salt µg/m3	IMPROVE Monitor
VISTAS States				
Cape Romain W	SC	12	0.20	
Chassahowitzka W	FL	11	0.08	
Cohutta W	GA	11	0.03	
Dolly Sods W	WV	10	0.02	
Everglades NP	FL	11	0.31	
Great Smoky Mtns. NP	TN	11	0.02	
James River Face W.	VA	11	0.02	
Linville Gorge	NC	11	0.02	
Mammoth Cave NP	KY	11	0.02	
Okefenokee W	GA	11	0.09	
Otter Creek W	WV	10	0.02	DOSO1
St. Marks W.	FL	11	0.03	
Shenandoah NP	VA	10	0.02	
Shining Rock W	NC	10	0.03	
Sipsey W	AL	11	0.05	
Swanquarter W	NC	12	0.13	
Wolf Island W.	GA	11	0.09	OKEF1
Wolf Island W.**	GA	12	0.20	ROMA1
Nearby States				
Breton W	LA	11	Unknown	
Brigantine W	NJ	12	0.22	
Caney Creek	AR	11	0.03	
Hercules-Glades	MO	11	0.04	
Mingo W	MO	12	0.01	
Upper Buffalo W	AR	11	0.03	

* Rayleigh scattering values for the relevant IMPROVE monitor are from the IMPROVE memo about the revised algorithm. Sea salt concentrations are averages for 2000-2004 based on data from the VIEWS web site.
** Alternative values for Wolf Island based on Cape Romain measurements. Being at sea level and on the coast, Cape Romain values may be more representative of Rayleigh and sea salt conditions at Wolf island than those at Okefenokee, which is above sea level and far from the shore.

1.34	50	1.64	1.5	2.45
1.37	51	1.66	1.52	2.48
1.41	52	1.68	1.54	2.5
1.44	53	1.71	1.55	2.51
1.47	54	1.73	1.57	2.53
1.51	55	1.76	1.59	2.56
1.54	56	1.78	1.61	2.58
1.58	57	1.81	1.63	2.59
1.62	58	1.83	1.65	2.62
1.66	59	1.86	1.67	2.66
1.7	60	1.89	1.69	2.69
1.74	61	1.92	1.71	2.73
1.79	62	1.95	1.73	2.78
1.83	63	1.99	1.75	2.83
1.88	64	2.02	1.78	2.83
1.93	65	2.06	1.8	2.86
1.98	66	2.09	1.83	2.89
2.03	67	2.13	1.86	2.91
2.08	68	2.17	1.89	2.95
2.14	69	2.22	1.92	3.01
2.19	70	2.26	1.95	3.05
2.25	71	2.31	1.98	3.13
2.31	72	2.36	2.01	3.17
2.37	73	2.41	2.05	3.21
2.43	74	2.47	2.09	3.25
2.5	75	2.54	2.13	3.27
2.56	76	2.6	2.18	3.35
2.63	77	2.67	2.22	3.42
2.7	78	2.75	2.27	3.52
2.78	79	2.84	2.33	3.57
2.86	80	2.93	2.39	3.63
2.94	81	3.03	2.45	3.69
3.03	82	3.15	2.52	3.81
3.12	83	3.27	2.6	3.95
3.22	84	3.42	2.69	4.04
3.33	85	3.58	2.79	4.11
3.45	86	3.76	2.9	4.28
3.58	87	3.98	3.02	4.49
3.74	88	4.23	3.16	4.61
3.93	89	4.53	3.33	4.86
4.16	90	4.9	3.53	5.12
4.45	91	5.35	3.77	5.38
4.84	92	5.93	4.06	5.75
5.37	93	6.71	4.43	6.17
6.16	94	7.78	4.92	6.72
7.4	95	9.34	5.57	7.35
7.4	96	9.34	5.57	7.35
7.4	97	9.34	5.57	7.35
7.4	98	9.34	5.57	7.35
7.4	99	9.34	5.57	7.35
7.4	100	9.34	5.57	7.35

Old and New F(RH) Values

Old F(RH)	RH	New Fs(RH)	New Fl(RH)	New Fss(RH)
1	1	1	1	1
1	2	1	1	1
1	3	1	1	1
1	4	1	1	1
1	5	1	1	1
1	6	1	1	1
1	7	1	1	1
1	8	1	1	1
1	9	1	1	1
1	10	1	1	1
1	11	1	1	1
1	12	1	1	1
1	13	1	1	1
1	14	1	1	1
1	15	1	1	1
1	16	1	1	1
1	17	1	1	1
1	18	1	1	1
1	19	1	1	1
1	20	1	1	1
1	21	1	1	1
1	22	1	1	1
1	23	1	1	1
1	24	1	1	1
1	25	1	1	1
1	26	1	1	1
1	27	1	1	1
1	28	1	1	1
1	29	1	1	1
1	30	1	1	1
1	31	1	1	1
1	32	1	1	1
1	33	1	1	1
1	34	1	1	1
1	35	1	1	1
1	36	1	1	1
1.02	37	1.38	1.31	1
1.04	38	1.4	1.32	1
1.06	39	1.42	1.34	1
1.08	40	1.44	1.35	1
1.1	41	1.46	1.36	1
1.13	42	1.48	1.38	1
1.15	43	1.49	1.39	1
1.18	44	1.51	1.41	1
1.2	45	1.53	1.42	1
1.23	46	1.55	1.44	1
1.26	47	1.57	1.45	2.36
1.28	48	1.59	1.47	2.38
1.31	49	1.62	1.49	2.42

<------------------- Modified size breakdown of natural background (nm) concentrations in presence of source contributions (8) ------------						<- Modified natural background bext (9									
[SmnmSO4]	[LgnmSO4]	[SmnmNO3]	[LgnmNO3]	[SmnmOC]	[LgnmOC]	bnmSO4	bnmNO3	bnmOC	bnm(Sum)	bext(Total)	%Change	dv(total)	dv(bkgd)	Δdv	NewRank
0.223	0.007	0.100	0.001	1.634	0.166	1.349	0.626	5.588	22.829	26.707	17.17	9.82	8.24	1.58	1
0.223	0.007	0.100	0.001	1.634	0.166	1.423	0.662	5.587	23.028	26.646	15.87	9.80	8.33	1.47	2
0.224	0.006	0.100	0.001	1.634	0.166	1.423	0.662	5.587	23.027	26.580	15.58	9.78	8.33	1.45	3
0.223	0.007	0.100	0.001	1.634	0.166	1.346	0.626	5.587	22.826	26.330	15.51	9.68	8.24	1.44	4
0.224	0.006	0.100	0.001	1.635	0.165	1.344	0.626	5.586	22.822	25.922	13.72	9.53	8.24	1.29	6
0.224	0.006	0.100	0.001	1.635	0.165	1.248	0.581	5.586	22.606	25.708	13.86	9.44	8.14	1.30	5
0.224	0.006	0.100	0.001	1.635	0.165	1.246	0.581	5.585	22.603	25.306	12.08	9.28	8.14	1.14	7
0.224	0.006	0.100	0.001	1.635	0.165	1.342	0.626	5.584	22.818	25.504	11.89	9.36	8.24	1.12	8
0.224	0.006	0.100	0.001	1.635	0.165	1.342	0.626	5.584	22.818	25.400	11.43	9.32	8.24	1.08	9
0.225	0.005	0.100	0.001	1.635	0.165	1.418	0.662	5.583	23.019	25.565	11.17	9.39	8.33	1.06	11
0.225	0.005	0.100	0.001	1.635	0.165	1.418	0.662	5.583	23.019	25.558	11.14	9.38	8.33	1.06	12
0.224	0.006	0.100	0.001	1.635	0.165	1.245	0.581	5.584	22.601	25.132	11.31	9.22	8.14	1.07	10
0.224	0.006	0.100	0.001	1.635	0.165	1.245	0.581	5.584	22.601	25.080	11.08	9.19	8.14	1.05	13
0.224	0.006	0.100	0.001	1.635	0.165	1.245	0.581	5.584	22.601	25.076	11.06	9.19	8.14	1.05	14
0.225	0.005	0.100	0.001	1.635	0.165	1.341	0.626	5.583	22.816	25.216	10.62	9.25	8.24	1.01	15
0.225	0.005	0.100	0.001	1.636	0.164	1.559	0.730	5.582	23.316	25.678	10.23	9.43	8.46	0.97	18
0.225	0.005	0.100	0.001	1.635	0.165	1.341	0.626	5.583	22.816	25.185	10.49	9.24	8.24	1.00	16
0.225	0.005	0.100	0.001	1.636	0.164	1.462	0.684	5.583	23.110	25.434	10.15	9.34	8.37	0.97	19
0.225	0.005	0.100	0.001	1.635	0.165	1.340	0.626	5.583	22.815	25.131	10.25	9.22	8.24	0.98	17
0.225	0.005	0.100	0.001	1.636	0.164	1.559	0.730	5.582	23.315	25.609	9.93	9.40	8.46	0.95	22
0.225	0.005	0.100	0.001	1.636	0.164	1.340	0.626	5.583	22.815	25.103	10.12	9.20	8.24	0.96	20
0.225	0.005	0.100	0.001	1.636	0.164	1.416	0.662	5.582	23.016	25.286	9.95	9.28	8.33	0.95	21

<------------------------- Source impact on bext (5) -----------------------								< Size breakdown of natural background (n) concentrations (						<------- Natural background bext (7) ------				
bsSO4	**bsNO3**	**bsOC**	**bsEC**	**bsPMC**	**bsPMF**	**baNO2**	**bs(Sum)**	**[SmnSO4]**	**[LgnSO4]**	**[SmnNO3]**	**[LgnNO3]**	**[SmnOC]**	**[LgnOC]**	**bnSO4**	**bnNO3**	**bnOC**	**bnSS**	**bn(Sum)**
2.191	0.000	0.144	0.606	0.182	0.755	0	3.879	0.227	0.003	0.0995	0.0005	1.638	0.162	1.328	0.626	5.575	1.765	22.79
2.098	0.000	0.130	0.546	0.164	0.68	0	3.618	0.227	0.003	0.0995	0.0005	1.638	0.162	1.404	0.662	5.575	1.855	23.00
2.045	0.000	0.130	0.541	0.162	0.675	0	3.553	0.227	0.003	0.0995	0.0005	1.638	0.162	1.404	0.662	5.575	1.855	23.00
1.963	0.000	0.132	0.553	0.166	0.69	0	3.504	0.227	0.003	0.0995	0.0005	1.638	0.162	1.328	0.626	5.575	1.765	22.79
1.740	0.000	0.116	0.488	0.147	0.609	0	3.100	0.227	0.003	0.0995	0.0005	1.638	0.162	1.328	0.626	5.575	1.765	22.79
1.705	0.000	0.119	0.502	0.151	0.625	0	3.102	0.227	0.003	0.0995	0.0005	1.638	0.162	1.231	0.581	5.575	1.692	22.58
1.479	0.000	0.105	0.44	0.132	0.548	0	2.704	0.227	0.003	0.0995	0.0005	1.638	0.162	1.231	0.581	5.575	1.692	22.58
1.500	0.000	0.102	0.426	0.128	0.53	0	2.686	0.227	0.003	0.0995	0.0005	1.638	0.162	1.328	0.626	5.575	1.765	22.79
1.461	0.000	0.096	0.403	0.121	0.502	0	2.583	0.227	0.003	0.0995	0.0005	1.638	0.162	1.328	0.626	5.575	1.765	22.79
1.473	0.000	0.092	0.385	0.116	0.48	0	2.546	0.227	0.003	0.0995	0.0005	1.638	0.162	1.404	0.662	5.575	1.855	23.00
1.464	0.000	0.092	0.386	0.116	0.481	0	2.539	0.227	0.003	0.0995	0.0005	1.638	0.162	1.404	0.662	5.575	1.855	23.00
1.382	0.000	0.098	0.412	0.124	0.514	0	2.531	0.227	0.003	0.0995	0.0005	1.638	0.162	1.231	0.581	5.575	1.692	22.58
1.354	0.000	0.096	0.404	0.121	0.504	0	2.479	0.227	0.003	0.0995	0.0005	1.638	0.162	1.231	0.581	5.575	1.692	22.58
1.353	0.000	0.096	0.403	0.121	0.502	0	2.475	0.227	0.003	0.0995	0.0005	1.638	0.162	1.231	0.581	5.575	1.692	22.58
1.345	0.000	0.090	0.379	0.114	0.472	0	2.400	0.227	0.003	0.0995	0.0005	1.638	0.162	1.328	0.626	5.575	1.765	22.79
1.429	0.000	0.080	0.335	0.101	0.417	0	2.362	0.227	0.003	0.0995	0.0005	1.638	0.162	1.547	0.730	5.575	1.945	23.30
1.343	0.000	0.088	0.369	0.111	0.459	0	2.370	0.227	0.003	0.0995	0.0005	1.638	0.162	1.328	0.626	5.575	1.765	22.79
1.354	0.000	0.083	0.348	0.105	0.434	0	2.324	0.227	0.003	0.0995	0.0005	1.638	0.162	1.450	0.684	5.575	1.881	23.09
1.296	0.000	0.088	0.366	0.11	0.456	0	2.316	0.227	0.003	0.0995	0.0005	1.638	0.162	1.328	0.626	5.575	1.765	22.79
1.372	0.000	0.079	0.331	0.099	0.413	0	2.294	0.227	0.003	0.0995	0.0005	1.638	0.162	1.547	0.730	5.575	1.945	23.30
1.280	0.000	0.086	0.362	0.109	0.451	0	2.288	0.227	0.003	0.0995	0.0005	1.638	0.162	1.328	0.626	5.575	1.765	22.79
1.311	0.000	0.082	0.344	0.103	0.429	0	2.269	0.227	0.003	0.0995	0.0005	1.638	0.162	1.404	0.662	5.575	1.855	23.00

bnEC	**bnPMC**	**bnPMF**	**bRay**
0.200	1.800	0.500	11

-- CALCULATIONS ------------------------------------

					<------------ Source (s) impact on concentrations (2) -- ------							<---- New F(RH) (3) ----			<---- Size breakdown of source concentrations (4)					
OldRank	YEAR	DAY	RECEPTOR	RH (1)	[SO4]	[NO3]	[OC]	[EC]	[PMC]	[PMF]	[NO2]	Fs(RH)	Fl(RH)	Fss(RH)	[SmSO4]	[LgSO4]	SmNO3	[LgNO3]	[SmOC]	[LgOC]
0	2002	66	427	76	0.374	0.000	0.047	0.061	0.303	0.755	0.000	2.6	2.18	3.35	0.362	0.011	0.0000	0.0000	0.0422	0.0043
0	2002	157	573	78	0.339	0.000	0.042	0.055	0.273	0.680	0.000	2.75	2.27	3.52	0.329	0.010	0.0000	0.0000	0.0381	0.0039
0	2002	343	475	78	0.331	0.000	0.042	0.054	0.270	0.675	0.000	2.75	2.27	3.52	0.321	0.009	0.0000	0.0000	0.0379	0.0038
0	2002	333	318	76	0.335	0.000	0.043	0.055	0.277	0.690	0.000	2.6	2.18	3.35	0.326	0.009	0.0000	0.0000	0.0386	0.0039
0	2002	84	573	76	0.298	0.000	0.038	0.049	0.245	0.609	0.000	2.6	2.18	3.35	0.290	0.008	0.0000	0.0000	0.0341	0.0034
0	2002	99	600	73	0.314	0.000	0.039	0.050	0.252	0.625	0.000	2.41	2.05	3.21	0.306	0.009	0.0000	0.0000	0.0350	0.0035
0	2002	112	600	73	0.273	0.000	0.034	0.044	0.220	0.548	0.000	2.41	2.05	3.21	0.266	0.007	0.0000	0.0000	0.0307	0.0031
0	2002	331	285	76	0.257	0.000	0.033	0.043	0.213	0.530	0.000	2.6	2.18	3.35	0.251	0.006	0.0000	0.0000	0.0297	0.0030
0	2002	77	548	76	0.250	0.000	0.031	0.040	0.202	0.502	0.000	2.6	2.18	3.35	0.244	0.006	0.0000	0.0000	0.0282	0.0028
0	2002	23	573	78	0.239	0.000	0.030	0.039	0.193	0.480	0.000	2.75	2.27	3.52	0.233	0.006	0.0000	0.0000	0.0270	0.0027
0	2002	6	257	78	0.238	0.000	0.030	0.039	0.193	0.481	0.000	2.75	2.27	3.52	0.232	0.006	0.0000	0.0000	0.0270	0.0027
0	2002	127	548	73	0.255	0.000	0.032	0.041	0.207	0.514	0.000	2.41	2.05	3.21	0.249	0.006	0.0000	0.0000	0.0288	0.0029
0	2002	132	548	73	0.250	0.000	0.031	0.040	0.202	0.504	0.000	2.41	2.05	3.21	0.244	0.006	0.0000	0.0000	0.0282	0.0028
0	2002	146	499	73	0.250	0.000	0.031	0.040	0.202	0.502	0.000	2.41	2.05	3.21	0.244	0.006	0.0000	0.0000	0.0282	0.0028
0	2002	332	256	76	0.231	0.000	0.029	0.038	0.190	0.472	0.000	2.6	2.18	3.35	0.225	0.005	0.0000	0.0000	0.0263	0.0027
0	2002	256	862	81	0.211	0.000	0.026	0.034	0.168	0.417	0.000	3.03	2.45	3.69	0.206	0.005	0.0000	0.0000	0.0234	0.0024
0	2002	61	548	76	0.230	0.000	0.028	0.037	0.185	0.459	0.000	2.6	2.18	3.35	0.225	0.005	0.0000	0.0000	0.0257	0.0026
0	2002	286	573	79	0.213	0.000	0.027	0.035	0.175	0.434	0.000	2.84	2.33	3.57	0.208	0.005	0.0000	0.0000	0.0243	0.0024
0	2002	319	256	76	0.222	0.000	0.028	0.037	0.183	0.456	0.000	2.6	2.18	3.35	0.217	0.005	0.0000	0.0000	0.0257	0.0026
0	2002	272	600	81	0.202	0.000	0.026	0.033	0.165	0.413	0.000	3.03	2.45	3.69	0.198	0.004	0.0000	0.0000	0.0232	0.0023
0	2002	46	287	76	0.220	0.000	0.028	0.036	0.182	0.451	0.000	2.6	2.18	3.35	0.215	0.005	0.0000	0.0000	0.0252	0.0025
0	2002	32	598	78	0.213	0.000	0.027	0.034	0.172	0.429	0.000	2.75	2.27	3.52	0.208	0.005	0.0000	0.0000	0.0241	0.0024

Notes:

(1) Derived from old F(RH) using the first two columns in the table on worksheet "F(RH)" (taken from EPA's natural conditions guidance document).

(2) [SO4] and [NO3] calculated by dividing bxSO4 and bxNO3 on input page by F(RH) and dry extinction efficiency of 3. Other particulate components calculated by dividing their respective bx terms by extinction efficiencies (4 for [OC], 10 for [EC], 0.6 for [PMC] and 1 for [PMF]). [NO2] is taken from values entered onto input page, which are multiplied by the chosen NO2/NOx factor. Note that here [OC] represents particulate organic matter, consistent with CALPOST's notation, not just the organic carbon alone.

(3) From 2nd to 5th columns in table on "F(RH)" worksheet (taken from new IMPROVE algorithm memo).

(4) Calculated using new IMPROVE procedures with total concentrations for SO4, NO3 and OC being sums of source and background concentrations, but the resulting size fractionation is then applied to the source impact concentrations only. Default OC concentration changed to 1.8 because of revised multiplier in new IMPROVE approach.

(5) Calculated by applying the new IMPROVE algorithm to concentrations in columns F through L.

(6) Calculated using new IMPROVE procedures with concentrations of SO4 and NO3 equal to default background values 0f 0.23 and 0.1. Concentration of OC changed from default of 1.4 to 1.8 because of change in multiplier.

(7) Calculated applying the new IMPROVE algorithm to EPA's default annual average natural concentrations for the East, with added sea salt term.

(8) The source's contributions increase total (background + source) concentrations and thus change the size distribution of the natural background portion of the aerosol. Values here calculated using new IMPROVE procedures with total concentrations for SO4, NO3 and OC being sums of source and background concentrations, but the resulting size weighting is then applied to the natural background concentrations only.

(9) Contributions to the background by EC, PMC, PMF, and Sea salt are same as for unmodified background aerosol.

6. SUMMARY OF BART MODELING ANALYSIS FOR PROGRESS ENERGY

The CALPUFF model (Version 5.756) was used to predict the maximum visibility impairment at four PSD Class I areas located within 300 km of the Progress Energy Florida Crystal River Power Plant. The nearest PSD Class I area is the Chassahowitzka National Wilderness Area (NWA), which is located approximately 21 km from the facility at the closest point. The other three Class I areas are: the St. Marks NWA, which is located approximately 174 km from the facility; the Okefenokee NWA, which is located approximately 178 km from the facility; and the Wolf Island NWA, which is located approximately 293 km from the facility. The CALPUFF modeling analysis followed the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) common protocol, version 3.2. The Department provided the applicant with 4-km "CALPUFF-ready" CALMET meteorological data for the period 2001-2003. Class I receptor locations were obtained from the National Park Service (NPS) and a Lambert Conformal Conic (LCC) coordinate system was used.

For the two BART-eligible sources, the PM/PM_{10} emissions and H_2SO_4 emission rates were determined from stack test data and AP-42 emission factors to reflect the maximum 24-hour average normal operation for the most recent 3 to 5 years. Emission rates of H_2SO_4 were input directly into the CALPUFF model while PM/PM_{10} emissions were speciated into six particulate species in specific size categories and modeled. . The facility is not subject to a BART review for SO_2 or NO_x emissions because of a CAIR project on Units -004 & -005; therefore these emission rates were not entered into CALPUFF. CALPOST method 6 was used to compute the extinction change (visibility impairment) in deciviews (dv) consistent with procedures outlined in the VISTAS modeling protocol.

Based on the predicted 24-hour visibility impairment values for 2001 to 2003, the 8^{th} highest (98^{th} percentile) for each year and the 22^{nd} highest values over the three years 2001-2003 were determined. These values are compared with the threshold of 0.50 delta deciview (dv). In addition, the model output shows the number of days that a dv greater than 0.50 were predicted for each year. The Class I area with the highest predicted impacts is the Chassahowitzka NWA, which is also the nearest to the facility. These predicted values for Chassahowitzka are shown in the table below for each control technology reviewed and show predicted impacts over 0.50 dv for all control strategies.

Control Technolgy	Continuously Acheivable Emission rate	8^{th} highest impairment, highest year (dv)	22^{nd} highest impairment over 2001-2003 (dv)	Number of days with impairment over 0.50 dv, highest year
Existing ESP	0.1 lb/MMBtu	0.71	0.68	14
Rebuilt ESP	0.015 lb/mmbtu	0.61	0.59	10
Polishing Baghouse	0.012 lb/mmbtu	0.60	0.57	10
New ESP	0.010 lb/mmbtu	0.58	0.56	10
Baghouse Conversion	0.006 lb/mmbtu	0.56	0.53	10

The applicant proposed the current control equipment for both sources as the top control option. The Department has chosen the rebuilt ESP option as the preliminary PM10 BART w/ fuel additive program

TABLE 5-2c
PM SPECIATION SUMMARY - UNITS 1 AND 2 WITH
PM EMISSION RATE OF 0.05 LB/MMBTU AND SULFUR CONTENT OF 0.7 PERCENT
FPL TURKEY POINT POWER PLANT

PM Category	Emission Unit [a]	Units	Total	Coarse PM	Soil (Fine PM)	Elemental Carbon (EC)	Inorganic (as H_2SO_4)	Organic
PM Filterable [b]	Units 1 & 2	lb/hr	400.0	133.33	246.93	19.73	NA	NA
		%	100%	33%	61.7%	4.9%	NA	NA
PM Condensable [c]	Units 1 & 2	lb/hr	59.60	NA	NA	NA	47.60	8.94
		%	95%	NA	NA	NA	80%	15%
Total PM_{10} (filterable+condensable)	Units 1 & 2	lb/hr	459.6	133.33	246.93	19.73	47.60	8.94
		%	99%	29.0%	53.7%	4.3%	10.4%	1.9%
Total PM_{10} (filterable+Organic Condensable PM)	Units 1 & 2	lb/hr	408.9	133.33	246.93	19.73	0.0	8.94
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	32.6%	60.4%	4.8%	0.0%	2.2%

PM Particle Size Distribution for CALPUFF Assessment

Species	Size Distribution by Category (%)					Emission Rate (lb/hr)		
	AP-42 (Table 1.3-4)		Cumulative	Individual Categories				
Name	Particle Size (microns)	Cumulative (%)	Normalized PM_{10} (%)	Filterable (%)	Organic Condensable	Filterable	Organic Condensable	Total
Total PM_{10}						400.0	8.9	408.9
PM0063	0.63	20.0%	28.2%	28.2%	50.0%	112.7	4.5	117.1
PM0100	1	39.0%	54.9%	26.8%	50.0%	107.0	4.5	111.5
PM0125	1.25	43.0%	60.6%	5.6%	0	22.5	0.0	22.5
PM0250	2.5	52.0%	73.2%	12.7%	0	50.7	0.0	50.7
PM0600	6	58.0%	81.7%	8.5%	0	33.8	0.0	33.8
PM1000	10	71.0%	100.0%	18.3%	0	73.2	0.0	73.2
Totals				100.0%	100.0%	400.0	8.9	408.9
							Total Modeled PM_{10}	408.9

[a] Heat input rate for unit and fuel heat content: 8,000 MMBtu/hr; 4,000 MMBtu/hr PER UNIT
150,000 Btu/gal fuel oil
0.7 % sulfur content

[b] PM emission rate: 0.05 lb/MMBtu; 7.5 lb/1000 gal

To determine $PM_{2.5}/PM_{10}$ Ratio, PM soil, PM EC
Filterable PM (Table 1.3-4, AP-42) = PM_{10}
PM fine consists of PM soil and PM elemental carbon

		lb/1000 gal	lb/1000 gal		
PM fine based on ratio of $PM_{2.5}$ (fine) to PM_{10} (filterable)	$PM_{2.5}$	0.028 x A	0.03	Ratio =	0.67 $PM_{2.5}/PM_{10}$
emission factor	PM_{10}	0.042 x A	0.05		

A = 1.12 x sulfur content + 0.37

PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.074 of $PM_{2.5}$

PM elemental carbon: 0.049 PM elemental carbon/PM_{10}
PM soil= $PM_{2.5}$ - PM elemental carbon: 0.62 PM soil/PM_{10}
$PM_{2.5}$: 0.67 $PM_{2.5}/PM_{10}$
PM coarse= PM_{10} - $PM_{2.5}$

[c] Condensable PM (Table 1.3-2, AP-42)

		lb/1000 gal	lb/MMBtu			
	CPM	1.500	0.0100			
CPM = Filterable PM (lb/hr)/FPM(%) x CPM (%)	Inorganic CPM	1.275	0.0085	(0.85 of total)	Assumed Sulfur content	1.0 %
	Organic CPM	0.225	0.0015	(0.15 of total)	from tests	
	Inorganic CPM	0.893	0.0060	(0.80 of total)	Sulfur content in analysis	0.7 %
Based on sulfur content	Organic CPM	0.225	0.0015	(0.20 of total)		
	CPM	1.118	0.0075			

TABLE 5-2b
PM SPECIATION SUMMARY - UNITS 1 AND 2 WITH
PM EMISSION RATE OF 0.07 LB/MMBTU AND SULFUR CONTENT OF 0.7 PERCENT
FPL TURKEY POINT POWER PLANT

PM Category	Emission Unit [a]	Units	Total	Coarse PM	Soil (Fine PM)	Elemental Carbon (EC)	Inorganic (as H_2SO_4)	Organic
PM Filterable [b]	Units 1 & 2	lb/hr	560.0	186.67	345.71	27.63	NA	NA
		%	100%	33%	61.7%	4.9%	NA	NA
PM Condensable [c]	Units 1 & 2	lb/hr	59.60	NA	NA	NA	47.60	8.94
		%	95%	NA	NA	NA	80%	15%
Total PM_{10} (filterable+condensable)	Units 1 & 2	lb/hr	619.6	186.67	345.71	27.63	47.60	8.94
		%	100%	30.1%	55.8%	4.5%	7.7%	1.4%
Total PM_{10} (filterable+Organic Condensable PM)	Units 1 & 2	lb/hr	568.9	186.67	345.71	27.63	0.0	8.94
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	32.8%	60.8%	4.9%	0.0%	1.6%

PM Particle Size Distribution for CALPUFF Assessment

Species Name	AP-42 (Table 1.3-4) Particle Size (microns)	AP-42 (Table 1.3-4) Cumulative (%)	Cumulative Normalized PM_{10} (%)	Individual Categories Filterable (%)	Individual Categories Organic Condensable	Emission Rate (lb/hr) Filterable	Emission Rate (lb/hr) Organic Condensable	Emission Rate (lb/hr) Total
Total PM_{10}						560.0	8.9	568.9
PM0063	0.63	20.0%	28.2%	28.2%	50.0%	157.7	4.5	162.2
PM0100	1.	39.0%	54.9%	26.8%	50.0%	149.9	4.5	154.3
PM0125	1.25	43.0%	60.6%	5.6%	0	31.5	0.0	31.5
PM0250	2.5	52.0%	73.2%	12.7%	0	71.0	0.0	71.0
PM0600	6	58.0%	81.7%	8.5%	0	47.3	0.0	47.3
PM1000	10	71.0%	100.0%	18.3%	0	102.5	0.0	102.5
Totals				100.0%	100.0%	560.0	8.9	568.9
							Total Modeled PM_{10}	568.9

[a] Heat input rate for unit and fuel heat content — 8,000 MMBtu/hr — 4,000 MMBtu/hr PER UNIT
150,000 Btu/gal fuel oil
0.7 % sulfur content

[b] PM emission rate — 0.07 lb/MMBtu — 10.5 lb/1000 gal

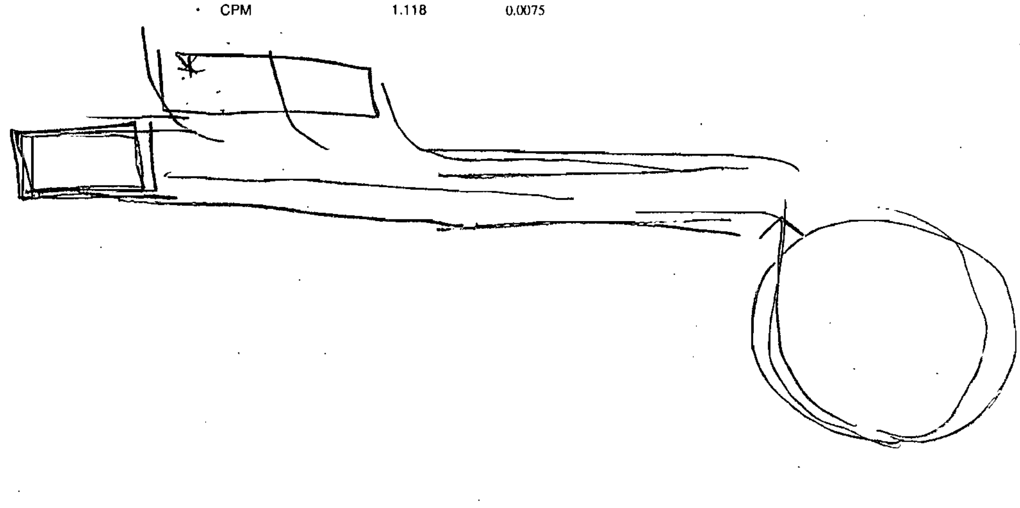
<u>To determine $PM_{2.5}/PM_{10}$ Ratio, PM soil, PM EC</u>
Filterable PM (Table 1.3-4, AP-42) = PM10
PM fine consists of PM soil and PM elemental carbon — lb/1000 gal — lb/1000 gal
PM fine based on ratio of $PM_{2.5}$ (fine) to PM_{10} (filterable) — $PM_{2.5}$ 0.028 x A — 0.03 — Ratio = 0.67 $PM_{2.5}/PM_{10}$
emission factor — PM_{10} 0.042 x A — 0.05
A = 1.12 x sulfur content + 0.37

PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.074 of $PM_{2.5}$

PM elemental carbon — 0.049 PM elemental carbon/PM_{10}
PM soil= $PM_{2.5}$ - PM elemental carbon — <u>0.62</u> PM soil/PM_{10}
$PM_{2.5}$ — 0.67 $PM_{2.5}/PM_{10}$
PM coarse= PM_{10} - $PM_{2.5}$

[c] Condensable PM (Table 1.3-2, AP-42)

		lb/1000 gal	lb/MMBtu			
	CPM	1.500	0.0100			
CPM = Filterable PM (lb/hr)/FPM(%) x CPM (%)	Inorganic CPM	1.275	0.0085	(0.85 of total)	Assumed Sulfur content from tests	1.0 %
	Organic CPM	0.225	0.0015	(0.15 of total)		
	Inorganic CPM	0.893	0.0060	(0.80 of total)	Sulfur content in analysis	0.7 %
Based on sulfur content	Organic CPM	0.225	0.0015	(0.20 of total)		
	CPM	1.118	0.0075			



5.2 Impacts of Control Technology Options

ESP Evaluation

Cost of Compliance

The total estimated capital, annualized, and incremental costs for an ESP are summarized in Table 5-1. The capital cost for two 400-MW units is estimated to be $94 million with an annualized cost of about $13.4 million. The cost effectiveness is over $10,000 per ton of PM removed. The improvement in visibility impact is about 0.1 dv for each of the years evaluated using the new IMPROVE algorithm. The cost effectiveness for ESPs would be about $134 million per dv improvement. It should be noted that the estimated cost does not include any changes in construction associated with the close proximity of the nuclear units (i.e., Turkey Point Units 3 and 4). The location of the ESP construction for Units 1 and 2 in close proximity to the nuclear units would increase security and potentially require Nuclear Regulatory Commission approval. This would likely increase costs as well as approval times when construction could begin.

Energy Impacts

Energy losses will occur with the ESP. The energy loses are due to the pressure drop and energy used in the transformer rectifier sets.

The energy required to operate an ESP would be about 4,370 MW-hrs per year for both units. This is about 0.5 MW per unit or 0.13 percent of the gross generation.

Non-Air Quality Environmental Impacts

The ESP would collect ash that would have to be either recycled or placed in a landfill. Ash from residual oil is sometimes recycled for its vanadium content. Otherwise the ash would have to be put in a landfill. About 1,257 tons of ash would be generated from the ESPs. This ash would have to be trucked from the site. About 50 trucks per year would be required.

Remaining Useful Life

FPL has no plans to shut down either unit in the near future. However, Units 1 and 2 are typically operated as cycling units.

Based on these reductions in the change in visibility impacts and the annualized operating cost of $13.4 million, the cost effectiveness of adding an ESP to each of the units is estimated to be $134 million or more for every 1 dv reduction in the change in visibility impact.

Alternative Emission Reduction Strategy

The PM emission data, including PM speciation, for this BART determination are presented in Tables 5-2a through 5-2c, for evaluating impacts due to FPL's proposed alternative emission reduction strategy. The modeling scenarios considered the following assumptions:

- Base case (current permit limits) with maximum fuel sulfur content of 1 percent and PM limit of 0.1 lb/MMBtu;
- Emission reduction case with maximum fuel sulfur content of 0.7 percent and PM limit of 0.07 lb/MMBtu; and
- Emission reduction case with maximum fuel sulfur content of 0.7 percent and PM limit of 0.05 lb/MMBtu.

To evaluate the potential improvements in visibility impacts with these proposed emission reductions, the visibility impacts predicted for the emission reduction cases were compared to those predicted for the base case.

The stack and operating data used in the modeling are the same as those presented in the Protocol. A summary of the 8th highest visibility impacts predicted for Units 1 and 2 for this strategy with the new IMPROVE algorithm for each modeled year is presented in Table 5-3a. These results are also compared to 8th highest visibility impacts predicted with current PM emissions.

As shown in Table 5-3a, the reductions in visibility impacts, based on the 8th highest visibility impact predicted for Units 1 and 2, with the emission reduction strategy are as follows:

- 29 percent reduction with a maximum fuel sulfur content of 0.7 percent and PM limit of 0.07 lb/MMBtu from impacts predicted for the base case;
- 41 percent reduction with maximum fuel sulfur content of 0.7 percent and PM limit of 0.05 lb/MMBtu from impacts predicted for the base case.

Alternative Emission Reduction Strategy

Cost of Compliance

The total estimated capital, annualized, and incremental costs for reducing the fuel sulfur content and reducing the PM limit with the capital improvement of installing state-of-the-art multi-cyclones are summarized in Table 5-1a. The capital cost for two 400-MW units is estimated to be $7.3 million with an annualized cost of about $1.9 million. The cost effectiveness is about $3,600 per ton of PM removed. The improvement in visibility impact is about 0.6 dv evaluated using the new IMPROVE algorithm. The cost effectiveness for this emission reduction strategy would be about $3.2 million per dv improvement.

Energy Costs

Energy losses will be minimal with the new state-of-the-art multi-cyclones.

Non-Air Quality Environmental Impacts

The non-air quality environmental impacts with the new multi-cyclones are expected to be minimal.

Remaining Useful Life

FPL has no plans to shut down either unit in the near future. However, Units 1 and 2 are typically operated as cycling units.

5.3 Visibility Impacts

ESP Evaluation

The PM emission data, including PM speciation, for this BART determination are presented in Table 5-2, when evaluating impacts with the ESP. The stack and operating data used in the modeling are the same as those presented in the Protocol. A summary of the 8th highest visibility impacts predicted for Units 1 and 2 with an ESP or fabric filter with the new IMPROVE algorithm for each modeled year is presented in Table 5-3. These results are also compared to 8th highest visibility impacts predicted with current PM emissions.

As shown in Table 5-3, the 8th highest visibility impact predicted for Units 1 and 2 with an ESP with the new IMPROVE algorithm is 1.35 dv compared to the 8th highest visibility impact of 1.45 dv predicted using current PM emissions. With a controlled PM emission rate of 0.03 lb/MMBtu, the change in visibility impact is 0.1 dv.

5.0 BART ANALYSIS FOR PM EMISSIONS

5.1 Available Retrofit Technologies

Unit No. 1 and Unit No. 2 at the Turkey Point Power Plant currently have multi-cyclones for particulate control. The multi-cyclones consist of two UOP tubular mechanical dust collectors with 695 tubes per collector. The collection efficiency for these multi-cyclones is high (about 90 percent) for particles that are 20 microns in diameter and larger. For particles with a mean diameter of 7.5 microns, the collection efficiency is 66.2 percent. The collection efficiency of the multi-cyclones for particles with a mean diameter of 2.5 microns is about 30 percent. As a result, ESPs and fabric filters would be the most effective PM-control devices that could be applied to reduce low diameter particles that contribute to visibility impacts. PM removal efficiencies of these devices can be greater than 99 percent. Both devices are also highly effective in controlling PM_{10} emissions. Other technologies, such as wet scrubbers, have not demonstrated equivalent levels of control for PM.

However, in lieu of adding PM-control devices to the units, the visibility impacts can also be improved by reducing the fuel sulfur content (which, in turns, reduces the sulfur dioxide and sulfuric acid mist emissions that contribute to visibility impairment) and by lowering the PM limit for each unit.

The following sections present descriptions of ESP and fabric filter control technologies as well as FPL's proposed alternative emission reduction strategy to reduce the fuel sulfur content and lower PM emission limits.

ESP

In an ESP, a high-voltage electric field is produced to impart an electric charge to the solid particles in the flue gas stream. The pulsating direct current voltage in the range of 20,000 to 100,000 volts is used to ionize the gas stream, known as corona. The ions, usually produced using a negative corona, are attracted to the particles while traveling in the ionized gas stream. These particles are then removed from the gas stream by migrating toward the oppositely charged collecting electrodes. Rapping mechanisms, that are operated intermittently, dislodge the collected particles, which subsequently fall into a hopper. ESP performance is highly dependent on the electrical characteristics or resistivity of the particle or aerosol to be collected.

ESP performance is dependent on a number of factors which influence the resistivity of the particle. These factors include the particle composition, flue gas characteristics, particle size distribution, and particle loading. These parameters can vary during normal operation and can influence ESP performance when gas streams come directly from the boiler.

Fabric Filters

In a fabric filter, PM is removed from the flue gas as it passes through a fabric filter media such as woven cloths or felts, or a nylon, fiberglass, or composition fabric; hence the term "fabric filter." The filters are normally arranged as a number of cylinders or tubes (commonly referred to as "bags"), through which the flue gas is directed. The filters are contained in a housing which has gas inlets and outlets. The flue gas enters the cylindrical filter from the bottom and flows upward, from either the inside of the cylinder to the outside or the opposite depending upon the design. Particulate collection occurs through several mechanisms, including gravitational settling, direct impaction, inertial impaction, diffusion, and electrostatic attraction. When the pressure drop reaches a predefined level, a section of the filter's bag is taken offline for cleaning. Various methods are used to clean the bags in the fabric filter. The three general types of cleaning are shaker cleaning, pulse-jet cleaning, and reverse-air cleaning. All three types of cleaning methods ensure that the fabric filter achieves the same low emission rates.

The shaker cleaning is accomplished by taking the bags off-line, shaking the bags of the fabric filter, and then deflating the bag by inducing a vacuum. The PM collected on the bags is dislodged and then falls into the collection hoppers at the bottom of the fabric filter.

In the pulse-jet method of cleaning, cleaning is accomplished off-line by directing a short burst of compressed air inside the filter bags. This burst produces a shock wave, which travels down the length of the bag, dislodging the accumulated dust cake. The collected PM then falls into the hoppers located below the bags. This is currently the best practice for cleaning.

In reverse air fabric filters, the PM is collected on the inside of the filter bags. Cleaning is accomplished by introducing a reverse flow of air through the bags. This causes the bag to collapse, thereby dislodging the filter cake. The dislodged PM falls into the collection hoppers for disposal.

Control Technology Feasibility and Alternative Emission Reduction Strategy

ESPs are available, technically feasible and demonstrated as effective PM control devices for oil-fired units. ESPs have been added to FPL's Port Everglades Plant, including the 400 MW class units that are very similar to Units 1 and 2 at the Turkey Point Power Plant. Fabric filters have not been applied to oil-fired units. The particles generated by oil-fired units may limit the ability of fabric filters to be an effective control. Studies conducted during the full-scale Orimulsion tests in the late 1980s at the FPL Sanford Plant found particles generated with an oil-based fuel caused considerable plugging of bags in pilot scale tests. The similarity of residual oil and Orimulsion suggest that fabric filters would not be an effective control for Turkey Point Units 1 and 2. As a result, ESPs are considered the appropriate control technology to achieve an emissions rate potentially applicable as BART for these units.

However, in lieu of adding ESPs to these unts, FPL proposes to improve visibility impacts using an alternative emission reduction strategy to achieve an effective BART Determination emission rate as follows:

- Reduction of the maximum allowable fuel sulfur content of 1.0 percent to 0.7 percent;
- Reduction of the maximum PM limit of 0.1 lb/MMBtu to 0.07 lb/MMBtu for steady state conditions;
- Reduction of the maximum PM limit of 0.3 lb/MMBtu to 0.2 lb/MMBtu during soot blowing; and
- Installation of state-of-the-art multi-cyclones to replace the current multi-cyclones.

% S
1 → .07
.1 lb/mm BTU
→ .7

These changes are proposed to be effective 5 years after EPA approves the state implementation plan (SIP) revision that FDEP must submit as part of the BART regulations. The date that this strategy would be implemented by FPL is anticipated to be in 2013 or 2014.

By reducing the fuel sulfur content, sulfur dioxide and sulfuric acid mist emissions that contribute to visibility impairment will also be reduced.

In addition, FPL is also proposing to conduct a fuel additive program with the goal of further reducing the PM limit to 0.05 lb/MMBtu for steady state conditions.

5.4 Selection of BART

Based on the high cost of reducing the visibility impact for little benefit, it is considered economically inappropriate to add an ESP to Unit No. 1 and Unit No. 2 at the Turkey Point Power Plant. As explained in Section 5.1, requiring these PM controls would have considerable cost ($94 million capital cost and $13.4 million annualized cost) while yielding very little visibility benefit (0.1 dv).

As an alternative emission reduction strategy, the proposed use of low sulfur (0.7 percent) residual oil and reduction in PM limit with new state-of-the-art multi-cyclones are considered economically appropriate to produce a significant visibility benefit (i.e., 29 percent reduction in visibility impacts from base case). With a fuel additive program to further reduction PM emissions, additional visibility benefits can be achieved (i.e., 41 percent reduction in visibility impacts from base case). This alternative emission reduction strategy proposed by FPL is considered appropriate as BART.

TABLE 5-3a
SUMMARY OF VISIBILITY MODELING IMPACTS AT EVERGLADES NATIONAL PARK FOR FPL TURKEY POINT POWER PLANT, UNITS 1 AND 2

			8th Highest Predicted Impact					
			1999 IMPROVE EQUATION			NEW IMPROVE EQUATION		
PM (lb/MMBtu)	Fuel Sulfur Content (%)	Units	2001	2002	2003	2001	2002	2003
0.10 [a]	1.0	dv	2.700	2.156	2.342	2.222	1.797	1.922
0.07	0.7	dv	1.982	1.560	1.700	1.614	1.293	1.390
0.05	0.7	dv	1.700	1.318	1.439	1.343	1.066	1.160
			Change (%) from Base Case					
0.10 [a]	1.0	%	0	0	0	0	0	0
0.07	0.7	%	-27	-28	-27	-27	-28	-28
0.05	0.7	%	-37	-39	-39	-40	-41	-40

[a] Base case with current maximum PM rate and fuel sulfur content allowed in permit.

SUMMARY OF BART MODELING ANALYSIS FOR FPL TURKEY POINT

The CALPUFF modeling system (CALPUFF Version 5.756) was used to predict the maximum visibility impairment at the only PSD Class I area within 300 kilometers (km) of Florida Power and Light Turkey Point Power Plant. The nearest PSD Class I area is the Everglades National Park (ENP), which is located approximately 21 km from the facility. The CALPUFF modeling analysis followed the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) common protocol, Version 3.2. The Department provided the applicant with 4 km "CALPUFF-ready" CALMET meteorological data. Class I receptor locations were obtained from the National Park Service (NPS) and a Lambert Conformal Conic (LCC) coordinate system was used.

Maximum visibility impacts are based on the predicted 24-hour visibility impairment values for 2001 to 2003, the 8th highest (98th percentile) for each year. These values are compared with a threshold of 0.5 deciview (dv). A dv is a standard visibility index. The Interagency Monitoring of Protected Visual Environments (IMPROVE) states that the dv scale is linear to humanly-perceived changes in visual air quality. For example, a dv near zero is considered a "pristine" atmosphere. Deciviews increase with visibility impairment.

Turkey Point has two BART-eligible sources for particulate matter. These sources are Units 1 and 2, which are oil and gas-fired conventional stream 400 megawatt (MW) units. Visibility impacts from the existing two units is greater than 0.5 dv therefore, the two units contribute to visibility impairment at the ENP and a BART determination is required.

The initial BART determination analysis predicted visibility improvement with the addition of ESP's to both Units 1 and 2. Initial emission rates were determined from stack test data and AP-42 emission factors to reflect the maximum 24-hour average normal operation. Emissions were speciated into six particulate species with regards to specific size categories and modeled. Results of this initial modeling predicted a visibility improvement of 0.1 dv.

Subsequent modeling followed as part of a revised BART determination analysis. This analysis does not include ESP's as BART and the initial modeling results with ESP's are not comparable with this subsequent modeling due to differences in initial emission rates, although the emissions were speciated in the same matter.

The subsequent BART determination analysis predicted visibility improvement based on particulate matter and percent sulfur fuel content. Base case emission rates for this modeling analysis were based on an emission rate of 0.1 lb/mmBtu with a sulfur fuel content of 1% or the allowable emission rates for Units 1 and 2. The base case was then compared to the proposed BART determination of 0.07 lb/mmBtu with a sulfur content of 0.7 percent. Further, modeling was done to show further reductions of particular matter with a fuel additive program (0.05 lb/mmBtu). The results of the analysis are shown in the table below.

Control Technology	PM Emission Rate	Sulfur Fuel Content	8th highest impairment
Existing Base Case	0.1 lb/mmBtu	1%	2.2 dv
Multi-Cyclones	0.7 lb/mmBtu	0.7%	1.6 dv
Fuel Additive Program	0.5 lb/mmBtu	0.7%	1.3 dv

The results predict a 29 and 41 percent visibility benefit for the proposed sulfur reduction and pm reductions of 0.7 and 0.5 lb/mmBtu respectively.

TABLE 5-2a
PM SPECIATION SUMMARY - UNITS 1 AND 2 WITH
PM EMISSION RATE OF 0.1 LB/MMBTU AND SULFUR CONTENT OF 1 PERCENT
FPL TURKEY POINT POWER PLANT

PM Category	Emission Unit [a]	Units	Total	Coarse PM	Soil (Fine PM)	Elemental Carbon (EC)	Inorganic (as H_2SO_4)	Organic
PM Filterable [b]	Units 1 & 2	lb/hr	800.0	266.67	493.87	39.47	NA	NA
		%	100%	33%	61.7%	4.9%	NA	NA
PM Condensable [c]	Units 1 & 2	lb/hr	80.00	NA	NA	NA	68.00	12.00
		%	100%	NA	NA	NA	85%	15%
Total PM_{10} (filterable+condensable)	Units 1 & 2	lb/hr	880.0	266.67	493.87	39.47	68.00	12.00
		%	100%	30.3%	56.1%	4.5%	7.7%	1.4%
Total PM_{10} (filterable+Organic Condensable PM)	Units 1 & 2	lb/hr	812.0	266.67	493.87	39.47	0.0	12.00
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	32.8%	60.8%	4.9%	0.0%	1.5%

PM Particle Size Distribution for CALPUFF Assessment

Species	Size Distribution by Category (%)					Emission Rate (lb/hr)		
	AP-42 (Table 1.3-4)		Cumulative	Individual Categories				
Name	Particle Size (microns)	Cumulative (%)	Normalized PM_{10} (%)	Filterable (%)	Organic Condensable	Filterable	Organic Condensable	Total
Total PM_{10}						800.0	12.0	812.0
PM0063	0.63	20.0%	28.2%	28.2%	50.0%	225.4	6.0	231.4
PM0100	1	39.0%	54.9%	26.8%	50.0%	214.1	6.0	220.1
PM0125	1.25	43.0%	60.6%	5.6%	0	45.1	0.0	45.1
PM0250	2.5	52.0%	73.2%	12.7%	0	101.4	0.0	101.4
PM0600	6	58.0%	81.7%	8.5%	0	67.6	0.0	67.6
PM1000	10	71.0%	100.0%	18.3%	0	146.5	0.0	146.5
Totals				100.0%	100.0%	800.0	12.0	812.0
							Total Modeled PM_{10}	812.0

[a] Heat input rate for unit and fuel heat content — 8,000 MMBtu/hr — 4,000 MMBtu/hr PER UNIT
150,000 Btu/gal fuel oil
1.0 % sulfur content

[b] PM emission rate — 0.1 lb/MMBtu — 15 lb/1000 gal

To determine $PM_{2.5}/PM_{10}$ Ratio, PM soil, PM EC
Filterable PM (Table 1.3-4, AP-42) = PM_{10}

		lb/1000 gal	lb/1000 gal		
PM fine consists of PM soil and PM elemental carbon					
PM fine based on ratio of $PM_{2.5}$ (fine) to PM_{10} (filterable)	$PM_{2.5}$	0.028 x A	0.04	Ratio =	0.67 $PM_{2.5}/PM_{10}$
emission factor	PM_{10}	0.042 x A	0.06		

A = 1.12 x sulfur content + 0.37

PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.074 of $PM_{2.5}$

PM elemental carbon — 0.049 PM elemental carbon/PM_{10}
PM soil= $PM_{2.5}$ - PM elemental carbon — 0.62 PM soil/PM_{10}
$PM_{2.5}$ — 0.67 $PM_{2.5}/PM_{10}$
PM coarse= PM_{10} - $PM_{2.5}$

[c] Condensable PM (Table 1.3-2, AP-42)

		lb/1000 gal	lb/MMBtu			
	CPM	1.500	0.0100			
CPM = Filterable PM (lb/hr)/FPM(%) x CPM (%)	Inorganic CPM	1.275	0.0085	(0.85 of total)	Assumed Sulfur content from tests	1.0 %
	Organic CPM	0.225	0.0015	(0.15 of total)		
	Inorganic CPM	1.275	0.0085	(0.85 of total)	Sulfur content in analysis	1.0 %
Based on sulfur content	Organic CPM	0.225	0.0015	(0.15 of total)		
	CPM	1.500	0.0100			

CALPOST Recalculation with New IMPROVE Algorithm

Version 2.
29 Sept. 2006

---------------------------- INPUT from CALPOST (based on old IMPROVE algorithm) -----------

1. At cell A7, import "Ranked Daily Visibility Change" (bext) table, including column headings, from CALPOST (22 days, max)

5. Check calculated values below against CALPOST's "Ranked Daily Visibility

(Optional) Enter 24hr NOx conc.

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)		TYPE	BEXT(Model	BEXT(BKG	BEXT(Total)	%CHANGE	F(RH)	bxSO4	bxNO3	bxOC	bxEC	bxPMC	bxPMF	Rank	dv(total)	dv(bkg)	Δdv	NOx(ppb)
2002	66	0	427	1675.841	-1484.63	D	4.645	20.77	25.415	22.36	2.6	2.915	0	0.186	0.606	0.182	0.755	1	9.33 ✓	7.31 ✓	2.018 ✓	
2002	157	0	573	1672.782	-1467.86	D	4.304	20.77	25.074	20.72	2.7	2.746	0	0.168	0.546	0.164	0.68	2	9.19	7.31	1.88	
2002	343	0	475	1674.821	-1479.04	D	4.223	20.77	24.993	20.33	2.7	2.678	0	0.167	0.541	0.162	0.675	3	9.16	7.31	1.85	
2002	333	0	318	1693.055	-1493.03	D	4.195	20.77	24.965	20.2	2.6	2.616	0	0.17	0.553	0.166	0.69	4	9.15	7.31	1.84	
2002	84	0	573	1672.782	-1467.86	D	3.716	20.77	24.486	17.89	2.6	2.322	0	0.15	0.488	0.147	0.609	5	8.96	7.31	1.65	
2002	99	0	600	1674.793	-1464.61	D	3.694	20.77	24.464	17.79	2.4	2.262	0	0.154	0.502	0.151	0.625	6	8.95	7.31	1.64	
2002	112	0	600	1674.793	-1464.61	D	3.222	20.77	23.992	15.51	2.4	1.966	0	0.135	0.44	0.132	0.548	7	8.75	7.31	1.44	
2002	331	0	285	1688.511	-1496.75	D	3.22	20.77	23.99	15.5	2.6	2.005	0	0.131	0.426	0.128	0.53	8	8.75	7.31	1.441	
2002	77	0	548	1673.292	-1470.66	D	3.103	20.77	23.873	14.94	2.6	1.953	0	0.124	0.403	0.121	0.502	9	8.70	7.31	1.39	
2002	23	0	573	1672.782	-1467.86	D	3.035	20.77	23.805	14.61	2.7	1.936	0	0.119	0.385	0.116	0.48	10	8.67	7.31	1.36	
2002	6	0	257	1699.145	-1497.68	D	3.026	20.77	23.796	14.57	2.7	1.924	0	0.119	0.386	0.116	0.481	11	8.67	7.31	1.36	
2002	127	0	548	1673.292	-1470.66	D	3.015	20.77	23.785	14.52	2.4	1.839	0	0.127	0.412	0.124	0.514	12	8.66	7.31	1.36	
2002	132	0	548	1673.292	-1470.66	D	2.956	20.77	23.726	14.23	2.4	1.802	0	0.124	0.404	0.121	0.504	13	8.64	7.31	1.33	
2002	146	0	499	1674.311	-1476.24	D	2.949	20.77	23.719	14.2	2.4	1.8	0	0.124	0.403	0.121	0.502	14	8.64	7.31	1.33	
2002	332	0	256	1696.615	-1498.15	D	2.88	20.77	23.65	13.87	2.6	1.8	0	0.116	0.379	0.114	0.472	15	8.61	7.31	1.30	
2002	256	0	862	1674.716	-1435.77	D	2.854	20.77	23.624	13.74	3	1.898	0	0.103	0.335	0.101	0.417	16	8.60	7.31	1.29	
2002	61	0	548	1673.292	-1470.66	D	2.849	20.77	23.619	13.72	2.6	1.797	0	0.113	0.369	0.111	0.459	17	8.59	7.31	1.29	
2002	286	0	573	1672.782	-1467.86	D	2.783	20.77	23.553	13.4	2.8	1.789	0	0.107	0.348	0.105	0.434	18	8.57	7.31	1.26	
2002	319	0	256	1696.615	-1498.15	D	2.781	20.77	23.551	13.39	2.6	1.735	0	0.113	0.366	0.11	0.456	19	8.57	7.31	1.26	
2002	272	0	600	1674.793	-1464.61	D	2.767	20.77	23.537	13.32	3	1.822	0	0.102	0.331	0.099	0.413	20	8.56	7.31	1.25	
2002	46	0	287	1693.57	-1495.82	D	2.747	20.77	23.517	13.22	2.6	1.713	0	0.111	0.362	0.109	0.451	21	8.55	7.31	1.24	
2002	32	0	598	1669.751	-1465.53	D	2.708	20.77	23.478	13.04	2.7	1.725	0	0.106	0.344	0.103	0.429	22	8.53	7.31	1.23	

3. Enter value of site-specific Rayleigh scattering coefficient, from "Rayleigh & Sea Salt" worksheet: 11

4. (Optional) Insert annual average sea salt concentration, from "Rayleigh & Sea Salt" worksheet. Leave blank if not used, i.e. default is 0.: 0.31

6. Enter desired NO2/NOx ratio (default is 0)

---------------------------------- OUTPUT (based on new IMPROVE algorithm) --------------------------

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)		TYPE	BEXT(Source	BEXT(BKG	BEXT(Total)	%CHANGE	RH(%)	bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	New Rank	dv(total)	dv(bkg)	Δdv
2002	66	0	427	1675.841	-1484.63	D	3.879	22.79	26.707	17.17	76	2.191	0	0.144	0.606	0.182	0.755	0	1	9.82	8.24	1.58
2002	157	0	573	1672.782	-1467.86	D	3.618	23.00	26.646	15.87	78	2.098	0	0.13	0.546	0.164	0.68	0	2	9.80	8.33	1.47
2002	343	0	475	1674.821	-1479.04	D	3.553	23.00	26.580	15.58	78	2.045	0	0.13	0.541	0.162	0.675	0	3	9.78	8.33	1.45
2002	333	0	318	1693.055	-1493.03	D	3.504	22.79	26.330	15.51	76	1.963	0	0.132	0.553	0.166	0.69	0	4	9.68	8.24	1.44
2002	84	0	573	1672.782	-1467.86	D	3.100	22.79	25.922	13.72	76	1.74	0	0.116	0.488	0.147	0.609	0	6	9.53	8.24	1.29
2002	99	0	600	1674.793	-1464.61	D	3.102	22.58	25.708	13.86	73	1.705	0	0.119	0.502	0.151	0.625	0	5	9.44	8.14	1.30
2002	112	0	600	1674.793	-1464.61	D	2.704	22.58	25.306	12.08	73	1.479	0	0.105	0.44	0.132	0.548	0	7	9.28	8.14	1.14
2002	331	0	285	1688.511	-1496.75	D	2.686	22.79	25.504	11.89	76	1.5	0	0.102	0.426	0.128	0.53	0	8	9.36	8.24	1.12
2002	77	0	548	1673.292	-1470.66	D	2.583	22.79	25.400	11.43	76	1.461	0	0.096	0.403	0.121	0.502	0	9	9.32	8.24	1.08
2002	23	0	573	1672.782	-1467.86	D	2.546	23.00	25.565	11.17	78	1.473	0	0.092	0.385	0.116	0.48	0	11	9.39	8.33	1.06
2002	6	0	257	1699.145	-1497.68	D	2.539	23.00	25.558	11.14	78	1.464	0	0.092	0.386	0.116	0.481	0	12	9.38	8.33	1.06
2002	127	0	548	1673.292	-1470.66	D	2.531	22.58	25.132	11.31	73	1.382	0	0.098	0.412	0.124	0.514	0	10	9.22	8.14	1.07
2002	132	0	548	1673.292	-1470.66	D	2.479	22.58	25.080	11.08	73	1.354	0	0.096	0.404	0.121	0.504	0	13	9.19	8.14	1.05
2002	146	0	499	1674.311	-1476.24	D	2.475	22.58	25.076	11.06	73	1.353	0	0.096	0.403	0.121	0.502	0	14	9.19	8.14	1.05
2002	332	0	256	1696.615	-1498.15	D	2.400	22.79	25.216	10.62	76	1.345	0	0.09	0.379	0.114	0.472	0	15	9.25	8.24	1.01
2002	256	0	862	1674.716	-1435.77	D	2.362	23.30	25.678	10.23	81	1.429	0	0.08	0.335	0.101	0.417	0	18	9.43	8.46	0.97
2002	61	0	548	1673.292	-1470.66	D	2.370	22.79	25.185	10.49	76	1.343	0	0.088	0.369	0.111	0.459	0	16	9.24	8.24	1.00
2002	286	0	573	1672.782	-1467.86	D	2.324	23.09	25.434	10.15	79	1.354	0	0.083	0.348	0.105	0.434	0	19	9.34	8.37	0.97
2002	319	0	256	1696.615	-1498.15	D	2.316	22.79	25.131	10.25	76	1.296	0	0.088	0.366	0.11	0.456	0	17	9.22	8.24	0.98
2002	272	0	600	1674.793	-1464.61	D	2.294	23.30	25.609	9.93	81	1.372	0	0.079	0.331	0.099	0.413	0	22	9.40	8.46	0.95
2002	46	0	287	1693.57	-1495.82	D	2.288	22.79	25.103	10.12	76	1.28	0	0.086	0.362	0.109	0.451	0	20	9.20	8.24	0.96
2002	32	0	598	1669.751	-1465.53	D	2.269	23.00	25.286	9.95	78	1.311	0	0.082	0.344	0.103	0.429	0	21	9.28	8.33	0.95

5.3 Visibility Impacts

The PM emission data, including PM speciation, for this BART determination are presented in Table 5-2. The stack and operating data used in the modeling are the same as those presented in the Protocol. A summary of the 8th highest visibility impacts predicted for Units 1 and 2 with an ESP or fabric filter with the new IMPROVE algorithm for each modeled year is presented in Table 5-3. These results are also compared to 8th highest visibility impacts predicted with current PM emissions.

As shown in Table 5-3, the 8th highest visibility impact predicted for Units 1 and 2 with an ESP with the new IMPROVE algorithm is 1.35 dv compared to the 8th highest visibility impact of 1.45 dv predicted using current PM emissions. With a controlled PM emission rate of 0.03 lb/MMBtu, the change in visibility impact is 0.1 dv.

Based on these reductions in the change in visibility impacts and the annualized operating cost of $13.4 million, the cost effectiveness of adding an ESP to each of the units is estimated to be $134 million or more for every 1 dv reduction in the change in visibility impact.

5.4 Selection of BART

Based on the high cost of reducing the visibility impact for little benefit, it is considered economically inappropriate to add an ESP to Unit No. 1 and Unit No. 2 at PTF. As explained in Section 5.1, requiring these PM controls would have considerable cost (capital cost of $94 million and $13.4 million-annualized cost) while yielding very little visibility benefit (0.1 dv). The use of low sulfur (1 percent) residual oil and multi-cyclones is considered appropriate as BART.

TABLE 5-1
COST EFFECTIVENESS OF DRY ESP FOR PM CONTROL
FPL TURKEY POINT POWER PLANT, UNITS 1 AND 2

Cost Items	Cost Factors[a]	Cost (2007 $)
DIRECT CAPITAL COSTS (DCC):		
Purchased Equipment Cost (PEC)	FPL Cost Estimate (2007)	94,000,000
ESP.	Included in Equipment and Materials	included
Ductwork to ESP inlet and oulet	Included in Equipment and Materials	included
Electrical switchgear, motor control centers	Included in Equipment and Materials	included
Instruments and Controls	Included in Equipment and Materials	included
Freight	Included in Equipment and Materials	included
Taxes	Not required for Pollution Control Equipment	included
Total PEC:		94,000,000
Direct Installation Costs		
Foundation and Structure Support	Included in Equipment and Materials	included
Handling & Erection	Included in Equipment and Materials	included
Electrical	Included in Equipment and Materials	included
Piping	Included in Equipment and Materials	included
Insulation for ductwork	Included in Equipment and Materials	included
Painting	Included in Equipment and Materials	included
Total Direct Installation Costs		
Total DCC:		94,000,000
INDIRECT CAPITAL COSTS (ICC):		
Contractor Fees +	Included in Equipment and Materials	included
Performance test +	Included in Equipment and Materials	included
Contingencies	Included in Equipment and Materials	included
Total ICC:		
TOTAL CAPITAL INVESTMENT (TCI):	DCC + ICC	94,000,000
DIRECT OPERATING COSTS (DOC):		
Operator	1/2 additional operator @ 65,000/year	33,000
Supervisor	20% of operating labor cost	6,600
Fan Power Requirement	2 inch pressure drop, $0.06/kwH	190,694
TR Sets	Est. Plate Area = 137,000 ft^2, $30/MW-hr	35,768
Maintenance Materials	Eng. Estimate = labor cost	150,000
Maintenance Labor	66.7% of Maintenance materials	100,050
Ash Disposal	Ash Disposal ($50/ton)	62,839
Total DOC:		578,951
INDIRECT OPERATING COSTS (IOC):		
Overhead	60% of oper. labor & maintenance	139,837
Property Taxes	1% of total capital investment	940,000
Insurance	1% of total capital investment	940,000
Administration	2% of total capital investment	1,880,000
Total IOC:		3,899,837
CAPITAL RECOVERY COSTS (CRC):	CRF of 0.0944 times TCI (20 yrs @ 7%)	8,873,600
ANNUALIZED COSTS (AC):	DOC + IOC + CRC	13,352,389
HISTORICAL MAXIMUM PM EMISSIONS (TPY) :	0.1 lb/MMBtu, 35,908,116 MMBtu/yr	1,795
MAXIMUM PM EMISSIONS WITH ESP (TPY) :	0.03 lb/MMBtu, 35,908,116 MMBtu/yr	539
REDUCTION IN PM EMISSIONS (TPY):		1,257
COST EFFECTIVENESS:	$ per ton of PM Removed	10,624

[a] Unless otherwise specified, factors and cost estimates reflect OAQPS Cost Manual, Section 3, Sixth edition.

TABLE 5-2
PM SPECIATION SUMMARY - UNITS 1 AND 2 WITH PM EMISSION RATE OF 0.03 LB/MMBTU
FPL TURKEY POINT POWER PLANT

PM Category	Emission Unit [a]	Units	Total	Coarse PM	Soil (Fine PM)	Elemental Carbon (EC)	Inorganic (as H_2SO_4)	Organic
PM Filterable [b]	Units 1 & 2	lb/hr	240.0	80.00	148.16	11.84	NA	NA
		%	100%	33%	61.7%	4.9%	NA	NA
PM Condensable [c]	Units 1 & 2	lb/hr	80.00	NA	NA	NA	68.00	12.00
		%	100%	NA	NA	NA	85%	15%
Total PM_{10} (filterable+condensable)	Units 1 & 2	lb/hr	320.0	80.00	148.16	11.84	68.00	12.00
		%	100%	25.0%	46.3%	3.7%	21.3%	3.8%
Total PM_{10} (filterable+Organic Condensable PM)	Units 1 & 2	lb/hr	252.0	80.00	148.16	11.84	0.0	12.00
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	31.7%	58.8%	4.7%	0.0%	4.8%

PM Particle Size Distribution for CALPUFF Assessment

Species	Size Distribution by Category (%)					Emission Rate (lb/hr)		
	AP-42 (Table 1.3-4)		Cumulative	Individual Categories				
Name	Particle Size (microns)	Cumulative (%)	Normalized PM1((%)	Filterable (%)	Organic Condensable	Filterable	Organic Condensable	Total
Total PM_{10}						240.0	12.0	252.0
PM0063	0.63	20.0%	31.7%	31.7%	50.0%	76.2	6.0	82.2
PM0100	1	28.0%	44.4%	12.7%	50.0%	30.5	6.0	36.5
PM0125	1.25	31.0%	49.2%	4.8%	0	11.4	0.0	11.4
PM0250	2.5	41.0%	65.1%	15.9%	0	38.1	0.0	38.1
PM0600	6	52.0%	82.5%	17.5%	0	41.9	0.0	41.9
PM1000	10	63.0%	100.0%	17.5%	0	41.9	0.0	41.9
Totals				100.0%	100.0%	240.0	12.0	252.0

Total Modeled PM_{10} 252.0

[a] Heat input rate for unit and fuel heat content — 8,000 MMBtu/hr — 4,000 MMBtu/hr PER UNIT
150,000 Btu/gal fuel oil
1.0 % sulfur content

[b] PM emission rate — 0.03 lb/MMBtu — 4.5 lb/1000 gal

To determine PM2.5/PM10 Ratio, PM soil, PM EC
Filterable PM (Table 1.3-4, AP-42) = PM10
PM fine consists of PM soil and PM elemental carbon

		lb/1000 gal	lb/1000 gal		
PM fine based on ratio of PM2.5 (fine) to PM10 (filterable)	PM2.5	0.028 x A	0.04	Ratio =	0.67 PM2.5/PM10
emission factor	PM10	0.042 x A	0.06		

A = 1.12 x sulfur content + 0.37

PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.074 of PM2.5

PM elemental carbon — 0.049 PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon — 0.62 PM soil/PM10
PM2.5 — 0.67 PM2.5/PM10
PM coarse= PM10 - PM2.5

[c] Condensable PM (Table 1.3-2, AP-42)

CPM = Filterable PM (lb/hr)/FPM(%) x CPM (%)

	lb/1000 gal	lb/MMBtu	
CPM	1.500	0.0100	
Inorganic CPM	1.275	0.0085	(0.85 of Total)
Organic CPM	0.225	0.0015	(0.15 of Total)

	lb/1000 gal	% Total PM
CPM	1.5	25.0%
Filterable PM	4.50	75.0%
Total PM	6.0	100.0%

TABLE 5-3
SUMMARY OF BART DETERMINATION MODELING RESULTS
FPL TURKEY POINT POWER PLANT, UNITS 1 AND 2

IMPROVE Algorithm	PM Rate (lb/MMBtu)	8th Highest Impact (dv)		
		2001	2002	2003
New	0.03	1.35	1.03	1.13
	0.1 [a]	1.45	1.12	1.23
1999	0.03	1.77	1.34	1.48
	0.1 [a]	1.89	1.44	1.58

[a] Exemption modeling based on this PM emission rate.

ATTACHMENT A

AIR MODELING PROTOCOL

TO EVALUATE

BEST AVAILABLE RETROFIT TECHNOLOGY (BART) OPTIONS

FOR FLORIDA POWER AND LIGHT GENERATING STATIONS

AIR MODELING PROTOCOL
TO EVALUATE
BEST AVAILABLE RETROFIT
TECHNOLOGY (BART) OPTIONS
FOR AFFECTED FPL PLANTS

Prepared For:
Florida Power & Light Company
700 Universe Boulevard
Juno Beach, Florida 33408

Prepared By:
Golder Associates Inc.
6241 NW 23rd Street, Suite 500
Gainesville, Florida 32653-1500

January 2007
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1.0 INTRODUCTION

1.1 Objectives

Under the regional haze regulations, which are contained in 40 CFR 51, Subpart P – Protection of Visibility, the U.S. Environmental Protection Agency (EPA) has issued final guidelines dated July 6, 2005, for Best Available Retrofit Technology (BART) determinations [70 Federal Register (FR) pages 39104-39172]. BART applies to certain large stationary sources known as BART-eligible sources. Sources are BART-eligible if they meet the following three criteria:

- Potential emissions of at least 250 tons per year (TPY) of a visibility-impairing pollutant [(sulfur dioxide (SO_2), nitrogen oxides (NO_x), and direct particulate matter less than 10 microns (PM_{10})];
- Contains emissions units that were put in place between August 7, 1962 and August 7, 1977; and
- Contains emission units that are source categories in the guidance.

The Florida Department of Environmental Protection (FDEP) has adopted EPA's rules contained in 40 CFR 51, Subpart P. The basic tenet of the regional haze program is the achievement of natural visibility conditions in Prevention of Significant Deterioration (PSD) Class I areas by the year 2064. Florida has four PSD Class I areas while Georgia has two PSD Class I areas that can be affected by Florida sources. BART is required for any BART-eligible source which FDEP determines emits any air pollutant which may "reasonably be anticipated to cause or contribute to any impairment of visibility in any Class I area." The BART guidelines establish a threshold value of 0.5 deciview (dv) for any single source for determining whether the source contributes to visibility impairment.

FDEP has identified seven BART-eligible sources with multiple BART-eligible emissions units within the FPL plants. These sources and units include:

- Cape Canaveral Power Plant (PCC)- Unit No. 1, Unit No. 2;
- Port Everglades Power Plant (PPE)- Unit No. 3, Unit No. 4;
- Turkey Point Power (PTF)- Unit No. 1, Unit No. 2;
- Manatee Power Plant (PMT)- Unit No. 1, Unit No. 2;
- Martin Power Plant (PMR)- Unit No. 1,Unit No. 2;

- Riviera Power Plant (PRV)- Unit No. 4; and
- Putnam Power Plant (PPN)- GT 1-1, GT 1-2, GT 2-1, and GT 2-2

Throughout this protocol the terms "source" and "facility" have the same meanings. The term "BART-eligible emissions unit" is defined as any single emissions unit that meets the criteria described above, except for the 250 TPY criteria, which applies to the BART-eligible source. A "BART-eligible source" is defined as the collection of all BART-eligible emissions units at a single facility. If a source has several emissions units, only those that meet the BART-eligible criteria are included in the definition of "BART-eligible source."

The FDEP requires that the California Puff (CALPUFF) modeling system be used to determine visibility impacts from BART-eligible sources at the PSD Class I areas. A source-specific modeling protocol is required to be submitted by the affected sources to the FDEP for review and approval. The source-specific modeling must be included in the BART application, due to FDEP no later than January 31, 2007.

This protocol describes the modeling procedures to be followed for performing the air modeling and includes site-specific data for each of FPL's BART-eligible emissions units. The site-specific data includes emissions unit locations, stack parameters, emission rates, and particular matter speciation information.

For guidance in preparing the air modeling protocol, the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) has developed a general modeling protocol outline that describes the recommended procedures for performing a visibility impairment analysis under the BART regulations [see *Protocol for the Application of the CALPUFF Model for Analyses of Best Available Retrofit Technology (BART)*, December 22, 2005 (Revision 3.2- August 31, 2006)]. The proposed modeling protocol for the facility follows the general procedures recommended by VISTAS.

1.2 Location of Sources

An area map showing the FPL plants and PSD Class I areas within 300 kilometers (km) of each plant is presented in Figure 1-1. The PSD Class I areas and their distances from the FPL plants are as follows:

- PCC- Chassahowitzka National Wilderness Area (NWA)- 182 km
  Everglades National Park (NP)- 295 km
  Okefenokee NWA- 270 km
- PPE- Everglades NP- 54 km
- PTF- Everglades NP- 21 km
- PMT- Chassahowitzka NWA- 116 km
  Everglades NP- 212 km
- PMR- Chassahowitzka NWA- 267 km
  Everglades NP- 145 km
- PRV- Everglades NP- 122 km
- PPN- Chassahowitzka NWA- 141 km
  Wolf Island NWA- 188 km
  Okefenokee NWA- 119 km

The general locations of the FPL plants, in UTM East and North coordinates, all in UTM Zone 17, are as follows:

- PCC- 523.1 km, East ; 3,148.7 km, North;
- PPE- 587.4 km, East ; 2,885.3 km, North;
- PTF- 567.4 km, East; 2,813.5 km, North;
- PMT- 367.3 km, East; 3,054.3 km, North;
- PMR- 543.1 km, East; 2,993.0 km, North;
- PRV- 594.2 km, East; 2,960.7 km, North; and
- PPN- 443.3 km, East; 3,277.7 km, North.

1.3 Source Impact Evaluation Criteria

The common BART modeling protocol describes the application of the CALPUFF modeling system for two purposes:

- Air quality modeling to determine whether a BART-eligible source is "subject to BART" – to evaluate whether a BART-eligible source is exempt from BART controls because it is not reasonably expected to cause or contribute to impairment of visibility in Class I areas; and
- Air quality modeling of emissions from sources that have been found to be subject to BART – to evaluate regional haze benefits of alternative control options and to document the benefits of the preferred option.

The common BART protocol identifies the first situation as the "BART exemption analysis" and the second situation as "BART control evaluation."

The final BART rule (70 FR 39118) states that the proposed threshold at which a source may "contribute" to visibility impairment should not be higher than 0.5 dv. The FDEP is also recommending the criterion of 0.5 dv.

Based on VISTAS recommendations regarding BART exemption analysis, "initial screening" and "refined" analyses can be performed to determine whether a BART-eligible source is subject to or exempt from BART. The initial screening analysis, which is based on a coarse scale 12-km regional VISTAS CALMET domain, is optional and answers two questions – whether (a) a particular source may be exempted from further BART analyses and (b) if refined (finer grid) CALPUFF analyses were to be undertaken, which Class I areas should be included.

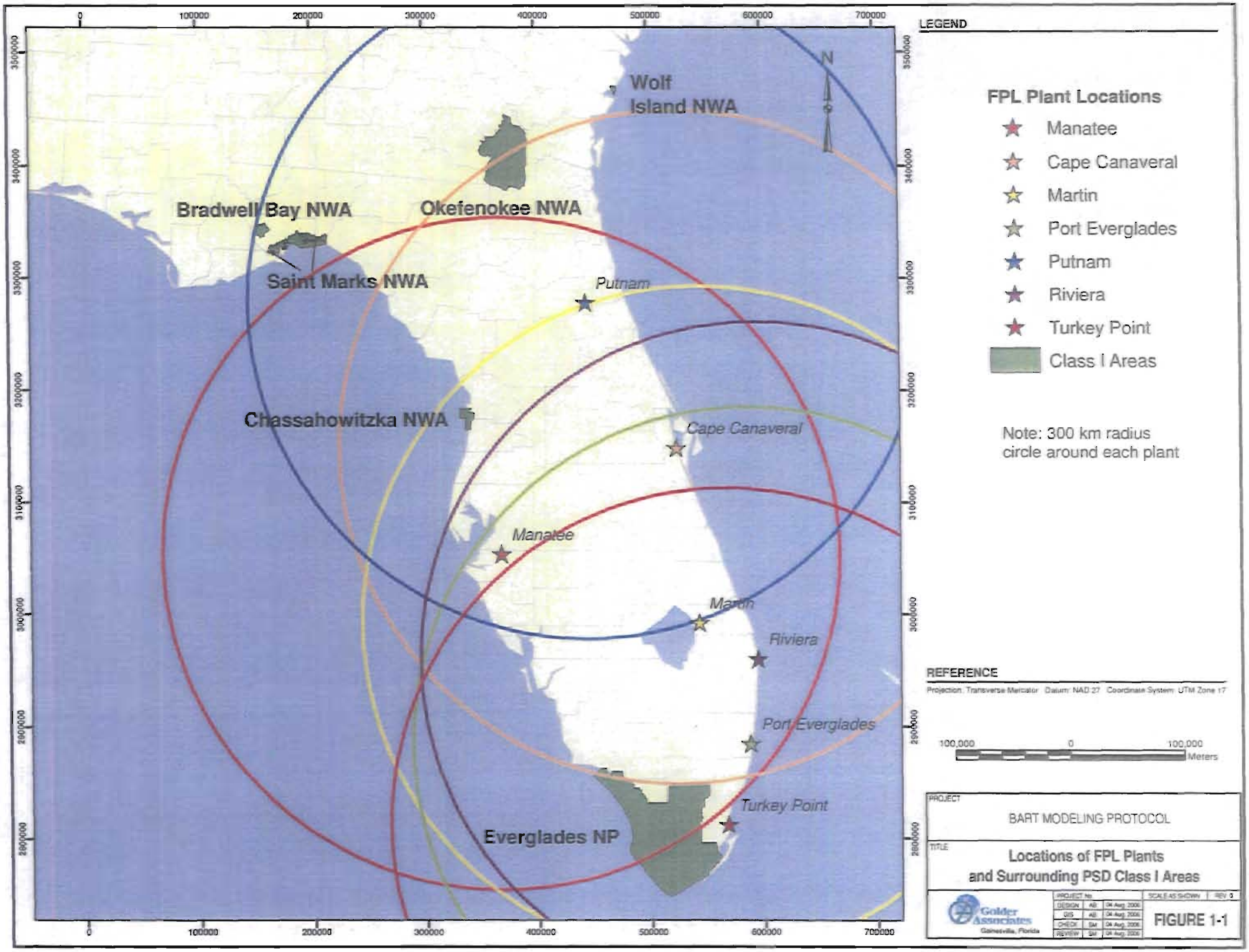
For the screening analysis, the highest predicted 24-hour impairment value is compared to the 0.5 dv criteria. If the highest predicted impacts are found to be less than 0.5 dv, no further analysis is required. But if the highest impact is predicted to be greater than 0.5 dv, then a refined, finer grid, analysis may be performed.

The refined analysis, which is based on a finer grid subregional California Meteorological Model (CALMET) domain, is the definitive test for whether a source is subject to BART. In the refined analysis, the 98th percentile, i.e., the 8th highest 24-hour average visibility impairment value in 1 year or the 22nd highest 24-hour average visibility impairment value over 3 years combined, whichever is higher, is compared to 0.5 dv.

The screening analysis is optional for large sources that will clearly exceed the initial screening thresholds or sources that are very close to the Class I areas, which will be better treated by a finer grid resolution. For the FPL BART analyses, only the refined analysis will be performed to determine whether the source is exempt from BART. All Class I areas within 300 km of the FPL plants will be included in the refined modeling analysis and modeling results will be presented for each evaluated Class I area.

If the BART exemption analysis reveals that a BART-eligible source is subject to BART controls, part of the BART review process involves evaluating the visibility benefits of different BART control measures. These benefits will also be determined by the refined analysis, where CALPUFF will be run with the baseline emission rates and again with emission rates reflective of BART control options.

It should be noted that the FDEP has performed BART exemption modeling analysis for the Putnam Power Plant since the pollutant emissions from the emissions units at this facility are relatively low. Based on that modeling analysis, the Putnam Power Plant was determined to have maximum predicted impacts less than the visibility impairment threshold of 0.5 dv. As a result, this plant is exempt from BART controls because it is not reasonably expected to cause or contribute to impairment of visibility in Class I areas. Therefore, visibility impairment modeling for this plant will not be conducted as part of the proposed modeling protocol. For completeness, the stack, operating, and emissions data for the Putnam Power Plant are included in this protocol.



TITLE: Locations of FPL Plants and Surrounding PSD Class I Areas

FIGURE 1-1

2.0 SOURCE DESCRIPTION

2.1 Source Applicability

The FDEP has published a list of potential BART-eligible sources (updated January 10, 2006), which is based on a survey questionnaire sent by FDEP to selected facilities in Florida on November 4, 2002 and April 18, 2003. FDEP's list contains a total of 15 potential BART-eligible source units from FPL plants. These plants are on the FDEP list since they are one of the 26 major source categories listed in the regulation and have emissions of one or more visibility-impairment pollutants [i.e., SO_2, NO_x, and particulate matter (PM)] that are greater than 250 TPY.

FPL verified the applicability of the BART rule to each plant as well as the list of BART-eligible units at each plant. This analysis consisted of a three-step procedure.

First, each plant is a BART-eligible source since it is classified under the source category of "Fossil fuel-fired steam electric plants of more than 250 million British thermal units (MMBtu) per hour heat input."

Second, each emissions unit at each plant was reviewed to determine which units met the date requirements for a BART-eligible unit. For each emissions unit, it was determined which unit began operation after August 7, 1962, and was existent on August 7, 1977.

Third, if an emissions unit met the date requirements for BART eligibility, the potential emissions of visibility impairing pollutants from each unit were identified. At present, the visibility impairing pollutants include SO_2, NO_x, and PM_{10}. Other potential visibilities impairing pollutants, such as volatile organic compounds (VOC), and ammonia, have been determined by the FDEP to have no significant effect on regional haze in Florida. As a result, the SO_2, NO_x, and PM_{10} emissions from the facility are the only pollutants that would be included in the analysis unless FDEP makes a determination to include the other pollutants.

On March 10, 2005, EPA issued the Clean Air Interstate Rule (CAIR) requiring affected electric generating units (EGUs) in the eastern U.S. to reduce emissions of NO_x and SO_2. Some issues regarding how the CAIR emission reductions would affect BART-eligible units pursued, and based on a proposed settlement agreement between the EPA and the Utility Air Regulatory (UARG), EGUs would have to model only particulate matter (PM) and primary sulfate emissions for either BART exemption or BART determination. FDEP has agreed to uphold the proposed agreement and, because the FPL Plants are subject to the provisions of CAIR, SO_2 and NO_x emissions will not be included in the air modeling analysis.

As shown in Table 2-1, the potential annual PM_{10} emissions from the BART-eligible units at each plant total more than 250 TPY based on data obtained by the FDEP. Because the total PM_{10} emissions from these units will be included in the BART control review, it is not necessary to quantify fugitive PM emissions from the BART-eligible units for source applicability under the BART regulation.

Based on discussions with the FDEP, fugitive PM emissions from BART-eligible units are not required to undergo BART control review nor need to be included in assessing visibility impairment since all of the FPL plants are more than 50 km from the nearest PSD Class I area, except for the FPL Turkey Point Plant. Because fugitive PM emissions from the Turkey Point Plant are minimal (the plant fires residual fuel oil), these PM emissions will not be included in the visibility impairment analysis.

2.2 Stack Parameters

The stack height above ground, stack diameter, exit velocity, and exit temperature for the BART-eligible sources at each FPL plant are presented in Tables 2-2 to 2-8. Each emission location is provided in UTM coordinates and VISTAS Lambert Conformal Conic (LCC) coordinate system.

2.3 Emission Rates for Visibility Impairment Analyses

The EPA BART guidance indicates that the emission rate to be used for BART modeling is the highest 24-hour actual emission rate with normal operations from the modeling period. Depending on the availability of the source data, the source emissions information should be based on the following, in order of priority:

- 24-hour maximum emissions based on continuous emission monitoring (CEM) data for the period 2001 through 2003;
- Facility stack test emissions;
- Potential to emit;
- Allowable permit limits; and
- AP-42 emission factors.

FPL provided the maximum PM_{10} emission rates which were based on annual compliance stack tests or, in the case of the Port Everglades Plant, the current Title V permit. The maximum 24-hour average emission rates for the BART-eligible units are also presented in Tables 2-2 to 2-8.

For the Port Everglades Plant, the PM emission rates for Units No. 1 and No. 2 are based on the current Title V Permit No. 0110036-006-AV issued January 1, 2004. In that permit, PM emissions during steady state operation shall not exceed 0.03 pounds per million Btu (lb/MMBtu) heat input effective November 1, 2007 for Unit No. 3 and June 1, 2007 for Unit No. 4. PM emissions during boiler cleaning (soot blowing) and load change shall not exceed an average of 0.1 lb/MMBtu during 3 hours in any 24-hour period for the same effective dates. PM emissions were calculated based on the maximum permitted steady state operation for 21 hours at 0.03 lb/MMBtu and soot blowing for 3 hours in a 24-hour period at 0.1 lb/MMBtu. These PM emission rates were also established in Air Construction Permit No. 0110036-005-AC issued July 14, 2003 for modifications at Units No. 1 through No. 4. Electrostatic precipitators (ESP) will be installed to meet these PM emission limits. The PM emission rates were based on applying the maximum permitted rates to the maximum heat input measured during the stack tests from 2001 to 2003.

As indicated in Section 1.3, FDEP has performed BART exemption modeling analyses for the Putnam Power Plant, which was determined to have maximum predicted impacts less than the visibility impairment threshold of 0.5 dv. As a result, visibility impairment modeling for this plant will not be conducted as part of the proposed modeling protocol. For completeness, the stack, operating, and emission data for the Putnam Power Plant are included in this protocol.

2.4 Particulate Matter Speciation

Based on the latest regulatory guidance, PM emissions by size category need to be considered in the appropriate species for the visibility analysis. The effect that each species has on visibility impairment is related to a parameter called the extinction coefficient. The higher the extinction coefficient, the greater the species' affect on visibility. Filterable PM is speciated into coarse (PMC), fine (PMF), and elemental carbon (EC), with default extinction efficiencies of 0.6, 1.0, and 10.0, respectively. PMC is PM with aerodynamic diameter between 10 microns and 2.5 microns. Both EC and PMF have aerodynamic diameters equal to or less than 2.5 microns. Condensable PM is comprised of inorganic PM, such as sulfate (SO_4), and organic PM, such as secondary organic aerosols (SOA). The extinction efficiencies for these species are 3 x f(RH) and 4, respectively, where f(RH) is the relative humidity factor.

Summaries of PM speciation for the FPL Plants are presented in Tables 2-2A through 2-7A. These species categories were generally based on the speciation profile provided by VISTAS for Uncontrolled Utility Residual Oil Boiler. The PM condensable emission rates were estimated based on emission factors for oil combustion presented in Table 1.3-2 in AP-42 while the different PM particle size categories were determined from particle size distribution for utility boilers firing residual oil provided in Table 1.3-4 in AP-42. The particle size distribution for the units at the Port Everglades Plant was based on information provided for a unit with an ESP while the particle size distribution for units at the other plants was based on a unit with no PM controls. The PM elemental carbon emission rates were based on data provided in EPA's January 2002 DRAFT "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon".

2.5 Building Dimensions for Downwash Effects

Based on discussions with FDEP, building downwash effects will generally not be considered in the modeling analysis because these effects are considered to be minimal in assessing impacts if the distance of the nearest PSD Class I area to a plant is greater than 50 km. For the FPL plants, including the Turkey Point Plant located about 21 km from the Everglades NP, building downwash effects are expected to be minimal and, therefore, not included in the analysis. The stacks for Unit No. 1 and No. 2 at the Turkey Point Plant are at Good Engineering Practice (GEP) height with no or minimal downwash effects.

TABLE 2-1
FPL BART-ELIGIBLE SOURCES AS OF JANUARY 10, 2006

Facility ID	Site Name	Site ID	Actual 2002 Emission (tons)		
			SO_2	NO_x	PM_{10}
0090006	CAPE CANAVERAL POWER PLANT	PCC	9,721	4,877	824
0110036	PORT EVERGLADES POWER PLANT	PPE	11,903	4,889	984
0250003	TURKEY POINT POWER PLANT	PTF	8,596	4,557	734
0810010	MANATEE POWER PLANT	PMT	31,199	9,840	2,500
0850001	FPL / MARTIN POWER PLANT	PMR	14,619	5,372	1,306
0990042	RIVIERA POWER PLANT	PRV	4,001	1,867	336
1070014	PUTNAM POWER PLANT	PPN	37	4,347	443

Source: FDEP, 2006.

TABLE 2-2
BART MODELING DATA INPUT
FPL CAPE CANAVERAL PLANT

Parameter	Units	Value			
Emission Unit		Unit 1		Unit 2	
Location					
UTM Coordinates					
East	km	523.12		523.07	
North	km	3,148.25		3,149.24	
Zone		17		17	
Lambert Conformal Coordinates [a]					
x	km	1596.04		1596.04	
y	km	-1138.47		-1138.47	
Stack Data					
Height	ft (m)	397	(121.0)	397	(121.0)
Diameter	ft (m)	18.7	(5.70)	18.7	(5.70)
Base elevation	ft (m)	12	(3.66)	12	(3.66)
Operating Data					
Exit gas temperature	°F (K)	287	(415)	287	(415)
Exit gas velocity	ft/s (m/s)	60.1	(18.3)	60.1	(18.3)
Emission Data					
PM	lb/hr (g/s)	145.9	(18.4)	144.0	(18.1)

[a] Based on common location using UTM coordinates of: East 523.1 km; North 3,148.7 km

TABLE 2-2A
PM SPECIATION SUMMARY - FPL CAPE CANAVERAL

PM Category	Emission Unit [a]	Units	Total	Coarse PM	Soil (Fine PM)	Elemental Carbon (EC)	Inorganic (as H_2SO_4)	Organic
PM Filterable [b]	Unit 1 & 2	lb/hr	289.9	78.62	181.85	29.43	NA	NA
		%	100%	27%	63%	10%	NA	NA
PM Condensable [c]	Unit 1 & 2	lb/hr	80.00	NA	NA	NA	68.00	12.00
		%	100%	NA	NA	NA	85%	15%
Total PM_{10} (filterable+condensable)	Unit 1 & 2	lb/hr	369.9	78.62	181.85	29.43	68.00	12.00
		%	100%	21.3%	49.2%	8.0%	18.4%	3.2%
Total PM_{10} (filterable+Organic Condensable PM)	Unit 1 & 2	lb/hr	301.9	78.62	181.85	29.43	0.0	12.00
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	26.0%	60.2%	9.7%	0.0%	4.0%

PM Particle Size Distribution for CALPUFF Assessment

Species Name	AP-42 (Table 1.3-4) Particle Size (microns)	Cumulative (%)	Cumulative Normalized PM10 (%)	Individual Categories Filterable (%)	Individual Categories Organic Condensable	Emission Rate (lb/hr) Filterable	Emission Rate (lb/hr) Organic Condensable	Emission Rate (lb/hr) Total
Total PM_{10}						289.9	12.0	301.9
PM0063	0.63	20.0%	28.2%	28.2%	50.0%	81.7	6.0	87.7
PM0100	1	39.0%	54.9%	26.8%	50.0%	77.6	6.0	83.6
PM0125	1.25	43.0%	60.6%	5.6%	0	16.3	0.0	16.3
PM0250	2.5	52.0%	73.2%	12.7%	0	36.7	0.0	36.7
PM0600	6	58.0%	81.7%	8.5%	0	24.5	0.0	24.5
PM1000	10	71.0%	100.0%	18.3%	0	53.1	0.0	53.1
Totals				100.0%	100.0%	289.9	12.0	301.9

Total Modeled PM_{10} 301.9

[a] Heat input rate for unit and fuel heat content — 8,000 MMBtu/hr — 4000 PER UNIT
150,000 Btu/gal fuel oil

[b] PM fine consists of PM soil and PM elemental carbon

		lb/1000 gal		
PM fine based on ratio of PM2.5 (fine) to PM10 (filterable)	PM2.5	4.3 x sulfur content factor	Ratio =	0.73 PM2.5/PM10
emission factor (Table 1.3-4, AP-42)	PM10	5.9 x sulfur content factor		

PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.074 of PM2.5

PM elemental carbon	0.10 PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon	0.63 PM soil/PM10
PM2.5	0.73 PM2.5/PM10
PM coarse= PM10 - PM2.5	

[c] Condensable PM (Table 1.3-2, AP-42)

	lb/1000 gal	lb/MMBtu	
Total	1.5	0.0100	
Inorganic	1.275	0.0085	(0.85 of Total)
Organic	0.225	0.0015	(0.15 of Total)

TABLE 2-3
BART MODELING DATA INPUT
FPL PORT EVERGLADES PLANT

Parameter	Units	Value			
Emission Unit		Unit 3		Unit 4	
Location					
UTM Coordinates					
East	km	587.39		587.35	
North	km	2,885.29		2,885.27	
Zone		17		17	
Lambert Conformal Coordinates [a]					
x	km	1,707.52		1,707.52	
y	km	-1391.47		-1391.47	
Stack Data					
Height	ft (m)	344	(104.9)	344	(104.9)
Diameter	ft (m)	18.1	(5.52)	18.1	(5.52)
Base elevation	ft (m)	11	(3.35)	11	(3.35)
Operating Data					
Heat input rate	MMBtu/hr	3,634 [b]		3,676 [b]	
Exit gas temperature	°F (K)	287	(415)	287	(415)
Exit gas velocity	ft/s (m/s)	63.0	(19.2)	61.9	(18.9)
Emission Data					
Steady state operation [c]					
PM	lb/MMBtu	0.03		0.03	
	lb/hr (g/s)	109.0	(13.7)	110.3	(13.9)
Soot blowing and load change [c]					
PM	lb/MMBtu	0.1		0.1	
	lb/hr (g/s)	363.4	(45.8)	367.6	(46.3)
Maximum 24-hour Rate [d]					
PM	lb/hr (g/s)	140.8	(17.7)	142.4	(17.9)

[a] Based on common location using UTM coordinates of: East 587.4 km; North 2,885.3 km

[b] Maximum heat input from stack tests performed during 2001 to 2003.

[c] Based on Title V and Air Construction Permits. PM emission limits are effective November 1, 2007 for Unit No. 3 and June 1, 2007 for Unit No. 4.

[d] Maximum 24-hour rate based on 21 hours of steady state operation
3 hours of soot blowing and load change

TABLE 2-3A
PM SPECIATION SUMMARY - FPL PORT EVERGLADES

PM Category	Emission Unit [a]	Units	Total	Coarse PM	Soil (Fine PM)	Elemental Carbon (EC)	Inorganic (as H_2SO_4)	Organic
PM Filterable [b]	Units 3 & 4	lb/hr	283.3	76.82	191.17	15.28	NA	NA
		%	100%	27%	67%	5%	NA	NA
PM Condensable [c]	Units 3 & 4	lb/hr	73.10	NA	NA	NA	62.14	10.97
		%	100%	NA	NA	NA	85%	15%
Total PM_{10} (filterable+condensable)	Units 3 & 4	lb/hr	356.4	76.82	191.17	15.28	62.14	10.97
		%	100%	21.6%	53.6%	4.3%	17.4%	3.1%
Total PM_{10} (filterable+Organic Condensable PM)	Units 3 & 4	lb/hr	294.2	76.82	191.17	15.28	0.0	10.97
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	26.1%	65.0%	5.2%	0.0%	3.7%

PM Particle Size Distribution for CALPUFF Assessment

Species	Size Distribution by Category (%)					Emission Rate (lb/hr)		
	AP-42 (Table 1.3-4 for ESP)		Cumulative	Individual Categories				
Name	Particle Size (microns)	Cumulative (%)	Normalized PM10 (%)	Filterable (%)	Organic Condensable	Filterable	Organic Condensable	Total
Total PM_{10}						283.3	11.0	294.2
PM0063	0.63	20.0%	31.7%	31.7%	50.0%	89.9	5.5	95.4
PM0100	1	28.0%	44.4%	12.7%	50.0%	36.0	5.5	41.5
PM0125	1.25	31.0%	49.2%	4.8%	0	13.5	0.0	13.5
PM0250	2.5	41.0%	65.1%	15.9%	0	45.0	0.0	45.0
PM0600	6	52.0%	82.5%	17.5%	0	49.5	0.0	49.5
PM1000	10	63.0%	100.0%	17.5%	0	49.5	0.0	49.5
Totals				100.0%	100.0%	283.3	11.0	294.2

Total Modeled PM_{10} 294.2

[a] Heat input rate for unit and fuel heat content — 7,310 MMBtu/hr (total for both units)
150,000 Btu/gal fuel oil
0.03 lb/MMBtu — 21 hours of steady state operation
0.10 lb/MMBtu — 3 hours of soot blowing and load change

[b] PM fine consists of PM soil and PM elemental carbon — lb/1000 gal
PM fine based on ratio of PM2.5 (fine) to PM10 (filterable) emission factor (Table 1.3-4, AP-42)
PM2.5 — 4.3 x sulfur content factor — Ratio = 0.73 PM2.5/PM10
PM10 — 5.9 x sulfur content factor

PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.074 of PM2.5

PM elemental carbon — 0.054 PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon — 0.67 PM soil/PM10
PM2.5 — 0.73 PM2.5/PM10
PM coarse= PM10 - PM2.5

[c] Condensable PM (Table 1.3-2, AP-42)

	lb/1000 gal	lb/MMBtu	
Total	1.5	0.0100	
Inorganic	1.275	0.0085	(0.85 of Total)
Organic	0.225	0.0015	(0.15 of Total)

TABLE 2-4
BART MODELING DATA INPUT
FPL TURKEY POINT PLANT

Parameter	Units	Value			
Emission Unit		Unit 1		Unit 2	
Location					
UTM Coordinates					
East	km	567.41		567.41	
North	km	2,813.41		2,813.56	
Zone		17		17	
Lambert Conformal Coordinates [a]					
x	km	1,700.37		1,700.37	
y	km	-1,467.79		-1,467.79	
Stack Data					
Height	ft (m)	400	(122.0)	400	(122.0)
Diameter	ft (m)	18.1	(5.52)	18.1	(5.52)
Base elevation	ft (m)	16	(4.88)	16	(4.88)
Operating Data					
Exit gas temperature	°F (K)	287	(415)	287	(415)
Exit gas velocity	ft/s (m/s)	63.8	(19.5)	62.7	(19.1)
Emission Data					
PM	lb/hr (g/s)	144.4	(18.2)	144.2	(18.2)

[a] Based on common location using UTM coordinates of: East 567.4 km; North 2,813.5 km

TABLE 2-4A
PM SPECIATION SUMMARY - FPL TURKEY POINT

PM Category	Emission Unit [a]	Units	Total	Coarse PM	Soil (Fine PM)	Elemental Carbon (EC)	Inorganic (as H_2SO_4)	Organic
PM Filterable [b]	Units 1 & 2	lb/hr	288.6	78.26	194.77	15.56	NA	NA
		%	100%	27%	67%	5%	NA	NA
PM Condensable [c]	Units 1 & 2	lb/hr	80.00	NA	NA	NA	68.00	12.00
		%	100%	NA	NA	NA	85%	15%
Total PM_{10} (filterable+condensable)	Units 1 & 2	lb/hr	368.6	78.26	194.77	15.56	68.00	12.00
		%	100%	21.2%	52.8%	4.2%	18.4%	3.3%
Total PM_{10} (filterable+Organic Condensable PM)	Units 1 & 2	lb/hr	300.6	78.26	194.77	15.56	0.0	12.00
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	26.0%	64.8%	5.2%	0.0%	4.0%

PM Particle Size Distribution for CALPUFF Assessment

Species Name	AP-42 (Table 1.3-4) Particle Size (microns)	AP-42 (Table 1.3-4) Cumulative (%)	Cumulative Normalized PM10 (%)	Individual Categories Filterable (%)	Individual Categories Organic Condensable	Emission Rate (lb/hr) Filterable	Emission Rate (lb/hr) Organic Condensable	Emission Rate (lb/hr) Total
Total PM_{10}						288.6	12.0	300.6
PM0063	0.63	20.0%	28.2%	28.2%	50.0%	81.3	6.0	87.3
PM0100	1	39.0%	54.9%	26.8%	50.0%	77.2	6.0	83.2
PM0125	1.25	43.0%	60.6%	5.6%	0	16.3	0.0	16.3
PM0250	2.5	52.0%	73.2%	12.7%	0	36.6	0.0	36.6
PM0600	6	58.0%	81.7%	8.5%	0	24.4	0.0	24.4
PM1000	10	71.0%	100.0%	18.3%	0	52.8	0.0	52.8
Totals				100.0%	100.0%	288.6	12.0	300.6

Total Modeled PM_{10} 300.6

[a] Heat input rate for unit and fuel heat content — 8,000 MMBtu/hr — 4000 PER UNIT
150,000 Btu/gal fuel oil

[b] PM fine consists of PM soil and PM elemental carbon — lb/1000 gal
PM fine based on ratio of PM2.5 (fine) to PM10 (filterable) emission factor (Table 1.3-4, AP-42)
PM2.5 — 4.3 x sulfur content factor — Ratio = 0.73 PM2.5/PM10
PM10 — 5.9 x sulfur content factor

PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.074 of PM2.5

PM elemental carbon — 0.054 PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon — 0.67 PM soil/PM10
PM2.5 — 0.73 PM2.5/PM10
PM coarse= PM10 - PM2.5

[c] Condensable PM (Table 1.3-2, AP-42)

	lb/1000 gal	lb/MMBtu	
Total	1.5	0.0100	
Inorganic	1.275	0.0085	(0.85 of Total)
Organic	0.225	0.0015	(0.15 of Total)

TABLE 2-5
BART MODELING DATA INPUT
FPL MANATEE PLANT

Parameter	Units	Value			
Emission Unit		Unit 1		Unit 2	
Location					
UTM Coordinates					
East	km	367.30		367.22	
North	km	3,054.33		3,054.33	
Zone		17		17	
Lambert Conformal Coordinates [a]					
x	km	1,457.37		1,457.37	
y	km	-1,260.90		-1,260.90	
Stack Data					
Height	ft (m)	499	(152.1)	499	(152.1)
Diameter	ft (m)	26.2	(7.99)	26.2	(7.99)
Base elevation	ft (m)	55	(16.77)	55	(16.77)
Operating Data					
Exit gas temperature	°F (K)	324.6	(436)	324.6	(436)
Exit gas velocity	ft/s (m/s)	68.7	(20.9)	68.7	(20.9)
Emission Data					
PM	lb/hr (g/s)	387.9	(48.9)	457.8	(57.7)

[a] Based on common location using UTM coordinates of: East 367.3 km; North 3,054.3 km

TABLE 2-5A
PM SPECIATION SUMMARY - FPL MANATEE

PM Category	Emission Unit [a]	Units	Total	Coarse PM	Soil (Fine PM)	Elemental Carbon (EC)	Inorganic (as H_2SO_4)	Organic
PM Filterable [b]	Units 1 & 2	lb/hr	845.7	229.34	570.75	45.61	NA	NA
		%	100%	27%	67%	5%	NA	NA
PM Condensable [c]	Units 1 & 2	lb/hr	173.00	NA	NA	NA	147.05	25.95
		%	100%	NA	NA	NA	85%	15%
Total PM_{10} (filterable+condensable)	Units 1 & 2	lb/hr	1018.7	229.34	570.75	45.61	147.05	25.95
		%	100%	22.5%	56.0%	4.5%	14.4%	2.5%
Total PM_{10} (filterable+Organic Condensable PM)	Units 1 & 2	lb/hr	871.7	229.34	570.75	45.61	0.0	25.95
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	26.3%	65.5%	5.2%	0.0%	3.0%

PM Particle Size Distribution for CALPUFF Assessment

Species Name	AP-42 (Table 1.3-4) Particle Size (microns)	AP-42 (Table 1.3-4) Cumulative (%)	Cumulative Normalized PM10 (%)	Individual Categories Filterable (%)	Individual Categories Organic Condensable	Emission Rate (lb/hr) Filterable	Emission Rate (lb/hr) Organic Condensable	Emission Rate (lb/hr) Total
Total PM_{10}						845.7	26.0	871.7
PM0063	0.63	20.0%	28.2%	28.2%	50.0%	238.2	13.0	251.2
PM0100	1	39.0%	54.9%	26.8%	50.0%	226.3	13.0	239.3
PM0125	1.25	43.0%	60.6%	5.6%	0	47.6	0.0	47.6
PM0250	2.5	52.0%	73.2%	12.7%	0	107.2	0.0	107.2
PM0600	6	58.0%	81.7%	8.5%	0	71.5	0.0	71.5
PM1000	10	71.0%	100.0%	18.3%	0	154.8	0.0	154.8
Totals				100.0%	100.0%	845.7	26.0	871.7

Total Modeled PM_{10} 871.7

[a] Heat input rate for unit and fuel heat content 17,300 MMBtu/hr 8650 PER UNIT
150,000 Btu/gal fuel oil

[b] PM fine consists of PM soil and PM elemental carbon

		lb/1000 gal		
PM fine based on ratio of PM2.5 (fine) to PM10 (filterable)	PM2.5	4.3 x sulfur content factor	Ratio =	0.73 PM2.5/PM10
emission factor (Table 1.3-4, AP-42)	PM10	5.9 x sulfur content factor		

PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.074 of PM2.5

PM elemental carbon 0.054 PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon 0.67 PM soil/PM10
PM2.5 0.73 PM2.5/PM10
PM coarse= PM10 - PM2.5

[c] Condensable PM (Table 1.3-2, AP-42)

	lb/1000 gal	lb/MMBtu	
Total	1.5	0.0100	
Inorganic	1.275	0.0085	(0.85 of Total)
Organic	0.225	0.0015	(0.15 of Total)

TABLE 2-6
BART MODELING DATA INPUT
FPL MARTIN PLANT

Parameter	Units	Value			
Emission Unit		Unit 1		Unit 2	
Location					
UTM Coordinates					
East	km	543.08		543.08	
North	km	2,993.09		2,993.00	
Zone		17		17	
Lambert Conformal Coordinates [a]					
x	km	1,643.61		1,643.61	
y	km	-1,291.11		-1,291.11	
Stack Data					
Height	ft (m)	499	(152.1)	499	(152.1)
Diameter	ft (m)	26.2	(7.99)	26.2	(7.99)
Base elevation	ft (m)	31	(9.45)	31	(9.45)
Operating Data					
Exit gas temperature	°F (K)	338	(443)	338	(443)
Exit gas velocity	ft/s (m/s)	68.7	(20.9)	68.7	(20.9)
Emission Data					
PM	lb/hr (g/s)	358.5	(45.2)	359.3	(45.3)

[a] Based on common location using UTM coordinates of: East 543.1 km; North 2,993.0 km

TABLE 2-6A
PM SPECIATION SUMMARY - FPL MARTIN

PM Category	Emission Unit [a]	Units	Total	Coarse PM	Soil (Fine PM)	Elemental Carbon (EC)	Inorganic (as H_2SO_4)	Organic
PM Filterable [b]	Units 1 & 2	lb/hr	717.8	194.66	484.43	38.71	NA	NA
		%	100%	27%	67%	5%	NA	NA
PM Condensable [c]	Units 1 & 2	lb/hr	173.00	NA	NA	NA	147.05	25.95
		%	100%	NA	NA	NA	85%	15%
Total PM_{10} (filterable+condensable)	Units 1 & 2	lb/hr	890.8	194.66	484.43	38.71	147.05	25.95
		%	100%	21.9%	54.4%	4.3%	16.5%	2.9%
Total PM_{10} (filterable+Organic Condensable PM)	Units 1 & 2	lb/hr	743.8	194.66	484.43	38.71	0.0	25.95
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	26.2%	65.1%	5.2%	0.0%	3.5%

PM Particle Size Distribution for CALPUFF Assessment

Species Name	AP-42 (Table 1.3-4) Particle Size (microns)	AP-42 (Table 1.3-4) Cumulative (%)	Cumulative Normalized PM10 (%)	Individual Categories Filterable (%)	Individual Categories Organic Condensable	Emission Rate (lb/hr) Filterable	Emission Rate (lb/hr) Organic Condensable	Emission Rate (lb/hr) Total
Total PM_{10}						717.8	26.0	743.8
PM0063	0.63	20.0%	28.2%	28.2%	50.0%	202.2	13.0	215.2
PM0100	1	39.0%	54.9%	26.8%	50.0%	192.1	13.0	205.1
PM0125	1.25	43.0%	60.6%	5.6%	0	40.4	0.0	40.4
PM0250	2.5	52.0%	73.2%	12.7%	0	91.0	0.0	91.0
PM0600	6	58.0%	81.7%	8.5%	0	60.7	0.0	60.7
PM1000	10	71.0%	100.0%	18.3%	0	131.4	0.0	131.4
Totals				100.0%	100.0%	717.8	26.0	743.8

Total Modeled PM_{10}: 743.8

[a] Heat input rate for unit and fuel heat content — 17,300 MMBtu/hr — 8650 PER UNIT
150,000 Btu/gal fuel oil

[b] PM fine consists of PM soil and PM elemental carbon — lb/1000 gal
PM fine based on ratio of PM2.5 (fine) to PM10 (filterable) emission factor (Table 1.3-4, AP-42)
PM2.5 4.3 x sulfur content factor — Ratio = 0.73 PM2.5/PM10
PM10 5.9 x sulfur content factor

PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.074 of PM2.5

PM elemental carbon — 0.054 PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon — 0.67 PM soil/PM10
PM2.5 — 0.73 PM2.5/PM10
PM coarse= PM10 - PM2.5

[c] Condensable PM (Table 1.3-2, AP-42)

	lb/1000 gal	lb/MMBtu	
Total	1.5	0.0100	
Inorganic	1.275	0.0085	(0.85 of Total)
Organic	0.225	0.0015	(0.15 of Total)

TABLE 2-7
BART MODELING DATA INPUT
FPL RIVIERA PLANT

Parameter	Units	Value	
Emission Unit		Unit 4	
Location			
UTM Coordinates			
East	km	594.19	
North	km	2,960.80	
Zone		17	
Lambert Conformal Coordinates			
x	km	1,700.54	
y	km	-1,314.51	
Stack Data			
Height	ft (m)	298	(90.9)
Diameter	ft (m)	16.0	(4.88)
Base elevation	ft (m)	11	(3.35)
Operating Data			
Exit gas temperature	°F (K)	263	(401)
Exit gas velocity	ft/s (m/s)	88.1	(26.9)
Emission Data			
SO_2	lb/hr (g/s)	5,322	(670.6)
NO_x	lb/hr (g/s)	2,095	(263.9)
PM	lb/hr (g/s)	157.2	(19.8)

TABLE 2-7A
PM SPECIATION SUMMARY - FPL RIVIERA

PM Category	Emission Unit [a]	Units	Total	Coarse PM	Soil (Fine PM)	Elemental Carbon (EC)	Inorganic (as H_2SO_4)	Organic
PM Filterable [b]	Unit 4	lb/hr	157.2	42.64	106.10	8.48	NA	NA
		%	100%	27%	67%	5%	NA	NA
PM Condensable [c]	Unit 4	lb/hr	61.00	NA	NA	NA	51.85	9.15
		%	100%	NA	NA	NA	85%	15%
Total PM_{10} (filterable+condensable)	Unit 4	lb/hr	218.2	42.64	106.10	8.48	51.85	9.15
		%	100%	19.5%	48.6%	3.9%	23.8%	4.2%
Total PM_{10} (filterable+Organic Condensable PM)	Unit 4	lb/hr	166.4	42.64	106.10	8.48	0.0	9.15
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	25.6%	63.8%	5.1%	0.0%	5.5%

PM Particle Size Distribution for CALPUFF Assessment

Species Name	AP-42 (Table 1.3-4) Particle Size (microns)	Cumulative (%)	Cumulative Normalized PM10 (%)	Individual Categories Filterable (%)	Individual Categories Organic Condensable	Emission Rate (lb/hr) Filterable	Organic Condensable	Total
Total PM_{10}						157.2	9.2	166.4
PM0063	0.63	20.0%	28.2%	28.2%	50.0%	44.3	4.6	48.9
PM0100	1	39.0%	54.9%	26.8%	50.0%	42.1	4.6	46.6
PM0125	1.25	43.0%	60.6%	5.6%	0	8.9	0.0	8.9
PM0250	2.5	52.0%	73.2%	12.7%	0	19.9	0.0	19.9
PM0600	6	58.0%	81.7%	8.5%	0	13.3	0.0	13.3
PM1000	10	71.0%	100.0%	18.3%	0	28.8	0.0	28.8
Totals				100.0%	100.0%	157.2	9.2	166.4

Total Modeled PM_{10} 166.4

[a] Heat input rate for unit and fuel heat content 6,100 MMBtu/hr 3050 PER UNIT
150,000 Btu/gal fuel oil

[b] PM fine consists of PM soil and PM elemental carbon — lb/1000 gal
PM fine based on ratio of PM2.5 (fine) to PM10 (filterable) — PM2.5 4.3 x sulfur content factor — Ratio = 0.73 PM2.5/PM10
emission factor (Table 1.3-4, AP-42) — PM10 5.9 x sulfur content factor

PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.074 of PM2.5

PM elemental carbon	0.054	PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon	0.67	PM soil/PM10
PM2.5	0.73	PM2.5/PM10
PM coarse= PM10 - PM2.5		

[c] Condensable PM (Table 1.3-2, AP-42)

	lb/1000 gal	lb/MMBtu	
Total	1.5	0.0100	
Inorganic	1.275	0.0085	(0.85 of Total)
Organic	0.225	0.0015	(0.15 of Total)

TABLE 2-8
BART MODELING DATA INPUT
FPL PUTNAM PLANT

Parameter	Units	Value							
Emission Unit		HRSG Stack 1, GT 1-1		HRSG Stack 1, GT 1-2		HRSG Stack 2, GT 2-1		HRSG Stack 2, GT 2-2	
<u>Location</u>									
UTM Coordinates									
East	km	443.35		443.35		443.35		443.35	
North	km	3,277.802		3,277.776		3,277.105		3,277.677	
Zone		17		17					
Lambert Conformal Coordinates [a]									
x	km	1,493.93		1,493.93		1,493.93		1,493.93	
y	km	-1,024.34		-1,024.34		-1,024.34		-1,024.34	
<u>Stack Data</u>									
Height	ft (m)	73	(22.3)	73	(22.3)	73	(22.3)	73	(22.3)
Diameter	ft (m)	48.0	(14.6)	48.0	(14.6)	48.0	(14.6)	48.0	(14.6)
Base elevation	ft (m)	23	(7.01)	23	(7.01)	23	(7.01)	23.0	(7.01)
<u>Operating Data</u>									
Exit gas temperature	°F (K)	327.6	(437)	327.6	(437)	327.6	(437)	327.6	(437)
Exit gas velocity	ft/s (m/s)	96.1	(29.3)	96.1	(29.3)	96.1	(29.3)	96.1	(29.3)
<u>Emission Data</u>									
PM	lb/hr (g/s)	8.0	(1.0)	8.0	(1.0)	8.0	(1.0)	8.0	(1.0)

[a] Based on common location using UTM coordinates of: East 443.3 km; North 3,277.7 km

3.0 GEOPHYSICAL AND METEOROLOGICAL DATA

3.1 Modeling Domain and Terrain

CALMET data sets have been developed by EarthTech that are based on the following 3 years of Fifth Generation Mesoscale Model (MM5) meteorological data assembled by VISTAS:

- 2001 MM5 dataset at 12-km grid (developed by EPA),
- 2002 MM5 dataset at 12-km grid (developed by VISTAS), and
- 2003 MM5 dataset at 36-km grid (developed by Midwest Regional Planning Organization).

For the finer grid modeling analysis (refined analysis), the 4-km spacing Florida CALMET domain can be used VISTAS has prepared a total of five sub-regional 4-km spacing CALMET domains. Domain 2 covers all Florida sources and Class I areas that can be potentially affected by the Florida sources.

Golder Associates Inc. (Golder) obtained these data sets from the FDEP. As indicated in Section 1.3, for this protocol, the exemption modeling will be based on the finer grid modeling since the FPL Plants are large sources that have the potential to exceed the initial screening thresholds. Therefore, only the refined analysis will be performed to determine whether the source is exempt from BART.

3.2 Land Use and Meteorological Database

The CALMET meteorological data sets to be used in the exemption modeling have been supplied by VISTAS. The CALMET data sets contain hourly meteorological data and land use parameters.

3.3 Air Quality Data Base

3.3.1 Ozone Concentrations

For these analyses, observed ozone data for 2001 to 2003 from CASTNet and Aerometric Information Retrieval System (AIRS) stations will be used. These datasets have been obtained from Earth Tech's website as recommended by FDEP.

3.3.2 Ammonia Concentrations

A constant monthly background ammonia concentration of 0.5 parts per billion (ppb) will be used based on FDEP's recommendation.

3.4 Natural Conditions at Class I Area

Based on VISTAS recommendation, Visibility Method 6 will be used in all BART-related modeling, which will compute extinction coefficients for hygroscopic species (modeled and background) using a monthly f(RH) in lieu of calculating hourly RH factors. Monthly RH values from Table A-3 of EPA's *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule* (Haze Guideline) will be used. Monthly f(RH) factors for the Class I areas within 300 km of the FPL plants are as follows:

Month	Chassahowitzka NWA	Everglades NP	Okefenokee NWA	Wolf Island NWA
January	3.8	2.7	3.5	3.5
February	3.5	2.6	3.2	3.2
March	3.4	2.6	3.1	3.1
April	3.2	2.4	3.0	3.0
May	3.3	2.4	3.6	3.6
June	3.9	2.7	3.7	3.7
July	3.9	2.6	3.7	3.7
August	4.2	2.9	4.1	4.1
September	4.1	3.0	4.0	4.0
October	3.9	2.8	3.8	3.8
November	3.7	2.6	3.5	3.5
December	3.9	2.7	3.6	3.6

Method 6 requires input of natural background (BK) concentrations of ammonium sulfate ($BKSO_4$), ammonium nitrate ($BKNO_3$), coarse particulates (BKPMC), organic carbon (BKOC), soil (BKSOIL), and elemental carbon (BKEC) in micrograms per cubic meter ($\mu g/m^3$). The model then calculates the natural background light extinction and haze index based on these values.

According to FDEP recommendations, the natural background light extinction may be based on haze index (HI) values (in dv) for either the annual average or the 20-percent best visibility days provided by EPA in Appendix B of the Haze Guideline document (using the 10th percentile HI value). For this BART analysis, the annual average HI values will be used to determine natural background light extinction of the Class I areas. The light extinction coefficient in inverse megameters (Mm^{-1}) is based on the concentration of the visibility impairing components and the extinction efficiency, in square meters per gram (m^2/g), for each component.

Per VISTAS and FDEP recommendations, the natural background light extinction that is equivalent to EPA-provided background HI values for each Class I area, based on the annual average, will be estimated using the following background values:

- Rayleigh scattering = 10 Mm^{-1};
- Concentrations of $BKSO_4$, $BKNO_3$, BKPMC, BKEC, and BKEC = 0.0; and
- BKSOIL concentration, which is estimated from the extinction coefficient that corresponds to EPA's HI value (corresponding to the annual average) and then subtracting the Rayleigh scattering of 10 Mm^{-1} (assumes that the extinction efficiency of soil is 1 m^2/g).

The BKSOIL concentration is estimated by subtracting the Rayleigh scattering of 10 Mm^{-1} from the extinction coefficient that corresponds to EPA's haze index value for the annual average light extinction coefficient, then dividing the remainder by the BKSOIL extinction efficiency of 1 m^2/g.

According to Appendix B of the Haze Guidance document, the annual average light extinction coefficients for each Class I area and corresponding calculated BKSOIL concentrations are as follows:

- Chassahowitzka NWA – 21.45 Mm^{-1} (equivalent to 7.63 dv); 11.45 $\mu g/m^3$;
- Everglades NP – 20.77 Mm^{-1} (equivalent to 7.31 dv); 10.77 $\mu g/m^3$;
- Okefenokee NWA – 21.40 Mm^{-1} (equivalent to 7.61 dv); 11.40 $\mu g/m^3$; and
- Wolf Island NWA – 21.34 Mm^{-1} (equivalent to 7.58 dv); 11.34 $\mu g/m^3$.

Currently, the atmospheric light extinction is estimated by an algorithm developed by the Interagency Monitoring of Protected Visual Environments (IMPROVE) committee, which was adopted by the EPA under the 1999 Regional Haze Rule (RHR). This algorithm for estimating light extinction from particle speciation data tends to underestimate light extinction for the highest haze conditions and overestimate it for the lowest haze conditions and does not include light extinction due to sea salt, which is important at sites near the sea coasts. As a result of these limitations, the IMPROVE Steering Committee recently developed a new algorithm (the "new IMPROVE algorithm") for estimating light extinction from particulate matter component concentrations, which provides a better correspondence between measured visibility and that calculated from particulate matter component concentrations.

The new algorithm splits the total sulfate, nitrate, and organic carbon compound concentrations into two fractions, representing small and large size distributions of those compounds. New terms added to the algorithm are light absorption by NO_2 gas and light scattering due to fine sea salt accompanied by its own hygroscopic scattering enhancement factor and Class I area specific Rayleigh scattering values rounded off to the nearest whole number. The EPA and the Federal Land Managers (FLMs) from the National Park Service and the U.S. Fish and Wildlife Service have determined that adding site-specific data (e.g., sea salt and site-specific Rayleigh scattering) to the old IMPROVE algorithm, for a hybrid approach, is not recommended and is allowing the optional use of the new IMPROVE algorithm.

As one or more of the Class I areas within 300 km of the FPL Plants are located near the sea coast, the new IMPROVE algorithm may additionally be used to calculate the natural background at these Class I areas. The new IMPROVE algorithm accounts for the background sea-salt concentrations and site-specific Rayleigh scattering. Since the new IMPROVE equation cannot be directly implemented using the existing version of the CALPUFF model without additional post-processing or model revision, VISTAS has developed a methodology for implementing the new IMPROVE equation using existing CALPUFF/CALPOST output in a spreadsheet. This spreadsheet, known as the CALPOST-IMPROVE Processor, will be used to re-calculate visibility impacts due to BART-eligible units if the visibility impacts determined using the old IMPROVE equation are predicted to be greater than 0.5 dv.

Because ambient NO_2 concentrations due to the FPL Plants are not being modeled, light absorption by NO_2 gas, which is a new term added to the new IMPROVE algorithm, will not be considered for the BART modeling analysis.

The following Class I area specific Rayleigh scattering (in Mm^{-1}) and sea salt concentrations (in $\mu g/m^3$) values will be used to evaluate the visibility impacts using the new CALPOST-IMPROVE Processor:

- Chassahowitzka NWA – 11 Mm^{-1} ; 0.08 $\mu g/m^3$
- Everglades NP – 11 Mm^{-1} ; 0.31 $\mu g/m^3$
- Okefenokee NWA – 11 Mm^{-1} ; 0.09 $\mu g/m^3$
- Wolf Island NWA – 11 Mm^{-1} ; 0.09 $\mu g/m^3$

4.0 AIR QUALITY MODELING METHODOLOGY

For predicting maximum visibility impairment at the Class I areas, the CALPUFF modeling system will be used. For BART-related visibility impact assessments, the CALPUFF model, Version 5.756 (060725), is recommended for use by EPA and VISTAS. Recent technical enhancements, including changes to the over-water boundary layer formulation and coastal effects modules (sponsored by the Minerals Management Service), are included in this version. The CALPUFF model is a non-steady-state long-range transport Lagrangian puff dispersion model applicable for estimating visibility impacts. The methods and assumptions used in the CALPUFF model will be based on the latest recommendations for CALPUFF analysis as presented in the VISTAS modeling protocol, Interagency Workgroup on Air Quality Models (IWAQM) Phase 2 Summary Report and the Federal Land Managers' Air Quality Related Values Work Group (FLAG) document. This model is also maintained by EPA on the Support Center for Regulatory Air Models (SCRAM) website.

4.1 Modeling Domain Configuration

The 4-km spacing Florida domain will be used for the BART-exemption modeling and, if required, modeling to evaluate visibility benefits of different BART control measures. VISTAS has prepared five sub-regional 4-km spacing CALMET domains. Domain 2 of these domains covers all of Florida and all PSD Class I areas that are potentially affected by sources in Florida.

4.2 CALMET Meteorological Domain

The refined CALMET domains, to be used for FPL's BART modeling, have been provided by the FDEP. The major features used in preparing these CALMET data have been described in Section 4.0 of the VISTAS BART modeling protocol.

4.3 CALPUFF Computational Domain and Receptors

The computational domain to be used for the refined Florida domain will be equal to the full extent of the meteorological domain. Visibility impacts will be predicted at each PSD Class I area using receptors provided by the Federal Land Managers. The receptors to be used for each of the PSD Class I areas are the National Park Service's (NPS) complete receptor sets and are presented in Figures 4-1 through 4-4.

4.4 CALPUFF Modeling Options

The major CALPUFF modeling options recommended in the IWAQM guidance (EPA, 1988; Pages B-1 through B-8), in addition to the recommendations in Section 4.3.3 of the VISTAS BART modeling protocol will be used. An example CALPUFF input file showing the modeling options is presented in Appendix A.

4.5 Light Extinction and Haze Impact Calculations

The CALPOST program will be used to calculate the light extinction and the haze impact. The Method 6 technique, which is recommended by the BART guideline document, will be used to compute change in light extinction.

4.6 QA/QC

Quality assurance procedures will be established to ensure that the setup and execution of the CALPUFF model and processing of the modeling results satisfy the regulatory objectives of the BART program. The meteorological datasets to be used in the modeling were developed and provided by VISTAS and therefore, no further QA will be required for these.

The CALPUFF modeling options are described in Section 4.4. The site-specific source data program will be independently confirmed by an independent modeler not involved in the initial setup of the modeling files. This verification will include:

- Units of measure;
- Verification of the correct source and receptor locations, including datum and projection;
- Confirmation of the switch selections relative to modeling guidance;
- Checks of the program switches and file names of the various processing steps; and
- Confirmation of the use of the proper version and level of each model.

In addition, all the data and program files needed to reproduce the modeling results will be supplied with the modeling report.

The source and emission data will be independently verified by Golder and FPL. The source coordinates and related projection/datum parameters will be checked using the CALPUFF GUI's

COORDS software and other comparable coordinate translation software such as CORPSCON and National Park Services Conversion Utilities software.

The POSTUTIL and CALPOST post-processor input files will be carefully checked to make sure of the following:

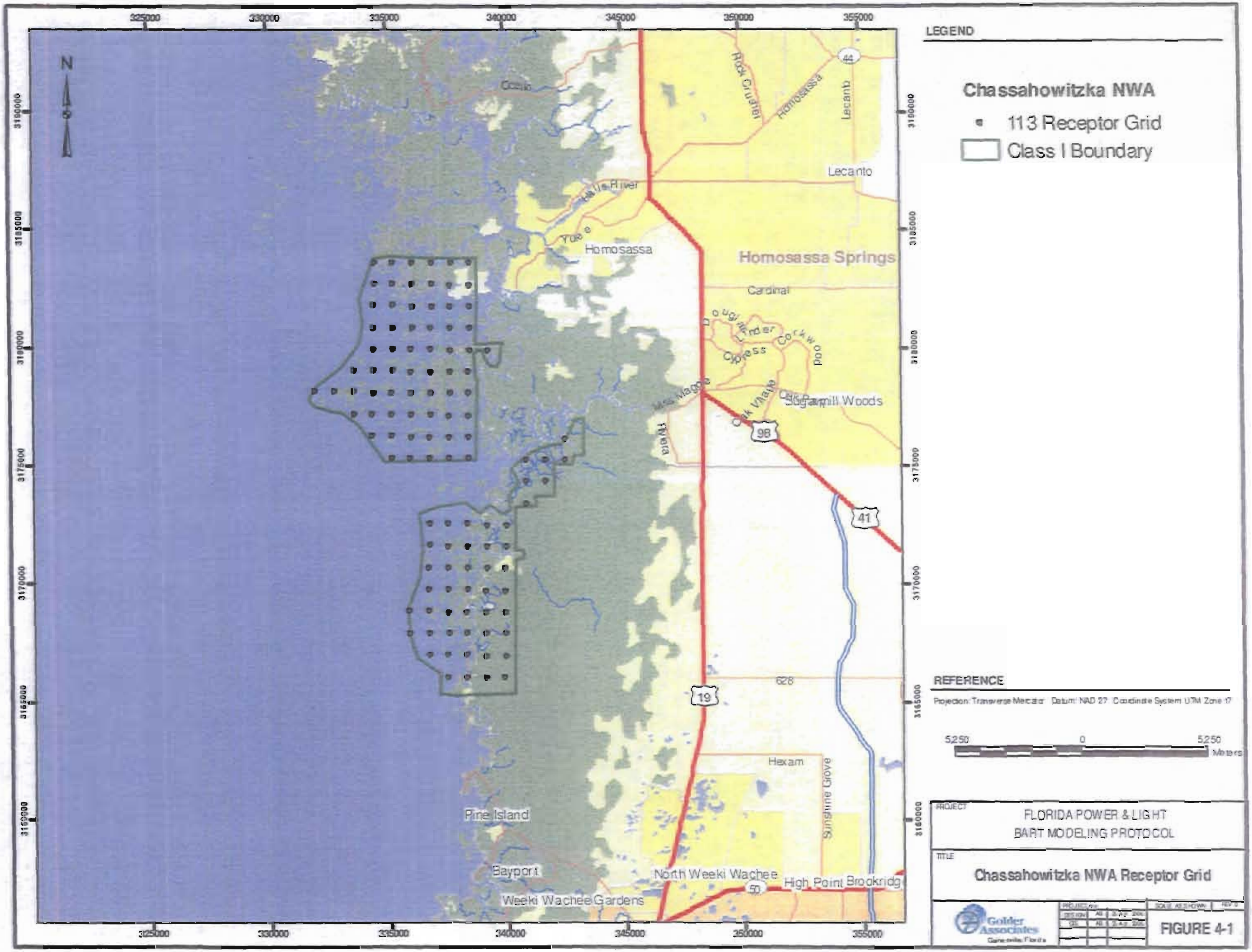
- Appropriate CALPUFF concentrations files are used in the POSTUTIL run;
- The PM species categories are computed using the appropriate fractions;
- Background light extinction computation method selected as Method 6;
- Correct monthly relative humidity adjustment factors used for the appropriate Class I area;
- Background light extinction values as described in Section 3.4 of this protocol;
- Appropriate species names for coarse and fine PM;
- Appropriate Rayleigh scattering term used; and
- Appropriate Class I receptors selected for each Class I area-specific CALPOST run.

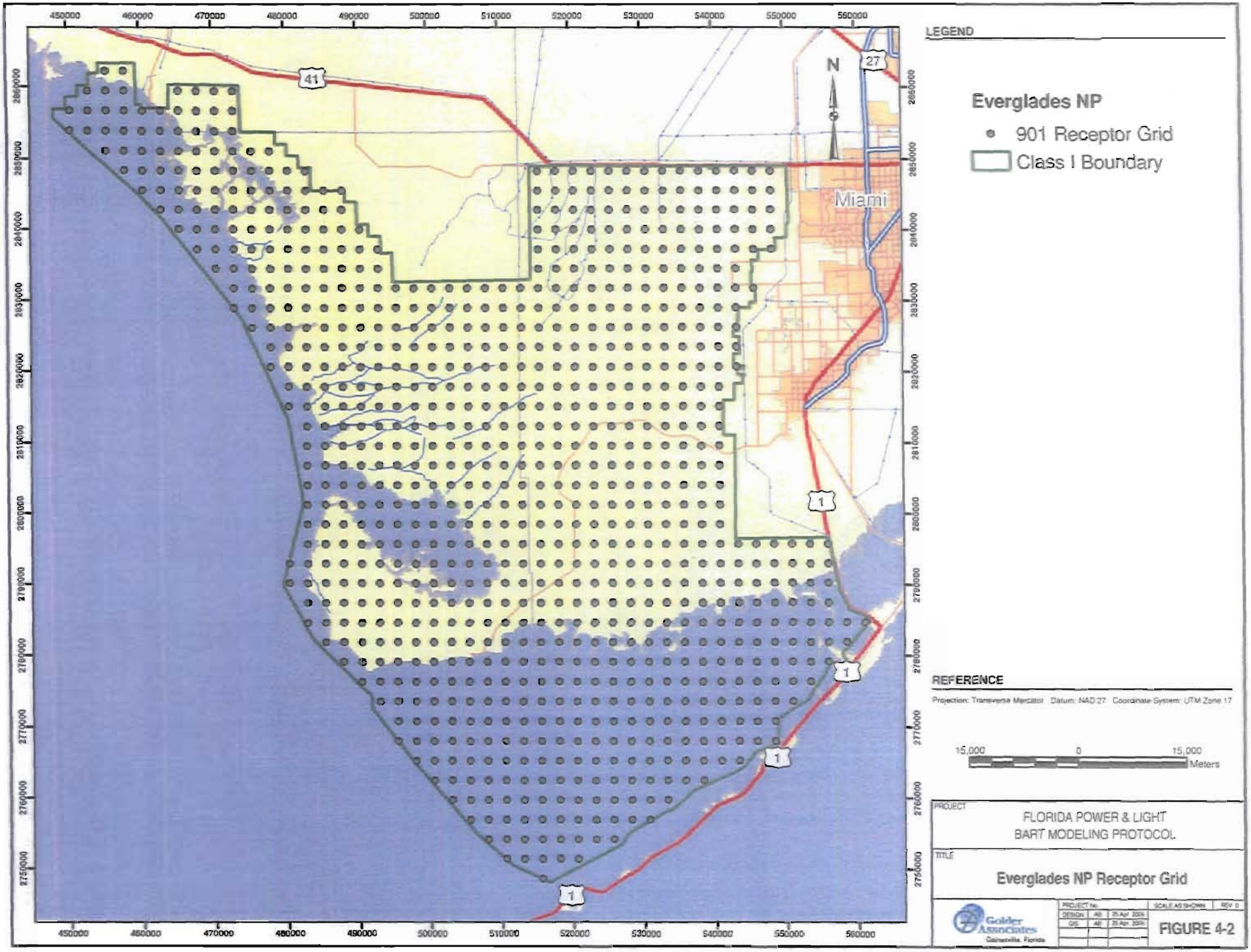
4.7 Modeling Report

A modeling report will be submitted containing the following information:

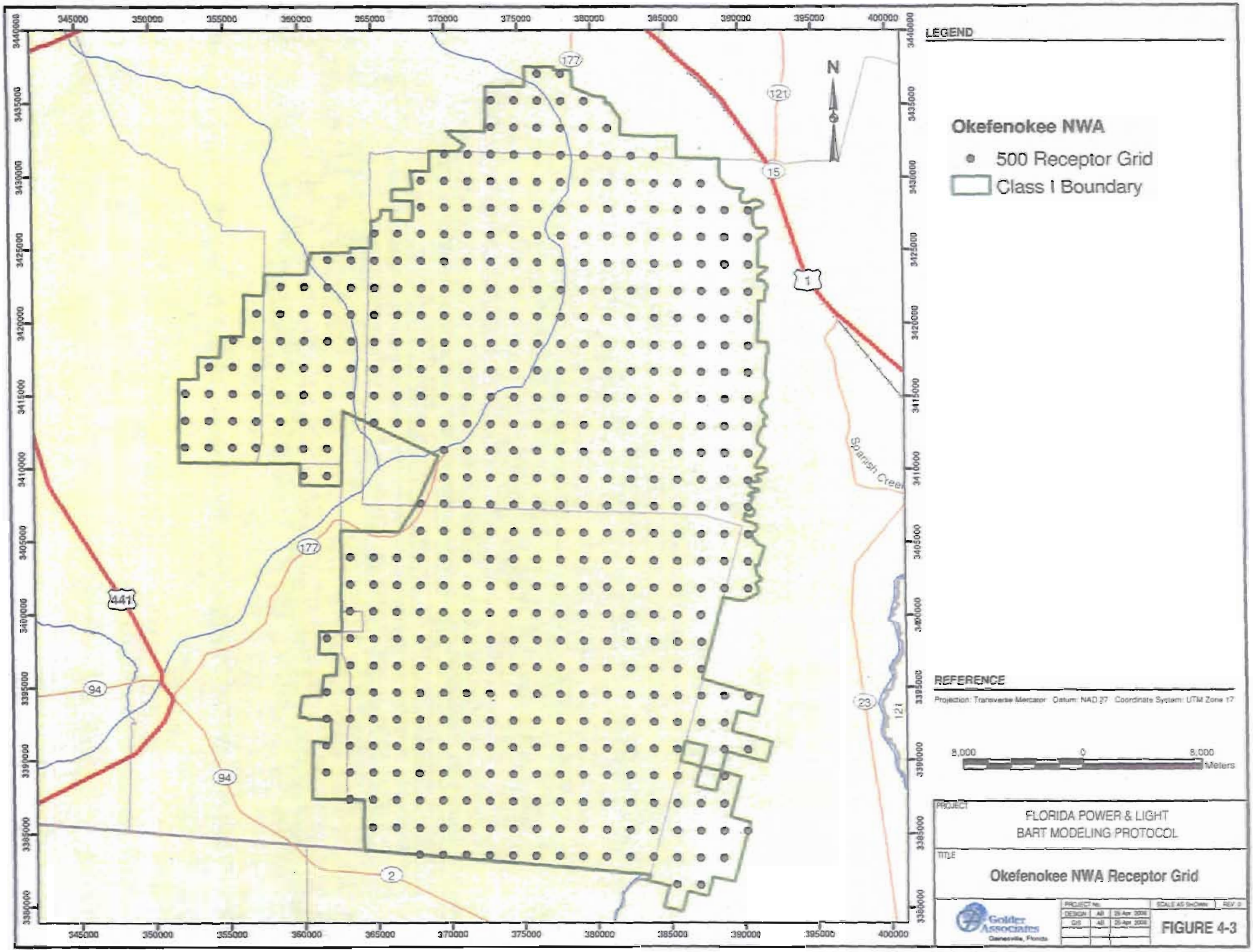
- Map of source location and Class I areas within 300 km of the source;
- Table showing visibility impacts at each Class I area within 300 km of the source; and
- For the refined modeling analysis, a table showing the eight highest visibility impairment values ranked in a descending order for the prime Class I area(s) of interest.
- Input and output files (excluding CALMET) used for either the exemption or determination modeling will be provided on CD.

The predicted visibility impairment results for the base emission case and selected BART emission scenarios, if applicable, will be included in the report to show the affect on visibility for each proposed control technology. Final recommendations for BART will also be presented, as needed, based on the analysis results of the five evaluation criteria presented in the regulations.

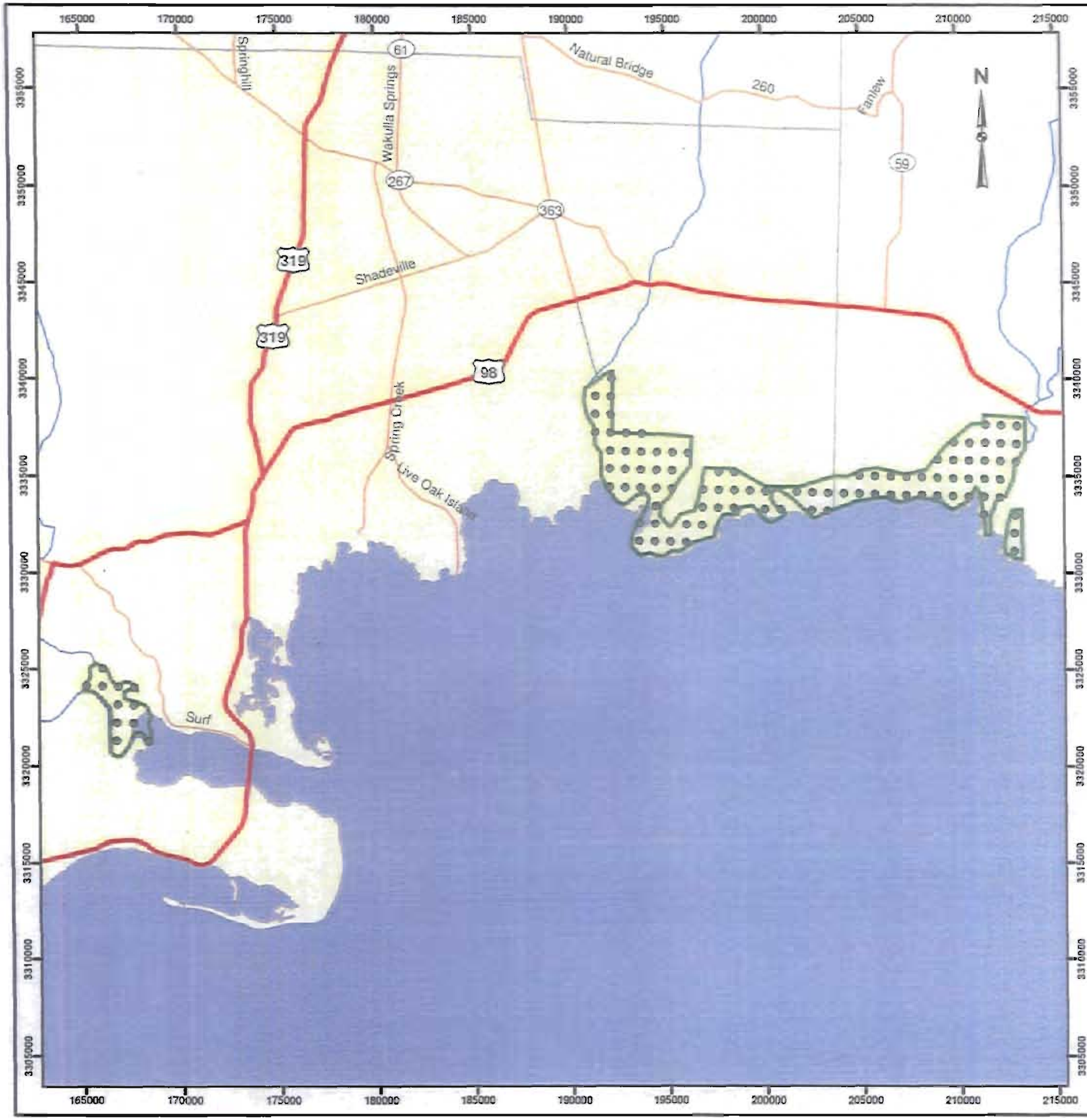

LEGEND
Chassahowitzka NWA
113 Receptor Grid
Class I Boundary
REFERENCE
Projection: Transverse Mercator Datum: NAD 27 Coordinate System UTM Zone 17
5250 0 5250
Meters
PROJECT
FLORIDA POWER & LIGHT
BART MODELING PROTOCOL
TITLE
Chassahowitzka NWA Receptor Grid
Golder Associates
FIGURE 4-1
325000
330000
335000
340000
345000
350000
355000
Homosassa
Homosassa Springs
Lecanto
Cardinal
Sugarmill Woods
Hexam
Pine Island
Bayport
North Weeki Wachee
High Point
Weeki Wachee Gardens
44
98
41
19
50
628



LEGEND
Everglades NP
901 Receptor Grid
Class I Boundary
REFERENCE
Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17
15,000 0 15,000
Meters
Miami
N
PROJECT
FLORIDA POWER & LIGHT
BART MODELING PROTOCOL
TITLE
Everglades NP Receptor Grid
Golder Associates
FIGURE 4-2



LEGEND
Okefenokee NWA
500 Receptor Grid
Class I Boundary
N
177
121
15
1
441
94
23
2
Spanish Creek
REFERENCE
Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17
8,000 0 8,000 Meters
PROJECT
FLORIDA POWER & LIGHT
BART MODELING PROTOCOL
TITLE
Okefenokee NWA Receptor Grid
Golder Associates
Gainesville, Florida
FIGURE 4-3



PROJECT

FLORIDA POWER & LIGHT
BART MODELING PROTOCOL

TITLE

Saint Marks NWA Receptor Grid

Golder Associates
Gainesville, Florida

SCALE AS SHOWN | REV. 0

FIGURE 4-4

APPENDIX A

EXAMPLE CALPUFF INPUT FILE

```
EXAMPLE FACILITY XYZ - CALPUFF
IMPACTS AT SOURCE-SPECIFIC CLASS I AREAS
4-km FLORIDA DOMAIN (VISTAS REFINED DOMAIN 2), 2001
--------------- Run title (3 lines) ------------------------------------------

                    CALPUFF MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    * METDAT =          *
    or
ISCMET.DAT    input    * ISCDAT =          *
    or
PLMMET.DAT    input    * PLMDAT =          *
    or
PROFILE.DAT   input    * PRFDAT =          *
SURFACE.DAT   input    * SFCDAT =          *
RESTARTB.DAT  input    * RSTARTB=          *
--------------------------------------------------------------------------------
CALPUFF.LST   output   ! PUFLST = PUFFEXP.LST !
CONC.DAT      output   ! CONDAT = PUFFEXP.CON !
DFLX.DAT      output   * DFDAT  =          *
WFLX.DAT      output   * WFDAT  =          *

VISB.DAT      output   * VISDAT =          *
TK2D.DAT      output   * T2DDAT =          *
RHO2D.DAT     output   * RHODAT =          *
RESTARTE.DAT  output   * RSTARTE=          *
--------------------------------------------------------------------------------
Emission Files
--------------
PTEMARB.DAT   input    * PTDAT  =          *
VOLEMARB.DAT  input    * VOLDAT =          *
BAEMARB.DAT   input    * ARDAT  =          *
LNEMARB.DAT   input    * LNDAT  =          *
--------------------------------------------------------------------------------
Other Files
-----------
OZONE.DAT     input    ! OZDAT  =C:\BARTHRO3\2001FLOz.DAT !
VD.DAT        input    * VDDAT  =          *
CHEM.DAT      input    * CHEMDAT=          *
H2O2.DAT      input    * H2O2DAT=          *
HILL.DAT      input    * HILDAT=          *
HILLRCT.DAT   input    * RCTDAT=          *
COASTLN.DAT   input    * CSTDAT=          *
FLUXBDY.DAT   input    * BDYDAT=          *
BCON.DAT      input    * BCNDAT=          *
DEBUG.DAT     output   * DEBUG =          *
MASSFLX.DAT   output   * FLXDAT=          *
MASSBAL.DAT   output   * BALDAT=          *
FOG.DAT       output   * FOGDAT=          *
--------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = T !
         F = UPPER CASE
NOTE: (1) file/path names can be up to 70 characters in length


Provision for multiple input files
----------------------------------

     Number of CALMET.DAT files for run (NMETDAT)
                                Default: 1       ! NMETDAT =   36  !

     Number of PTEMARB.DAT files for run (NPTDAT)
                                Default: 0       ! NPTDAT =  0  !

     Number of BAEMARB.DAT files for run (NARDAT)
```

```
                                        Default: 0        ! NARDAT =  0  !

    Number of VOLEMARB.DAT files for run (NVOLDAT)
                                        Default: 0        ! NVOLDAT =  0  !

!END!

-------------
Subgroup (0a)
-------------

  The following CALMET.DAT filenames are processed in sequence if NMETDAT>1

Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-01A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-01B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-01C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-02A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-02B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-02C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-03A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-03B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-03C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-04A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-04B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-04C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-05A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-05B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-05C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-06A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-06B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-06C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-07A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-07B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-07C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-08A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-08B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-08C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-09A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-09B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-09C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-10A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-10B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-10C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-11A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-11B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-11C.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-12A.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-12B.DAT ! !END!
CALMET.DAT    input    ! METDAT =E:\FLA4KM\2001\MET2001-DOM2-12C.DAT ! !END!
-------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

    Option to run all periods found
    in the met. file     (METRUN)   Default: 0        ! METRUN =   0  !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in met. file

     Starting date:    Year (IBYR) -- No default       ! IBYR =  2001  !
     (used only if    Month (IBMO) -- No default       ! IBMO =  1  !
      METRUN = 0)       Day (IBDY) -- No default       ! IBDY =  1  !
                       Hour (IBHR) -- No default       ! IBHR =  1  !

     Base time zone        (XBTZ) -- No default        ! XBTZ = 5.0  !
        PST = 8., MST = 7.
        CST = 6., EST = 5.

     Length of run (hours) (IRLG) -- No default        ! IRLG = 8760 !

     Number of chemical species (NSPEC)
                                        Default: 5     ! NSPEC = 11   !
```

```
Number of chemical species
to be emitted  (NSE)              Default: 3        ! NSE = 9   !

Flag to stop run after
SETUP phase (ITEST)               Default: 2        ! ITEST =  2   !
(Used to allow checking
of the model inputs, files, etc.)
      ITEST = 1 - STOPS program after SETUP phase
      ITEST = 2 - Continues with execution of program
                  after SETUP

Restart Configuration:

   Control flag (MRESTART)        Default: 0        ! MRESTART =  0   !

      0 = Do not read or write a restart file
      1 = Read a restart file at the beginning of
          the run
      2 = Write a restart file during run
      3 = Read a restart file at beginning of run
          and write a restart file during run

   Number of periods in Restart
   output cycle (NRESPD)          Default: 0        ! NRESPD =  0   !

      0 = File written only at last period
     >0 = File updated every NRESPD periods

Meteorological Data Format (METFM)
                                  Default: 1        ! METFM =  1   !

      METFM = 1 - CA MET binary file (CA MET.MET)
      METFM = 2 - ISC ASCII file (ISCMET.MET)
      METFM = 3 - AUSP UME ASCII file (P MMET.MET)
      METFM =   - CTDM plus tower file (PROFI E.DAT) and
                  surface parameters file (SURFACE.DAT)

P  sigma-y is ad usted by the factor (A ET P TIME)  0.2
Averaging Time (minutes) (A ET)
                                  Default:  0.0     ! A ET =  0. !
P  Averaging Time (minutes) (P TIME)
                                  Default:  0.0     ! P TIME =  0. !


!END!


--------------------------------------------------------------------------------

INPUT  ROUP: 2 -- Technical options
--------------


    ertical distribution used in the
   near field (M AUSS)                    Default: 1     ! M AUSS =  1   !
      0 = uniform
      1 =  aussian

   Terrain ad ustment method
   (MCTAD )                               Default: 3     ! MCTAD  =  3   !
      0 = no ad ustment
      1 = ISC-type of terrain ad ustment
      2 = simple, CA PUFF-type of terrain
          ad ustment
      3 = partial plume path ad ustment

   Subgrid-scale complex terrain
   flag (MCTS )                           Default: 0     ! MCTS   =  0   !
      0 = not modeled
      1 = modeled

   Near-field puffs modeled as
   elongated 0 (MS U )                    Default: 0     ! MS U   =  0   !
      0 = no
```

```
   1 = yes (slug model used)

Transitional plume rise modeled ?
(MTRANS)                            Default: 1     ! MTRANS =  1   !
   0 = no  (i.e., final rise only)
   1 = yes (i.e., transitional rise computed)

Stack tip downwash? (MTIP)          Default: 1     ! MTIP =  1  !
   0 = no  (i.e., no stack tip downwash)
   1 = yes (i.e., use stack tip downwash)

Vertical wind shear modeled above
stack top? (MSHEAR)                 Default: 0     ! MSHEAR =  0  !
   0 = no  (i.e., vertical wind shear not modeled)
   1 = yes (i.e., vertical wind shear modeled)

Puff splitting allowed? (MSPLIT)    Default: 0     ! MSPLIT =  0  !
   0 = no (i.e., puffs not split)
   1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM)     Default: 1     ! MCHEM =  1   !
   0 = chemical transformation not
       modeled
   1 = transformation rates computed
       internally (MESOPUFF II scheme)
   2 = user-specified transformation
       rates used
   3 = transformation rates computed
       internally (RIVAD/ARM3 scheme)
   4 = secondary organic aerosol formation
       computed (MESOPUFF II scheme for OH)

Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 1, or 3)      Default: 0     ! MAQCHEM =  0   !
   0 = aqueous phase transformation
       not modeled
   1 = transformation rates adjusted
       for aqueous phase reactions

Wet removal modeled ? (MWET)        Default: 1     ! MWET =  1   !
   0 = no
   1 = yes

Dry deposition modeled ? (MDRY)     Default: 1     ! MDRY =  1   !
   0 = no
   1 = yes
   (dry deposition method specified
    for each species in Input Group 3)

Method used to compute dispersion
coefficients (MDISP)                Default: 3     ! MDISP =  3   !

   1 = dispersion coefficients computed from measured values
       of turbulence, sigma v, sigma w
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.
   5 = CTDM sigmas used for stable and neutral conditions.
       For unstable conditions, sigmas are computed as in
       MDISP = 3, described above.  MDISP = 5 assumes that
       measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
(Used only if MDISP = 1 or 5)       Default: 3     ! MTURBVW =  3  !
   1 = use sigma-v or sigma-theta measurements
       from PROFILE.DAT to compute sigma-y
       (valid for METFM = 1, 2, 3, 4)
   2 = use sigma-w measurements
       from PROFILE.DAT to compute sigma-z
       (valid for METFM = 1, 2, 3, 4)
```

```
   3 = use both sigma-(v/theta) and sigma-w
       from PROFILE.DAT to compute sigma-y and sigma-z
       (valid for METFM = 1, 2, 3, 4)
   4 = use sigma-theta measurements
       from PLMMET.DAT to compute sigma-y
       (valid only if METFM = 3)

Back-up method used to compute dispersion
when measured turbulence data are
missing (MDISP2)                       Default: 3     ! MDISP2 =  3  !
(used only if MDISP = 1 or 5)
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.

PG sigma-y,z adj. for roughness?       Default: 0     ! MROUGH =  0  !
(MROUGH)
   0 = no
   1 = yes

Partial plume penetration of           Default: 1     ! MPARTL =  1  !
elevated inversion?
(MPARTL)
   0 = no
   1 = yes

Strength of temperature inversion      Default: 0     ! MTINV =  0  !
provided in PROFILE.DAT extended records?
(MTINV)
   0 = no (computed from measured/default gradients)
   1 = yes

PDF used for dispersion under convective conditions?
                                       Default: 0     ! MPDF =  0  !
(MPDF)
   0 = no
   1 = yes

Sub-Grid TIBL module used for shore line?
                                       Default: 0     ! MSGTIBL = 0  !
(MSGTIBL)
   0 = no
   1 = yes

Boundary conditions (concentration) modeled?
                                       Default: 0     ! MBCON = 0  !
(MBCON)
   0 = no
   1 = yes


Analyses of fogging and icing impacts due to emissions from
arrays of mechanically-forced cooling towers can be performed
using CALPUFF in conjunction with a cooling tower emissions
processor (CTEMISS) and its associated postprocessors.  Hourly
emissions of water vapor and temperature from each cooling tower
cell are computed for the current cell configuration and ambient
conditions by CTEMISS. CALPUFF models the dispersion of these
emissions and provides cloud information in a specialized format
for further analysis. Output to FOG.DAT is provided in either
'plume mode' or 'receptor mode' format.

Configure for FOG Model output?
                                       Default: 0     ! MFOG =  0   !
(MFOG)
   0 = no
   1 = yes  - report results in PLUME Mode format
   2 = yes  - report results in RECEPTOR Mode format
```

```
     Test options specified to see if
     they conform to regulatory
     values? (MREG)                          Default: 1     ! MREG =  1   !

        0 = NO checks are made
        1 = Technical options must conform to USEPA
            Long Range Transport (LRT) guidance
                        METFM     1 or 2
                        AVET      60. (min)
                        PGTIME    60. (min)
                        MGAUSS    1
                        MCTADJ    3
                        MTRANS    1
                        MTIP      1
                        MCHEM     1 or 3 (if modeling SOx, NOx)
                        MWET      1
                        MDRY      1
                        MDISP     2 or 3
                        MPDF      0 if MDISP=3
                                  1 if MDISP=2
                        MROUGH    0
                        MPARTL    1
                        SYTDEP    550. (m)
                        MHFTSZ    0

!END!

--------------------------------------------------------------------------------

INPUT GROUP: 3a, 3b -- Species list
-------------------

------------
Subgroup (3a)
------------

  The following species are modeled:

! CSPEC =          SO2 !          !END!
! CSPEC =          SO4 !          !END!
! CSPEC =          NOX !          !END!
! CSPEC =         HNO3 !          !END!
! CSPEC =          NO3 !          !END!
! CSPEC =       PM0063 !          !END!
! CSPEC =       PM0100 !          !END!
! CSPEC =       PM0125 !          !END!
! CSPEC =       PM0250 !          !END!
! CSPEC =       PM0600 !          !END!
! CSPEC =       PM1000 !          !END!

                                                          Dry                OUTPUT GROUP
    SPECIES          MODELED          EMITTED          DEPOSITED               NUMBER
     NAME         (0=NO, 1=YES)    (0=NO, 1=YES)    (0=NO,                  (0=NONE,
   (Limit: 12                                        1=COMPUTED-GAS          1=1st CGRUP,
    Characters                                       2=COMPUTED-PARTICLE     2=2nd CGRUP,
    in length)                                       3=USER-SPECIFIED)       3= etc.)

!          SO2  =          1,               1,            1,                 0    !
!          SO4  =          1,               1,            2,                 0    !
!          NOX  =          1,               1,            1,                 0    !
!         HNO3  =          1,               0,            1,                 0    !
!          NO3  =          1,               0,            2,                 0    !
!       PM0063  =          1,               1,            2,                 1    !
!       PM0100  =          1,               1,            2,                 1    !
!       PM0125  =          1,               1,            2,                 1    !
!       PM0250  =          1,               1,            2,                 1    !
!       PM0600  =          1,               1,            2,                 1    !
!       PM1000  =          1,               1,            2,                 1    !

!END!

-------------
Subgroup (3b)
```

```
-------------
  The following names are used for Species-Groups in which results
  for certain species are combined (added) prior to output.  The
  CGRUP name will be used as the species name in output files.
  Use this feature to model specific particle-size distributions
  by treating each size-range as a separate species.
  Order must be consistent with 3(a) above.

! CGRUP =          PM10 !     !END!

INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM     ! PMAP = LCC  !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                    Default=0.0      ! FEAST  = 0.000  !
     (FNORTH)                   Default=0.0      ! FNORTH = 0.000  !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                   No Default       ! IUTMZN =  0 !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                   Default: N       ! UTMHEM = N  !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection

     Latitude and Longitude (decimal degrees) of projection origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                    No Default       ! RLAT0 =  40N !
     (RLON0)                    No Default       ! RLON0 =  97W !

         TTM :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         LCC :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         PS  :  RLON0 identifies central (grid N/S) meridian of projection
                RLAT0 selected for convenience
         EM  :  RLON0 identifies central meridian of projection
                RLAT0 is REPLACED by 0.0N (Equator)
         LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
                RLAT0 identifies latitude of tangent-point of mapping plane

     Matching parallel(s) of latitude (decimal degrees) for projection
     (Used only if PMAP= LCC or PS)
     (XLAT1)                    No Default       ! XLAT1 = 33N  !
     (XLAT2)                    No Default       ! XLAT2 = 45N  !

         LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
         PS  :  Projection plane slices through Earth at XLAT1
                (XLAT2 is not used)

     ----------
     Note:  Latitudes and longitudes should be positive, and include a
            letter N,S,E, or W indicating north or south latitude, and
            east or west longitude.  For example,
            35.9  N Latitude  =  35.9N
            118.7 E Longitude = 118.7E


     Datum-region
```

The Datum-Region for the coordinates is identified by a character string. Many mapping products currently available use the model of the Earth known as the World Geodetic System 1984 (WGS-84). Other local models may be in use, and their selection in CALMET will make its output consistent with local mapping products. The list of Datum-Regions with official transformation parameters is provided by the National Imagery and Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)

WGS-84	WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
NAS-C	NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
NAR-C	NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
NWS-84	NWS 6370KM Radius, Sphere
ESR-S	ESRI REFERENCE 6371KM Radius, Sphere

```
Datum-region for output coordinates
(DATUM)                    Default: WGS-G      ! DATUM = NWS-84 !
```

METEOROLOGICAL Grid:

Rectangular grid defined for projection PMAP,
with X the Easting and Y the Northing coordinate

```
        No. X grid cells (NX)      No default     ! NX = 263   !
        No. Y grid cells (NY)      No default     ! NY = 206    !
     No. vertical layers (NZ)      No default     ! NZ =  10   !

       Grid spacing (DGRIDKM)      No default     ! DGRIDKM = 4. !
                                   Units: km

            Cell face heights
                (ZFACE(nz+1))      No defaults
                                   Units: m
   ! ZFACE = 0.,20.,40.,80.,160.,320.,640.,1200.,2000.,3000.,4000. !

        Reference Coordinates
       of SOUTHWEST corner of
            grid cell(1, 1):

        X coordinate (XORIGKM)     No default     ! XORIGKM =  721.995 !
        Y coordinate (YORIGKM)     No default     ! YORIGKM = -1598.000 !
                                  Units: km
```

COMPUTATIONAL Grid:

The computational grid is identical to or a subset of the MET. grid. The lower left (LL) corner of the computational grid is at grid point (IBCOMP, JBCOMP) of the MET. grid. The upper right (UR) corner of the computational grid is at grid point (IECOMP, JECOMP) of the MET. grid. The grid spacing of the computational grid is the same as the MET. grid.

```
   X index of LL corner (IBCOMP)      No default     ! IBCOMP =  1  !
             (1 <= IBCOMP <= NX)

   Y index of LL corner (JBCOMP)      No default     ! JBCOMP =  1  !
             (1 <= JBCOMP <= NY)


   X index of UR corner (IECOMP)      No default     ! IECOMP = 263 !
             (1 <= IECOMP <= NX)

   Y index of UR corner (JECOMP)      No default     ! JECOMP = 206 !
             (1 <= JECOMP <= NY)
```

SAMPLING Grid (GRIDDED RECEPTORS):

The lower left (LL) corner of the sampling grid is at grid point (IBSAMP, JBSAMP) of the MET. grid. The upper right (UR) corner of the

```
     sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
     The sampling grid must be identical to or a subset of the computational
     grid.  It may be a nested grid inside the computational grid.
     The grid spacing of the sampling grid is DGRIDKM/MESHDN.

        Logical flag indicating if gridded
        receptors are used (LSAMP)          Default: T      ! LSAMP = F !
        (T=yes, F=no)

        X index of LL corner (IBSAMP)       No default      ! IBSAMP =  1    !
         (IBCOMP <= IBSAMP <= IECOMP)

        Y index of LL corner (JBSAMP)       No default      ! JBSAMP =  1    !
         (JBCOMP <= JBSAMP <= JECOMP)


        X index of UR corner (IESAMP)       No default      ! IESAMP =  263 !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)       No default      ! JESAMP =  206   !
         (JBCOMP <= JESAMP <= JECOMP)


       Nesting factor of the sampling
        grid (MESHDN)                       Default: 1      ! MESHDN =  1   !
        (MESHDN is an integer >= 1)

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 5 -- Output Options
--------------
                                                   *                      *
     FILE                      DEFAULT VALUE             VALUE THIS RUN
     ----                      -------------             --------------

   Concentrations (ICON)              1                  !  ICON  =  1    !
   Dry Fluxes (IDRY)                  1                  !  IDRY  =  0    !
   Wet Fluxes (IWET)                  1                  !  IWET  =  0    !
   Relative Humidity (IVIS)           1                  !  IVIS  =  0    !
    (relative humidity file is
     required for visibility
     analysis)
   Use data compression option in output file?
   (LCOMPRS)                               Default: T    ! LCOMPRS = T !

   *
    0 = Do not create file, 1 = create file


    DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

       Mass flux across specified boundaries
       for selected species reported hourly?
       (IMFLX)                             Default: 0    ! IMFLX =  0   !
         0 = no
         1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
                 are specified in Input Group 0)

       Mass balance for each species
       reported hourly?
       (IMBAL)                             Default: 0    ! IMBAL =  0   !
         0 = no
         1 = yes (MASSBAL.DAT filename is
             specified in Input Group 0)


    LINE PRINTER OUTPUT OPTIONS:

       Print concentrations (ICPRT)        Default: 0    ! ICPRT =  0    !
       Print dry fluxes (IDPRT)            Default: 0    ! IDPRT =  0    !
       Print wet fluxes (IWPRT)            Default: 0    ! IWPRT =  0    !
```

```
       (0 = Do not print, 1 = Print)

       Concentration print interval
       (ICFRQ) in hours                  Default: 1         ! ICFRQ =  24   !
       Dry flux print interval
       (IDFRQ) in hours                  Default: 1         ! IDFRQ =  1    !
       Wet flux print interval
       (IWFRQ) in hours                  Default: 1         ! IWFRQ =  1    !

       Units for Line Printer Output
       (IPRTU)                           Default: 1         ! IPRTU =  3    !
                          for             for
                     Concentration    Deposition
           1 =          g/m**3         g/m**2/s
           2 =         mg/m**3        mg/m**2/s
           3 =         ug/m**3        ug/m**2/s
           4 =         ng/m**3        ng/m**2/s
           5 =        Odour Units

       Messages tracking progress of run
       written to the screen ?
       (IMESG)                           Default: 2         ! IMESG =  2    !
         0 = no
         1 = yes (advection step, puff ID)
         2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)


     SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

                 ---- CONCENTRATIONS ----    ------ DRY FLUXES ------    ------ WET FLUXES ------    --
MASS FLUX --
   SPECIES
   /GROUP        PRINTED?  SAVED ON DISK?    PRINTED?  SAVED ON DISK?    PRINTED?  SAVED ON DISK?    SAVED
ON DISK?
   -------       ------------------------    ------------------------    ------------------------    ------
---------
!         SO2 =     0,           1,             0,           1,             0,           1,             0    !
!         SO4 =     0,           1,             0,           1,             0,           1,             0    !
!         NOX =     0,           1,             0,           1,             0,           1,             0    !
!        HNO3 =     0,           1,             0,           1,             0,           1,             0    !
!         NO3 =     0,           1,             0,           1,             0,           1,             0    !
!        PM10 =     0,           1,             0,           1,             0,           1,             0    !

     OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

       Logical for debug output
       (LDEBUG)                                   Default: F     ! LDEBUG = F !

       First puff to track
       (IPFDEB)                                   Default: 1     ! IPFDEB =  1  !

       Number of puffs to track
       (NPFDEB)                                   Default: 1     ! NPFDEB =  1  !

       Met. period to start output
       (NN1)                                      Default: 1     ! NN1 =  1   !

       Met. period to end output
       (NN2)                                      Default: 10    ! NN2 =  10  !

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs
-------------------------


---------------
Subgroup (6a)
---------------
       Number of terrain features (NHILL)       Default: 0     ! NHILL =  0   !

       Number of special complex terrain
```

```
        receptors  (NCTREC)                     Default: 0      ! NCTREC =  0   !

        Terrain and CTSG Receptor data for
        CTSG hills input in CTDM format ?
        (MHILL)                                 No Default      ! MHILL =  2   !
        1 = Hill and Receptor data created
            by CTDM processors & read from
            HILL.DAT and HILLRCT.DAT files
        2 = Hill data created by OPTHILL &
            input below in Subgroup (6b);
            Receptor data in Subgroup (6c)

        Factor to convert horizontal dimensions  Default: 1.0   ! XHILL2M = 1. !
        to meters (MHILL=1)

        Factor to convert vertical dimensions    Default: 1.0   ! ZHILL2M = 1. !
        to meters (MHILL=1)

        X-origin of CTDM system relative to      No Default     ! XCTDMKM = 0.0E00 !
        CALPUFF coordinate system, in Kilometers (MHILL=1)

        Y-origin of CTDM system relative to      No Default     ! YCTDMKM = 0.0E00 !
        CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

---------------
Subgroup (6b)
---------------

                         1 **
     HILL information


HILL        XC        YC       THETAH  ZGRID  RELIEF    EXPO 1    EXPO 2   SCALE 1    SCALE 2
AMAX1     AMAX2
 NO.       (km)      (km)      (deg.)   (m)     (m)       (m)       (m)       (m)        (m)        (m)
(m)
----      ----      ----       ------  -----  ------    ------    ------    -------    -------    ----
-     -----

---------------
Subgroup (6c)
---------------

    COMPLEX TERRAIN RECEPTOR INFORMATION

                         XRCT         YRCT        ZRCT          XHH
                         (km)         (km)         (m)
                        ------        -----       ------        ----


-------------------
1
     Description of Complex Terrain Variables:
          XC, YC  = Coordinates of center of hill
          THETAH  = Orientation of major axis of hill (clockwise from
                    North)
          ZGRID   = Height of the  0  of the grid above mean sea
                    level
          RELIEF  = Height of the crest of the hill above the grid elevation
          EXPO 1  = Hill-shape exponent for the major axis
          EXPO 2  = Hill-shape exponent for the major axis
          SCALE 1 = Horizontal length scale along the major axis
          SCALE 2 = Horizontal length scale along the minor axis
          AMAX    = Maximum allowed axis length for the major axis
          BMAX    = Maximum allowed axis length for the major axis

          XRCT, YRCT = Coordinates of the complex terrain receptors
          ZRCT    = Height of the ground (MSL) at the complex terrain
                    Receptor
          XHH     = Hill number associated with each complex terrain receptor
                    (NOTE: MUST BE ENTERED AS A REAL NUMBER)

   **
```

NOTE: DATA for each hill and CTSG receptor are treated as a separate
input subgroup and therefore must end with an input group terminator.

INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases

SPECIES NAME	DIFFUSIVITY (cm**2/s)	ALPHA STAR	REACTIVITY	MESOPHYLL RESISTANCE (s/cm)	HENRY'S LAW COEFFICIENT (dimensionless)
! SO2 =	0.1509,	1000,	8,	0,	0.04 !
! NOX =	0.1656,	1,	8,	5,	3.5 !
! HNO3 =	0.1628,	1,	18,	0,	0.00000008 !

!END!

INPUT GROUP: 8 -- Size parameters for dry deposition of particles

For SINGLE SPECIES, the mean and standard deviation are used to compute a deposition velocity for NINT (see group 9) size-ranges, and these are then averaged to obtain a mean deposition velocity.

For GROUPED SPECIES, the size distribution should be explicitly specified (by the 'species' in the group), and the standard deviation for each should be entered as 0. The model will then use the deposition velocity for the stated mean diameter.

SPECIES NAME	GEOMETRIC MASS MEAN DIAMETER (microns)	GEOMETRIC STANDARD DEVIATION (microns)
! SO4 =	0.48,	2. !
! NO3 =	0.48,	2. !
! PM0063 =	0.63,	0. !
! PM0100 =	1.00,	0. !
! PM0125 =	1.25,	0. !
! PM0250 =	2.50,	0. !
! PM0600 =	6.00,	0. !
! PM1000 =	10.00,	0. !

!END!

INPUT GROUP: 9 -- Miscellaneous dry deposition parameters

```
Reference cuticle resistance (s/cm)
(RCUTR)                            Default: 30     !  RCUTR = 30.0 !
Reference ground resistance  (s/cm)
(RGR)                              Default: 10     !    RGR = 10.0 !
Reference pollutant reactivity
(REACTR)                           Default: 8      ! REACTR = 8.0 !

Number of particle-size intervals used to
evaluate effective particle deposition velocity
(NINT)                             Default: 9      !   NINT =  9   !

Vegetation state in unirrigated areas
(IVEG)                             Default: 1      !   IVEG =  1   !
   IVEG=1 for active and unstressed vegetation
   IVEG=2 for active and stressed vegetation
```

```
        IVEG=3 for inactive vegetation

!END!

-------------------------------------------------------------------------------


INPUT GROUP: 10 -- Wet Deposition Parameters
---------------


                     Scavenging Coefficient -- Units: (sec)**(-1)

       Pollutant      Liquid Precip.       Frozen Precip.
       ---------      --------------       --------------
!         SO2 =         3.0E-05,              0.0E00 !
!         SO4 =         1.0E-04,              3.0E-05 !
!        HNO3 =         6.0E-05,              0.0E00 !
!         NO3 =         1.0E-04,              3.0E-05 !
!      PM0063 =         1.0E-04,              3.0E-05 !
!      PM0100 =         1.0E-04,              3.0E-05 !
!      PM0125 =         1.0E-04,              3.0E-05 !
!      PM0250 =         1.0E-04,              3.0E-05 !
!      PM0600 =         1.0E-04,              3.0E-05 !
!      PM1000 =         1.0E-04,              3.0E-05 !

!END!

-------------------------------------------------------------------------------


INPUT GROUP: 11 -- Chemistry Parameters
---------------

     Ozone data input option (MOZ)     Default: 1            ! MOZ =  1   !
     (Used only if MCHEM = 1, 3, or 4)
        0 = use a monthly background ozone value
        1 = read hourly ozone concentrations from
            the OZONE.DAT data file

     Monthly ozone concentrations
     (Used only if MCHEM = 1, 3, or 4 and
      MOZ = 0 or MOZ = 1 and all hourly O3 data missing)
     (BCKO3) in ppb                    Default: 12*80.
     !  BCKO3 = 12*50. !

     Monthly ammonia concentrations
     (Used only if MCHEM = 1, or 3)
     (BCKNH3) in ppb                   Default: 12*10.
     !  BCKNH3 = 12*0.5 !

     Nighttime SO2 loss rate (RNITE1)
     in percent/hour                   Default: 0.2          ! RNITE1 = .2 !

     Nighttime NOx loss rate (RNITE2)
     in percent/hour                   Default: 2.0          ! RNITE2 = 2.0 !

     Nighttime HNO3 formation rate (RNITE3)
     in percent/hour                   Default: 2.0          ! RNITE3 = 2.0 !

     H2O2 data input option (MH2O2)    Default: 1            ! MH2O2 =  1   !
     (Used only if MAQCHEM = 1)
        0 = use a monthly background H2O2 value
        1 = read hourly H2O2 concentrations from
            the H2O2.DAT data file

     Monthly H2O2 concentrations
     (Used only if MQACHEM = 1 and
      MH2O2 = 0 or MH2O2 = 1 and all hourly H2O2 data missing)
     (BCKH2O2) in ppb                  Default: 12*1.
     !  BCKH2O2 = 12*1 !
```

```
--- Data for SECONDARY ORGANIC AEROSOL (SOA) Option
    (used only if MCHEM = 4)

    The SOA module uses monthly values of:
         Fine particulate concentration in ug/m^3 (BCKPMF)
         Organic fraction of fine particulate     (OFRAC)
         VOC / NOX ratio (after reaction)         (VCNX)
    to characterize the air mass when computing
    the formation of SOA from VOC emissions.
    Typical values for several distinct air mass types are:

       Month    1    2    3    4    5    6    7    8    9   10   11   12
               Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

    Clean Continental
       BCKPMF   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.
       OFRAC  .15  .15  .20  .20  .20  .20  .20  .20  .20  .20  .20  .15
       VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

    Clean Marine (surface)
       BCKPMF  .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5
       OFRAC  .25  .25  .30  .30  .30  .30  .30  .30  .30  .30  .30  .25
       VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

    Urban - low biogenic (controls present)
       BCKPMF  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.
       OFRAC  .20  .20  .25  .25  .25  .25  .25  .25  .20  .20  .20  .20
       VCNX     4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.

    Urban - high biogenic (controls present)
       BCKPMF  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.
       OFRAC  .25  .25  .30  .30  .30  .55  .55  .55  .35  .35  .35  .25
       VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

    Regional Plume
       BCKPMF  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.
       OFRAC  .20  .20  .25  .35  .25  .40  .40  .40  .30  .30  .30  .20
       VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

    Urban - no controls present
       BCKPMF 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100.
       OFRAC  .30  .30  .35  .35  .35  .55  .55  .55  .35  .35  .35  .30
       VCNX     2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.

    Default: Clean Continental
    !  BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !
    !  OFRAC  = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15 !
    !  VCNX   = 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00 !

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters
---------------

    Horizontal size of puff (m) beyond which
    time-dependent dispersion equations (Heffter)
    are used to determine sigma-y and
    sigma-z (SYTDEP)                           Default: 550.    ! SYTDEP = 5.5E02 !

    Switch for using Heffter equation for sigma z
    as above (0 = Not use Heffter; 1 = use Heffter
    (MHFTSZ)                                   Default: 0       ! MHFTSZ =  0   !

    Stability class used to determine plume
    growth rates for puffs above the boundary
    layer (JSUP)                               Default: 5       ! JSUP =  5   !

    Vertical dispersion constant for stable
    conditions (k1 in Eqn. 2.7-3)  (CONK1)     Default: 0.01    ! CONK1 = .01 !
```

```
Vertical dispersion constant for neutral/
unstable conditions (k2 in Eqn. 2.7-4)
(CONK2)                                      Default: 0.1     ! CONK2 = .1 !

Factor for determining Transition-point from
Schulman-Scire to Huber-Snyder Building Downwash
scheme (SS used for Hs < Hb + TBD * HL)
(TBD)                                        Default: 0.5     ! TBD = .5 !
   TBD < 0    ==> always use Huber-Snyder
   TBD = 1.5 ==> always use Schulman-Scire
   TBD = 0.5 ==> ISC Transition-point

Range of land use categories for which
urban dispersion is assumed
(IURB1, IURB2)                               Default: 10      ! IURB1 =  10  !
                                                      19      ! IURB2 =  19  !

Site characterization parameters for single-point Met data files ---------
(needed for METFM = 2,3,4)

   Land use category for modeling domain
   (ILANDUIN)                                Default: 20      ! ILANDUIN =  20  !

   Roughness length (m) for modeling domain
   (Z0IN)                                    Default: 0.25    ! Z0IN = .25 !

   Leaf area index for modeling domain
   (XLAIIN)                                  Default: 3.0     ! XLAIIN = 3.0 !

   Elevation above sea level (m)
   (ELEVIN)                                  Default: 0.0     ! ELEVIN = .0 !

   Latitude (degrees) for met location
   (XLATIN)                                  Default: -999.   ! XLATIN = -999.0 !

   Longitude (degrees) for met location
   (XLONIN)                                  Default: -999.   ! XLONIN = -999.0 !

Specialized information for interpreting single-point Met data files -----

   Anemometer height (m) (Used only if METFM = 2,3)
   (ANEMHT)                                  Default: 10.     ! ANEMHT = 10.0 !

   Form of lateral turbulance data in PROFILE.DAT file
   (Used only if METFM = 4 or MTURBVW = 1 or 3)
   (ISIGMAV)                                 Default: 1       ! ISIGMAV =  1  !
       0 = read sigma-theta
       1 = read sigma-v

   Choice of mixing heights (Used only if METFM = 4)
   (IMIXCTDM)                                Default: 0       ! IMIXCTDM =  0  !
       0 = read PREDICTED mixing heights
       1 = read OBSERVED mixing heights

Maximum length of a slug (met. grid units)
(XMXLEN)                                     Default: 1.0     ! XMXLEN = 1.0 !

Maximum travel distance of a puff/slug (in
grid units) during one sampling step
(XSAMLEN)                                    Default: 1.0     ! XSAMLEN = 1.0 !

Maximum Number of slugs/puffs release from
one source during one time step
(MXNEW)                                      Default: 99      ! MXNEW =  99   !

Maximum Number of sampling steps for
one puff/slug during one time step
(MXSAM)                                      Default: 99      ! MXSAM =  99   !

Number of iterations used when computing
the transport wind for a sampling step
that includes gradual rise (for CALMET
and PROFILE winds)
(NCOUNT)                                     Default: 2       ! NCOUNT =  2   !
```

```
Minimum sigma y for a new puff/slug (m)
(SYMIN)                                        Default: 1.0    ! SYMIN = 1.0  !

Minimum sigma z for a new puff/slug (m)
(SZMIN)                                        Default: 1.0    ! SZMIN = 1.0  !

Default minimum turbulence velocities sigma-v and sigma-w
for each stability class over land and over water (m/s)
(SVMIN(12) and SWMIN(12))

                   ---------- LAND ----------          --------- WATER ----------
   Stab Class :  A    B    C    D    E    F            A    B    C    D    E    F
                ---  ---  ---  ---  ---  ---          ---  ---  ---  ---  ---  ---
Default SVMIN : .50, .50, .50, .50, .50, .50,         .37, .37, .37, .37, .37, .37
Default SWMIN : .20, .12, .08, .06, .03, .016,        .20, .12, .08, .06, .03, .016

     ! SVMIN = 0.500, 0.500, 0.500, 0.500, 0.500, 0.500, 0.370, 0.370, 0.370, 0.370, 0.370, 0.370!
     ! SWMIN = 0.200, 0.120, 0.080, 0.060, 0.030, 0.016, 0.200, 0.120, 0.080, 0.060, 0.030, 0.016!

Divergence criterion for dw/dz across puff
used to initiate adjustment for horizontal
convergence (1/s)
Partial adjustment starts at CDIV(1), and
full adjustment is reached at CDIV(2)
(CDIV(2))                                      Default: 0.0,0.0  ! CDIV = .0, .0 !

Minimum wind speed (m/s) allowed for
non-calm conditions. Also used as minimum
speed returned when using power-law
extrapolation toward surface
(WSCALM)                                       Default: 0.5    ! WSCALM = .5 !

Maximum mixing height (m)
(XMAXZI)                                       Default: 3000.  ! XMAXZI = 3000.0 !

Minimum mixing height (m)
(XMINZI)                                       Default: 50.    ! XMINZI = 50.0 !

Default wind speed classes --
5 upper bounds (m/s) are entered;
the 6th class has no upper limit
(WSCAT(5))                           Default    :
                                     ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8 (10.8+)

                          Wind Speed Class :  1     2     3     4     5
                                             ---   ---   ---   ---   ---
                                  ! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.80 !

Default wind speed profile power-law
exponents for stabilities 1-6
(PLX0(6))                            Default    : ISC RURAL values
                                     ISC RURAL : .07, .07, .10, .15, .35, .55
                                     ISC URBAN : .15, .15, .20, .25, .30, .30

                           Stability Class :  A     B     C     D     E     F
                                             ---   ---   ---   ---   ---   ---
                                   ! PLX0 = 0.07, 0.07, 0.10, 0.15, 0.35, 0.55 !

Default potential temperature gradient
for stable classes E, F (degK/m)
(PTG0(2))                            Default: 0.020, 0.035
                                        ! PTG0 = 0.020,   0.035 !

Default plume path coefficients for
each stability class (used when option
for partial plume height terrain adjustment
is selected -- MCTADJ=3)
(PPC(6))                   Stability Class :  A     B     C     D     E     F
                              Default  PPC : .50,  .50,  .50,  .50,  .35,  .35
                                             ---   ---   ---   ---   ---   ---
                                  !  PPC = 0.50, 0.50, 0.50, 0.50, 0.35, 0.35 !

Slug-to-puff transition criterion factor
equal to sigma-y/length of slug
(SL2PF)                                 Default: 10.       ! SL2PF = 10.0 !
```

```
Puff-splitting control variables ------------------------

  VERTICAL SPLIT
  --------------

  Number of puffs that result every time a puff
  is split - nsplit=2 means that 1 puff splits
  into 2
  (NSPLIT)                                Default:   3        ! NSPLIT =  3  !

  Time(s) of a day when split puffs are eligible to
  be split once again; this is typically set once
  per day, around sunset before nocturnal shear develops.
  24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)
  0=do not re-split    1=eligible for re-split
  (IRESPLIT(24))                          Default:  Hour 17 = 1
  !  IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

  Split is allowed only if last hour's mixing
  height (m) exceeds a minimum value
  (ZISPLIT)                               Default: 100.       ! ZISPLIT = 100.0 !

  Split is allowed only if ratio of last hour's
  mixing ht to the maximum mixing ht experienced
  by the puff is less than a maximum value (this
  postpones a split until a nocturnal layer develops)
  (ROLDMAX)                               Default: 0.25       ! ROLDMAX = 0.25 !


  HORIZONTAL SPLIT
  ----------------

  Number of puffs that result every time a puff
  is split - nsplith=5 means that 1 puff splits
  into 5
  (NSPLITH)                               Default:   5        ! NSPLITH =  5  !

  Minimum sigma-y (Grid Cells Units) of puff
  before it may be split
  (SYSPLITH)                              Default:  1.0       ! SYSPLITH = 1.0 !

  Minimum puff elongation rate (SYSPLITH/hr) due to
  wind shear, before it may be split
  (SHSPLITH)                              Default:  2.        ! SHSPLITH = 2.0 !

  Minimum concentration (g/m^3) of each
  species in puff before it may be split
  Enter array of NSPEC values; if a single value is
  entered, it will be used for ALL species
  (CNSPLITH)                              Default:  1.0E-07   ! CNSPLITH = 1.0E-07 !

Integration control variables ------------------------

  Fractional convergence criterion for numerical SLUG
  sampling integration
  (EPSSLUG)                               Default:   1.0e-04  ! EPSSLUG = 1.0E-04 !

  Fractional convergence criterion for numerical AREA
  source integration
  (EPSAREA)                               Default:   1.0e-06  ! EPSAREA = 1.0E-06 !

  Trajectory step-length (m) used for numerical rise
  integration
  (DSRISE)                                Default:   1.0      ! DSRISE = 1.0 !

!END!

-------------------------------------------------------------------------------

INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
--------------------------------
```

```
---------------
Subgroup (13a)
---------------

     Number of point sources with
     parameters provided below      (NPT1)  No default  !  NPT1 =  1 !

     Units used for point source
     emissions below                (IPTU)  Default: 1  !  IPTU =   3  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  !  NSPT1 = 0  !

     Number of point sources with
     variable emission parameters
     provided in external file      (NPT2)  No default  !  NPT2 =  0  !

     (If NPT2 > 0, these point
     source emissions are read from
     the file: PTEMARB.DAT)

!END!

---------------
Subgroup (13b)
---------------
                                         a
          POINT SOURCE: CONSTANT DATA
          -----------------------------
                                                                               b          c
  Source       X           Y        Stack     Base      Stack    Exit  Exit    Bldg.  Emission
   No.     Coordinate Coordinate Height Elevation Diameter  Vel.  Temp.   Dwash   Rates
              (km)       (km)       (m)       (m)        (m)   (m/s) (deg. K)
  ------   ---------- ---------- ------  ------   -------- ----- -------- ----- --------
****************    EMISSION RATES ARE IN LB/HR    ****************SO2****SO4***NOX****HNO3**NO3**PM10

Project-Specific Source Input
--------

     a
      Data for each source are treated as a separate input subgroup
      and therefore must end with an input group terminator.

      SRCNAM  is a 12-character name for a source
              (No default)
      X       is an array holding the source data listed by the column headings
              (No default)
      SIGYZI  is an array holding the initial sigma-y and sigma-z (m)
              (Default: 0.,0.)
      FMFAC   is a vertical momentum flux factor (0. or 1.0) used to represent
              the effect of rain-caps or other physical configurations that
              reduce momentum rise associated with the actual exit velocity.
              (Default: 1.0  -- full momentum used)

     b
      0. = No building downwash modeled, 1. = downwash modeled
      NOTE: must be entered as a REAL number (i.e., with decimal point)

     c
      An emission rate must be entered for every pollutant modeled.
      Enter emission rate of zero for secondary pollutants that are
      modeled, but not emitted.  Units are specified by IPTU
      (e.g. 1 for g/s).

---------------
Subgroup (13c)
```

```
---------------

          BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH
          -------------------------------------------------------
Source                                                                a
 No.      Effective building width and height (in meters) every 10 degrees
------    ----------------------------------------------------------------
       1  ! SRCNAM = BLR2        !
       1  !  HEIGHT =  11.28,  11.28,  11.28,  11.28,  11.28,  11.28,
              11.28,  11.28,  11.28,   7.93,   7.93,   7.93,
               7.93,   7.93,   7.93,  11.28,  11.28,  11.28,
              11.28,  11.28,  11.28,  11.28,  11.28,  11.28,
              11.28,  11.28,  11.28,   7.93,   7.93,   7.93,
               7.93,   7.93,   7.93,  11.28,  11.28,  11.28 !
       1  !  WIDTH =   45.44,  44.94,  43.07,  42.54,  44.67,  45.45,
              44.85,  42.89,  39.62,  26.50,  21.73,  16.30,
              13.98,  19.63,  24.68,  38.82,  42.34,  44.57,
              45.44,  44.94,  43.07,  42.54,  44.67,  45.45,
              44.85,  42.89,  39.62,  26.50,  21.73,  16.30,
              13.98,  19.63,  24.68,  38.82,  42.34,  44.57 !
       1  !  LENGTH =  35.15,  29.61,  23.18,  21.80,  28.39,  34.13,
              38.82,  42.34,  44.57,  36.22,  36.50,  35.67,
              35.03,  36.30,  36.47,  44.85,  42.89,  39.62,
              35.15,  29.61,  23.18,  21.80,  28.39,  34.13,
              38.82,  42.34,  44.57,  36.22,  36.50,  35.67,
              35.03,  36.30,  36.47,  44.85,  42.89,  39.62 !
       1  !  XBADJ =  -42.73, -41.87, -39.73, -39.27, -41.93, -43.32,
             -43.39, -42.14, -39.62, -19.16, -19.34, -18.93,
             -18.59, -19.17, -19.16,  -7.22,  -2.31,   2.68,
               7.58,  12.25,  16.55,  17.47,  13.54,   9.19,
               4.57,  -0.19,  -4.95, -17.06, -17.16, -16.74,
             -16.44, -17.13, -17.30, -37.63, -40.58, -42.30 !
       1  !  YBADJ =   13.16,   8.60,   3.77,  -1.18,  -6.08, -10.81,
             -15.20, -19.14, -22.49,   0.34,   0.15,  -0.04,
              -0.23,  -0.41,  -0.58, -23.98, -20.97, -17.33,
             -13.16,  -8.60,  -3.77,   1.18,   6.08,  10.81,
              15.20,  19.14,  22.49,  -0.34,  -0.15,   0.04,
               0.23,   0.41,   0.58,  23.98,  20.97,  17.33 !

!END!


--------

    a
     Each pair of width and height values is treated as a separate input
     subgroup and therefore must end with an input group terminator.

---------------
Subgroup (13d)
---------------
                                                     a
         POINT SOURCE: VARIABLE EMISSIONS DATA
         ---------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 13b.  Factors entered multiply the rates in 13b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                              Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)
```

```
--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------------------------


INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters
--------------------------------

---------------
Subgroup (14a)
---------------

     Number of polygon area sources with
     parameters specified below (NAR1)        No default   !  NAR1 =  0   !

     Units used for area source
     emissions below            (IARU)        Default: 1   !  IARU =   1  !
           1 =        g/m**2/s
           2 =       kg/m**2/hr
           3 =       lb/m**2/hr
           4 =     tons/m**2/yr
           5 =     Odour Unit * m/s  (vol. flux/m**2 of odour compound)
           6 =     Odour Unit * m/min
           7 =     metric tons/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  !  NSAR1 =  0  !

     Number of buoyant polygon area sources
     with variable location and emission
     parameters (NAR2)                        No default   !  NAR2 =  0   !
     (If NAR2 > 0, ALL parameter data for
     these sources are read from the file: BAEMARB.DAT)

!END!

---------------
Subgroup (14b)
---------------
                                             a
          AREA SOURCE: CONSTANT DATA
          ----------------------------
                                                              b
Source           Effect.    Base      Initial    Emission
No.              Height   Elevation   Sigma z     Rates
                   (m)       (m)        (m)
-------          ------    ------     --------   ---------


--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.
    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IARU
     (e.g. 1 for g/m**2/s).

---------------
Subgroup (14c)
---------------

           COORDINATES (UTM-km) FOR EACH VERTEX(4) OF EACH POLYGON
           --------------------------------------------------------
Source                                                                a
```

```
 No.       Ordered list of X followed by list of Y, grouped by source
------     ------------------------------------------------------------


--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.


---------------
Subgroup (14d)
---------------
                                                 a
          AREA SOURCE: VARIABLE EMISSIONS DATA
          ---------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 14b.  Factors entered multiply the rates in 14b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)


--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------------------------

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters
---------------------------

---------------
Subgroup (15a)
---------------

     Number of buoyant line sources
     with variable location and emission
     parameters (NLN2)                              No default  !  NLN2 =  0   !

     (If NLN2 > 0, ALL parameter data for
      these sources are read from the file: LNEMARB.DAT)

     Number of buoyant line sources (NLINES)        No default   ! NLINES =  0   !

     Units used for line source
     emissions below                (ILNU)          Default: 1  !  ILNU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =      tons/yr
           5 =      Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =      Odour Unit * m**3/min
           7 =      metric tons/yr

     Number of source-species
```

```
     combinations with variable
     emissions scaling factors
     provided below in (15c)        (NSLN1) Default: 0   !  NSLN1 =   0   !

     Maximum number of segments used to model
     each line (MXNSEG)                             Default: 7    ! MXNSEG =   7   !

     The following variables are required only if NLINES > 0.  They are
     used in the buoyant line source plume rise calculations.

        Number of distances at which                Default: 6    ! NLRISE =   6   !
        transitional rise is computed

        Average building length (XL)                No default    ! XL = .0 !
                                                    (in meters)

        Average building height (HBL)               No default    ! HBL = .0 !
                                                    (in meters)

        Average building width (WBL)                No default    ! WBL = .0 !
                                                    (in meters)

        Average line source width (WML)             No default    ! WML = .0 !
                                                    (in meters)

        Average separation between buildings (DXL)  No default    ! DXL = .0 !
                                                    (in meters)

        Average buoyancy parameter (FPRIMEL)        No default    ! FPRIMEL = .0 !
                                                    (in m**4/s**3)

!END!

---------------
Subgroup (15b)
---------------

            BUOYANT LINE SOURCE: CONSTANT DATA
            ----------------------------------
                                                                                  a
Source     Beg. X      Beg. Y      End. X     End. Y     Release    Base        Emission
 No.     Coordinate  Coordinate  Coordinate Coordinate   Height   Elevation      Rates
            (km)        (km)        (km)       (km)        (m)       (m)
------   ----------  ----------  ---------  ----------  -------   ---------    ---------

--------

     a
      Data for each source are treated as a separate input subgroup
      and therefore must end with an input group terminator.

     b
      An emission rate must be entered for every pollutant modeled.
      Enter emission rate of zero for secondary pollutants that are
      modeled, but not emitted.  Units are specified by ILNTU
      (e.g. 1 for g/s).

---------------
Subgroup (15c)
---------------
                                                             a
            BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA
            --------------------------------------------

      Use this subgroup to describe temporal variations in the emission
      rates given in 15b.  Factors entered multiply the rates in 15b.
      Skip sources here that have constant emissions.

      IVARY determines the type of variation, and is source-specific:
      (IVARY)                                 Default: 0
            0 =        Constant
            1 =        Diurnal cycle (24 scaling factors: hours 1-24)
            2 =        Monthly cycle (12 scaling factors: months 1-12)
            3 =        Hour & Season (4 groups of 24 hourly scaling factors,
                                 where first group is DEC-JAN-FEB)
```

```
           4 =       Speed & Stab.  (6 groups of 6 scaling factors, where
                                     first group is Stability Class A,
                                     and the speed classes have upper
                                     bounds (m/s) defined in Group 12
           5 =       Temperature    (12 scaling factors, where temperature
                                     classes have upper bounds (C) of:
                                     0, 5, 10, 15, 20, 25, 30, 35, 40,
                                     45, 50, 50+)
```

----
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.

```
INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters
--------------------------

---------------
Subgroup (16a)
---------------

     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  !  NVL1 =  0   !

     Units used for volume source
     emissions below in 16b       (IVLU)     Default: 1  !  IVLU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (16c)      (NSVL1)    Default: 0  !  NSVL1 =  0  !

     Number of volume sources with
     variable location and emission
     parameters                   (NVL2)     No default  !  NVL2 =   0   !

     (If NVL2 > 0, ALL parameter data for
      these sources are read from the VOLEMARB.DAT file(s) )

!END!

---------------
Subgroup (16b)
---------------
                                                a
          VOLUME SOURCE: CONSTANT DATA
          ----------------------------
                                                                          b
         X UTM      Y UTM      Effect.    Base     Initial    Initial   Emission
      Coordinate  Coordinate   Height   Elevation  Sigma y    Sigma z    Rates
         (km)        (km)        (m)       (m)       (m)        (m)
      ----------  ----------   ------    ------   --------   --------   --------
```

----
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are

```
     modeled, but not emitted.  Units are specified by IVLU
     (e.g. 1 for g/s).

---------------
Subgroup (16c)
---------------
                                                       a
          VOLUME SOURCE: VARIABLE EMISSIONS DATA
          ----------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 16b.  Factors entered multiply the rates in 16b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                  Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)


--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.

-------------------------------------------------------------------------------

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information
-----------------------

---------------
Subgroup (17a)
---------------

     Number of non-gridded receptors (NREC)  No default   !  NREC = 744 !

!END!

---------------
Subgroup (17b)
---------------
                                                    a
           NON-GRIDDED (DISCRETE) RECEPTOR DATA
           ------------------------------------

                      X            Y           Ground        Height   b
Receptor          Coordinate   Coordinate    Elevation   Above Ground
  No.                (km)         (km)          (m)           (m)
--------          ----------   ----------    ---------   ------------
RECEPTORS OBTAINED FROM THE NPS/FWS EXTRACTION PROGRAM
ALL RECEPTORS ARE LCC (KM)

PROJECT-SPECIFIC CLASS I AREA RECEPTORS

    a
     Data for each receptor are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     Receptor height above ground is optional.  If no value is entered,
     the receptor is placed on the ground.
```