

# Air Quality Modeling

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Appendix J presents a review of the air quality modeling performed for the proposed Calypso Port in accordance with regulatory requirements.

## AIR QUALITY MODELING

### OVERVIEW

The air quality impact assessment in various sections of the Deepwater Port License Application for the proposed Project submitted by Calypso (the Applicant) has been reviewed, along with responses to data gap questions submitted to the Applicant. The scope of the review included identification of the assumptions used to define operating scenarios, checking emissions estimates and meteorological inputs, checking model inputs, and verification of dispersion modeling results. Findings from that review are described below, along with their implications on the environmental impact assessment for air quality. A full copy of the air quality calculations reviewed by the U.S. Coast Guard (USCG) is available in Appendix E of the Deepwater Port License Application Calypso LNG Project, Florida, Volume I, which is posted on the Federal Docket (<http://www.regulations.gov> under Docket Number USCG-2006-26009). The information contained in Appendix E is the full Air Permit Application submitted by the Applicant, which includes:

- Modeling parameters (e.g., meteorological data, mixing height, and atmospheric stability);
- Input emission values and averaging periods;
- Background concentrations; and
- Emission calculations for each phase of the proposed Project.

Specific sources and Docket file names include:

- Appendix E, Attachment C-4, Description of Proposed Construction and Air Emission Sources, Docket file USCG-2006-26009-0012.
- Appendix E, Attachment C-8, Air Quality Impact Since 1977 / Cumulative Analysis, Docket file USCG-2006-26009-0016.
- Appendix E, Attachment C-9, Modeling Protocol for Source Impact Analysis / NAAQS / PSD / Increment Consumption / Additional Impact Analysis, Docket file USCG-2006-26009-0017.
- Appendix E, Attachment C-10, Modeling Results for the Source Impact Analysis/ NAAQS / PSD / Increment Consumption / Additional Impact Analysis, Docket file USCG-2006-26009-0018.
- Appendix E, Attachment C-11, Air Emissions Inventory, Docket file USCG-2006-26009-0019.

To locate and download this information from the Federal Docket, proceed to the Federal Docket web site (<http://www.regulations.gov>) and, under the search field, enter the full Docket file name of the file you wish to view (e.g., USCG-2006-26009-0012), and click on the “Go” field. This will take you to Appendix E, Attachment C-4; clicking on the PDF file symbol will allow you to either view or download the document. To locate the other attachments of Appendix E, enter the appropriate Docket file name in the search field.

### MODELS USED IN THE IMPACT ANALYSIS

The ambient air quality impacts due to air pollutants emitted from the Port were assessed with dispersion modeling. The methodology is in accordance with USEPA’s Guideline on Air Quality

Models, Revised (USEPA 2003), incorporated as Appendix W of 40 CFR Part 51 and Federal Register Revision to the Guideline on Air Quality Models (USEPA 2005). Modeling guidance was also obtained from the Florida DEP and USEPA Region 4. Modeling procedures established by the Minerals Management Service (MMS) for analysis of offshore emission sources (MMS 1989) were reviewed and used in the analysis.

The location of the proposed Calypso Port in the ocean requires the use of an air quality dispersion model specifically designed to evaluate over-water sources. The Offshore and Coastal Dispersion (OCD) model was developed by Hanna et al. (1984 and 1985) and is designed to evaluate the transport and dispersion of emissions to a shoreline from an offshore source such as the proposed Calypso Port that is located over water. The OCD model is optimized for estimating dispersion in an over-water environment by incorporating atmospheric stability calculation methodology that accounts for the effect of water/air temperature differences and by explicitly treating the transition from over-water to over-land dispersion at the shoreline. The OCD model also includes a downwash calculation procedure to evaluate air quality impacts over water in the immediate vicinity of the proposed Calypso Port due to aerodynamic effects of air flow over the structures of the LNG vessels (the SRS, TRVs, and LNG carriers) at the proposed Calypso Port. The OCD model was used to estimate impacts at both near-field receptors over water beyond the 850-meter Safety Zone and onshore in Florida.

At distances beyond 50 kilometers (km) where the underlying dispersion assumption used in the OCD model is no longer appropriate, other models are used to evaluate more distant impacts. To assess impacts at more distant (more than 50 km) Class 1 areas, the Interagency Workgroup on Air Quality Modeling (IWAQM) and FLM Air Quality Related Group (FLAG) recommendations were used for the analysis (USEPA 1998, FLAG 2000). For individual source inputs involving transport distances on the order of 50 to 250 km, the IWAQM recommends using a Lagrangian (a mathematical formulation that follows the air pollution plume parcels as they move in the atmosphere) puff model like CALPUFF; therefore, the CALPUFF model was used to evaluate air quality impacts at far-field locations such as Everglades National Park. CALPUFF is a multi-layer, gridded, non-steady-state puff dispersion model that can simulate the effects of temporally and spatially varying meteorological conditions on pollutant transport. In addition, CALPUFF removes pollutants by simulating the removal processes of dry and wet deposition and the transformation process of pollutant species through chemical reactions. The input data requirements for CALPUFF includes a meteorological data file prepared by the CALMET preprocessor (USEPA 2004), and a control file that defines the modeling domain, the modeling options, and source information. The primary outputs from CALPUFF are hourly concentrations and hourly deposition fluxes evaluated at user-specified receptor locations. CALMET version v5.720, which makes use of the VISTAS Regional Domain 2 data set<sup>1</sup>, and CALPUFF version 5.754 were used in this modeling study<sup>2</sup>.

### **Air Quality Modeling for Construction**

Construction activities occurring at the proposed Calypso Port location would include installation and placement of various Project components on the seafloor. Project components include, but are not limited

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<sup>1</sup> VISTAS Regional Domain 2, VISTASBART is the Visibility Improvement Tribal Association of the Southeast and the Best Available Retrofit Technology Information Program designed to address regional haze and visibility in the southeastern United States (<http://www.vistas-sesarm.org/BART/index.asp>). The meteorological dataset covers the 3-year period of 2001 through 2003.

<sup>2</sup> Currently, USEPA is not accepting CALPUFF version 5.754 for regulatory analysis. The VISTAS Regional Domain 2 data set is preferred by the state agencies but is not compatible with the regulatory version of CALPUFF (version 5.711a). USEPA is pursuing a new regulatory version of CALPUFF (version 5.8 level 070623) that will work with the VISTAS MET data set. CALPUFF modeling may be repeated when USEPA has successfully developed, approved, and released CALPUFF version 5.8 for use in regulatory applications.

to, suction piles, gravity anchors, mooring chains, pipelines, buoys, and flexible risers. The duration of construction would be from 3 to 5 months. The primary construction vessels include a dynamically positioned (DP) pipelay vessel and an anchor-handling supply tug (AHST). The DP pipelay vessel would operate with up to eight engines on distillate fuel oil with 0.05 percent sulfur content for 8 days at 24 hours per day at 75-percent load, plus a contingency of an additional 8 full days at 15-percent load due to weather or mechanical problems during installation. The AHTS would operate with up to four engines using diesel fuel at 0.05 percent sulfur for up to 95 days at 24 hours per day at 75-percent load, plus a contingency of an additional 31 full days at 15-percent load due to weather or mechanical problems during construction. This also includes time needed for the AHTS to conduct the pre-installation and post-installation surveys.

In addition to the primary vessels, a supply vessel and a crew vessel would operate during the construction period. The supply vessel would deliver construction consumables, equipment, food, and other supplies, and would take away any trash or equipment to be returned to shore; the crew vessel would perform the crew changes. The supply and crew vessels would operate with two engines each for up to 87 days at 24 hours per day; they would use diesel fuel with 0.05 percent sulfur content at 50- and 25-percent load, respectively, plus a contingency of an additional 27 full days at 15-percent load due to weather or mechanical problems during construction.

Air quality impacts due to construction activities were calculated with the OCD model using the construction emissions presented in Table 4.9.1-1 of the FEIS. The emission rates presented in Table 4.9.1-1 reflect a correction to the annual average NO<sub>x</sub> emissions rate as reported by the Applicant in Table 3-7, Attachment C-9 (Calypso LNG 2006a); the emissions rate of NO<sub>x</sub> changed from the reported value of 0.08 to 697.8 tons per year (tpy). (Note: To calculate emissions concentrations during the 3- to 5-month construction period, an annual emissions rate was calculated by assuming that construction occurred for a 12-month period and this rate was entered into the OCD model. Five years of meteorological data (2000–2004) for over-water and over-land sites were used to model the air quality impacts. All sources were modeled as point sources, and vessel-specific stack parameter information was used to characterize the associated plume rise from each source. Building and structure parameters were included in the modeling of the emissions to model building wake effects. The NO<sub>x</sub> emissions were conservatively assumed to be completely converted to nitrogen dioxide (NO<sub>2</sub>). Maximum air quality impacts from the modeling of the emissions were compared with the NAAQS and FAAQS.

Two sets of receptors were used for the OCD modeling. A 5,600-meter by 5,600-meter Cartesian grid system was centered between the East and West Buoys of the proposed Calypso Port, with 100-meter spacing in the x and y direction. Receptors were excluded within the 850-meter Safety Zone around each buoy because the public would be excluded from this area. The net number of receptors in this grid was 2,732. The second receptor grid consisted of a radial grid every 10 degrees centered on the West Buoy of the proposed Calypso LNG facility. Receptor rings were placed every 100 meters between the boundary of the Safety Zone out to 1 km, every 250 meters between 1 and 5 km, every 500 meters between 5 and 10 km, and every 1 km from 10 to 50 km. This results in a total of 1,836 receptors. An additional 104 shoreline receptors were placed along the Florida coast, spaced at an interval of 1 km. The receptor locations are shown in Figure J-1 at the end of this appendix.

The OCD model requires surface and upper-air meteorological data from representative over-land and over-water sites. The over-water meteorological data were obtained from the Fowey Rocks Station (Buoy FWYF1), located 10 miles offshore. While other coastal meteorological stations are located closer to the proposed Calypso Port than Fowey Rocks Station, the distance offshore of the Fowey Rocks Station is similar to the distance offshore of the proposed Calypso Port, which makes the station the most representative of offshore weather conditions. Representative over-land meteorological surface data were

based on data collected at the Fort Lauderdale-Hollywood Airport, which is approximately 12 miles (20 km) southwest of the proposed Calypso Port.

Upper-air data were used to calculate mixing heights for both over-land and over-water sites, based on twice-daily radiosonde data collected at the Miami International Airport, located approximately 30 miles (48 km) southwest of the proposed Calypso Port. This near-coast station was used to prepare the mixing height for both the over-land and over-water station. Because of the proximity of the Miami International Airport to the coast, the station has a strong marine influence; therefore, mixing heights based on the upper-air soundings closely approximate over-water mixing heights during periods with on-shore flow. During the review of this approach, USCG identified that winds were offshore approximately 30 percent of the time each year. During these periods, it may be more appropriate to estimate the mixing height based on a neutral atmosphere scaling relationship, which uses the wind speed friction velocity from the over-water station, Fowey Rocks, and local latitude to estimate the mixing height. However, because this situation only occurs 30 percent of the time and the offshore winds would transport emissions away from onshore receptors, USCG did not use the data from the Fowey Rocks Station and local latitude to estimate the mixing height.

The modeling results are presented in Table 4.9.1-2 of the FEIS, which compares the modeled construction emission concentrations to the NAAQS and FAAQS. As noted earlier, the construction emissions rates were underestimated by the Applicant for the annual emissions rates. Using the revised NO<sub>x</sub> construction emissions rates resulted in a peak annual average NO<sub>x</sub> construction impact of 5.6 micrograms per cubic meter (µg/m<sup>3</sup>), compared to the previously calculated concentration of less than 0.01 µg/m<sup>3</sup>. When combined with the background concentration which ranged from 10 to 11µg/m<sup>3</sup> over the 5 meteorological years, the impact remains well below the 100-µg/m<sup>3</sup> NO<sub>x</sub> NAAQS. The revised NO<sub>x</sub> construction emissions value of 5.6 µg/m<sup>3</sup> is the value that is presented in Table 4.9.1-2 of the FEIS.

### Air Quality Modeling for Operations

Routine operations (vaporization and ship hoteling) of the proposed Calypso Port would include:

- The SRS would be semi-permanently moored on the East Buoy and would receive LNG from LNG carriers, vaporize LNG, and offload natural gas. A new LNG carrier would arrive at the proposed Calypso Port every 2 days.
- TRVs would deliver and vaporize LNG and offload natural gas through the West Buoy. A new TRV would arrive at the proposed Calypso Port every 5 days.

**SRS.** The SRS would be a permanently stationed emissions source at the proposed Calypso Port. The sources of emissions are four boilers, each with a heat input capacity of approximately 277 MMBtu/hr firing natural gas, and one thermal oxidizer. The boilers would generate the steam needed for vaporization of LNG from the LNG carriers. The boilers would utilize low-NO<sub>x</sub> burners and selective catalytic reduction (SCR) for emissions control; they were conservatively assumed to operate 8,760 hours per year. Four onboard power-generating engines also would operate, each with an output rating of approximately 8,550 kW. These engines would operate 8,760 hours per year. The power-generating engines would utilize selective catalytic reduction plus Oxidation Catalyst (SCR+ Oxidation Catalyst) for emissions control.

A thermal oxidizer on the SRS, TRVs, and LNG carriers would provide the capability to burn off LNG, which would relieve excess pressure in the LNG tanks during initial hookup to the buoy and during periods with low gas send-out. The thermal oxidizer would operate for 3 hours per week.

**TRVs.** Each TRV would be equipped with two boilers for LNG vaporization, four dual-fuel (DF) power generation engines, and one thermal oxidizer. The vaporization boilers would have a heat input capacity of 332 MMBtu/hr each at 87-percent load and would be used while vaporizing the LNG. Two DF engines with capacity of 7,600 kilowatts (kW) each fueled by natural gas with emission controls (lean NO<sub>x</sub> burners) would be used at full capacity while the TRV is discharging the LNG cargo. The two remaining DF engines, each with 11.4-megawatt (MW) capacity, would be used only for propulsion to and from the proposed Calypso Port. During the approach to the proposed Calypso Port and during connection and disconnection from the buoy, the two 7.6-MW TRV engines would need to run at only 40-percent capacity.

**LNG Carriers.** The LNG carrier boilers would operate to provide locomotion, power generation, and discharging of the LNG to the SRS. Two onboard boilers would operate during berthing/unberthing operations and discharging; each would have a capacity of 9.48 MMBtu/hr. The boilers have conservatively been assumed to operate on distillate fuel oil with a 1.5-percent sulfur content. As noted, a thermal oxidizer on the LNG carriers would burn off LNG when needed to relieve excess pressure in the LNG tanks. One LNG vessel every 2 days would be involved in discharging or berthing/unberthing operations at the proposed Calypso Port. The LNG carrier would operate 24 hours per day, of which 18 hours would be spent discharging and 6 hours berthing/unberthing. Emissions have been estimated assuming that an LNG carrier would make a visit once every 2 days, with a maximum of 183 visits per year.

### Criteria Pollutant Emissions from Stationary Sources

**SRS.** The criteria pollutant emissions for the SRS boilers were based on information obtained by the Applicant from a representative marine boiler, with NO<sub>x</sub> emissions based on 31 parts per million by volumetric, on a dry basis (ppmvd), corrected to 3-percent oxygen (O<sub>2</sub>). This NO<sub>x</sub> emissions level is expected to be achieved using low-NO<sub>x</sub> burner technology, in combination with FGR. The equipment manufacturer estimates that the CO emissions at full load are expected to be 20 ppmvd at 3-percent O<sub>2</sub>. These NO<sub>x</sub> and CO outlet concentrations are equivalent to emissions levels of approximately 0.012 lb/MMBtu and 0.015 lb/MMBtu, respectively. The emissions of the other criteria pollutants (i.e., PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and VOC) are based on the appropriate emissions factors cited for natural gas combustion, as adjusted for the design heating value of natural gas, in USEPA's AP-42, "Compilation of Air Pollutant Emission Factors," Table 1.4-2, "Emission Factors for Criteria Pollutants from Natural Gas Combustion." In addition to the boiler, four 8,550-kW engines would operate on the SRS continuously burning natural gas. Emissions from these engines were based on information obtained by the Applicant from a representative marine engine, assuming a 100-percent load using SCR + Oxidation Catalyst. The controlled emissions factors yield emissions levels of 0.12 grams per kilowatt hour (g/KWh), 0.15 g/KWh, and 0.02 g/KWh for NO<sub>x</sub>, CO, and PM<sub>10</sub>, respectively.

**TRVs.** The TRV boilers are designed to operate in a manner similar to the SRS boiler. The criteria pollutant emissions for the TRV were based on information obtained by the Applicant from a representative marine boiler, with NO<sub>x</sub> emissions based on 31 ppmvd, corrected to 3-percent O<sub>2</sub>. This NO<sub>x</sub> emissions level is expected to be achieved by the application of low-NO<sub>x</sub> burner technology, in combination with FGR. According to the representative manufacturer, CO emissions at full load are expected to be 20 ppmvd at 3-percent O<sub>2</sub>. These NO<sub>x</sub> and CO outlet concentrations are equivalent to emissions levels of approximately 0.038 lb/MMBtu and 0.015 lb/MMBtu, respectively. The emissions of the other criteria pollutants (i.e., PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and VOC) were based on the appropriate emissions factors cited for natural gas combustion, as adjusted for the design heating value of natural gas, in USEPA's AP-42, "Compilation of Air Pollutant Emission Factors," Table 1.4-2, "Emission Factors for Criteria Pollutants from Natural Gas Combustion." In addition to the boiler, two 7,600-kW engines operating on the TRV would continuously burn natural gas. Emissions from these engines were based on

information obtained by the Applicant from a representative marine engine, assuming 100-percent load for lean-burning engines with no additional control. The uncontrolled emissions factors yield emissions levels of 1.2 g/KWh, 1.0 g/KWh, and 0.065 g/KWh for NO<sub>x</sub>, CO, and PM<sub>10</sub>, respectively.

**LNG Carriers.** The LNG carrier would operate two 9.48-MMBtu/hr boilers. These LNG carriers use conventional distillate fuel oil. Emissions factors were based on USEPA's AP-42, "Emission Factor for Criteria Pollutants for Fuel Oil Combustion," Table 1.3-1, "Criteria Pollutant Emission Factors for Fuel Oil Combustion," for NO<sub>x</sub>, and CO; and USEPA's AP-42, "Emission Factor for Total Organic Compounds from Uncontrolled Fuel Oil Combustion Sources," Table 1.3-3, "Emission Factors for Total Organic Compounds (TOC), Methane, and Nonmethane TOC (Nmtoc) from Uncontrolled Fuel Oil Combustion," for the SO<sub>2</sub>, VOC, PM<sub>10</sub>, and PM<sub>2.5</sub> emissions factors.

**Thermal Oxidizer.** A thermal oxidizer would operate to relieve excess pressure in the LNG tanks during initial hookup. The heat input was based on a boil-off gas combustion rate of 4,200 cubic meters per hour, which yields a heat input of 154 MMBtu/hr. Emissions factors for NO<sub>x</sub> and CO were obtained from USEPA's AP-42, "Emission Factors for Flare Operations," Table 13.5-1, "Industrial Flares." The other criteria pollutant factors came from the Neptune LNG Application Study (Calypso LNG 2006b).

The vessels and operations described above represent the primary sources of stationary air emissions associated with operation of the proposed Calypso Port. Maximum hourly and annual emissions rates for the criteria pollutant emissions from the SRS, TRVs, LNG carriers, and the thermal oxidizers are presented in Table 4.9.1-3 of the FEIS.

**Secondary Sources of Stationary Emissions.** The secondary sources of stationary emissions associated with operation of the proposed Calypso Port include operation of the support vessels (crew vessels and fueling vessel), and berthing and unberthing of the LNG carriers. The crew vessel would operate two engines with an average engine output of 250 kW, operating on diesel fuel with 0.05-percent sulfur for 1 hour every 2 days or 183 hours per year. The fueling vessel would operate two engines with an average engine output of 400 kW, operating on diesel fuel with 0.05-percent sulfur for 2 hours once per month or 24 hours per year. Emissions from the LNG carrier during berthing/unberthing operations also would contribute to secondary emissions. The annual criteria pollutant emissions from berthing and unberthing operations of LNG carriers and operations of support vessels are presented in Table 4.9.1-4 of the FEIS.

## Mobile Source Emissions

Mobile source emissions would be emitted by vessels operating within the approximately 850-meter-radius Safety Zone around the proposed Calypso Port. These include emissions from TRVs and LNG carriers while in transit and support vessels, including ocean-going tugs, crew vessels, and fueling vessels, transiting the Safety Zone. The ocean-going tugs are the largest source of mobile emissions, as three tugs using two engines would operate at an output of 2,000 kW per engine for approximately 915 hours per year for positioning vessels during the berthing and unberthing process. Two of the tugs would remain at the proposed Calypso Port and would function as support vessels, operating two engines at an output of 750 kW per engine for approximately 7,845 hours per year. Emissions factors for the tugs are from USEPA's AP-42, "Compilation of Air Pollutant Emission Factors – Stationary Internal Combustion Engines," Table 3.4-1, "Gaseous Emission Factors for Stationary Diesel Fuel Engines." The annual emissions of criteria pollutants from the mobile sources within the Safety Zone (an approximately 850-meter radius around the proposed Calypso Port) are summarized in Table 4.9.1-5 of the FEIS. As noted earlier, emissions rates for the ocean-going tugs were under-reported by the Applicant by a factor of 6 in the *Air Emission Inventory* (Calypso LNG 2006b), which shows on page 47 an NO<sub>x</sub> emissions rate of 29.45 tpy. The multiplication is incorrect and should be 176.67 tpy. This same mistake is also true for estimates of SO<sub>2</sub> and PM emissions for the ocean-going tugs. The corrected values are presented in

Table 4.9.1-5 of the FEIS. The Applicant's assumption of an engine load of 100 percent (the full 2,000 kW), a conservative emissions estimate, was incorporated into the values presented in Table 4.9.1-5 of the FEIS. The tugs likely would operate at an average load factor lower than 100 percent. The overall effect of this conservative assumption is an over-estimate of PM emissions (up to 37 percent), followed by NO<sub>x</sub> emissions (up to 16 percent), and SO<sub>2</sub> emissions (less than 1 percent). See additional discussion under Model Parameters for Class I and Class II Areas.

### **Hazardous Air Pollutant Emissions**

The major sources of HAP emissions include the boilers and power generation engines. The emissions from the vaporization boilers were based on emissions factors cited in Section 1.4, "Natural Gas Combustion" of USEPA's AP-42 document. Each of the SRS vaporization boilers have a maximum heat input of 277 MMBtu/hr, and the four boilers would operate continuously throughout the year or 8,760 hours per year. Each of the two TRV vaporization boilers have a maximum heat input of 332 MMBtu/hr, and these two boilers also would operate 8,760 hours per year. Each of the two LNG boilers would have a maximum heat input of 9.47 MMBtu/hr during discharging and would operate 3,294 hours per year. The HAP emissions from the boilers are summarized in Table 4.9.1-6 of the FEIS.

The HAP emissions from the power generation engines were based on emissions factors cited in the USEPA (FIRE) 6.25 database for large-bore DF engines. Engine manufacturers indicate that an SCR + Oxidation Catalyst applied to the SRS power generation engines would provide up to a 90-percent reduction in VOC emissions, depending on the type of VOC. Based on vendor-supplied test data, application of this technology would result in a 76-percent reduction in HAP emissions. The HAP emissions from both the SRS and TRV power generation engines are summarized in Table 4.9.1-7 of the FEIS. Based on the overall HAP emissions rate, the proposed Project would be a major HAP source because the maximum emissions rate for the individual HAP (hexane) would exceed 10 tpy.

### **Air Quality Model Parameters during Operations**

As described for modeling construction impacts, the near-field (within 50 km) source receptors and onshore receptors were evaluated using the OCD air quality model, and the CALPUFF dispersion model was used to assess the far-field (beyond 50 km at Class I air quality areas) impact. In addition, the OCD model was used to evaluate the air quality impacts during routine operations for the following analyses:

- PSD analysis of potential ambient air quality impacts to the Class II areas;
- Comparison with NAAQS and FAAQS for all routine emission sources; and
- The potential ambient air quality impacts at sensitive PSD Class II areas.

In general, the modeling for routine operations used the same modeling input methodologies described earlier for construction. The CALPUFF modeling system was used to assess the potential ambient air quality impacts at sensitive PSD Class I areas. The CALPUFF model inputs include all of the emission sources presented in Tables 4.9.1-3 through 4.9.1-5 of the FEIS. All of these emissions were modeled as point sources, and vessel-specific stack parameter information was used to characterize the associated plume rise from each source. For the CALPUFF Class 1 area impact assessment, discrete receptors were placed over the area of the Everglades National Park. A total of 901 receptors were specified based on National Park Service boundary information for Everglades National Park, available at ([http://www.nps.gov/gis/data\\_info/park\\_gisdata/fl.htm](http://www.nps.gov/gis/data_info/park_gisdata/fl.htm)). The interval between receptors is approximately 2 km. Discrete receptors also were placed at 2-km intervals at the boundaries of the PSD Class II sensitive areas, including the Arthur R. Marshall Loxahatchee National Wildlife Refuge (51 receptors), Biscayne National Park (63 receptors), and Big Cypress National Preserve (144 receptors). The size of the CALPUFF computational modeling domain is approximately 260 km east-west by 290 km

north-south. The size of the domain was selected to encompass the proposed Calypso Port and the Class I area of the Everglades National Park, with at least a 50-km buffer zone to allow for the possible recirculation of puffs beyond the proposed Calypso Port and the Class I area. A horizontal grid spacing interval of 4 km was used to specify the variation of meteorological conditions; nine vertical grid cells were set with cell face heights at 0, 20, 40, 80, 160, 320, 640, 1,200, 2,000, 3,000, and 4,000 meters above ground level. SO<sub>2</sub>, NO<sub>x</sub>, and PM<sub>10</sub> emissions were modeled using stack parameter data for each stationary, support, and mobile emissions source. Building downwash was incorporated by using the BPIP-PRIME program. CALPUFF analyses were performed with the removal process of dry and wet deposition plus chemical transformation. The deposition modeling was performed using standard default options.

As identified earlier, the VISTAS Regional Domain 2 CALMET output meteorological dataset was used in this analysis. This version of the CALPUFF modeling system is recommended by VISTAS and incorporates recent technical enhancements, including changes to the over-water boundary layer formulation and coastal effects modules sponsored by MMS. An existing preprocessed CALMET output meteorological data set for the VISTAS Regional Domain 2 was obtained from the Florida DEP. The data set included data for years 2001, 2002, and 2003. The data set incorporates output from a prognostic meteorological model along with available data on surface weather (both land and over water) and upper-air weather, in combination with geophysical data (land use type, terrain elevation, surface roughness length, albedo, Bowen ratio, soil heat flux, vegetation leaf area index, and anthropogenic heat flux) to develop an optimal meteorological data set for use in air quality modeling. The resulting data set provides a physically realistic meteorological data set that provides a best estimate of conditions where observations are not available while using information where observations are available.

As presented in Section 4.9 of the FEIS, the modeling of air quality during operation represents the former NO<sub>x</sub> emission rates from the SRS of 51.1 pounds per hour and 224 tpy, rather than the updated emission rates of 2.232 pounds per hour and 97.84 tpy associated with the use of the SCR units on each of the four boilers. This reduction in NO<sub>x</sub> emissions would result in a slight decrease in the modeled concentration of NO<sub>2</sub> presented in Tables 4.9.1-9 to 4.9.1-11 of the FEIS.

Potential ambient air quality impacts to the Class II areas (PSD analysis), as well as the potential ambient air quality impacts at sensitive PSD Class II areas, were modeled using the OCD model. The ambient concentrations associated with routine emission sources were compared against applicable significant impact levels (SILs). The results of this comparison, as discussed in Section 4.9 of the FEIS, found that only the 3-hour and 24-hour SO<sub>2</sub> impacts exceeded the SIL, which requires that a cumulative SO<sub>2</sub> analysis (maximum impact within the significant impact area [SIA] from nearby SO<sub>2</sub> emitting sources that affect the SIA and all emissions sources associated with the proposed Calypso Port) be performed to determine whether allowable increments were exceeded. Table J-1 presents the background emission source inventory for the SO<sub>2</sub> cumulative analysis.

Cumulative modeling of the nearby SO<sub>2</sub> emission sources<sup>3</sup> plus the emissions from the proposed Project showed that the 3-hour and 24-hour SO<sub>2</sub> impacts would be below the allowable incremental consumption. All the sensitive Class II areas impacts were less than 5 percent of the Class II SILs.

<sup>3</sup> The SO<sub>2</sub> emission sources considered in the cumulative analysis are presented in Table 4-5 of Volume I, Appendix E, Attachment C-10, Air Modeling Report in the Calypso Deepwater Port License Application. This document is available on the Federal Docket <http://www.regulations.gov>.

**TABLE J-1  
Nearby Emission Source Inventory for SO<sub>2</sub> Cumulative Analysis**

Facility ID	Owner/ Company Name	Site Name	UTM North (km)	UTM East (km)	Distance from Project Site (km)	EU ID	SO <sub>2</sub> Emission Rate (g/s)	Stack Ht (m)	Exit Temp (K)	VEL (m/s)	DIAM (m)
0990045	City of Lake Worth Utilities	Tom G. Smith Power Plant	2943.7	592.8	48	LAKWTHU3	103.95	38.1	408.2	7.71	2.13
0990045	City of Lake Worth Utilities	Tom G. Smith Power Plant	2943.7	592.8	48	LAKWTHU4	129.85	35.1	418.2	17.0	2.29
0990045	City of Lake Worth Utilities	Tom G. Smith Power Plant	2943.7	592.8	48	LAKWTHU5	11.59	22.9	450.4	18.29	0.94
0990045	City of Lake Worth Utilities	Tom G. Smith Power Plant	2943.7	592.8	48	LAKWTHHR	12.79	45.7	377.6	13.74	5.49
0990042	Florida Power & Light (PRV)	Riviera Power Plant	2960.6	594.3	64	RIVU34	2113.65	90.8	401.5	18.9	4.88
0110037	Florida Power & Light (PFL)	Fort Lauderdale Power Plant	2883.3	580.1	26	LAUDU45	271.15	45.7	438.7	14.6	5.49
0110037	Florida Power & Light (PFL)	Fort Lauderdale Power Plant	2883.3	580.1	26	LDGT1_12	552.9	13.7	733.2	114.31	2.37
0110037	Florida Power & Light (PFL)	Fort Lauderdale Power Plant	2883.3	580.1	26	LDGT1324	552.8	13.4	733.2	28.43	4.75
0110036	Florida Power & Light (PPE)	Port Everglades Power Plant	2885.3	587.4	19	PTEVU12	1593.9	104.5	415.9	26.72	4.27
0110036	Florida Power & Light (PPE)	Port Everglades Power Plant	2885.3	587.4	19	PTEVU34	2772	104.5	414.8	23.88	5.52
0110036	Florida Power & Light (PPE)	Port Everglades Power Plant	2885.3	587.4	19	PTEVGTS	530.7	13.4	733.2	28.43	4.75
0250014	Rinker Material Corp.	Tarmac Rinker	2852.1	557.5	64	TARMC1	5.67	61.0	465.0	12.8	2.44
0250014	Rinker Material Corp.	Tarmac Rinker	2852.1	557.5	64	TABMC2P	24.57	61.0	422.0	9.1	2.44
0250014	Rinker Material Corp.	Tarmac Rinker	2852.1	557.5	64	TARMC3P	51.43	61.0	450.0	11.04	4.57
0112120	Wheelabrator North Broward, Inc.	Wheelabrator North Broward	2907.6	583.9	22	NBRRF	12.4	61.0	380.0	18.3	1.5
0112119	Wheelabrator South Broward, Inc.	Wheelabrator South Broward	2883.4	578.9	27	SBCRRF	13.29	59.4	381.0	18.01	3.96

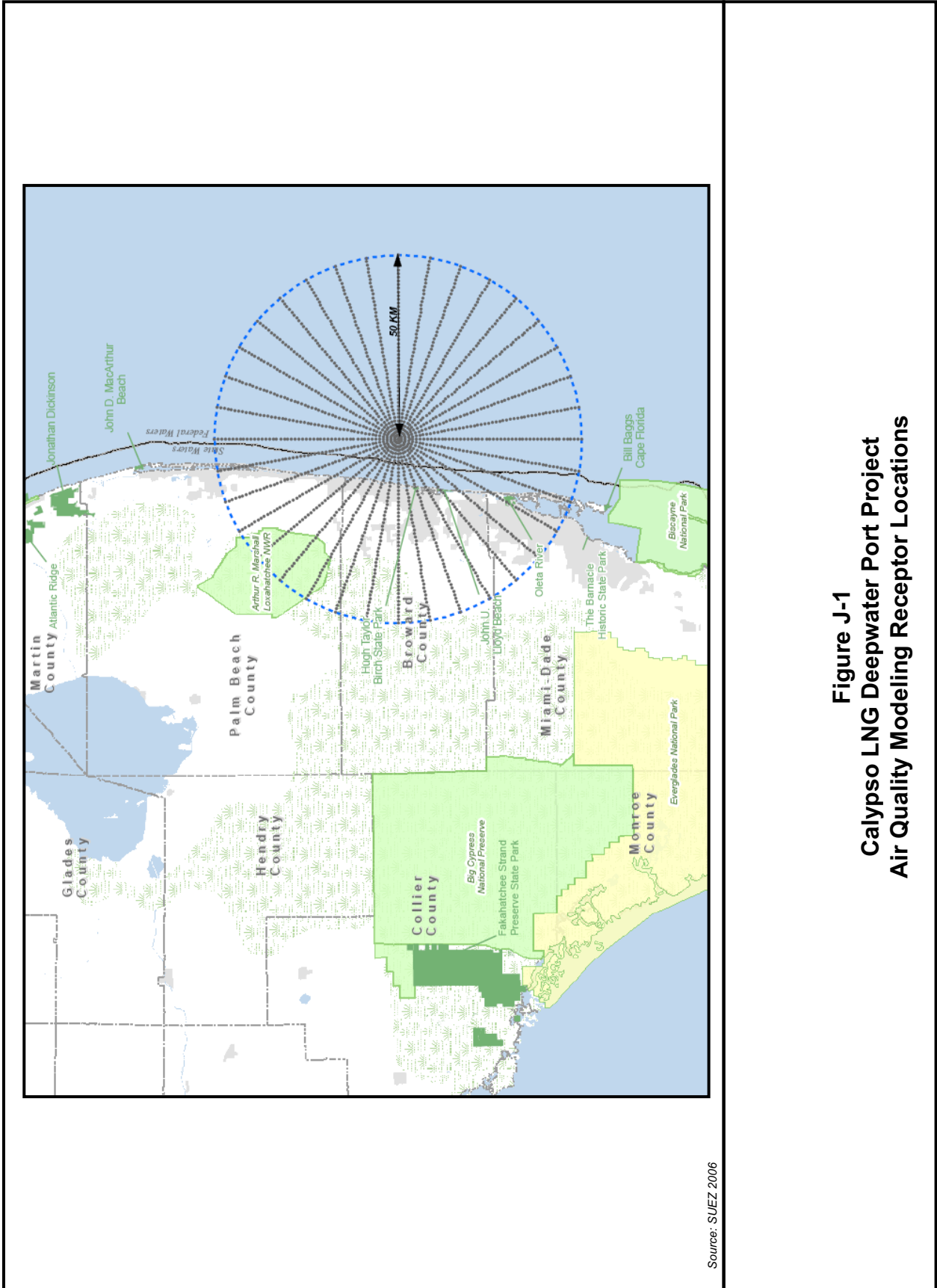
Source: Florida Department of Environmental Protection 2006.  
Key: EU = Emission Unit.

Potential impacts to ambient air quality for all proposed Calypso Port emissions during routine operations were modeled using the OCD model. The results showed only SO<sub>2</sub> with concentrations equal to or larger than the SIL, thereby requiring SO<sub>2</sub> cumulative impact modeling with nearby emission sources, and the addition of representative maximum ambient monitored background concentration for a conservative comparison with the NAAQS and FAAQS (see Table 4.9.1-10 of the FEIS). The other pollutants do not have any values in the column Maximum Modeled Concentration and Nearby Sources because their maximum concentrations are less than applicable SIL. Comparisons of the maximum Project-only concentrations plus background monitored values for all pollutants other than SO<sub>2</sub> are provided for demonstration purposes. In all cases, the maximum impacts of the proposed Project in combination with background concentration are below both the NAAQS and FAAQS. In addition, the values presented for the criteria pollutants would occur at sea, and the maximum shoreline impacts would be approximately an order of magnitude less.

As discussed earlier, the value reported in the Air Emission Inventory (Attachment C-11) on page 47 shows an NO<sub>x</sub> emission rate of 29.45 tpy. The multiplication is incorrect, and the NO<sub>x</sub> emission rate should be 176.67 tpy. Modeling using the correct emissions rates found that, for the peak impact year, the annual NO<sub>2</sub> increased from 13.6 to 18 µg/m<sup>3</sup>. Nevertheless, when these results are combined with background concentrations of 17 µg/m<sup>3</sup>, the maximum concentrations remain well below the 100-µg/m<sup>3</sup> NO<sub>2</sub> NAAQS. Corrected results for PM and in particular PM<sub>2.5</sub> (as all proposed Project source emissions were considered less than 2.5 microns) show an increase for the maximum concentration from 3.9 to 12 µg/m<sup>3</sup> for the 24-hour average and from 0.5 to 1.8 µg/m<sup>3</sup> for the annual average. When combined with the background concentrations of 22.3 and 8.8 µg/m<sup>3</sup> for the 24-hour and annual average, respectively, the maximum concentrations of 34.3 and 10.6 µg/m<sup>3</sup> remain below the NAAQS PM<sub>2.5</sub> standards of 35 and 15 µg/m<sup>3</sup>, respectively, for these parameters. SO<sub>2</sub> emissions also would increase from 0.0008 to 0.0048 tpy but would result in a minimal impact on maximum SO<sub>2</sub> concentration because SO<sub>2</sub> emissions would be dominated by the 64.5-tpy emissions rate from the LNG carrier boilers. The corrected values presented above are the values included in Table 4.9.1-10 of the FEIS.

Potential ambient air quality impacts at the nearest PSD Class I area, Everglades National Park, were evaluated using the CALPUFF model with all of the operations emissions sources (Tables 4.9.1-3 through 4.9.1-5 of the FEIS). Table 4.9.1-11 of the FEIS compares the maximum predicted impact with the PSD Class I area SILs. As this table illustrates, the emissions would not significantly impact air quality at the Everglades National Park Class I area. Other potential air quality-related impacts for Everglades National Park include visibility and acid deposition. Visibility is assessed in terms of potential change to deciview<sup>4</sup>. The largest deciview change modeled was less than 30 percent of the 0.5 threshold value. For acid deposition, the largest change was 30 percent of the data analysis threshold of 0.01 kilograms per hectare-year. Therefore, the air quality and air quality-related impacts in Class 1 areas (visibility and acid deposition) would not be significant.

<sup>4</sup> A deciview is a visual index designed to be linear with respect to perceived visual air quality changes. A 1-deciview change represents a perceptible change in visual air quality to the average person.



**Figure J-1**  
**Calypso LNG Deepwater Port Project**  
**Air Quality Modeling Receptor Locations**

Source: SUEZ, 2006

**REFERENCES**

- Calypso LNG 2007 Best Available Control Technology (BACT) Analysis. October 9, 2007
- Calypso LNG 2006a Deepwater Port License Application, Calypso LNG Project, Florida, Volume 1, Appendix E, Attachment C-9: Air Quality and PSD Analysis Modeling Protocol, Prepared by Ecology & Environment, Inc. September 2006.
- Calypso LNG 2006b Deepwater Port License Application, Calypso LNG Project, Florida, Volume 1, Appendix E, Attachment C-11: Air Emission Inventory, Attachment 4, Neptune Data (Thermal Oxidizer) 2006.
- FLAG 2000 Federal Land Managers' Air Quality Related Values Workgroup (FLAG). 2000. Phase I Report, USFS, NPS, USFWS. December.
- MMS 1989 Minerals Management Service. 1989. OCD: The Offshore and Coastal Dispersion (OCD) Model Volume 1: User's Guide. (Report No. A085-1.)
- Hanna et al. 1984 Hanna S., Schulman L., Paine R., Pleim J. (1984): The Offshore and Coastal Dispersion (OCD) Model User's Guide, Revised. (OCS Study, MMS 84-0069.)
- Hanna et al. 1985 Hanna S., Schulman L., Paine R., Pleim J., Baer M. (1985): "Development and evaluation of the offshore and coastal dispersion (OCD) model," Journal of Air Pollution Control Association 35: 1039-1047
- USEPA 1998 U.S. Environmental Protection Agency. 1998. Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts. (EPA-454/R-98-019.) December.
- USEPA AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, available at <http://www.epa.gov/ttn/chief/ap42/>.