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BUREAU OF AIR REGULATION

AIR MODELING REPORT FOR ASSESSING BEST AVAILABLE CONTROL TECHNOLOGIES RELATED TO BEST AVAILABLE RETROFIT TECHNOLOGY PROGRESS ENERGY FLORIDA CRYSTAL RIVER PLANT

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January 2007 063-9571

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LIST OF ACRONYMS AND ABBREVIATIONS

AAQS	Ambient Air Quality Standards
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
gal/hr	gallons per hour
HAP	hazardous air pollutant
HSH	highest, second-highest
km	kilometer
LAER	lowest achievable emission rate
lbs/hr	pounds per hour
lb/MMBtu	pounds per million British thermal units
m	meter
MACT	Maximum Achievable Control Technology
MMBtu/hr	million British thermal units per hour
$MMft^3$	million cubic feet
MMscf/yr	million standard cubic feet per year
NAAQS	National Ambient Air Quality Standards
NSPS	New Source Performance Standards
NSR	new source review
NWA	National Wilderness Area
OAQPS	Office of Air Quality Planning and Standards
PCP	pollution control project
PM	particulate matter

PM_{10}	particulate matter with an aerodynamic diameter equal to or less than 10 micrometers
ppmv	parts per million by volume
PSD	prevention of significant deterioration
RBLC	RACT, BACT, LAER Clearinghouse
scf/hr	standard cubic foot per hour
SIL	significant impact level
SIP	State Implementation Plan
TPD	tons per day
TPH	tons per hour
TPY	tons per year
μm	micrometer
$\mu g/m^3$	micrograms per cubic meter

1.0 INTRODUCTION

Progress Energy Florida (Progress) operates the Crystal River Power Plant located on Power Line Road, West of U.S. Highway 19, Crystal River, Citrus County, Florida. The Crystal River plant consists of four coal-fired fossil fuel steam generating (FFSG) units with electrostatic precipitators; two natural draft cooling towers for FFSG Units 4 and 5; helper mechanical cooling towers for FFSG Units 1, 2 and Nuclear Unit 3; coal, fly ash, and bottom ash handling facilities, and relocatable diesel fired generator(s). The facility is currently operating under Title V Permit No. 0170004-009-AV, most recently issued on January 1, 2005.

Under 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 U.S. Environmental Protection Agency (EPA) has issued final rules and guidelines, dated July 6, 2005, for Best Available Retrofit Technology (BART) determinations [Federal Register (FR), Volume 70, 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:

- Contains emissions units that are one of the 26 listed source categories in the guidance;
- Contains emissions units that were put in place between August 7, 1962 and August 7, 1977; and
- Potential emissions from the emissions units 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 of equal to or less than 10 microns (PM_{10})].

The Crystal River Plant has been identified as a BART-eligible source with multiple BART-eligible emissions units.

The Florida Department of Environmental Protection (FDEP) has proposed to adopt EPA's visibility protection rules and guidelines contained in 40 CFR 51, Subpart P. Final adoption of these rules is expected by the end of this year.

The basic tenant 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 [i.e., located in Florida or within 300 kilometers (km) of Florida].

BART is required for any BART-eligible source (facility) that FDEP determines emits any air pollutant that 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 (facility) for determining whether the source contributes to visibility impairment. The term "BART-eligible emissions unit" is defined as any single emissions unit that meets the criteria described above, except for the 250 TPY criterion, which applies to the entire 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."

Progress previously submitted a BART applicability analysis and modeling protocol to the FDEP in September 2006. The report identified the BART-eligible emissions units, and determined that the BART-eligible source was not exempt from BART based on its potential visibility impacts on the Class I areas. Based on that analysis, the final list of BART-eligible, non-fugitive emissions units for Crystal River are as follows:

- Unit 1 Fossil Fuel Steam Generator (FFSG EU 001); and
- Unit 2 Fossil Fuel Steam Generator (FFSG EU 002).

Each of these emissions units requires an analysis of BART control options and a BART determination. This BART application addresses these requirements with a description of the BART-eligible emissions units (Section 2.0), the BART exemption analysis and results (Section 3.0), requirements for analysis of BART control options (Section 4.0) and the BART control technology analysis (Section 5.0). The BART Protocol Report, which was revised in December 2006 to reflect comments received from the FDEP, is included as Appendix A.

2.0 DESCRIPTION OF BART-ELIGIBLE EMISSIONS UNITS

Progress' Crystal River Plant is located on Power Line Road, West of U.S. Highway 19, Crystal River, in Citrus County, Florida. An area map showing the facility location and PSD Class I areas located within 300 km of the facility was presented in Figure 1-1 of the BART Protocol Report (Appendix A). The PSD Class I areas and their distances from Crystal River are as follows:

- Chassahowitzka National Wilderness Area (NWA) - 21 km;
- Wolf Island NWA - 293 km;
- Okefenokee NWA - 178 km; and
- Saint Marks NWA - 174 km.

Bradwell Bay PSD Class I area is located within 300 km of the Crystal River facility, but visibility impairment is not an air quality-related value (AQRV) for Bradwell Bay.

The Universal Transverse Mercator (UTM) coordinates of the Crystal River plant are approximately 334.3 km East and 3204.5 km North in UTM Zone 17.

Progress is proposing BART for each emissions unit at the facility that is BART-eligible. A description of each of these emissions units is presented in the following sections.

2.1 Unit No. 1 Fossil Fuel Steam Generator (EU 001)

Crystal River currently operates Unit 1, a Fossil Fuel Steam Generator (FFSG), further characterized as a pulverized coal dry bottom boiler, tangentially-fired, rated at 440.5 MW, 3,750 MMBtu/hr, burning bituminous coal; or a bituminous coal and bituminous coal briquette mixture. Distillate fuel oil may be burned as a startup fuel. Emissions are exhausted through a 502 ft stack. This unit may also burn oily flyash and on-specification used oil.

PM/PM_{10} emissions from Unit 1 are controlled by means of a high-efficiency electrostatic precipitator, manufactured by Buell Manufacturing Company, Inc.

Particulate matter emissions are limited to 0.1 lb/MMBtu heat input and 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.

2.2 Unit No. 2 Fossil Fuel Steam Generator (EU 002)

Crystal River currently operates Unit 2, a Fossil Fuel Steam Generator (FFSG), further characterized as a pulverized coal dry bottom boiler, tangentially-fired, rated at 523.8 MW, 4,795 MMBtu/hr, burning bituminous coal; or a bituminous coal and bituminous coal briquette mixture. Distillate fuel oil may be burned as a startup fuel. Emissions are exhausted through a 499 ft stack. This unit may also burn oily flyash and on-specification used oil.

PM/PM_{10} emissions from Unit 2 are controlled by means of a high-efficiency electrostatic precipitator, manufactured by Buell Manufacturing Company, Inc.

Particulate matter emissions are limited to 0.1 lb/MMBtu heat input and 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

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 Group (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 Progress' Crystal River plant is subject to the provisions of CAIR, SO_2 and NO_x emissions were not included in the air modeling analysis.

The potential annual PM_{10} emissions for Crystal River's BART-eligible emissions units are greater than the 250 TPY threshold. Therefore, PM_{10} emissions will be included in the visibility impairment assessment for the facility. Potential PM_{10} emissions were calculated based on maximum permitted soot blowing for three hours in a 24-hour period at 0.3 lb/MMBtu and normal operation for 21 hours at 0.1 lb/MMBtu. These values would represent the highest potential PM_{10} emissions from these units in a 24-hour period. The maximum 24-hour average emission rates for the BART-eligible units at Crystal River that are used in the exemption modeling were presented in Table 2-3 of the BART Protocol (see Appendix A). Detailed emissions calculations and supporting documentation were also presented in the BART Protocol.

A BART modeling protocol for affected Progress plants was submitted to the FDEP in September 2006 and a revised protocol, incorporating comments received from the FDEP, is included as Appendix A. 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 discussed in more detail below.

3.1 Emission Rates

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.

PM_{10} emission rates for Crystal River were evaluated based on actual emissions test data. Actual emissions data were obtained for annual stack tests conducted from 2001 through 2006. The test results representative of the highest 24-hour value were used for each unit. The lone exception is the results for Unit 2 obtained in September 2005. Test results were reported to the FDEP as 0.1 lb/MMBTU, right at the regulatory limit for the unit. Although the unit was considered in compliance with the particulate standard, due to the unusually high results, it was removed from service and inspected for causal reasons. It was found that seals between the hot and cold side of the air heater were deteriorated to a point where leak-by could result in a lower stack temperature which might lead to pre-mature condensation of gases into sulfate particulates. It was thought that this could bias the test results upward, and the air heater seals were replaced. As the results for 2005 were not representative of normal operation, they were not used in this analysis.

In addition, representative annual baseline emissions (tons per year or TPY) must be considered in the BART control option analysis for the purpose of determining cost effectiveness of alternative emission control technologies. Therefore, the highest annual PM_{10} emissions, as reported in the AORs and based on annual stack test data, were used in the control technology assessment. Actual PM test data, as well as maximum 24-hour and annual baseline emissions, are provided in Tables 3-1 and 3-2.

Based on the latest regulatory guidance, PM emissions by size category are required 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*f(RH) and 4, respectively, where f(RH) is the relative humidity factor.

The PM emissions from the BART-eligible units at the Crystal River plant were speciated into the recommended size and species categories using the latest EPA Publication AP-42. The species categories for Crystal River Units 1 and 2 were determined from the speciation profile for Dry Bottom Boiler burning pulverized coal with ESP provided in Table 1.1-5 in AP-42. The different size categories were determined from particle size distribution for Dry Bottom PC Boilers with ESP provided in Table 1.1-6 in AP-42. Detailed PM speciation summaries were presented in Tables 2-6 and 2-7 of the BART Protocol (Appendix A).

3.2 Modeling Methodology

The CALPUFF model, Version 5.756, was used to predict the maximum visibility impairment at the PSD Class I areas located within 300 km of the Crystal River facility. 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 Crystal River Plant's 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 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. A detailed description of the new IMPROVE algorithm and its implementation is presented in section 3.4 of the Protocol.

Both the 1999 and new IMPROVE algorithms were used to calculate the natural background light extinction at the Class I areas for the BART modeling analysis. Visibility impacts were predicted at each PSD Class I area using receptors provided by the National Park Service and are represented in Figures 4-1 through 4-5 of the Protocol.

3.3 BART Exemption Modeling Results

Summaries of the maximum visibility impairment values for the Crystal River BART-eligible emission units, estimated using the 1999 IMPROVE algorithm, are presented in Tables 3-3 and 3-4. In Table 3-3, 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. 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 8 highest visibility impairment values predicted at the PSD Class I areas are presented in Table 3-4.

As shown in Tables 3-3 and 3-4, the 8th highest visibility impairment values predicted for 2001 and 2002 at three of the PSD Class I areas using the 1999 IMPROVE algorithm are greater than 0.5 dv. The 8th highest visibility impairment values predicted for 2003 using the 1999 IMPROVE algorithm are greater than 0.5 dv at all four of the PSD Class I areas. The 22nd highest visibility impairment values predicted over the 3-year period at these PSD Class I areas are also greater than 0.5 dv.

As a result, the visibility impacts were evaluated at the four PSD Class I areas with the new IMPROVE algorithm. Similar to the results presented using the 1999 IMPROVE algorithm, summaries of the maximum visibility impairment values estimated using the new IMPROVE algorithm are presented in Tables 3-5 and 3-6. As shown in Tables 3-5 and 3-6 the 8th highest visibility impairment values predicted for all years at three of the PSD Class I areas using the new IMPROVE algorithm are greater than 0.5 dv. The Wolf Island NWA values were less than the 0.5 dv threshold for all years. The 8th highest visibility impairment values predicted for 2003 using the new IMPROVE algorithm are greater than 0.5 dv at all four of the PSD Class I areas. The 22nd highest visibility impairment values predicted over the 3-year period are also greater than 0.5 dv, for all PSD Class I areas except the Wolf Island NWA.

Based on these results, the Crystal River facility is subject to the BART requirements and a BART determination analysis is required for each of the BART-eligible emissions units at the facility. Since the visibility impacts due to the facility were found to be the highest at the Chassahowitzka NWA, the BART determination analysis will include only the Chassahowitzka NWA.

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 Part 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. 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.

EPA believes that the same rationale also holds true for emissions standards developed for municipal waste incinerators under the Clean Air Act (CAA) section 111(d), and for many new source review/prevention of significant deterioration (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, you must identify the most stringent option and a reasonable set of options for analysis that reflects a comprehensive list of available technologies. 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 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 need not be considered as available; we do not expect the source owner to purchase or construct a process or control device that has not already been demonstrated in practice.

Where a NSPS exists for a source category (which is the case for most of the categories affected by BART), you should include a level of control equivalent to the NSPS as one of the control options. The NSPS standards are codified in 40 CFR part 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, we do 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 as 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 that were 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 unresolvable 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, you should consider the technology to be technically feasible. The cost of a control alternative is considered later in the process.

A possible outcome of the BART procedures discussed in these guidelines is the evaluation of multiple control technology alternatives which result in essentially equivalent emissions. It is not EPA's intent to encourage evaluation of unnecessarily large numbers of control alternatives for every emissions unit. Consequently, one should use judgment in deciding on those alternatives for which you will conduct the detailed impacts analysis (Step 4 below). For example, if two or more control techniques result in control levels that are essentially identical, considering the uncertainties of emissions factors and other parameters pertinent to estimating performance, you may evaluate only the less costly of these options. You should narrow the scope of the BART analysis in this way only if there is a negligible difference in emissions and energy and non-air quality environmental impacts between control alternatives.

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) Insure 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 PM_{10} 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 electrostatic precipitators (ESPs) are two of the many examples of such control techniques that can perform at a wide range of levels. It is not EPA's intent to require analysis of each possible level of efficiency for a control technique, as such an analysis would result in a large number of options. It is important, however, that in analyzing the technology one take into account the most stringent emission control level that the technology is capable of achieving. One should consider recent regulatory decisions and performance data (*e.g.*, manufacturer's data, engineering estimates and the experience of other sources) when identifying an emissions performance level or levels to evaluate.

In assessing the capability of the control alternative, latitude exists to consider special circumstances pertinent to the specific source under review, or regarding the prior application of the control alternative. However, the basis for choosing the alternate level (or range) of control in the BART analysis should be explained. One may encounter cases where it is necessary to evaluate other levels of control in addition to the most stringent level for a given device.

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, you should consider improving performance when sources with electrostatic precipitators (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, specify the control system design parameters. 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 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). In order 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. 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 ($/yr) and emission rates are calculated in tons per year (tons/yr), the result is an average cost-effectiveness number in (annualized) dollars per ton ($/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. You can then convert these units into dollar costs and, where appropriate, factor these costs into the control cost analysis. Generally do not consider indirect energy impacts (such as energy to produce raw materials for construction of control equipment).

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, you should use this shorter time period in your 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 five 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 you have 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 deciview 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}). If the source is making the visibility determination, one should review and approve or disapprove of the source's analysis before making the expected improvement determination. 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-hr 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. You have flexibility to assess visibility improvements due to BART controls by one or more methods. You may consider the frequency, magnitude, and duration components of impairment. 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.

Note that 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 $/deciview);

(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, you could then substitute a different technology or combination of technologies.

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, you may take into consideration the conditions of the plant and the economic effects of requiring the use of a control technology. Where these effects are judged to have a severe impact on plant operations you may consider them in the selection process, but you may wish to provide an economic analysis that demonstrates, in sufficient detail for public review, the specific economic effects, parameters, and reasoning. 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.

Enforceable Limits/Compliance Date

To complete the BART process, the permitting agency must establish enforceable emission limits that reflect the BART requirements and require compliance within a given period of time. In particular, they must establish an enforceable emission limit for each subject emission unit at the source and for each pollutant subject to review that is emitted from the source. In addition, the agency must require compliance with the BART emission limitations no later than five years after EPA approves its regional haze SIP.

If technological or economic limitations in the application of a measurement methodology to a particular emission unit make a conventional emissions limit infeasible, you may instead prescribe a design, equipment, work practice, operation standard, or combination of these types of standards. The permitting authority should consider allowing sources to "average" emissions across any set of BART-eligible emission units within a fence line, so long as the emission reductions from each pollutant being controlled for BART would be equal to those reductions that would be obtained by simply controlling each of the BART-eligible units that constitute BART-eligible source.

The agency should ensure that any BART requirements are written in a way that clearly specifies the individual emission unit(s) subject to BART regulation. Because the BART requirements themselves are "applicable" requirements of the CAA, they must be included as title V permit conditions according to the procedures established in 40 CFR part 70 or 40 CFR part 71.

Section 302(k) of the CAA requires emissions limits such as BART to be met on a continuous basis. Although this provision does not necessarily require the use of continuous emissions monitoring (CEMs), it is important that sources employ techniques that ensure compliance on a continuous basis. Monitoring requirements generally applicable to sources, including those that are subject to BART, are governed by other regulations. See, *e.g.*, 40 CFR part 64 (compliance assurance monitoring); 40 CFR 70.6(a)(3) (periodic monitoring); 40 CFR 70.6(c)(1) (sufficiency monitoring). Note also that while EPA does not believe that CEMs would necessarily be required for all BART sources, the vast majority of electric generating units potentially subject to BART already employ CEM technology for other programs, such as the acid rain program. In addition, emissions limits must be enforceable as a practical matter (contain appropriate averaging times, compliance verification procedures and recordkeeping requirements). In light of the above, the permit must:

- Be sufficient to show compliance or noncompliance (i.e., through monitoring times of operation, fuel input, or other indices of operating conditions and practices); and

- Specify a reasonable averaging time consistent with established reference methods, contain reference methods for determining compliance, and provide for adequate reporting and recordkeeping so that air quality agency personnel can determine the compliance status of the source; and

- For EGUS, specify an averaging time of a 30-day rolling average, and contain a definition of "boiler operating day" that is consistent with the definition in the proposed revisions to the NSPS for utility boilers in 40 CFR Part 60, Subpart Da. One should consider a boiler operating day to be any 24-hour period between 12:00 midnight and the following midnight during which any fuel is combusted at any time at the steam generating unit. This would allow 30-day rolling average emission rates to be calculated consistently across sources.

5.0 BART ANALYSIS FOR PM EMISSIONS FROM UNIT NOS. 1 AND 2

5.1 Available Retrofit Control Technologies

Combustion of coal in a pulverized coal-fired boiler creates ash, which is the non-combustible portion of the fuel. The ash is solid and therefore is classified as PM. A portion of this PM, approximately 20 percent, falls to the bottom of the boiler as bottom ash and is removed by the bottom ash system. The majority of the PM, approximately 80 percent, is fly ash and is entrained by the flue gases leaving the boiler. The majority of this fly ash is then collected by the flue gas PM removal system.

As part of the BART analysis, a review was performed of previous PM BACT determinations for fossil fuel-fired electric utility steam generating units (EUSGUs) listed in the RACT/BACT/LAER Clearinghouse (RBLC) on EPA's webpage. A summary of BACT determinations for EUSGUs from this review is presented in Table 5-1. From the review of previous BACT determinations, it is evident that PM BACT determinations for existing and new EUSGUs have largely been based on the use of electrostatic precipitator (ESPs) and fabric filters (baghouses), which are the most effective PM control devices being successfully applied to coal-fired power plants. PM removal efficiencies of these devices can be greater than 99.8 percent. Both devices are also highly effective in controlling PM_{10} emissions. Other technologies, such as mechanical collectors and wet scrubbers, have not demonstrated equivalent levels of control. BACT determinations *for new units* have been in the range of 0.01 to 0.25 lb/MMBtu for PM emissions.

The New Source Performance Standards (NSPS) are a set of national emission standards that apply to specific categories of new sources. As stated in the 1977 CAA Amendments, these standards "shall reflect the degree of emission limitation and the percentage reduction achievable through application of the best technological system of continuous emission reduction the Administrator determines has been adequately demonstrated."

The emission limitations covered under 40 CFR Subpart Da, would affect EUSGUs similar to the BART-affected units at Crystal River. This NSPS limits NO_X, SO_2, and PM emissions from electric utility generating units capable of combusting more than 73 MW (250 MMBtu/hr heat input) using fossil fuel. For a unit firing bituminous coal only, Subpart Da limits PM emissions to 0.015 lb/MMBtu or 0.03 lb/MMBtu and greater than 99.9 percent control efficiency.

5.2 Control Technology Feasibility

For emission units subject to a BART review, there will often be control measures or devices already in place. This is the case for Crystal River Unit Nos. 1 and 2, which are equipped with high-efficiency ESPs. 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 as 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.

Based on the reviews conducted in Section 5.1, additional control options, discussed below, were identified as "available". Each of these are discussed below in terms of technical feasibility.

STEP 2— Eliminate Technically Infeasible Options

In Step 2, the source evaluates the technical feasibility of the control options that were 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 unresolvable 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, you should consider the technology to be technically feasible. The cost of a control alternative is considered later in the process.

5.2.1 Fuel Techniques

Fuel Substitution, or fuel switching, is a common means of reducing emissions from combustion sources, such as electric utilities and industrial boilers. It involves replacing the current fuel with a fuel that emits less of a given pollutant when combusted.

For fuel substitution to be practical there must be a suitable replacement fuel available at an acceptable cost. Crystal River's primary fuel for Unit Nos. 1 and 2 is bituminous coal. As discussed previously in Section 4.0, 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, the BART analysis is not required to consider building a natural gas-fired electric turbine although the turbine may be inherently less polluting on a per unit basis. Therefore, substitution of the fuel was not considered further.

5.2.2 Electrostatic Precipitators

Collection of PM by ESPs involves the ionization of the gas stream passing through the ESP; the charging, migration, and collection of particles on oppositely charged surfaces; and the removal of particles from the collection surfaces. There are two basic types of ESPs – dry and wet. In dry ESPs, the PM is removed by rappers, which vibrate the collection surface, dislodging the material and allowing it to fall into the collection hoppers. Wet ESPs use water to rinse the particulates off of the collection surfaces.

ESP performance is highly dependent on the electrical characteristics or resistivity of the particle or aerosol to be collected. 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.

ESPs have several advantages when compared with other control devices. They are very efficient collectors, even for small particles and can treat large volumes of gas with a low-pressure drop. ESPs can operate over a wide range of temperatures and generally have low operating costs. The disadvantages of ESPs are large capital costs, large space requirements, and difficulty in controlling particles with high resistivity.

Unit Nos. 1 and 2 currently employ a dry ESP to control PM/PM_{10} emissions. Crystal River will continue to use the existing ESPs in the future for PM/PM_{10} control on these units.

5.2.3 Fabric Filters

Baghouses, or fabric filters, utilize porous fabric to clean an airstream. There are several types of baghouses, including reverse-air, shaker, and pulsejet baghouses. The dust that accumulates on the surface of the filter aids in the filtering of fine dust particles. PM/PM_{10} control efficiencies for fabric filters are typically greater than 99 percent.

During fabric filtration, flue gas is sent through the fabric by forced-draft fans. The fabric is responsible for some filtration, but more significantly it acts as support for the dust layer that accumulates. The layer of dust, also known as the filter cake, is a highly efficient filter, even for submicron particles. Woven fabrics rely on the filtration of the dust cake much more than felted fabrics.

Fabric filters offer high efficiencies and are flexible to treat many types of dusts and a wide range of volumetric gas flow rates. In addition, fabric filters can be operated with low pressure drops. Some potential disadvantages are:

- High moisture gas streams and sticky particles can plug the fabric and bind to the filter, requiring bag replacement;

- High temperatures can damage fabric bags; and
- Fabric filters have a potential for fire or explosion due to the carryover of combustible fly ash.

Serious concerns exist over the ability of a baghouse to operate long term in a harsh environment, on flue gas containing significant moisture and high sulfur content.

5.2.4 Summary of Technically Feasible Options

In conclusion, the technically feasible PM controls for Units No. 1 and 2 include ESPs and baghouses. Options deemed to be technically infeasible were not considered further.

5.3 Impacts of Control Technology Options

As previously discussed, the commonly accepted and feasible PM controls for coal-fired electric steam generating units include the use of ESPs and baghouses. BACT control levels of as low as 0.01 lb/MMBtu have been permitted for *new coal-fired units*. For *existing units*, the value would be higher due to retrofit issues. While PEF does not believe that Units 1 and 2 can continuously achieve levels lower than the actual historical PM emissions used in this analysis, a "best-case" PM control level of 0.015 lb/MMBtu was assumed to determine if any visibility improvement would be apparent. This approach would render a formal control technology impact determination moot, if the application of the most stringent technology indicated no improvement in visibility.

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. The permitting agency has flexibility 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 deciview improvement may merit a stronger weighting in one case versus another, so one "bright line" may not be appropriate.

For the Crystal River facility, PM/PM_{10} emissions were determined for Units 1 and 2, based on the assumption that emissions were at a "new unit" BACT-level of 0.015 lb/MMBtu. These results are summarized in Table 5-2. A speciation summary, reflecting these revised emissions values, is presented in Tables 5-3 and 5-4 for Units 1 and 2, respectively. The model was then run at these revised emission rates according to the accepted methodology in the protocol, for comparison to the pre-control emission rates (i.e., the actual PM data presented in Table 3-1).

The modeled impacts are presented in Tables 5-5 through 5-8. Comparison of these results to the BART exemption modeling results (Tables 3-3 through 3-6) indicates that there is no discernable improvement in visibility. This is attributable to the fact that the ability of PM/PM_{10} emissions to affect visibility improvement/degradation is minimal compared to the affects of SO_2 and NO_X emissions.

5.4 Selection of BART

The preceding analysis indicated that, independent of the type of PM/PM_{10} control device (ESP or baghouse), if a BACT-level of PM/PM_{10} emission control (i.e., 0.015 lb/MMBtu) were assumed for Units 1 and 2, and used in a modeling assessment, the resulting impacts assessment would show no net improvement in visibility over the base case. Therefore, the proposed BART technology for PM/PM_{10} emissions control from Unit Nos. 1 and 2 is the continued use of an ESP, taking into consideration the fact that these FFSGs are existing units. Although new units have been permitted with PM/PM_{10} emission rates as low as 0.015 lb/MMBtu, Unit Nos. 1 and 2 would unlikely be able to achieve as low an emission rate due to their inherent limitations as existing sources. In any event, the BART modeling supports the conclusion that a reduction in PM emissions to levels as low as recent BACT determinations for new units (i.e., 0.015 lb/MMBtu, or less than one-half of the current actual emission level), results in no measurable improvement in visibility.

TABLES

Table 3-1
Crystal River Units 1 & 2 - ACTUAL PM/PM10 TEST DATA SUMMARY

Unit 1 Permit Limitations:	Sootblowing Mode:	0.3 lb/Mbtu
	Non-Sootblowing:	0.1 lb/Mbtu
	Heat Input:	3750 MMBtu/hr
Unit 2 Permit Limitations:	Sootblowing Mode:	0.3 lb/Mbtu
	Non-Sootblowing:	0.1 lb/Mbtu
	Heat Input:	4795 MMBtu/hr

	Sootblowing (lb/Mbtu)	Heat Input (MMBtu/hr)	Non-Sootblowing (lb/Mbtu)	Heat Input (MMBtu/hr)	Actual PM Emissions (lb/hr)	MAX (lb/hr)
Unit 1						
2001	0.052	3630	0.037	3621	140.82	
2002	0.024	3458	0.021	3458	73.91	
2003	0.023	3557	0.036	3557	122.27	
2004	0.011	3520	0.028	3636	93.92	
2005	0.02	3642	0.04	3651	136.89	
2006	0.02	3671	0.02	3681	73.6	
						140.82
Unit 2						
2001	0.007	4546	0.008	4546	35.8	
2002	0.011	4354	0.013	4354	55.51	
2003	0.015	4438	0.011	4438	51.04	
2004	0.021	4384	0.027	4390	115.22	
2005*	0.113		0.1		487.29	
2006	0.003	4610	0.002	4682	9.92	
						115.22 **

* No Heat Input Rate available, used HI shown in permit No. 0170004-009-AV.
** Based on the 2nd highest average, due to the inaccurate Non-soothblowing value of 0.1 lb/Mmbtu.

Table 3-2
Crystal River Units 1 & 2 Annual PM/PM10 Data (TPY)

	Unit 1 Coal PM	PM10	Oil PM	PM10	Unit 2 Coal PM	PM10	Oil PM	PM10
2005	407.286	315.091	0.551	0.276	1359.111	910.604	0.523	0.262
2004	278.432	186.549	0.528	0.264	370.978	248.555	0.348	0.174
2003	304.598	204.081	0.511	0.255	161.36	108.111	0.631	0.315
2002	268.973	180.212	0.442	0.221	181.705	121.742	0.398	0.199
2001	422.758	283.248	0.662	0.311	95.088	63.709	0.629	0.314

PARTICULATE MATTER - TOTAL

Coal = Test Data (Lb/mmBtu) x Fuel(tons) x Heat Content (Btu/Lb) x 21hrs/24hrs (normal operation)
Coal = Test Data (Lb/mmBtu) x Fuel(tons) x Heat Content (Btu/Lb) x 3hrs/24hrs (soot-blowing)

PARTICULATE MATTER - PM10

Coal = Test Data (Lb/mmBtu) x Fuel(tons) x Heat Content (Btu/Lb) x 21hrs/24hrs * 0.67 (normal operation)
Coal = Test Data (Lb/mmBtu) x Fuel(tons) x Heat Content (Btu/Lb) x 3hrs/24hrs * 0.67 (soot-blowing)

PARTICULATE MATTER - TOTAL Emission Factor = 2

#2 Oil = Emission Factor(2 Lb/1000 Gal) x Fuel(bbl) * 42 Gal/bbl / 2000 Lb/Ton

PARTICULATE MATTER - PM10 Emission Factor = 1

#2 Oil = Emission Factor(1 Lb/1000 Gal) x Fuel(bbl) * 42 Gal/bbl / 2000 Lb/Ton

TABLE 3-3
SUMMARY OF BART EXEMPTION MODELING RESULTS - PROGRESS ENERGY CRYSTAL RIVER POWER PLANT
1999 IMPROVE ALGORITHM

Class I Area	Distance (km) of Source to Nearest Class I Area Boundary	Number of Days and Receptors with 8th Highest 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)	
Saint Marks NWA	174	20	101	0.63	14	101	0.66	25	101	0.85	0.74
Chassahowitzka NWA	21	85	113	4.41	89	113	4.71	75	113	5.24	5.09
Wolf Island NWA	293	0	0	0.21	1	30	0.19	1	2	0.30	0.24
Okefenokee NWA	178	6	417	0.45	7	500	0.49	5	276	0.43	0.47

TABLE 3-4
BART EXEMPTION ANALYSIS RESULTS FOR
PROGRESS ENERGY CRYSTAL RIVER POWER PLANT
VISIBILITY IMPACT RANKINGS AT CLASS I AREAS
1999 IMPROVE ALGORITHM

		Predicted Deciview (dv)		
Class I Area	**Rank**	**2001**	**2002**	**2003**
Saint Marks NWA	1	1.544	1.043	1.086
	2	1.316	0.815	1.085
	3	0.990	0.784	0.981
	4	0.909	0.739	0.929
	5	0.851	0.714	0.922
	6	0.796	0.702	0.907
	7	0.700	0.681	0.907
	8	0.633	0.655	0.851
Chassahowitzka NWA	1	7.299	9.607	7.487
	2	5.992	8.830	6.848
	3	5.935	8.644	6.795
	4	5.215	8.398	6.513
	5	5.088	7.407	6.230
	6	5.032	6.534	5.880
	7	4.685	5.295	5.852
	8	4.408	4.711	5.240
Wolf Island NWA	1	0.484	0.710	0.521
	2	0.474	0.478	0.470
	3	0.370	0.327	0.374
	4	0.339	0.256	0.349
	5	0.250	0.232	0.331
	6	0.249	0.229	0.299
	7	0.234	0.205	0.295
	8	0.209	0.188	0.295
Okefenokee NWA	1	0.839	0.852	0.612
	2	0.612	0.777	0.580
	3	0.606	0.727	0.548
	4	0.552	0.687	0.536
	5	0.541	0.613	0.502
	6	0.517	0.603	0.486
	7	0.455	0.583	0.452
	8	0.451	0.492	0.433

TABLE 3-5
SUMMARY OF BART EXEMPTION MODELING RESULTS - PROGRESS ENERGY CRYSTAL RIVER POWER PLANT
NEW IMPROVE ALGORITHM

Class I Area	Distance (km) of Source to Nearest Class I Area Boundary	Number of Days and Receptors with 8th Highest 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)	
Saint Marks NWA	174	21	NA	0.52	15	NA	0.53	28	NA	0.70	0.59
Chassahowitzka NWA	21	86	NA	3.86	89	NA	4.09	75	NA	4.59	4.41
Wolf Island NWA	293	0	NA	0.15	1	NA	0.14	1	NA	0.21	0.18
Okefenokee NWA	178	6	NA	0.36	8	NA	0.40	5	NA	0.35	0.37

TABLE 3-6
BART EXEMPTION ANALYSIS RESULTS FOR
PROGRESS ENERGY CRYSTAL RIVER POWER PLANT
VISIBILITY IMPACT RANKINGS AT CLASS I AREAS
NEW IMPROVE ALGORITHM

Class I Area	Rank	Predicted Deciview (dv) 2001	2002	2003
Saint Marks NWA	1	1.282	0.858	0.885
	2	1.092	0.668	0.902
	3	0.817	0.644	0.814
	4	0.749	0.611	0.762
	5	0.701	0.584	0.764
	6	0.653	0.580	0.747
	7	0.572	0.561	0.729
	8	0.517	0.535	0.704
Chassahowitzka NWA	1	6.637	9.011	6.774
	2	5.278	8.245	6.177
	3	5.224	7.977	6.070
	4	4.529	7.858	5.791
	5	4.408	6.745	5.512
	6	4.393	5.859	5.212
	7	4.065	4.606	5.185
	8	3.862	4.089	4.591
Wolf Island NWA	1	0.359	0.528	0.391
	2	0.352	0.357	0.348
	3	0.271	0.239	0.273
	4	0.247	0.191	0.255
	5	0.181	0.171	0.242
	6	0.186	0.168	0.224
	7	0.172	0.148	0.218
	8	0.154	0.140	0.212
Okefenokee NWA	1	0.680	0.688	0.493
	2	0.491	0.631	0.460
	3	0.486	0.584	0.436
	4	0.443	0.552	0.431
	5	0.438	0.496	0.399
	6	0.419	0.475	0.389
	7	0.360	0.472	0.362
	8	0.359	0.397	0.346

Table 5-1 PM/PM10 BACT SUMMARY

Project	Plant Size MW	Heat Input MMBtu/hr	Controlled PM/PM$_{10}$ lb/MMBtu	PM/PM10 lb/MW-hr	Opacity Limits %	Comments
Seminole Electric Unit 3 - Flroida	750	7,500	0.013	0.13		Filterable (100% coal), ESP and WESP
Thoroughbred - Kentucky	1,500	14,886	0.018	0.18	20	ESP and WESP - opacity 6-minute average
Louisville Gas & Electric - Kentucky	750	6,942	0.018	0.17	20	Pulse Jet Fabric Filter (0.015 lb/MMBtu filterable) - opacity 6-minute average
River Hill Power - Pennsylvania	290	NA	0.012	NA		Fabric Filter
Prairie State-Illinois	1,500	14,900	0.015	0.15	20	ESP - opacity 6-minute average
Elm Road-Wisconsin	1,230	12,360	0.018	0.18	20	Fabric Filter; 20% opacity
Longview-West Virginia	600	6,114	0.018	0.18	10	Fabric Filter
			0.018	0.18		PM10 w/condensible
City Public Service-Texas	750	8,000	0.022	0.23		Fabric Filter; includes condensables
Public Service of Colorado	750	7,421	0.013	0.13	10	PM Fabric Filter; 10% opacity
			0.022	0.22		PM w/condensable
			0.012	0.12		PM10 Filterable
			0.02	0.20		PM10 w/condensable
Longleaf Energy-Georgia	1,200	12,278	0.07	0.72		Fabric Filter
Spurlock Generating Station Unit 4 Kentucky	278	2500	0.015	0.13	20	Fabric Filter
Public Service Corp Wausau - Wisconsin	500	5,176	0.02	0.21	40	PM (Total), Fabric Filter w/condensable
			0.018	0.19		PM10 - Filterable and Condensable
NRG Energy - Louisiana	575	6,566	0.018	0.21		ESP and Fabric Filter
			0.015	0.17		PM
Sandy Creek - Texas	800	NA	0.04	NA		Fabric Filter
Sempra Twin Oaks - Texas	600	NA	0.035	NA		Fabric Filter
TXU Oak Grove - Texas	1,720	8,970	0.04	0.21		Fabric Filter
Southwest Springfield - Missouri	275	2,725	0.018	0.18		Fabric Filter
Omaha Public Power - Nebraska	660	NA	0.018	NA		Fabric Filter
Municipal Energy Hastings - Nebraska	220	2,211	0.018	0.18	≥20	Fabric Filter
Xcel Energy/Comanche Station - Colorodo	750	7,421	0.012	0.12	20	PM10 (Filterable) Fabric Filter
			0.013	0.13		PM (Filterable)
			0.022	0.22		PM (Total)
Bull Mountain - Montana	780	8,026	0.015	0.15		PM (Filterable)
Intermountain Power Service - Utah	950	9,050	0.012	0.11	20	PM10 (Filterable) Fabric Filter
			0.013	0.12		PM (Filterable)
			0.024	0.23		PM (Total)
NEVCO Energy - Utah	270	2,532	0.0154	0.14		PM10 (Filterable) Fabric Filter
Springerville Generating Station Units 3 and 4 - Arizona	800	8,400	0.015	0.16	15	PM10 (Filterable), Fabric Filter
			0.055	0.58		PM10 (Filterable and condensable)
Desert Rock - New Mexico	1,500	6,800	0.02	0.09	10	PM10 (Filterable) Fabric Filter
TS Power Plant - Nevada	200	2,030	0.012	0.12		Fabric Filter
Indeck-Elwood LLC - Illinois	660	5,800	0.015	0.13	20	PM (Filterable) - opacity 6-minute average
JEA Northside - Florida	595	5,528	0.011	0.10	10	PM10/TSP Fabric Filter or ESP
MidAmerican Energy - Iowa	750	-	0.027	-	40	PM w/condensible
			0.018	-		PM filterable
			0.025	-		PM10 w/condensible
Sante Cooper - South Carolina	1320	11,100	0.015	0.13	20	PM
			0.018	0.15		PM10
			0.03	0.25		PM (total)
Montana Dakota Utilities - North Dakota	220	2,116	0.0167	0.16		PM filterable
			0.013	0.13		PM10 filterable
			0.0275	0.26		PM10 w/condensible
Newmont - Nevada	200	2,030	0.012	0.12	≥20	PM10 filterable
Sand Sage - Kansas	660	6,501	0.015	0.15	20	Fabric Filter PM
			0.035	0.34		PM10: 6 test runs of 120 minutes each
Black Hills - Wyoming	500	-	0.012	-		PM
AES Beaver Valley - Pennsylvania	215	-	0.02	-		PM10
Plum Point Energy - Arkansas	800	-	0.018	-		PM10
KCP&L - Missouri	850	7,800	0.024	0.22	20	PM10 Filterable and Condensable
			0.014	0.13		Filterable PM10
			0.015	0.14		Filterable PM

Table 5-2
Crystal River Units 1 and 2 - PM/PM10 BACT-Level Controlled Emissions

Unit 1 Permit Limitations:	Sootblowing Mode:	0.3 lb/Mbtu
	Non-Sootblowing:	0.1 lb/Mbtu
	Heat Input:	3750 MMBtu/hr
Unit 2 Permit Limitations:	Sootblowing Mode:	0.3 lb/Mbtu
	Non-Sootblowing:	0.1 lb/Mbtu
	Heat Input:	4795 MMBtu/hr

	Sootblowing (lb/Mbtu)	Heat Input (MMBtu/hr)	Non-Sootblowing (lb/Mbtu)	Heat Input (MMBtu/hr)	Actual PM Emissions (lb/hr)
Unit 1					
Control Rechnology	0.015	3750	0.015	3750	56.25
Unit 2					
Control Rechnology	0.015	4795	0.015	4795	71.93

Control Level of 0.015 MMBtu/hr.

TABLE 5-3
PM SPECIATION SUMMARY - CRYSTAL RIVER Unit 1

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	lb/hr	56.3	31.25	24.08	0.93	NA	NA
		%	100%	56%	43%	1.6%	NA	NA
PM Condensable [c]	Unit 1	lb/hr	562.50	NA	NA	NA	80.00	482.50
		%	100%	NA	NA	NA	80%	20%
Total PM_{10} (filterable+condensable)	Unit 1	lb/hr	618.8	31.25	24.08	0.93	80.00	482.50
		%	100%	5.1%	3.9%	0.1%	12.9%	78.0%
Total PM_{10} (filterable+Organic Condensable PM)	Unit 1	lb/hr	538.8	31.25	24.08	0.93	0.0	482.50
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	5.8%	4.5%	0.2%	0.0%	89.6%

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}						56.3	482.5	538.8
PM0063	0.63	18.5%	33.3%	33.3%	50.0%	18.7	241.3	260.0
PM0100	1	0.0%	0.0%	0.0%	50.0%	0.0	241.3	241.3
PM0125	1.25	0.0%	0.0%	0.0%	0	0.0	0.0	0.0
PM0250	2.5	25.9%	46.6%	13.3%	0	7.5	0.0	7.5
PM0600	6	0.0%	0.0%	0.0%	0	0.0	0.0	0.0
PM1000	10	55.6%	100.0%	53.4%	0	30.0	0.0	30.0
Totals				100.0%	100.0%	56.3	482.5	538.8

Total Modeled PM_{10} 538.8

[a] Heat input rate for unit and fuel heat content — 3,750 MMBtu/hr — 3,750 Unit 1
1.80 sulfur content (%)

[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 0.24 lb/ton — Ratio = 0.44 PM2.5/PM10
emission factor (Table 1.1-5, AP-42) — PM10 0.54 lb/ton

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

PM elemental carbon — 0.016 PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon — 0.43 PM soil/PM10
PM2.5 — 0.44 PM2.5/PM10
PM coarse= PM10 - PM2.5

[c] Condensable PM (Table 1.1-6, AP-42)

	lb/MMBtu	
Total	0.1 x S - 0.03	
	0.15	
Inorganic	0.12	(0.80 of Total)
Organic	0.03	(0.20 of Total)

TABLE 5-4
PM SPECIATION SUMMARY - CRYSTAL RIVER Unit 2

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	lb/hr	71.9	39.96	30.79	1.18	NA	NA
		%	100%	56%	43%	1.6%	NA	NA
PM Condensable [c]	Unit 1	lb/hr	719.25	NA	NA	NA	184.40	534.85
		%	100%	NA	NA	NA	80%	20%
Total PM_{10} (filterable+condensable)	Unit 1	lb/hr	791.2	39.96	30.79	1.18	184.40	534.85
		%	100%	5.1%	3.9%	0.1%	23.3%	67.6%
Total PM_{10} (filterable+Organic Condensable PM)	Unit 1	lb/hr	606.8	39.96	30.79	1.18	0.0	534.85
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	6.6%	5.1%	0.2%	0.0%	88.1%

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 PM10 (%)	Filterable (%)	Organic Condensable	Filterable	Organic Condensable	Total
Total PM_{10}						71.9	534.9	606.8
PM0063	0.63	18.5%	33.3%	33.3%	50.0%	23.9	267.4	291.4
PM0100	1	0.0%	0.0%	0.0%	50.0%	0.0	267.4	267.4
PM0125	1.25	0.0%	0.0%	0.0%	0	0.0	0.0	0.0
PM0250	2.5	25.9%	46.6%	13.3%	0	9.6	0.0	9.6
PM0600	6	0.0%	0.0%	0.0%	0	0.0	0.0	0.0
PM1000	10	55.6%	100.0%	53.4%	0	38.4	0.0	38.4
Totals				100.0%	100.0%	71.9	534.9	606.8

Total Modeled PM_{10} 606.8

[a] Heat input rate for unit and fuel heat content — 4,795 MMBtu/hr — 4,795 Unit 1
1.80 sulfur content (%)

[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	0.24 lb/ton	Ratio =	0.44 PM2.5/PM10
emission factor (Table 1.1-5, AP-42)	PM10	0.54 lb/ton		

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

PM elemental carbon	0.016 PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon	0.43 PM soil/PM10
PM2.5	0.44 PM2.5/PM10
PM coarse= PM10 - PM2.5	

[c] Condensable PM (Table 1.1-6, AP-42)

	lb/MMBtu	
Total	0.1 x S - 0.03	
	0.15	
Inorganic	0.12	(0.80 of Total)
Organic	0.03	(0.20 of Total)

TABLE 5-5
SUMMARY OF BART EXEMPTION MODELING RESULTS WITH BACT-LEVEL PM/PM10 CONTROL - PROGRESS ENERGY CRYSTAL RIVER POWER PLANT
1999 IMPROVE ALGORITHM

Class I Area	Distance (km) of Source to Nearest Class I Area Boundary	Number of Days and Receptors with 8th Highest 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)	
Saint Marks NWA	174	27	101	0.75	22	101	0.78	37	101	0.99	0.86
Chassahowitzka NWA	21	92	113	4.96	95	113	5.42	79	113	5.87	5.73
Wolf Island NWA	293	2	30	0.26	2	30	0.22	2	30	0.35	0.29
Okefenokee NWA	178	8	489	0.54	11	500	0.58	8	500	0.50	0.56

TABLE 5-6
BART EXEMPTION ANALYSIS RESULTS WITH BACT-LEVEL PM/PM10 CONTROL FOR
PROGRESS ENERGY CRYSTAL RIVER POWER PLANT
VISIBILITY IMPACT RANKINGS AT CLASS I AREAS
1999 IMPROVE ALGORITHM

Class I Area	Rank	Predicted Deciview (dv) 2001	2002	2003
Saint Marks NWA	1	1.831	1.237	1.285
	2	1.566	0.967	1.263
	3	1.171	0.929	1.144
	4	1.065	0.856	1.099
	5	1.008	0.836	1.096
	6	0.939	0.818	1.089
	7	0.825	0.784	1.072
	8	0.753	0.777	0.994
Chassahowitzka NWA	1	8.166	10.693	8.361
	2	6.783	9.783	7.684
	3	6.772	9.689	7.675
	4	5.938	9.324	7.361
	5	5.773	8.304	7.022
	6	5.725	7.298	6.691
	7	5.382	6.019	6.536
	8	4.964	5.419	5.872
Wolf Island NWA	1	0.577	0.850	0.605
	2	0.553	0.561	0.558
	3	0.440	0.395	0.450
	4	0.413	0.305	0.421
	5	0.299	0.274	0.397
	6	0.294	0.270	0.360
	7	0.282	0.252	0.353
	8	0.260	0.224	0.351
Okefenokee NWA	1	0.976	0.996	0.728
	2	0.731	0.907	0.706
	3	0.727	0.872	0.651
	4	0.643	0.819	0.625
	5	0.638	0.718	0.604
	6	0.608	0.718	0.572
	7	0.552	0.676	0.548
	8	0.543	0.579	0.504

TABLE 5-7
SUMMARY OF BART EXEMPTION MODELING RESULTS WITH BACT-LEVEL PM/PM10 CONTROL - PROGRESS ENERGY CRYSTAL RIVER POWER PLANT
NEW IMPROVE ALGORITHM

Class I Area	Distance (km) of Source to Nearest Class I Area Boundary	Number of Days and Receptors with 8th Highest 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)	
Saint Marks NWA	174	28	NA	0.61	23	NA	0.64	39	NA	0.79	0.70
Chassahowitzka NWA	21	93	NA	4.30	95	NA	4.69	79	NA	5.13	4.98
Wolf Island NWA	293	2	NA	0.19	2	NA	0.16	2	NA	0.26	0.21
Okefenokee NWA	178	9	NA	0.43	13	NA	0.46	9	NA	0.40	0.44

TABLE 5-8
BART EXEMPTION ANALYSIS RESULTS WITH BACT-LEVEL PM/PM10 CONTROL FOR
PROGRESS ENERGY CRYSTAL RIVER POWER PLANT
VISIBILITY IMPACT RANKINGS AT CLASS I AREAS
NEW IMPROVE ALGORITHM

		Predicted Deciview (dv)		
Class I Area	**Rank**	**2001**	**2002**	**2003**
Saint Marks NWA	1	1.510	1.010	1.042
	2	1.294	0.785	1.040
	3	0.962	0.760	0.939
	4	0.873	0.699	0.899
	5	0.826	0.678	0.877
	6	0.763	0.668	0.893
	7	0.670	0.638	0.879
	8	0.612	0.635	0.794
Chassahowitzka NWA	1	7.386	9.954	7.514
	2	5.939	9.057	6.898
	3	5.921	8.875	6.815
	4	5.127	8.647	6.504
	5	4.974	7.503	6.175
	6	4.980	6.517	5.906
	7	4.651	5.204	5.769
	8	4.298	4.685	5.127
Wolf Island NWA	1	0.424	0.628	0.447
	2	0.406	0.414	0.409
	3	0.319	0.286	0.326
	4	0.300	0.224	0.305
	5	0.216	0.200	0.287
	6	0.216	0.197	0.258
	7	0.206	0.180	0.257
	8	0.190	0.164	0.258
Okefenokee NWA	1	0.781	0.797	0.579
	2	0.582	0.727	0.558
	3	0.578	0.695	0.513
	4	0.511	0.653	0.497
	5	0.508	0.573	0.476
	6	0.486	0.561	0.456
	7	0.436	0.539	0.434
	8	0.430	0.460	0.400

APPENDIX A

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 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
- at an existing federally enforceable state air operation permit (FESOP) or Title V permitted facility.

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 & Revised/Renewal 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: **PROGRESS ENERGY FLORIDA, INC.**	
2. Site Name: **CRYSTAL RIVER POWER PLANT**	
3. Facility Identification Number: **0170004**	
4. Facility Location...: Street Address or Other Locator: **NORTH OF CRYSTAL RIVER, WEST OF U.S. 19** City: **CRYSTAL RIVER** County: **CITRUS** Zip Code: **34428**	
5. Relocatable Facility? ☐ Yes ☒ No	6. Existing Title V Permitted Facility? ☒ Yes ☐ No

Application Contact

1. Application Contact Name: **DAVE MEYER, SENIOR ENVIRONMENTAL SPECIALIST**
2. Application Contact Mailing Address... Organization/Firm: **PROGRESS ENERGY FLORIDA** Street Address: **100 CENTRAL AVE CX1B** City: **ST. PETERSBURG** State: **FL** Zip Code: **33701**
3. Application Contact Telephone Numbers... Telephone: **(727) 820-5295** ext. Fax: **(727) 820-5229**
4. Application Contact Email Address: **DAVE.MEYER@PGNMAIL.COM**

Application Processing Information (DEP Use)

1. Date of Receipt of Application:	
2. Project Number(s):	
3. PSD Number (if applicable):	
4. Siting Number (if applicable):	

Purpose of Application

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

Air Construction Permit

☒ Air construction permit.

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

The attached report presents the BART determination and modeling analysis results for Progress Energy Florida's (PEF) Crystal River Power Plant. This report is being provided to the Florida Department of Environmental Protection (FDEP) to satisfy any remaining requirements under the BART Rule (40 CFR 51, Subpart P) and proposed Rule 62-296.340 of the Florida Administrative Code (F.A.C.) as it pertains to this facility. The source information and methodologies used for the BART analysis for this facility are the same as those presented in the document entitled "Air Modeling Protocol to Evaluate Best Available Retrofit Technology (BART) Options for PEF", submitted to the FDEP in 2006. A copy of this document has been included for reference in Appendix A to the attached report. For the Crystal River Power Plant, the BART-eligible units are not exempt from BART determination. As a result, the referenced report includes a BART determination analysis.

Based on these modeling results, the maximum visibility impacts showed no improvement over the base case, even when assuming a control level for PM emissions that is comparable to recent BACT determinations. As a result, PEF believes that no further PM controls are required for the Crystal River Power Plant under proposed Rule 62-296.340(5)(c), F.A.C.

FACILITY INFORMATION

Scope of Application

Emissions Unit ID Number	Description of Emissions Unit	Air Permit Type	Air Permit Proc. Fee
001	FFSG, Unit 1	AC1F	NA
002	FFSG, Unit 2	AC1F	NA

Application Processing Fee

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

FACILITY INFORMATION

Owner/Authorized Representative Statement

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

1.	Owner/Authorized Representative Name : BERNIE CUMBIE, PLANT MANAGER
2.	Owner/Authorized Representative Mailing Address... Organization/Firm: PROGRESS ENERGY Street Address: 100 CENTRAL AVE CN77 City: ST PETERSBURG State: FLORIDA Zip Code: 33701
3.	Owner/Authorized Representative Telephone Numbers... Telephone: (352) 563-4484 ext: Fax: (352) 563-4496
4.	Owner/Authorized Representative Email Address: BERNIE.CUMBIE@PGNMAIL.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.

Bernie W Cumbie — 1/31/07

Signature — 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

Professional Engineer Certification

1. Professional Engineer Name: **SCOTT OSBOURN** Registration Number: **57557**	
2. Professional Engineer Mailing Address... Organization/Firm: **Golder Associates Inc.**** Street Address: **5100 West Lemon St., Suite 114** City: **Tampa** State: **FL** Zip Code: **33609**	
3. Professional Engineer Telephone Numbers... Telephone: **(813) 287-1717** ext.**211** Fax: **(813) 287-1716**	
4. Professional Engineer Email Address: **SOSBOURN@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.

Signature: Scott Osbourn Date: 1/31/07

(seal)

SCOTT OSBOURN LICENSE NO. 57557 STATE OF FLORIDA PROFESSIONAL ENGINEER

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

APPENDIX B

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

Golder Associates Inc.
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Golder Associates

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

Prepared for:
Progress Energy Florida
100 Central Avenue
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Prepared By:
Golder Associates Inc.
5100 West Lemon Street
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Tampa, Florida 33609

DISTRIBUTION:

2 Copies	Florida Department of Environmental Protection
2 Copies	Progress Energy Florida
2 Copies	Golder Associates Inc.

December 2006 063-9571

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1.0 INTRODUCTION

1.1 Objectives

Under the regional haze regulations, which are contained in Title 40, Part 51 of the Code of Federal Regulations (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 [Federal Register (FR), Volume 70, 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 emissions units that are one of the 26 listed source categories in the guidance.

The Florida Department of Environmental Protection (FDEP) has proposed to adopt EPA's visibility protection rules and guidelines contained in 40 CFR 51, Subpart P. Final adoption of these rules is expected by the end of this year.

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 [i.e., located in Florida or within 300 kilometers (km) of Florida].

BART is required for any BART-eligible source that the FDEP determines emits any air pollutant that 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 three Progress Energy Florida facilities as BART-eligible sources with multiple BART-eligible emissions units. These plants include:

- Crystal River Power Plant - steam generators 1 and 2 (EU ID Nos. 001 and 002, respectively);
- Anclote Power Plant – steam generators 1 and 2 (EU ID Nos. 001 and 002, respectively); and
- Bartow Power Plant – steam generator No. 3 (EU ID 003)

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 Progress Energy Florida's BART-eligible emissions units. The site-specific data includes emissions unit locations, stack parameters, emission rates, and PM_{10} speciation information.

For guidance in preparing the air modeling protocol, the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) has developed a "common" 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 Progress Energy's Florida facilities follows the general procedures recommended by VISTAS.

1.2 Location of Source

The Crystal River Power Plant is located on Power Line Rd., West of U.S. Highway 19, in Crystal River, Citrus County; the Anclote Power Plant is located at 1729 Baillies Bluff Rd., in Holiday, Pasco

County; and the Bartow Power Plant is located at 1601 Weedon Island Drive, St. Petersburg, Pinellas County. An area map showing the Crystal River, Anclote and Bartow Power Plants and PSD Class I areas located within 300 kilometers (km) of the each plant is presented in Figure 1-1. The PSD Class I areas and their distances from the plants are as follows:

- Crystal River - Chassahowitzka National Wilderness Area NWA - 21 km,
  Wolf Island NWA - 293 km,
  Okefenokee NWA - 178 km, and
  Saint Marks NWA - 174 km.
- Anclote Plant - Chassahowitzka National Wilderness Area NWA - 48 km,
  Everglades National Park NP - 287 km,
  Okefenokee NWA - 265 km, and
  Saint Marks NWA - 239 km.
- Bartow Plant - Chassahowitzka National Wilderness Area NWA - 83 km,
  Everglades National Park NP - 247 km,
  Okefenokee NWA - 297 km, and
  Saint Marks NWA - 280 km.

Bradwell Bay PSD Class I area is located within 300 km of the Crystal River and Anclote facilities, but visibility impairment is not required to be addressed for this area.

The general location of the Progress Energy Florida plants, in Universal Transverse Mercator (UTM) coordinates are as follows:

- Crystal River Plant – 334.3 km East, 3204.5 km North, Zone 17;
- Anclote Plant – 324.4 km East, 3118.7 km North, Zone 17; and
- Bartow Plant – 342.4 km East, 3082.6 km North, Zone 17.

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 the "BART control analysis."

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 the 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 course scale 12-km regional VISTAS 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 one year or the 22nd highest 24-hour average visibility impairment value over three years combined, whichever is higher, is compared to 0.5 dv criteria.

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 Progress Energy Florida 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 Progress Energy Florida plants except Bradwell Bay 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 the BART-eligible source is subject to the BART control analysis, part of the BART review process involves evaluating the visibility benefits of different BART control measures. These benefits will be determined by the refined analysis, where CALPUFF will be executed with the baseline emission rates and again with emission rates reflective of BART control options.

2.0 SOURCE DESCRIPTION

2.1 Source Applicability

The Crystal River Power Plant operates four coal-fired fossil fuel steam generators (FFSGs), the Anclote Power Plant operates two fuel oil-fired FFSGs and the Bartow Power Plant operates three fuel oil-fired FFSGs. 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 five potential BART-eligible emissions units from the Crystal River (2), Anclote (2) and Bartow (1) Power Plants. These plants are on the FDEP list since they are one of the 26 major source categories identified in the BART regulation [fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour (MMBtu/hr) heat input] and has potential emissions of visibility impairment pollutants (i.e., SO_2, NO_x, and PM_{10}) that are greater than 250 TPY.

Progress Energy Florida 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 classified under the source category of "Fossil-fuel fired steam electric plants of more than 250 MMBtu/hr heat input".

Second, each emissions unit and 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 units began operation after August 7, 1962, and also were in existence 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 visibility 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.

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 Group (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 Progress Energy Florida plants are subject to the provisions of CAIR, SO_2 and NO_x emissions were not included in the air modeling analysis.

As shown in Table 2-1, the potential annual PM_{10} emissions from the BART-eligible emissions units total more than 250 TPY for each of the plants. Because the emissions of one or more pollutants are greater than the 250 TPY threshold, PM_{10} emissions will be included in the visibility impairment assessment for the facility.

2.2 Stack Parameters

The stack height above ground, stack diameter, exit velocity, and exit temperature for the BART-eligible emissions units at the Crystal River, Anclote, and Bartow Power Plants are presented in Table 2-2. The general location of each plant is provided in UTM coordinates and in the VISTAS domain 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 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.

PM_{10} emission rates for Crystal River and Anclote were based on actual emissions test data, and Bartow Power Plants were obtained from the current Title V Permit No. 1030011-009-AV. PM_{10} emissions of all five affected units at these three plants were calculated based on maximum permitted soot blowing for three hours in a 24-hour period at 0.3 lb/MMBtu and normal operation for 21 hours at 0.1 lb/MMBtu. These values would represent the highest potential PM_{10} emissions from these units in a 24-hour period. In addition, actual emissions data were obtained for these units, based on annual stack tests conducted from 2001 through 2006. While this data is representative of normal operation, it may not represent the highest 24-hour value that may be demonstrated. Therefore, this protocol reserves the ability to use either actual data or allowable data in the BART modeling analysis, as may be appropriate. The maximum 24-hour average PM_{10} emission rates for the BART-eligible units at these three plants, currently based on allowable permit limits, are presented in Table 2-3.

2.4 PM 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*f(RH) and 4, respectively, where f(RH) is the relative humidity factor.

A summary of PM speciation is presented in Table 2-4 for Bartow Unit 3 and Table 2-5 for Anclote Units 1 and 2. PM speciation for Crystal River Units 1 and 2 are presented in Table 2-6 and Table 2-7. The species categories for Crystal River Units 1 and 2 were determined from the speciation profile for Utility Coal Boiler with ESP provided in Table 1.1-5 in AP-42. The different size categories were determined from particle size distribution for Utility Coal Boilers with ESP provided in Table 1.1-6 in AP-42. The species categories for Bartow Unit 3, and Anclote Units 1 and 2 were determined from the VISTAS provided speciation profile for Uncontrolled Utility Residual Oil Boiler for 2.5 percent sulfur fuel and 1.8 percent sulfur fuel. The different size categories were determined from particle size distribution for Uncontrolled Residual Oil-fired Utility Boilers provided in Table 1.3-4 in AP-42.

2.5 Building Dimension

Based on discussions with FDEP, building downwash effects will be considered for Crystal River Power Plant, but will not be considered in the modeling for the Anclote and Bartow Power Plants, as these effects are considered to be minimal in assessing impacts as the distance of the nearest PSD Class I area is more than 50 km from both of these plants.

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 data set at 12 km grid (developed by EPA),
- 2002 MM5 data set at 12 km grid (developed by VISTAS), and
- 2003 MM5 data set 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 for the years 2001-2003 will 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 Crystal River, Anclote and Bartow Power Plants are large sources that are likely to exceed the initial screening thresholds. Therefore, for the Progress Energy Florida BART analyses, 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 domains to be used in the exemption modeling have been supplied by VISTAS.

3.3 Air Quality Database

3.3.1 Ozone Concentrations

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

3.3.2 Ammonia Concentrations

A fixed 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 RH factors for the Class I areas within 300 km of the Progress Energy Florida plants are as follows:

Month	Chassahowitzka NWA	Everglades NP	Okefenokee NWA	Saint Marks NWA	Wolf Island NWA
January	3.8	2.7	3.5	3.7	3.4
February	3.5	2.6	3.2	3.4	3.1
March	3.4	2.6	3.1	3.4	3.1
April	3.2	2.4	3.0	3.4	3.0
May	3.3	2.4	3.6	3.5	3.3
June	3.9	2.7	3.7	4.0	3.7
July	3.9	2.6	3.7	4.1	3.7
August	4.2	2.9	4.1	4.4	4.1
September	4.1	3.0	4.0	4.2	4.0
October	3.9	2.8	3.8	3.8	3.7
November	3.7	2.6	3.5	3.7	3.5
December	3.9	2.7	3.6	3.8	3.5

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 should 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 Guidance document (using the 10th percentile HI value). For the Progress Energy Florida's 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 the EPA-provided background HI for each Class I area, based on annual average, will be estimated using the following background values:

- Rayleigh scattering = 10 Mm^{-1};
- Concentrations of BKSO4, BKNO3, BKPMC, BKEC, and BKEC = 0.0; and
- BKSOIL concentration, which is estimated by subtracting the Rayleigh scattering of 10 Mm^{-1} from the extinction coefficient that corresponds to EPA's annual average HI value, then dividing the remainder by the BKSOIL extinction efficiency of 1 m^2/g.

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

- Chassahowitzka NWA – 21.45 Mm-1 (equivalent to 7.63 dv); 11.45 µg/m3;
- Everglades NP – 20.77 Mm-1 (equivalent to 7.31 dv); 10.77 µg/m3;
- Okefenokee NWA – 21.40 Mm-1 (equivalent to 7.61 dv); 11.40 µg/m3;
- Saint Marks NWA – 21.53 Mm-1 (equivalent to 7.67 dv); 11.53 µg/m3; and
- Wolf Island NWA – 21.34 Mm-1 (equivalent to 7.58 dv); 11.34 µg/m3.

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 U.S. Environmental Protection Agency (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 Progress Energy Florida facilities 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 Progress Energy Florida's BART-eligible units in addition to the visibility impacts determined using the old IMPROVE equation.

It is assumed that ambient NO_2 concentrations due to Progress Energy Florida's BART eligible unit would be very small as to cause negligible light absorption, so light absorption by NO_2 gas, which is a new term added to the new IMPROVE algorithm, will not be considered for Progress Energy's 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 $\mu g/m^3$
- Saint Marks NWA – 11 Mm^{-1} ; 0.03 $\mu g/m^3$
- Okefenokee NWA – 11 Mm^{-1} ; 0.09 $\mu g/m^3$
- Wolf Island NWA – 12 Mm^{-1} ; 0.20 $\mu g/m^3$

4.0 AIR QUALITY MODELING METHODOLOGY

For predicting maximum visibility impairment at the Class I Area, 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 the 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 the 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 cover sources in Florida and Class I areas that are affected by the sources in Florida.

4.2 CALMET Meteorological Domain

The refined CALMET domain, to be used for Progress Energy Florida's BART modeling has 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 modeling 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 represented in Figures 4-1 through 4-5.

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 guidance, will be used to compute change in light extinction.

4.6 Quality Assurance and Quality Control (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 will be independently confirmed by an independent modeler not involved in the initial setup of the modeling files. The data verification will cover the following:

1. proper units of measure;
2. verification of the correct source and receptor locations, including datum and projection;
3. confirmation of the switch selections relative to modeling guidance;
4. checks of the program switches and file names of the various processing steps; and
5. confirmation of the use of the proper version and level of each model program.

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 Progress Energy. 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 verify 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 using the current visibility algorithm, and as warranted, the new IMPROVE equation; 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 all evaluated BART emission scenarios 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, based on the analysis results of the five evaluation criteria presented in the BART regulation.

TABLES

TABLE 2-1
BART ELIGIBILITY ANALYSIS FOR PROGRESS ENERGY FLORIDA - CRYSTAL RIVER, ANCLOTE AND BARTOW POWER PLANTS
(FACILITY IDS 0170004, 1010017 AND 1030011)

EU ID	Emission Unit	BART Category [a]	Dates: Start-Up	Dates: Initial Construction	In Existence on 8/7/1977 ? (Yes/No)	Began Operation After 8/7/1962 ? (Yes/No)	Meets BART Date Criteria ? (Yes/No)	SO_2, NO_x, or PM Source ? (Yes/No)	BART Eligible ? (Yes/No)	Potential PM_{10} Emissions (TPY)	Comments
Crystal River Power Plant											
001	Fossil Fuel Steam Generator, Unit 1	1	1966	--	Yes	Yes	Yes	Yes	Yes	2,053.1	
002	Fossil Fuel Steam Generator, Unit 2	1	1969	--	Yes	Yes	Yes	Yes	Yes	2,625.3	
004	Fossil Fuel Steam Generator, Unit 4	1	1982	--	No	Yes	No	Yes	No	3,649.1	
003	Fossil Fuel Steam Generator, Unit 5	1	1984	--	No	Yes	No	Yes	No	3,649.1	
									Crystal River Total TPY =	11,976.6	
Anclote Power Plant											
001	Fossil Fuel Fired Steam Generator #1	1	Oct. 16, 1974	--	Yes	Yes	Yes	Yes	Yes	2,777.5	
002	Fossil Fuel Fired Steam Generator #2	1	In existance before 8/7/1977	--	Yes	Yes	Yes	Yes	Yes	2,714.0	Unit 2 started operating on October 31, 1978, however it was "in existance" on August 7, 1977. Therefore, it is technically a BART-eligible unit.
									Anclote Total TPY =	5,491.5	
Bartow Power Plant											
001	Fossil Fuel Fired Steam Generator with Electrostatic Precipitator, No. 1 Unit	1	1958	--	Yes	No	No	Yes	No	668.0	
002	Fossil Fuel Fired Steam Generator, No. 2 Unit	1	1961	--	Yes	No	No	Yes	No	721.1	
003	Fossil Fuel Fired Steam Generator, No. 3 Unit	1	1963	--	Yes	Yes	Yes	Yes	Yes	1,240.6	
									Bartow Total TPY =	2,629.7	

[a] BART category 1 is Steam Electric Plants of More Than 250 MMBtu/hr Heat Input.

TABLE 2-2
SUMMARY OF STACK AND OPERATING PARAMETERS AND LOCATIONS FOR THE BART-ELIGIBLE EMISSIONS UNITS
CRYSTAL RIVER, ANCLOTE AND BARTOW POWER PLANTS

		Stack Parameters				Operating Parameters				
		Height		Diameter		Flow Rate	Exit Temperature		Velocity	
Emission Unit	Model ID	ft	m	ft	m	(acfm)	°F	K	ft/s	m/s
Crystal River Power Plant										
Unit 1 - Fossil Fuel Steam Generator	CRYSTN01	499	152.10	15.0	4.57	1,407,923	291	417.0	132.8	40.47
Unit 2 - Fossil Fuel Steam Generator	CRYSTN02	502	153.01	16.0	4.88	1,931,324	300	422.0	160.1	48.80
Unit 4 - Fossil Fuel Steam Generator	CRYSTN04	600	182.88	25.5	7.77	2,111,300	253	395.9	68.9	21.00
Unit 5 - Fossil Fuel Steam Generator	CRYSTN05	600	182.88	25.5	7.77	2,111,300	253	395.9	68.9	21.00
Anclote Power Plant										
Unit 1 - Fossil Fuel Fired Steam Generator	ANCLTN01	499	152.10	24.0	7.32	1,699,026	320	433.2	62.6	19.08
Unit 2 - Fossil Fuel Fired Steam Generator	ANCLTN02	499	152.10	24.0	7.32	1,692,307	320	433.2	62.3	19.00
Bartow Power Plant										
Unit 1 - Fossil Fuel Fired Steam Generator w/Electrostatic Precipitator	BARTWN01	300	91.44	9.0	2.74	454,227	312	428.7	119.0	36.27
Unit 2 - Fossil Fuel Fired Steam Generator	BARTWN02	300	91.44	9.0	2.74	389,338	305	424.8	102.0	31.09
Unit 3 - Fossil Fuel Fired Steam Generator	BARTWN03	300	91.44	11.0	3.35	644,325	275	408.2	113.0	34.44

Note: All emissions units will be collocated for the purpose of modeling. The facility coordinates are as follows:

UTM Coordinates: Crystal River - Zone 17, 334.3 km East, 3,204.5 km North.
Anclote - Zone 17, 324.4 km East, 3,118.7 km North.
Bartow - Zone 17, 342.4 km East, 3082.6 km North.

Lat/Long: Crystal River - 28° 57' 34.74" North, 82° 42' 1" West.
Anclote - 28° 11'2.15" North, 82° 47' 19.71" West.
Bartow - 27° 51' 38.67" North, 82° 36' 1.99" West.

Lambert Conformal Conic (LCC) coordinate, VISTAS Domain:
Crystal River - 1,398.529 km, -1,116.13 km
Anclote - 1403.524 km, -1,203.559 km
Bartow - 1,427.695 km, -1,236.590 km

TABLE 2-3
SUMMARY OF MAXIMUM 24-HOUR AVERAGE EMISSION RATES FOR THE BART-ELIGIBLE EMISSIONS UNITS
CRYSTAL RIVER, ANCLOTE AND BARTOW POWER PLANTS

Source	EU ID	Model ID	Heat Input Rate (MMBtu/hr)	Allowable Emission Rate: Normal Operation (lb/MMBtu)	Allowable Emission Rate: Soot Blowing (lb/MMBtu)	Daily PM_{10} Emissions: Normal Operation (lb)	Daily PM_{10} Emissions: Soot Blowing (lb)	Daily Average PM_{10} Emissions (lb/hr)	Condensable PM (lb/MMBtu)	Condensable PM (lb/hr)
Crystal River Power Plant[a]										
Unit 1 - Fossil Fuel Steam Generator*	001	CRYSTN01	3,750	0.1	0.3	7875	3375	468.8	0.07	262.5
Unit 2 - Fossil Fuel Steam Generator*	002	CRYSTN02	4,795	0.1	0.3	10069.5	4315.5	599.4	0.07	335.65
Unit 4 - Fossil Fuel Steam Generator	004	CRYSTN04	6,665	0.1	0.3	13996.5	5998.5	833.1	0.07	466.55
Unit 5 - Fossil Fuel Steam Generator	003	CRYSTN05	6,665	0.1	0.3	13996.5	5998.5	833.1	0.07	466.55
Anclote Power Plant[b]										
Unit 1 - Fossil Fuel Fired Steam Generator*	001	ANCLTN01	5,073	0.1	0.3	10653.3	4565.7	634.1	—	—
Unit 2 - Fossil Fuel Fired Steam Generator*	002	ANCLTN02	4,957	0.1	0.3	10409.7	4461.3	619.6	—	—
Bartow Power Plant[c]										
Unit 1 - Fossil Fuel Fired Steam Generator w/Electrostatic Precipitator	001	BARTWN01	1,220	0.1	0.3	2562	1098	152.5	—	—
Unit 2 - Fossil Fuel Fired Steam Generator	002	BARTWN02	1,317	0.1	0.3	2765.7	1185.3	164.6	—	—
Unit 3 - Fossil Fuel Fired Steam Generator	003	BARTWN03	2,266	0.1	0.3	4758.6	2039.4	283.3	—	—

* Used actual PM test data for modeling.

[a] Based on permit limit in permit No. 0170004-009-AV.
[b] Based on permit limit in permit No. 1010017-008-AV.
[c] Based on permit limit in permit No. 1030011-009-AV.
Soot blowing is assured to occur for 3 hours with normal operations for the remaining 21 hours.

Condensable PM from AP-42 Table 1.1-5

TABLE 2-4
PM SPECIATION SUMMARY - BARTOW

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 3	lb/hr	283.3	76.81	191.16	15.28	NA	NA
		%	100%	27%	67%	5%	NA	NA
PM Condensable [c]	Unit 3	lb/hr	22.66	NA	NA	NA	19.26	3.40
		%	100%	NA	NA	NA	85%	15%
Total PM_{10} (filterable+condensable)	Unit 3	lb/hr	305.9	76.81	191.16	15.28	19.26	3.40
		%	100%	25.1%	62.5%	5.0%	6.3%	1.1%
Total PM_{10} (filterable+Organic Condensable PM)	Unit 3	lb/hr	286.6	76.81	191.16	15.28	0.0	3.40
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	26.8%	66.7%	5.3%	0.0%	1.2%

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 PM10 (%)	Filterable (%)	Organic Condensable	Filterable	Organic Condensable	Total
Total PM_{10}						283.3	3.4	286.6
PM0063	0.63	20.0%	28.2%	28.2%	50.0%	79.8	1.7	81.5
PM0100	1	39.0%	54.9%	26.8%	50.0%	75.8	1.7	77.5
PM0125	1.25	43.0%	60.6%	5.6%	0	16.0	0.0	16.0
PM0250	2.5	52.0%	73.2%	12.7%	0	35.9	0.0	35.9
PM0600	6	58.0%	81.7%	8.5%	0	23.9	0.0	23.9
PM1000	10	71.0%	100.0%	18.3%	0	51.9	0.0	51.9
Totals				100.0%	100.0%	283.3	3.4	286.6

Total Modeled PM_{10} 286.6

[a] Heat input rate for unit and fuel heat content 2,266 MMBtu/hr 2,266 Unit 3
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 2-5
PM SPECIATION SUMMARY - ANCLOTE

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	707.02	191.73	477.15	38.13	NA	NA
		%	100%	27%	67%	5%	NA	NA
PM Condensable [c]	Unit 1 & 2	lb/hr	100.30	NA	NA	NA	85.26	15.05
		%	100%	NA	NA	NA	85%	15%
Total PM_{10} (filterable+condensable)	Unit 1 & 2	lb/hr	807.3	191.73	477.15	38.13	85.26	15.05
		%	100%	23.7%	59.1%	4.7%	10.6%	1.9%
Total PM_{10} (filterable+Organic Condensable PM)	Unit 1 & 2	lb/hr	722.1	191.73	477.15	38.13	0.0	15.05
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	26.6%	66.1%	5.3%	0.0%	2.1%

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}						707.0	15.0	722.1
PM0063	0.63	20.0%	28.2%	28.2%	50.0%	199.2	7.5	206.7
PM0100	1	39.0%	54.9%	26.8%	50.0%	189.2	7.5	196.7
PM0125	1.25	43.0%	60.6%	5.6%	0	39.8	0.0	39.8
PM0250	2.5	52.0%	73.2%	12.7%	0	89.6	0.0	89.6
PM0600	6	58.0%	81.7%	8.5%	0	59.7	0.0	59.7
PM1000	10	71.0%	100.0%	18.3%	0	129.5	0.0	129.5
Totals				100.0%	100.0%	707.0	15.0	722.1

Total Modeled PM_{10} 722.1

[a] Heat input rate for unit and fuel heat content — 10,030 MMBtu/hr; 150,000 Btu/gal fuel oil — 5,073 Unit 1; 4,957 Unit 2

[b] PM fine consists of PM soil and PM elemental carbon
PM fine based on ratio of PM2.5 (fine) to PM10 (filterable) emission factor (Table 1.3-4, AP-42)

	lb/1000 gal		
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 2-6
PM SPECIATION SUMMARY - CRYSTAL RIVER Unit 1

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	lb/hr	140.8	78.23	60.27	2.32	NA	NA
		%	100%	56%	43%	1.6%	NA	NA
PM Condensable [c]	Unit 1	lb/hr	544.50	NA	NA	NA	78.00	466.50
		%	100%	NA	NA	NA	80%	20%
Total PM_{10} (filterable+condensable)	Unit 1	lb/hr	685.3	78.23	60.27	2.32	78.00	466.50
		%	100%	11.4%	8.8%	0.3%	11.4%	68.1%
Total PM_{10} (filterable+Organic Condensable PM)	Unit 1	lb/hr	607.3	78.23	60.27	2.32	0.0	466.50
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	12.9%	9.9%	0.4%	0.0%	76.8%

PM Particle Size Distribution for CALPUFF Assessment

Species Name	Size Distribution by Category (%): 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	Organic Condensable	Total
Total PM_{10}						140.8	466.5	607.3
PM0063	0.63	18.5%	33.3%	33.3%	50.0%	46.9	233.3	280.1
PM0100	1	0.0%	0.0%	0.0%	50.0%	0.0	233.3	233.3
PM0125	1.25	0.0%	0.0%	0.0%	0	0.0	0.0	0.0
PM0250	2.5	25.9%	46.6%	13.3%	0	18.7	0.0	18.7
PM0600	6	0.0%	0.0%	0.0%	0	0.0	0.0	0.0
PM1000	10	55.6%	100.0%	53.4%	0	75.2	0.0	75.2
Totals				100.0%	100.0%	140.8	466.5	607.3

Total Modeled PM_{10} 607.3

[a] Heat input rate for unit and fuel heat content 3,630 MMBtu/hr 3,630 Unit 1
1.80 sulfur content (%)

[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 0.24 lb/ton — Ratio = 0.44 PM2.5/PM10
emission factor (Table 1.1-5, AP-42) — PM10 0.54 lb/ton

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

PM elemental carbon	0.016 PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon	0.43 PM soil/PM10
PM2.5	0.44 PM2.5/PM10
PM coarse= PM10 - PM2.5	

[c] Condensable PM (Table 1.1-6, AP-42)

	lb/MMBtu	
Total	0.1 x S - 0.03	
	0.15	
Inorganic	0.12	(0.80 of Total)
Organic	0.03	(0.20 of Total)

TABLE 2-7
PM SPECIATION SUMMARY - CRYSTAL RIVER Unit 2

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	lb/hr	115.2	64.00	49.31	1.89	NA	NA
		%	100%	56%	43%	1.6%	NA	NA
PM Condensable [c]	Unit 1	lb/hr	658.50	NA	NA	NA	94.00	564.50
		%	100%	NA	NA	NA	80%	20%
Total PM_{10} (filterable+condensable)	Unit 1	lb/hr	773.7	64.00	49.31	1.89	94.00	564.50
		%	100%	8.3%	6.4%	0.2%	12.1%	73.0%
Total PM_{10} (filterable+Organic Condensable PM)	Unit 1	lb/hr	679.7	64.00	49.31	1.89	0.0	564.50
Modeled PM Speciation % (SO_4 modeled separately)		%	100%	9.4%	7.3%	0.3%	0.0%	83.1%

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 PM10 (%)	Filterable (%)	Organic Condensable	Filterable	Organic Condensable	Total
Total PM_{10}						115.2	564.5	679.7
PM0063	0.63	18.5%	33.3%	33.3%	50.0%	38.3	282.3	320.6
PM0100	1	0.0%	0.0%	0.0%	50.0%	0.0	282.3	282.3
PM0125	1.25	0.0%	0.0%	0.0%	0	0.0	0.0	0.0
PM0250	2.5	25.9%	46.6%	13.3%	0	15.3	0.0	15.3
PM0600	6	0.0%	0.0%	0.0%	0	0.0	0.0	0.0
PM1000	10	55.6%	100.0%	53.4%	0	61.5	0.0	61.5
Totals				100.0%	100.0%	115.2	564.5	679.7

Total Modeled PM_{10} 679.7

[a] Heat input rate for unit and fuel heat content 4,390 MMBtu/hr 4,390 Unit 1
1.80 sulfur content (%)

[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	0.24 lb/ton	Ratio =	0.44 PM2.5/PM10
emission factor (Table 1.1-5, AP-42)	PM10	0.54 lb/ton		

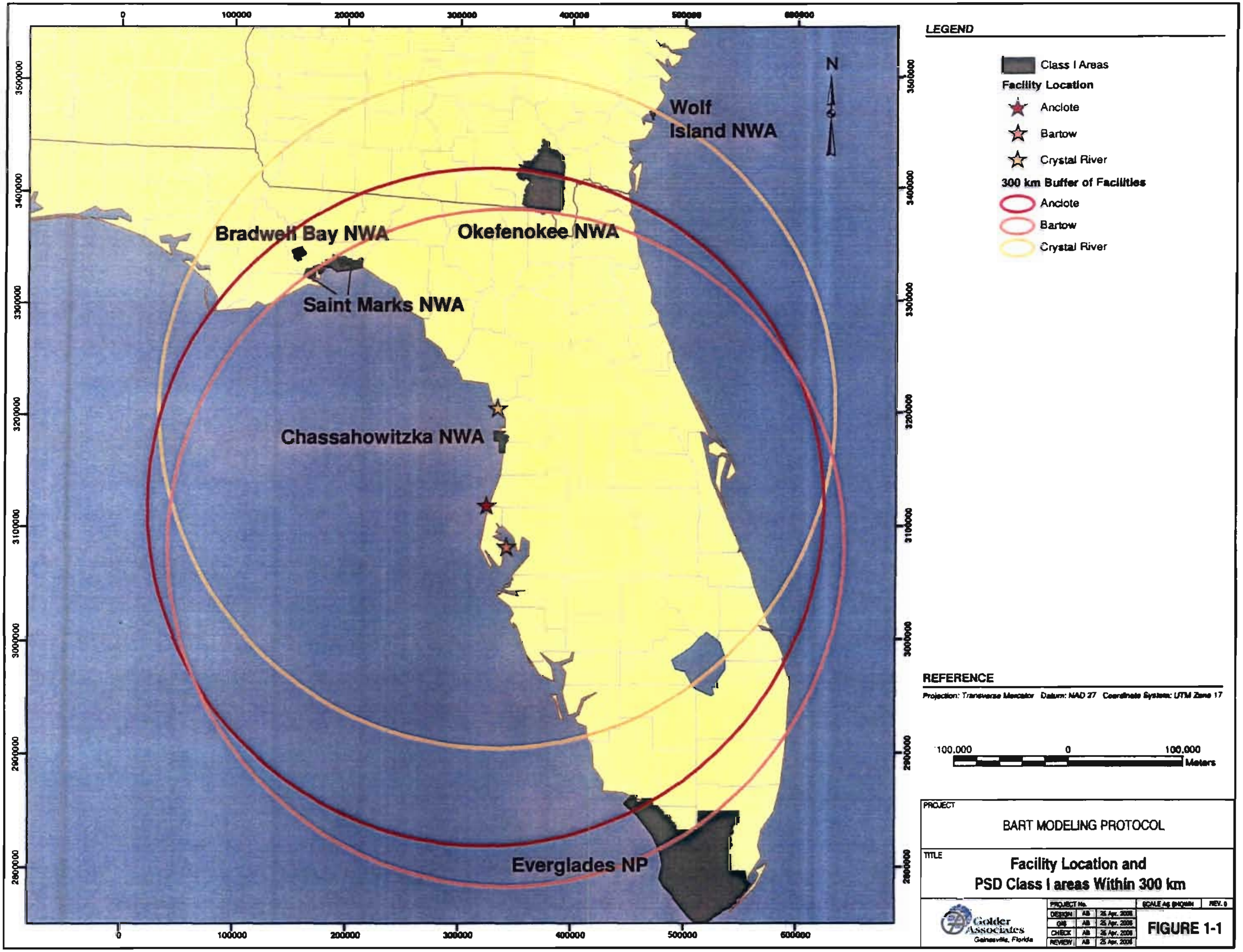
PM elemental carbon based on EPA's "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", Table 5, January 2002 DRAFT
0.037 of PM2.5

PM elemental carbon	0.016 PM elemental carbon/PM10
PM soil= PM2.5 - PM elemental carbon	0.43 PM soil/PM10
PM2.5	0.44 PM2.5/PM10
PM coarse= PM10 - PM2.5	

[c] Condensable PM (Table 1.1-6, AP-42)

	lb/MMBtu	
Total	0.1 x S - 0.03	
	0.15	
Inorganic	0.12	(0.80 of Total)
Organic	0.03	(0.20 of Total)

FIGURES



REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

PROJECT

BART MODELING PROTOCOL

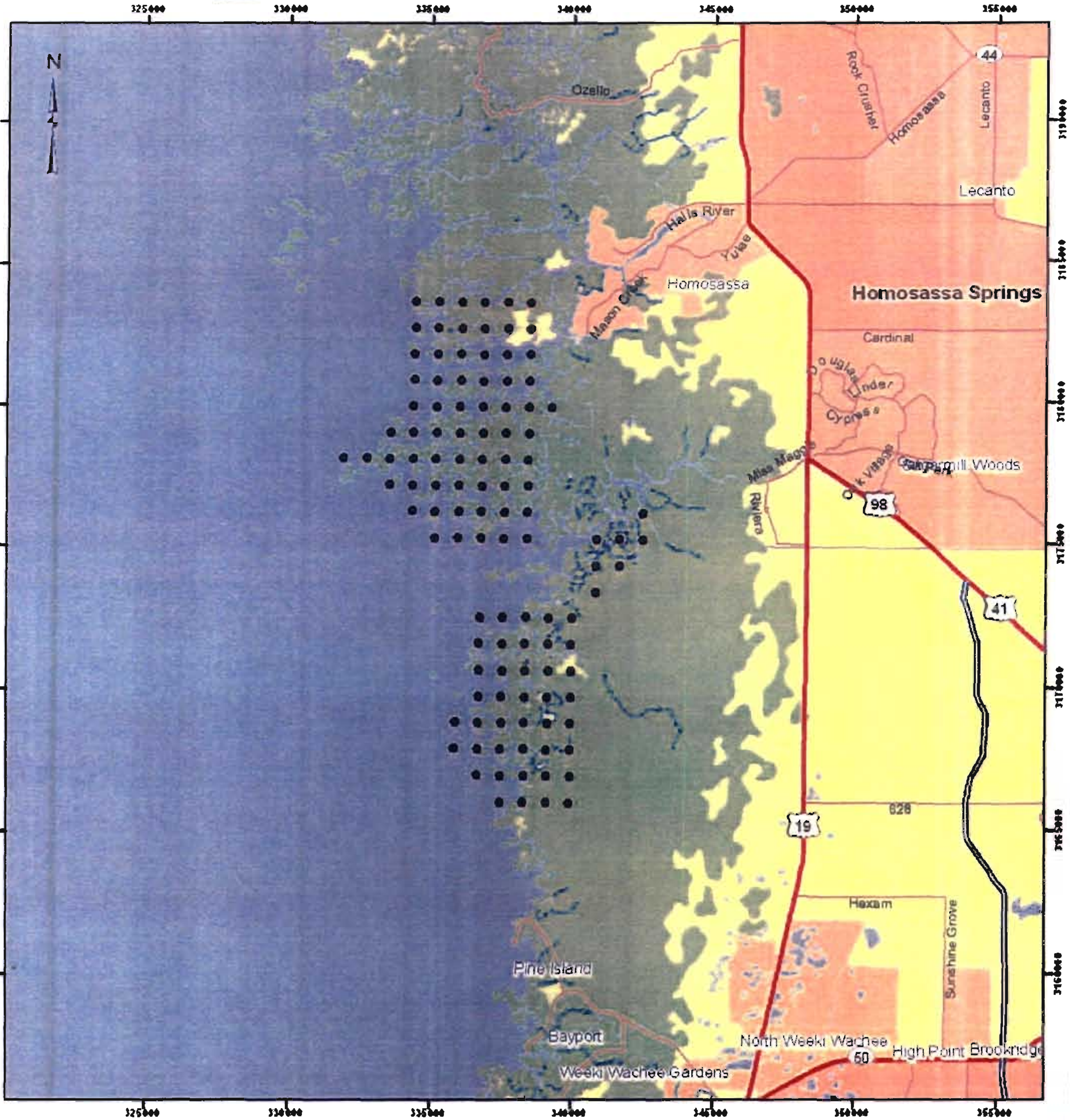
TITLE

Facility Location and PSD Class I areas Within 300 km

Golder Associates
Gainesville, Florida

PROJECT No.			SCALE AS SHOWN	REV. 0
DESIGN	AB	25 Apr. 2006		
GIS	AB	25 Apr. 2006		
CHECK	AB	25 Apr. 2006		
REVIEW	AB	25 Apr. 2006		

FIGURE 1-1



LEGEND

Chassahowitzka NWA

- 113 Receptor Grid

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

6,250 0 6,250 Meters

PROJECT

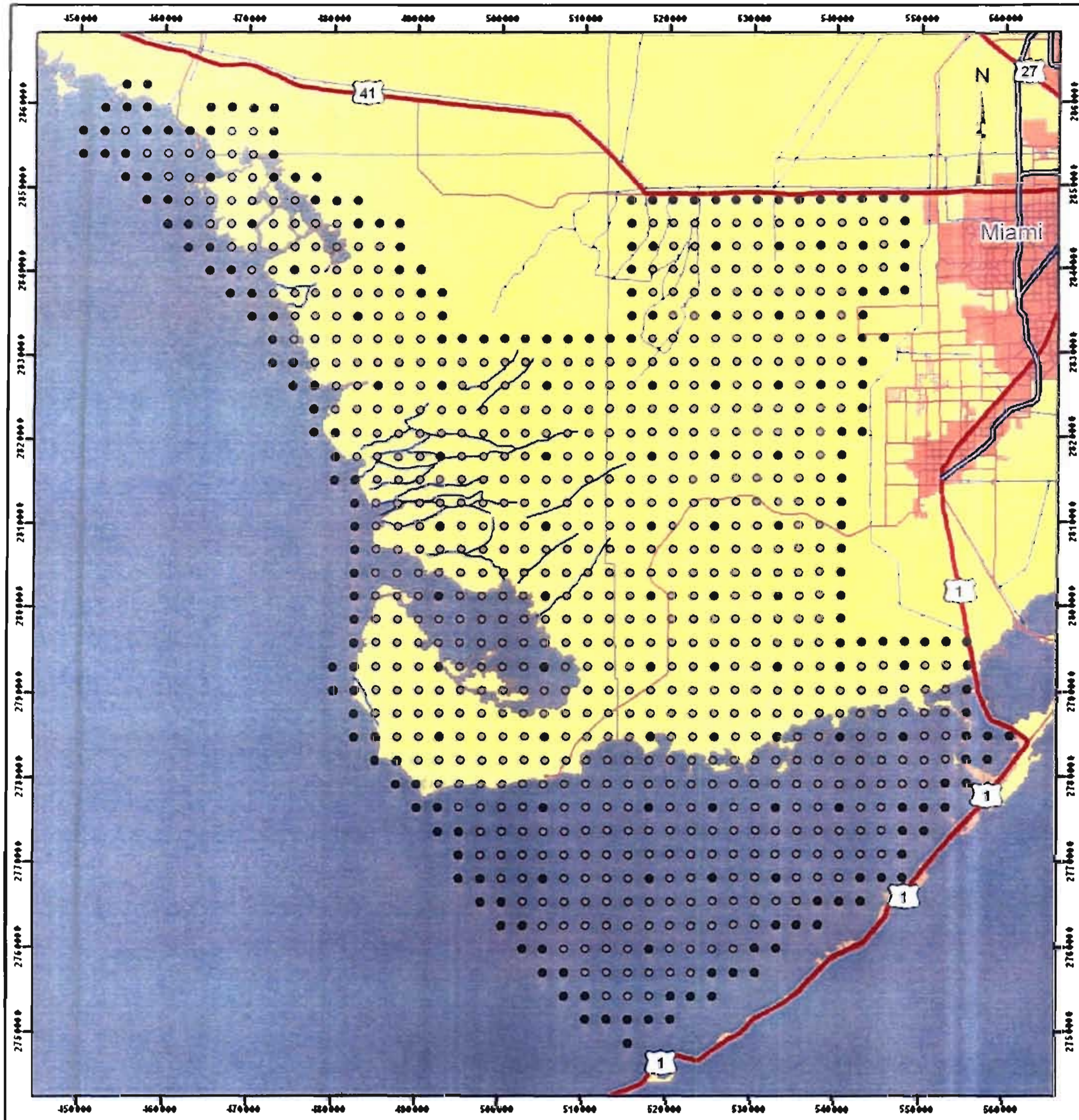
BART MODELING PROTOCOL

TITLE

CALPUFF Modeling Receptors
Chassahowitzka NWA

Golder Associates
Gainesville, Florida

FIGURE 4-1



LEGEND

Everglades NP

- ● 251 Thinned Receptor Grid
- ○ Receptors Removed

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

16,000 0 16,000 Meters

PROJECT

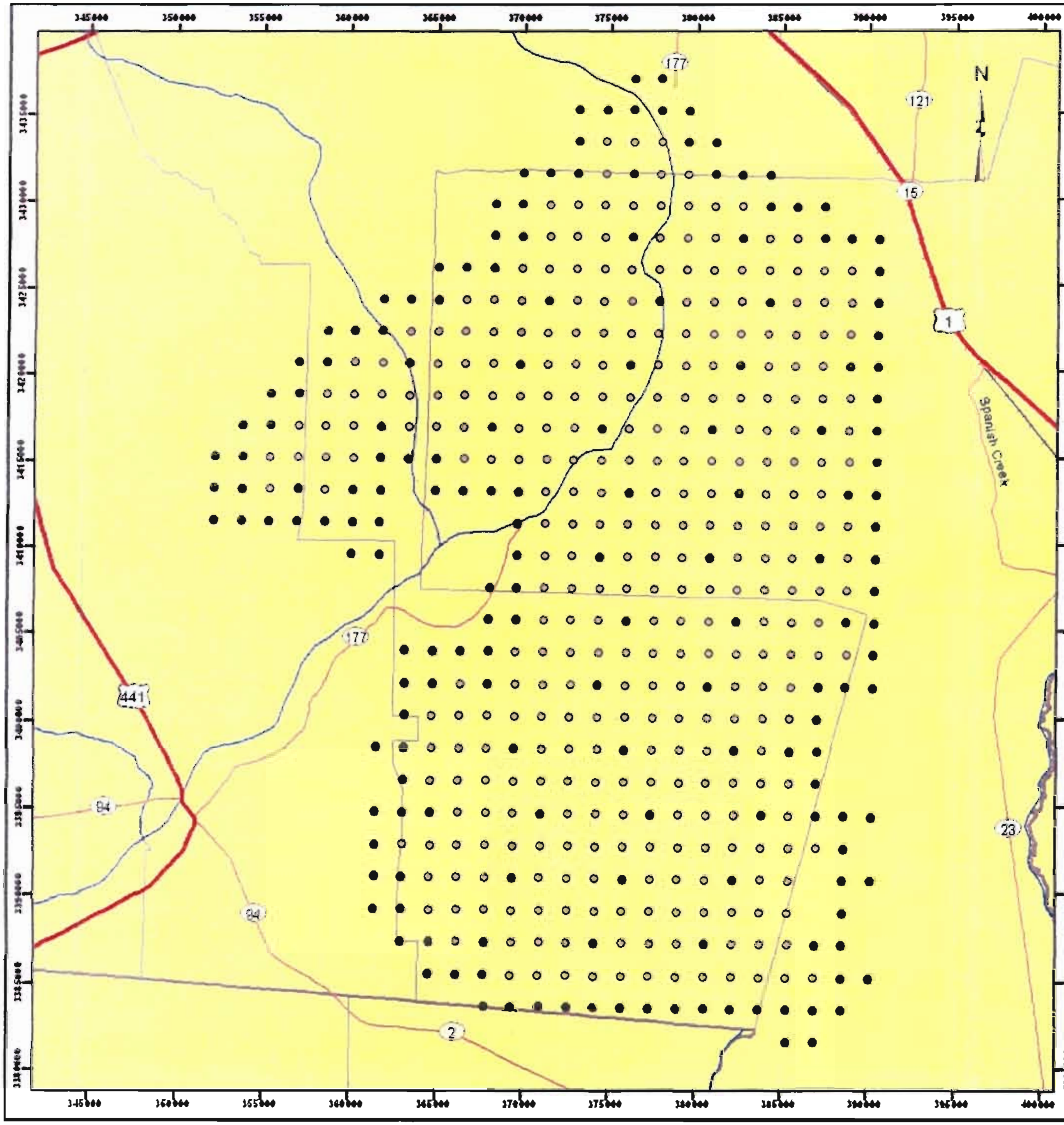
BART MODELING PROTOCOL

TITLE

CALPUFF Modeling Receptors
Everglades

Golder Associates
Gainesville, Florida

FIGURE 4-2



LEGEND

Okefenokee NWA

- ● 180 Thinned Receptor Grid
- ○ Receptors Removed

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

5,400 0 5,400 Meters

PROJECT

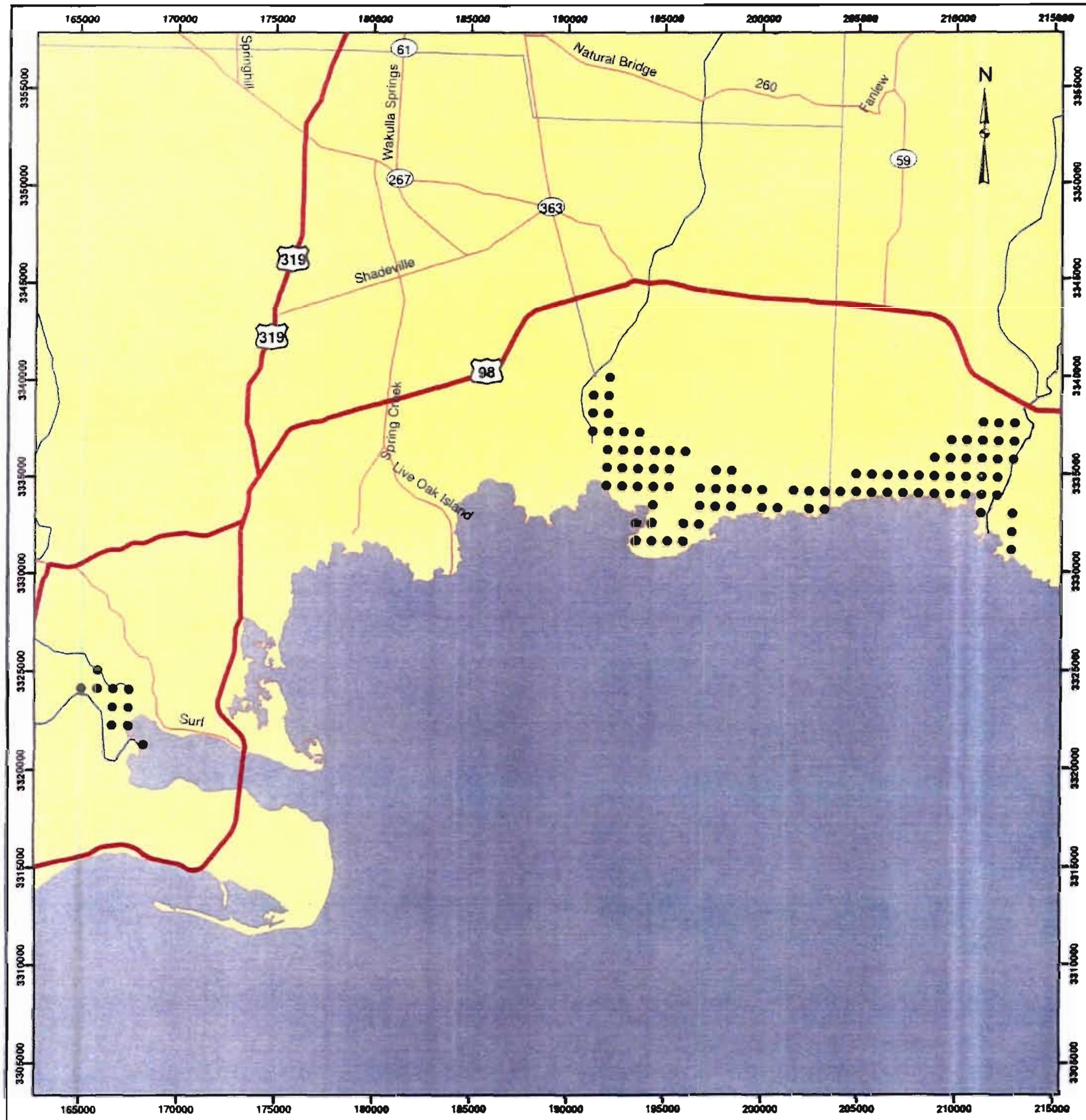
BART MODELING PROTOCOL

TITLE

CALPUFF Modeling Receptors Okeefenokee

Golder Associates
Gainesville, Florida

FIGURE 4-3



LEGEND

Saint Marks NWA

- 100 Receptor Grid

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

5,000 0 5,000 Meters

PROJECT

BART MODELING PROTOCOL

TITLE

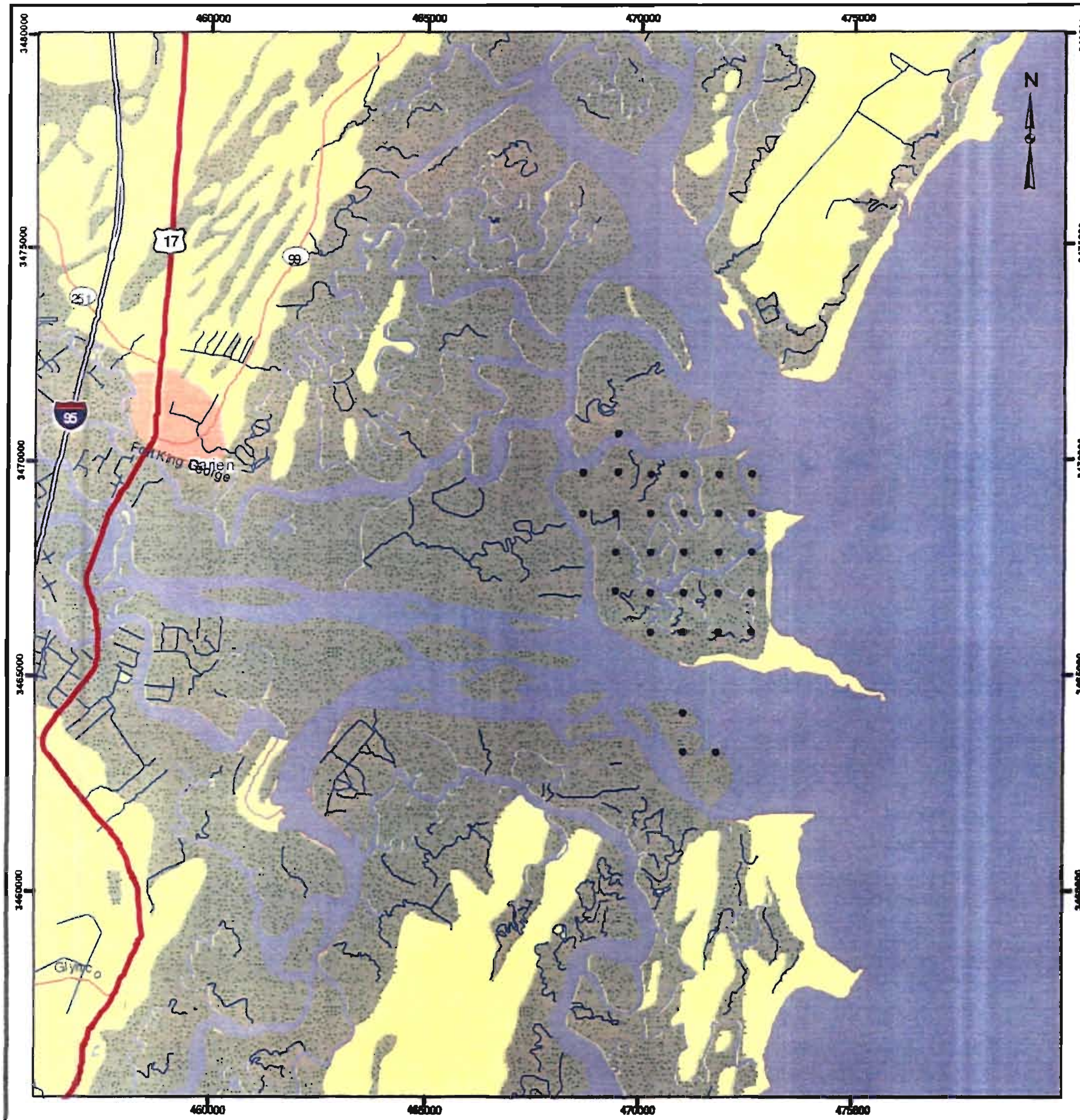
CALPUFF Modeling Receptors
Saint Marks

Golder Associates
Gainesville, Florida

PROJECT No.		
DESIGN	AB	25 Apr. 2006
GIS	AB	25 Apr. 2006

SCALE AS SHOWN REV. 0

FIGURE 4-4



LEGEND

Wolf Island NWA

- 30 Receptor Grid

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

3,000 0 3,000 Meters

PROJECT

BART MODELING PROTOCOL

TITLE

Wolf Island NWA Receptor Grid

Golder Associates
Gainesville, Florida

FIGURE 4-5

APPENDIX A

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 - CALMET binary file (CALMET.MET)
           METFM = 2 - ISC ASCII file (ISCMET.MET)
           METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
           METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
                       surface parameters file (SURFACE.DAT)

     PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
     Averaging Time (minutes) (AVET)
                                     Default: 60.0    ! AVET = 60. !
     PG Averaging Time (minutes) (PGTIME)
                                     Default: 60.0    ! PGTIME = 60. !


!END!

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

INPUT GROUP: 2 -- Technical options
--------------


     Vertical distribution used in the
     near field (MGAUSS)                   Default: 1     ! MGAUSS =  1   !
        0 = uniform
        1 = Gaussian

     Terrain adjustment method
     (MCTADJ)                              Default: 3     ! MCTADJ =  3   !
        0 = no adjustment
        1 = ISC-type of terrain adjustment
        2 = simple, CALPUFF-type of terrain
            adjustment
        3 = partial plume path adjustment

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

     Near-field puffs modeled as
     elongated 0 (MSLUG)                   Default: 0     ! MSLUG =  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     DIFFUSIVITY      ALPHA STAR      REACTIVITY    MESOPHYLL RESISTANCE      HENRY'S LAW
COEFFICIENT
       NAME        (cm**2/s)                                             (s/cm)
(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      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!


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


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)

POINT SOURCE: VARIABLE EMISSIONS DATA[a]

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)

AREA SOURCE: CONSTANT DATA [a]

Source No.	Effect. Height (m)	Base Elevation (m)	Initial Sigma z (m)	Emission Rates [b]

----
[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)

VOLUME SOURCE: VARIABLE EMISSIONS DATA[a]

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)

NON-GRIDDED (DISCRETE) RECEPTOR DATA[a]

Receptor No.	X Coordinate (km)	Y Coordinate (km)	Ground Elevation (m)	Height[b] Above Ground (m)

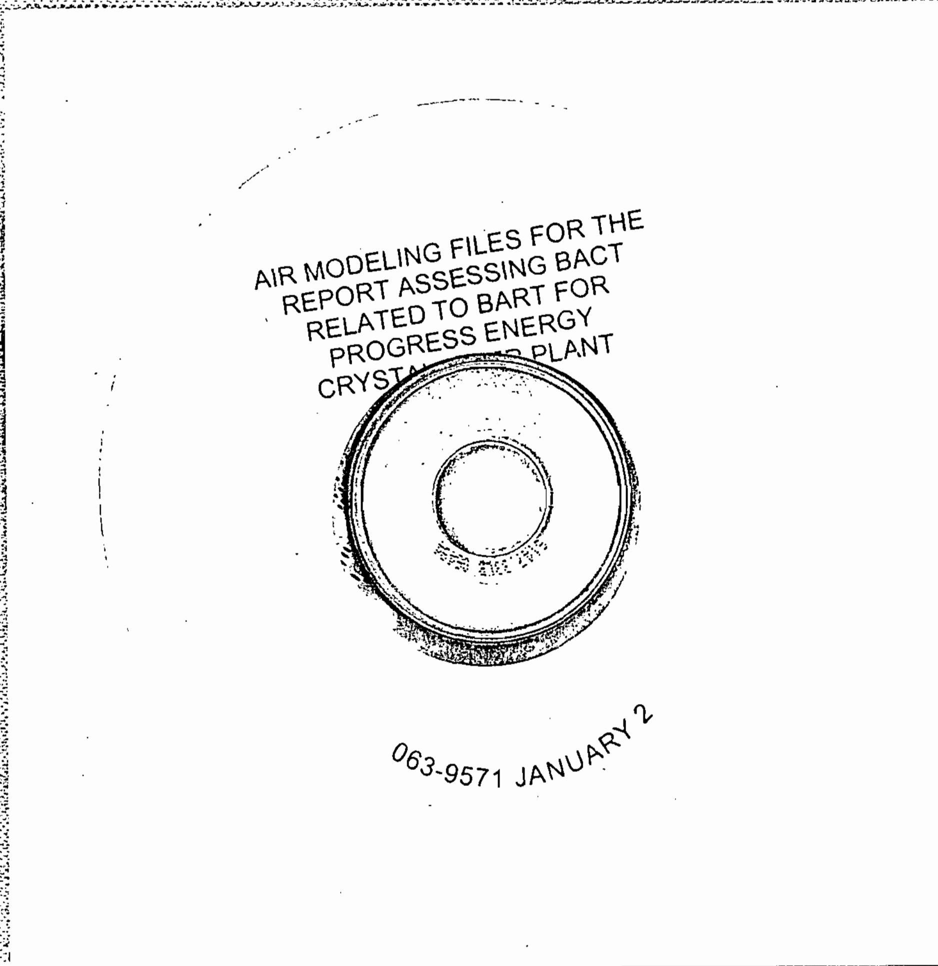
RECEPTORS OBTAINED FROM THE NPS/FWS EXTRACTION PROGRAM
ALL RECEPTORS ARE LCC (KM)

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.

CD ENCLOSURE


AIR MODELING FILES FOR THE
REPORT ASSESSING BACT
RELATED TO BART FOR
PROGRESS ENERGY
CRYST
PLANT
063-9571 JANUARY 2