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Florida Municipal Power Agency
Treasure Coast Energy Center Unit 1

B&V Project 138859
B&V File 32.1100
B&V Letter No. BV/TP-0002
Date: January 7, 2005

Al Linero
Florida Department of Environmental Protection
Bureau of Air Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Subject: Treasure Coast Energy Center Combined Cycle Unit 1 Project Class II and Class I Air Dispersion Modeling Protocols

The Florida Municipal Power Agency (FMPA) is implementing the installation of a Nominal Net 310 MW 1x1 F-Class combined cycle unit (Project) at the new Treasure Coast Energy Center near Fort Pierce, FL.

Since the proposed Project will result in emissions greater than the major source threshold for at least one prevention of significant deterioration (PSD) pollutant, the PSD significant emission levels (SELs) will apply to the project. As such, the Project will be considered a new PSD major stationary source by the Florida Department of Environmental Protection (FDEP). It is anticipated that the proposed Project will be major for the following pollutants: NO_x, CO, SO_2, VOC, PM/PM_{10}, and sulfuric acid mist; thereby requiring PSD review for those pollutants. As part of that review, an air dispersion modeling demonstration must be performed to ensure that the proposed Project will comply with the appropriate ambient air quality thresholds in the surrounding areas.

Prior to such demonstration, the enclosed air dispersion modeling protocols have been developed for your review in an effort to obtain concurrence with the proposed modeling methodologies. The modeling methodologies presented in this document were discussed with FDEP personnel at a pre-application meeting held at the FDEP offices in Tallahassee on December 15, 2004. We look forward to your concurrence with this modeling methodology at your earliest convenience. If you have any questions or comments, please feel free to contact me at 913-458-7928.

Regards,

BLACK & VEATCH

Tim Hillman
Senior Air Quality Scientist

Attachments

cc: Rick Casey - FMPA
Kevin Fleming – FMPA
Susan Schumann – FMPA
Stanley Armbruster – B&V
Myron Rollins – B&V
Mike Soltys – B&V
Bob Holmes – B&V
File

FLORIDA MUNICIPAL POWER AGENCY
TREASURE COAST ENERGY CENTER
COMBINED CYCLE UNIT 1

CLASS II AND CLASS I
AIR DISPERSION MODELING PROTOCOLS

PREPARED BY
BLACK & VEATCH

JANUARY 2005

ATTACHMENT 1

FLORIDA MUNICIPAL POWER AGENCY
TREASURE COAST ENERGY CENTER
COMBINED CYCLE UNIT 1

ISC CLASS II MODELING PROTOCOL

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JANUARY 2005

Air Quality Modeling Assumptions and Methodology

Modeling Scenario: As a new major stationary source, the air quality impact analysis (AQIA) will be performed for Unit 1, a nominally rated 310 MW (net) 1x1 combined cycle unit to be installed at the new Treasure Coast Energy Center site near Fort Pierce, St. Lucie County, Florida. The location of the proposed project is illustrated in the attached Figure.

Air Dispersion Model: ISCST3 (Latest version)

Model Options: USEPA Default and Flat terrain.

GEP & Downwash: USEPA's BPIP program will be used to determine GEP stack height and direction specific building downwash parameters for the Unit 1 stack. Structures associated with the new site will be included in the BPIP analysis.

Receptor Grids: A 10 km nested rectangular receptor grid consisting of 100 m spacing out to 1 km, 250 m spacing from 1 km to 2.5 km, 500 m spacing from 2.5 km to 5 km, and 1,000 m spacing from 5 km to 10 km. Fenceline receptors will be placed at 100 m intervals, and a 100 m fine grid will be placed at maximum impact locations.

max modeled concentrations w/in 10% of max should be modeled w/ 100m grid

Dispersion Coefficients: Rural: Based on visual inspection of a 7.5 minute USGS topographic map of the site using the Auer method.

Meteorological Data: Refined level modeling sequential hourly meteorological data will consist of surface data and upper air data from the West Palm Beach Morrison Field (No. 12844) met station for the years 1987-1991. The files will be obtained from the Support Center for Regulatory Air Models website and processed with the USEPA meteorological processor PCRammet.

Vero? more recent WPB? x

Pollutants to be Modeled: The pollutants that are currently expected to be modeled are PM_{10}, NO_x, SO_2, and CO.

Source Modeling Parameters: Representative combustion turbine performance and emissions data for the several operating configurations; including natural gas firing, fuel oil firing with water injection, evaporative cooling, and duct firing. The performance and emission data will be determined across 50, 75, and 100 percent load cases at ambient temperatures of 26, 59, 73, and 100 °F. Enveloping will be used to determine the worst-case hourly emission rates and operating parameters for each load case that will be used for short-term modeling impacts. Emission rates and operating parameters for annual modeling impacts will be based on annual average data, at 100 percent load.

Modeled impacts: It is anticipated that the maximum model predicted pollutant impacts will be less than their respective PSD SILs. If the model predicted impacts exceed the SILs, additional agency consultation will be initiated regarding increment and cumulative air quality impact analyses.

Class I Analysis: For analysis of the Everglades National Park Class I area, which lies beyond 50 km from the proposed project, the CALPUFF model will be used. The CALPUFF modeling protocol is discussed in Attachment 2 of this submittal.

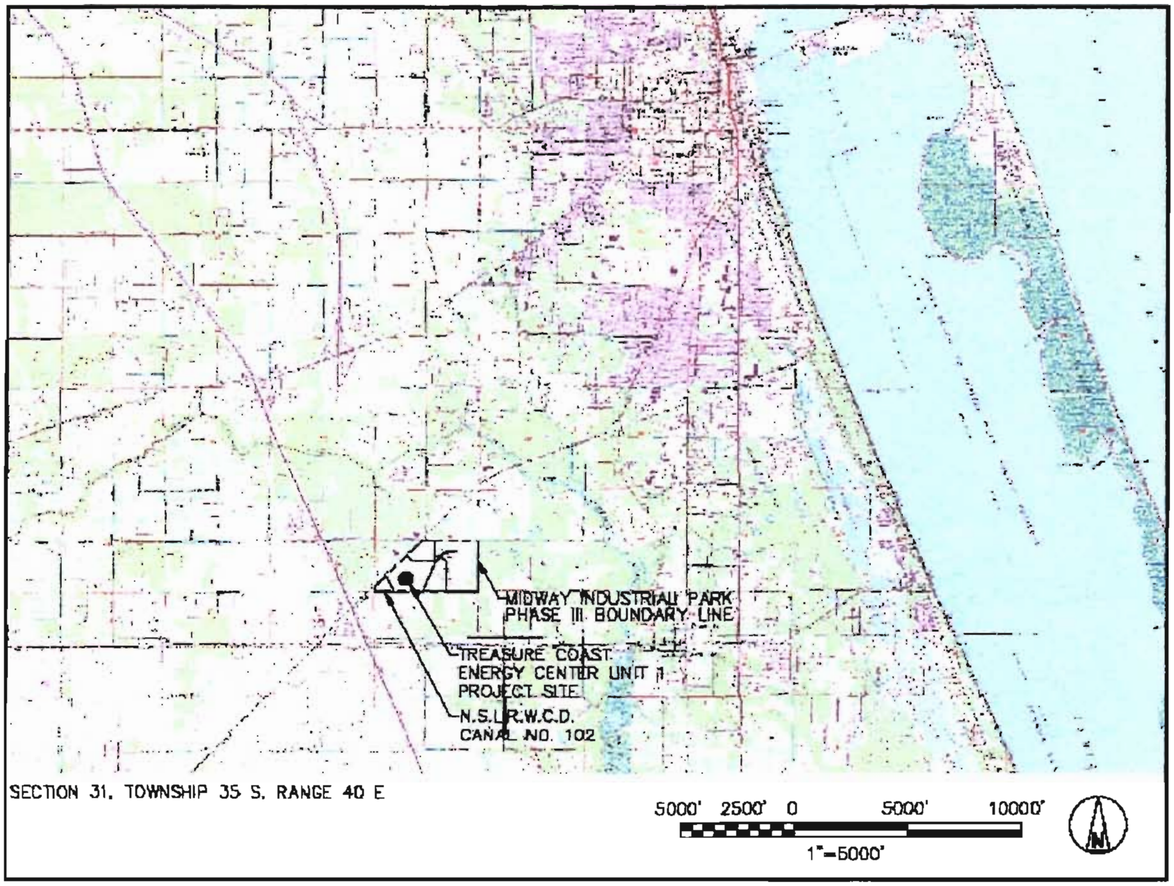
Toxics: No toxic modeling analysis is required.

Emissions from other facility components?

All pollutants with significant emission rates should be modeled.

PSD assessment should include PM2.5, VOC

Emission values to be modeled should be associated w/ the maximum impacts not necessarily the maximum emission levels



Treasure Coast Energy Center Unit 1
Proposed Project Location

Make sure fenceline is around TCEC itself not Midway Industrial Park.

ATTACHMENT 2

FLORIDA MUNICIPAL POWER AGENCY
TREASURE COAST ENERGY CENTER
COMBINED CYCLE UNIT 1

CALPUFF CLASS I MODELING PROTOCOL

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BLACK & VEATCH

JANUARY 2005

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1.0 Introduction

As part of the air impact evaluation for the proposed Treasure Coast Energy Center's Combined Cycle Unit 1 (hereinafter referred to as the Project), analyses of the proposed project's effect on the Everglades National Park (ENP) will be performed. The ENP is a Prevention of Significant Deterioration (PSD) Class I area located in southern Florida approximately 180 km south-southwest of the proposed project site. Federal Class I areas are afforded special environmental protection through the use of Air Quality Related Values (AQRVs). The AQRVs of interest in this protocol are regional haze and deposition. Additionally, Class I Significant Impact Levels (SILs) will be evaluated and compared to the recommended thresholds. Figure 1-1 presents the location of the proposed project site with respect to the ENP.

The methodology of the refined CALPUFF analysis will closely follow those procedures recommended in the Interagency Workgroup on Air Quality Modeling (IWAQM) Phase II report dated December 1998 and the Phase I Federal Land Managers' Air Quality Related Values Workgroup (FLAG) report dated December 2000 where appropriate for model option selections. This protocol includes a discussion of the meteorological and geophysical databases to be used in the analysis, the preparation of those databases for introduction into the modeling system, and the air modeling approach to assess impacts at ENP.

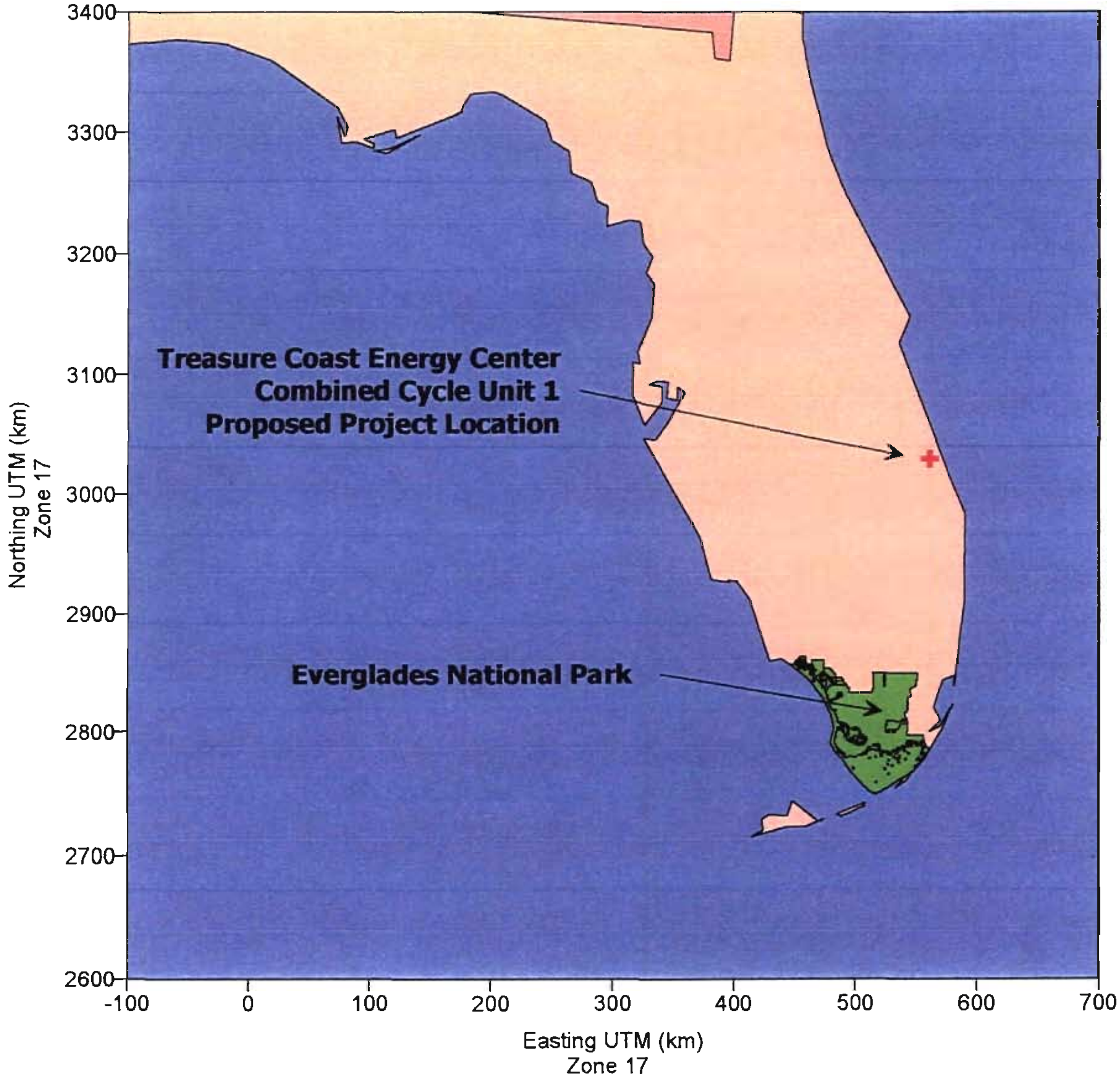

Figure 1-1 Proposed Project Location with respect to Everglades National Park

2.0 Model Selection and Inputs

2.1 Model Selection

The California Puff (CALPUFF, Version 5.711A, Level 040716) air modeling system will be used to model the proposed project and assess the AQRVs at ENP. CALPUFF is a non-steady state Lagrangian Gaussian puff long-range transport model that includes algorithms for building downwash effects as well as chemical transformations (important for visibility controlling pollutants), and wet/dry deposition. The CALMET model, a preprocessor to CALPUFF, is a diagnostic meteorological model that produces three-dimensional fields of wind and temperature and two-dimensional fields of other meteorological parameters. CALMET was designed to process raw meteorological, terrain, and land-use databases to be used in the air modeling analysis. The CALPUFF modeling system uses a number of FORTRAN preprocessor programs that extract data from large databases and converts the data into formats suitable for input to CALMET. The processed data produced from CALMET will be input to CALPUFF to assess pollutant specific impacts.

2.2 CALPUFF Model Settings

The CALPUFF settings contained in Table 2-1 will be used for the modeling analyses.

2.3 Building Wake Effects

The CALPUFF analysis will include the facility's building dimensions to account for the effects of building-induced downwash on the emission sources. Dimensions for all significant building structures will be processed with the Building Profile Input Program (BPIP), Version 95086, and included in the CALPUFF model input.

2.4 Receptor Locations

The CALPUFF analysis will use an array of discrete receptors for ENP, which were created and distributed by the NPS for standardized use in Class I analyses. Terrain throughout the ENP is included in the same NPS- provided receptor file.

Table 2-1
CALPUFF Model Settings

Parameter	Setting
Pollutant Species	SO_2, SO_4, NO_x, HNO_3, and NO_3, and PM_{10}
Chemical Transformation	MESOPUFF II scheme
Deposition	Include both dry and wet deposition, plume depletion
Meteorological/Land Use Input	CALMET
Plume Rise	Transitional plume rise, Stack-tip downwash, Partial plume penetration
Dispersion	Puff plume element, PG/MP coefficients, rural ISC mode, ISC building downwash scheme
Terrain Effects	Partial plume path adjustment
Output	Create binary concentration and wet/dry deposition files including output species for all pollutants.
Model Processing	Regional Haze: Highest predicted 24-hour change as processed by CALPOST. Deposition: Highest predicted annual total sulfur and nitrogen values in deposition units. Class I SILs: Highest predicted concentrations at the applicable averaging periods for those pollutants that exceed the respective PSD Significant Emission Levels (SELs).
Background Values	Monthly Ammonia: 0.5 ppb; Monthly background ozone will be based on a review of the available monitoring stations' values averaged for each month. Additionally, hourly background ozone values from several reporting stations may be assessed for inclusion into the CALPUFF modeling.

2.5 Meteorological Data Processing

The California Puff meteorological and geophysical data preprocessor (CALMET, Version 5.53A, Level 040716) will be used to develop the gridded parameter fields required for the refined AQRV modeling analyses. The following sections discuss the data to be used and processed in the CALMET model.

2.5.1 CALMET Settings

The CALMET settings, including horizontal and vertical grid coverage and resolution of prognostic mesoscale meteorological data, will be chosen to adequately characterize the area within the CALMET domain.

2.5.2 Modeling Domain

The size of the domain used for the modeling will be based on the distances needed to cover the area from the proposed project to the receptors at the ENP with at least a 50-km buffer zone in each direction. The modeling analysis will be performed in the UTM coordinate system. A rectangular modeling domain extending 215 km in the east-west (x) direction and 385 km in the north-south (y) direction will be used for the refined modeling analysis. The southwest corner of the domain is the origin and is located at 400 km Easting and 2,695 km Northing (based on UTM Zone 17, North American Datum (NAD) 1927 coordinates). The grid resolution for the domain will be 5 km. A grid spacing of 5 km yields 43 grid cells in the x-direction and 77 grid cells in the y-direction. Figure 2-1 illustrates the size and location of the modeling domain.

2.5.3 Mesoscale Model Data

Pennsylvania State University in conjunction with the National Center for Atmospheric Research (NCAR) Assessment Laboratory have developed mesoscale meteorological data sets of prognostic wind fields, or "guess" fields, for the United States. The hourly meteorological variables used to create these data sets (wind, temperature, dew point depression, and geopotential height for eight standard levels and up to 15 significant levels) are extensive and are used to populate the modeling domain with meteorological data. The analysis will use 1990 MM4, 1992 MM5, and 1996 MM5 mesoscale meteorological data sets to initialize the CALMET wind fields for each modeled year. The three years of MM data will be obtained from a NPS database provided to Black & Veatch. The extraction program accompanying the data will be used to obtain the

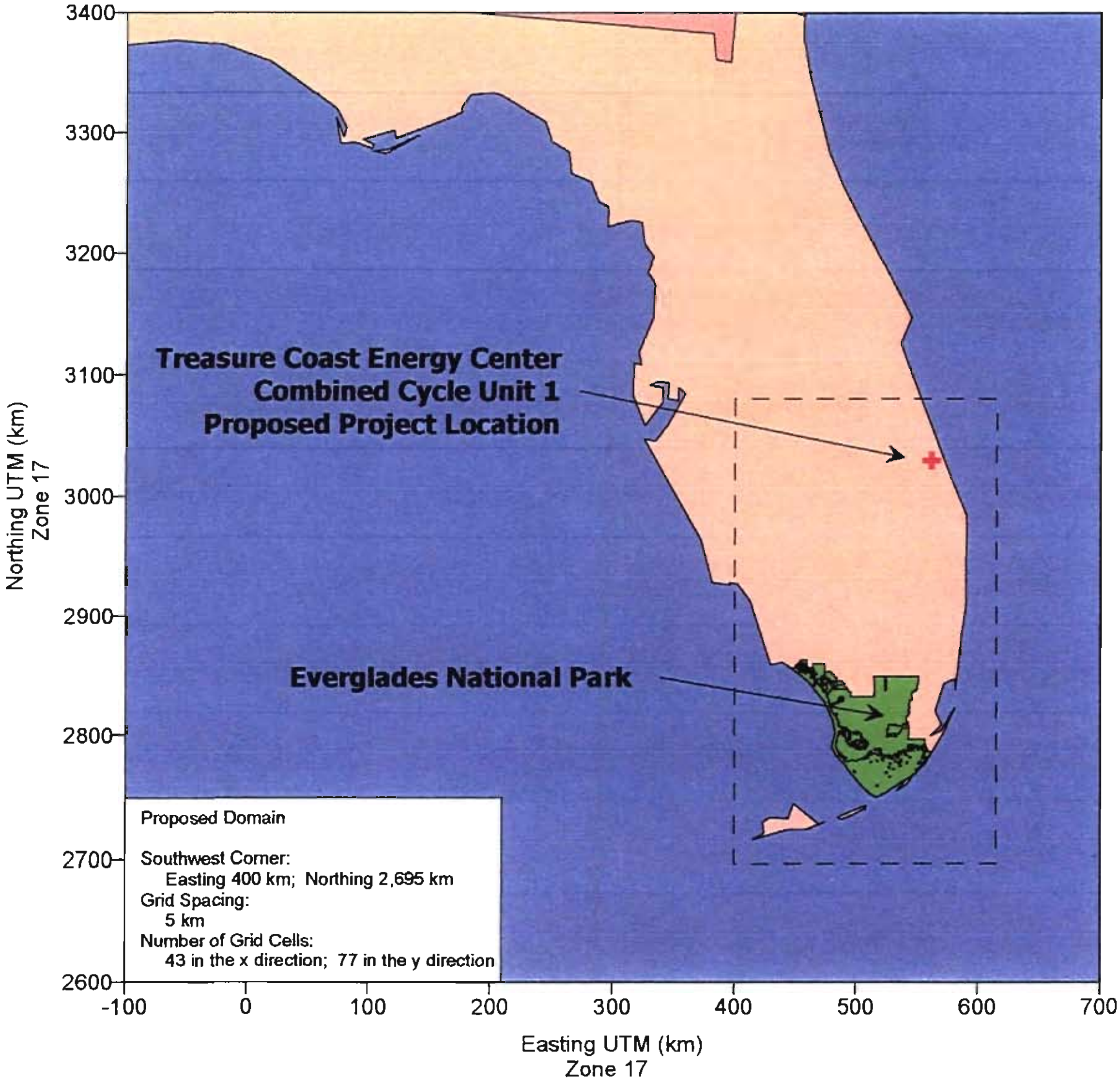

Figure 2-1 Proposed CALPUFF Modeling Domain

appropriate MM data points to cover the modeling domain. The 1990 MM4 and 1992 MM5 data have a horizontal spacing, or resolution, of 80 km. The 1996 MM5 data has a resolution of 36 km. The meteorological observations contained with the MM data sets are assumed to be of sufficient density, both temporally and spatially, to make the need for discrete meteorological station observation unnecessary. Thus, CALMET will be run with the No Observations mode developed in the latest version available from the model developer, EarthTech.

2.5.4 Geophysical Data Processing

Terrain elevations for each grid cell of the modeling domain will be obtained from 1-degree Digital Elevation Model (DEM) files obtained from US Geographical Survey (USGS). The DEM data will be extracted for the modeling domain grid using the CALMET preprocessor program TERREL. Land-use data, based on annual averaged values, will also be obtained from the USGS. Land-use values for the domain grid will be extracted with the preprocessor programs CTGCOMP and CTGPROC. Other parameters processed for the modeling domain include surface roughness, surface albedo, Bowen ratio, soil heat flux, and leaf index field. Once preprocessed, all of the land-use parameters will be combined with the terrain information in a processor called MAKEGEO. This processor will produce one GEO.DAT file for input to CALMET.

2.6 Project Emissions

The proposed Project will have the capability of operating in several configurations; including natural gas firing, fuel oil firing with water injection, evaporative cooling, and duct firing. The maximum pound per hour emission rates from Unit 1 at 100% load, across the several operating configurations, and the average annual temperature will be used for the pollutants modeled with CALPUFF. Those pollutants include NO_x, SO_2, and PM_{10}. Only emissions from Unit 1 will be assessed for long-range transport.

3.0 CALPUFF Analyses

The preceding model inputs and settings for the CALPUFF modeling system will be used to complete the Class I analyses on the ENP, including regional haze, deposition, and Class I SILs.

3.1 Regional Haze Analysis

A regional haze analysis will be performed for the ENP for ammonium sulfates, ammonium nitrates, and particulate matter by appropriately characterizing model predicted outputs of SO_4, NO_3, and PM_{10} concentrations.

3.1.1 Visibility

Visibility is an AQRV for the ENP. Visibility can take the form of plume blight for nearby areas, or regional haze for long distances (e.g., distances beyond 50 km). Because the ENP lies beyond 50 km from the proposed project, the change in visibility is analyzed as regional haze. Regional haze impairs visibility in all directions over a large area by obscuring the clarity, color, texture, and form of what is seen. Current regional haze guidelines characterize a change in visibility by either of the following methods:

1. Change in the visual range, defined as the greatest distance that a large dark object can be seen, or
2. Change in the light-extinction coefficient (b_{ext}).

Visual range can be related to extinction with the following equation:

$$b_{ext}(Mm^{-1}) = 3912 / vr(Mm^{-1})$$

Visual range (vr) is a measure of how far away a large black object can be seen in the atmosphere under several severe assumptions including: an absolutely dark target, uniform lighting conditions (cloud free skies), uniform extinction in all directions, a limiting contrast discrimination level, a target high enough in elevation to account for earth curvature, and several other factors. Visual range is, at best, a limited concept that allows relatively simple comparisons between visual air quality levels and should not be thought of as the absolute distance that can be seen through the atmosphere.

The b_{ext} is the attenuation of light per unit distance due to the scattering (light reduced away from the site path) and absorption (light captured by aerosols and turned into heat energy) by gases and particles in the atmosphere. A change in the extinction coefficient produces a perceived visual change that is measured by a visibility index called the deciview. The deciview (dv) is defined as:

$$dv = 10 \ln (1 + b_{exts} / b_{extb})$$

where: b_{exts} is the extinction coefficient calculated for the source, and
b_{extb} is the background extinction coefficient

A uniform incremental change in b_{extb} or visual range does not necessarily result in uniform changes in perceived visual air quality. In fact, perceived changes in visibility are best related to a percent change in extinction. Based on NPS guidance, if the change in extinction is less than 5 percent, no further analysis is required. An index similar to the deciview that simply quantifies the percent change in visibility due to the operation of a source is calculated as:

$$\Delta\% = (b_{exts} / b_{extb}) \times 100$$

3.1.2 Background Visual Ranges and Relative Humidity Factors

The background visual range is based on data representative of historical conditions at the ENP. The background visual range, or constituents thereof, for the ENP will be obtained from the Phase I FLAG Report, December 2000. The average relative humidity factor for each day will be computed by determining the relative humidity factor for each hour's relative humidity for the 24-hour period that the impact occurred. This factor, based on each relative humidity will be obtained by using Table 2.A-1 of Appendix 2.A of the Phase I FLAG Report. These factors (a relative humidity factor for each relative humidity) will then be used to determine the average relative humidity factor for that day (24-hour period). All of this is accomplished with the use of the CALPOST post-processor.

3.1.3 Interagency Workgroup On Air Quality Modeling (IWAQM) Guidelines

The CALPUFF air modeling analysis will closely follow the recommendations contained in the *IWAQM Phase II Summary Report and Recommendations for Modeling Long Range Transport Impacts*, (USEPA, 12/98) where appropriate. Table 3-1 summarizes the IWAQM Phase II recommendations. The methodology in Table 3-1 will be used to compute the results of the regional haze analysis. However, CALPOST now possesses the ability to

Table 3-1 Outline of IWAQM Refined Modeling Analyses Recommendations *	
Meteorology	Use CALMET (minimum 6 to 10 layers in the vertical; top layer must extend above the maximum mixing depth expected); horizontal domain extends 50 to 80 km beyond outer receptors and source being modeled; terrain elevation and land-use data is resolved for the situation.
Receptors	Within Class I area(s) of concern; NPS will provide the modeling receptors.
Dispersion	1. CALPUFF with default dispersion settings. 2. Use MESOPUFF II chemistry with wet and dry deposition 3. Define background values for ozone and ammonia for area
Processing	Use highest predicted 24-hr SO_4, PM_{10} and NO_3 values; compute a day-average relative humidity factor (f(RH)) for the worst day for each predicted species, calculate extinction coefficients and compute percent change in extinction using the FLAG supplied background extinction where appropriate. This can all now be accomplished with the use of Method 2 in the CALPOST post-processor.
* *IWAQM Phase II Summary Report and Recommendations for Modeling Long Range Transport Impacts* (USEPA, 12/98).	

post-process the modeling results specific to the regional haze analysis through the selection of one of seven modeling options. The post-processing selection will be made to calculate regional haze based on the appropriate available data/resources. Specifically, regional haze will be calculated using Method 2, which consists of computing extinctions from speciated PM measurements using hourly relative humidity adjustments for observed and modeled sulfate and nitrates. Based on recent correspondence with staff of the NPS for similar analyses, the relative humidity will be capped at 95 percent. A supplementary analysis will be performed with the relative humidity capped at 98 percent for informational purposes only. Method 7, which eliminates hours during which visibility limiting weather events occur, may be explored as necessary. While this process occurs within CALPOST, a typical calculation methodology is illustrated below.

Calculation

Refined impacts will be calculated as follows:

1. Obtain 24-hour SO_4, NO_3, and PM_{10} impacts, in units of micrograms per cubic meter ($\mu g/m^3$).
2. Convert the SO_4 impact to $(NH_4)_2SO_4$ by the following formula:

   $(NH_4)_2SO_4$ (μg/m3) = SO_4 ($\mu g/m^3$) x molecular weight $(NH_4)_2SO_4$ / molecular weight SO_4

   $(NH_4)_2SO_4$ ($\mu g/m^3$) = SO_4 ($\mu g/m^3$) x 132/96 = SO_4 ($\mu g/m^3$) x 1.375

   Convert the NO_3 impact to NH_4NO_3 by the following formula:

   NH_4NO_3 (μg/m3) = NO_3 ($\mu g/m^3$) x molecular weight NH_4NO_3 / molecular weight NO_3

   NH_4NO_3 ($\mu g/m^3$) = NO_3 ($\mu g/m^3$) x 80/62 = NO_3 ($\mu g/m^3$) x 1.29
3. Compute b_{exts} (extinction coefficient calculated for the source) with the following formula:

   b_{exts} = 3 x NH_4NO_3 x f(RH) + 3 x $(NH_4)_2SO_4$ x f(RH) + 1 x PM_{10}
4. Compute b_{extb} (background extinction coefficient) using the background visual range (km) from the FLAG document with the following formula:

   b_{extb} = 3.912 / Visual range (km)
5. Compute the change in extinction coefficients:

in terms of deciviews:

$$dv = 10 \ln (1 + b_{exts} / b_{extb})$$

in terms of percent change of visibility:

$$\Delta\% = (b_{exts} / b_{extb}) \times 100$$

Based on the predicted SO_4, NO_3, and PM_{10} concentrations, the proposed project's emissions will be compared to a 5 percent change in light extinction of the background levels. This is equivalent to a change in deciview of 0.5.

3.2 Deposition Analyses

Deposition analyses will be performed for ENP for both total sulfur and total nitrogen. The analyses will follow those procedures and methodologies set forth in the IWAQM Phase II Report and the *Guide for Applying the USEPA Class I Screening Methodology with the CALPUFF Modeling System* document, developed by Earth Tech, Inc. (the model developers) in September 2001. This document is a guide for using the POSTUTIL processor to perform deposition analyses. Specifically, deposition analyses will be performed as follows:

1. Perform CALPUFF model runs using the specified options previously mentioned in Section 2.0 (including output of both dry and wet deposition).
2. Use POSTUTIL to combine the wet and dry flux output files from CALPUFF and scale the contributions of SO_2, SO_4, NO_x, NO_3, and HNO_3 such that total (i.e., wet and dry) nitrogen and total sulfur flux are contained in the same file. The POSTUTIL file is set up such that SO_2 and SO_4 contribute sulfur mass and SO_4, NO_x, HNO_3, and NO_3 contribute to the nitrogen mass.
3. Apply the appropriate scaling factors found in IWAQM Phase II Report (Section 3.3 Deposition Calculations) to the CALPOST runs to account for the conversion of grams to kilograms, square meters to hectares (ha), seconds to hours, and hours to a year. Thus, the CALPOST results are in kg/ha/yr.

The model-predicted results will be compared to the 0.01 kg/ha/year Deposition Analysis Threshold (DAT) developed jointly by the NPS and the U.S. Fish and Wildlife Service (FWS).

3.3 Class I Impact Analysis

Ground-level impacts (in $\mu g/m^3$) onto the ENP will be calculated for NO_x, SO_2, and PM_{10} criteria pollutants for each applicable averaging period. The results of this analysis will be compared with the Class I Significant Impact Levels (SILs) calculated as 4 percent of the Class I Increment values. Should the model predicted impacts onto the ENP exceed the Class I SILs, an appropriately derived inventory of PSD increment consuming sources will be developed through FDEP and modeled with the CALPUFF modeling system for comparison to the Class I Increment values.