# Oregon Clean Energy Center


# Dispersion Modeling Report

*Volume 2*
*Siemens SGT-8000H Turbine Scenario*

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### List of Acronyms and Abbreviations

| | |
|---|---|
| % | percent |
| °F | degrees Fahrenheit |
| °K | degrees Kelvin |
| µg/m$^3$ | micrograms per cubic meter |
| ACGIH | American Conference of Governmental Industrial Hygienists |
| AERMAP | terrain data preprocessor |
| AERMET | meteorological data preprocessor |
| AERMOD | air dispersion model |
| AERSURFACE | surface characteristics preprocessor |
| AQRV | Air Quality Related Values |
| Aux. Boiler | auxiliary boiler |
| AWMA | Air and Waste Management Association |
| BACT | Best Available Control Technology |
| BAT | Best Available Technology |
| BPIP | Building Profile Input Program |
| BPIPPRM | PRIME Version of BPIP |
| BP | British Petroleum |
| Btu | British thermal units |
| CAA | Clean Air Act |
| CCGT | combined cycle gas turbine |
| CFR | Code of Federal Regulations |
| CO | carbon monoxide |
| $CO_2e$ | carbon dioxide equivalents |
| CTG | combustion turbine generator |
| DAPC | Department of Air Pollution Control |
| DB | duct burner |

| | |
|---|---|
| DLN | dry low $NO_x$ |
| EPRI | Electric Power Research Institute |
| FLAG | Federal Land Managers' Air Quality Related Values Working Group |
| FLM | Federal Land Manager |
| GEP | Good Engineering Practice |
| GHG | greenhouse gases |
| $g/m^2/yr$ | grams per square meter per year |
| g/s | grams per second |
| Hp | horsepower |
| HRSG | heat recovery steam generator |
| HRSGN | northern heat recovery steam generator |
| HRSGS | southern heat recovery steam generator |
| $H_2SO_4$ | sulfuric acid mist |
| ISO | International Organization for Standardization |
| km | kilometer |
| kV | kilovolt |
| kW | kilowatts |
| m | meters |
| m/s | meters per second |
| MAGLC | Maximum Allowable Ground Level Concentration |
| $mg/m^3$ | milligrams per cubic meter |
| MMBtu | million British thermal units |
| msl | mean sea level |
| MW | megawatts |
| NAAQS | National Ambient Air Quality Standards |
| Nat. gas | natural gas |
| $O_3$ | ozone |

| | |
|---|---|
| OCE | Oregon Clean Energy |
| Ohio EPA | Ohio Environmental Protection Agency |
| ODNR | Ohio Department of Natural Resources |
| NED | National Elevation Dataset |
| NPS | National Park Service |
| NWS | National Weather Service |
| $NO_2$ | nitrogen dioxide |
| $NO_x$ | nitrogen oxides |
| Pb | Lead |
| $PM_{10}$ | particulate matter with a diameter equal to or less than 10 microns |
| $PM_{2.5}$ | particulate matter with a diameter equal to or less than 2.5 microns |
| ppb | parts per billion |
| ppm | parts per million |
| the Project | the Oregon Clean Energy Center |
| PSD | Prevention of Significant Deterioration |
| the PSD Permit Application | the Prevention of Significant Deterioration Preconstruction Permit Application |
| SCR | selective catalytic reduction |
| SER | Significant Emission Rate |
| SIL | Significant Impact Level |
| SMC | Significant Monitoring Concentration |
| $SO_2$ | sulfur dioxide |
| STG | steam turbine generator |
| TAP | toxic air pollutant |
| TES | Toledo Environmental Services Division |
| TLV | threshold limit value |
| tpy | tons per year |

| | |
|---|---|
| TSP | total suspended particulates |
| ULSD | ultra-low sulfur diesel |
| USEPA | United States Environmental Protection Agency |
| USFS | United States Forest Service |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| VOC | volatile organic compounds |

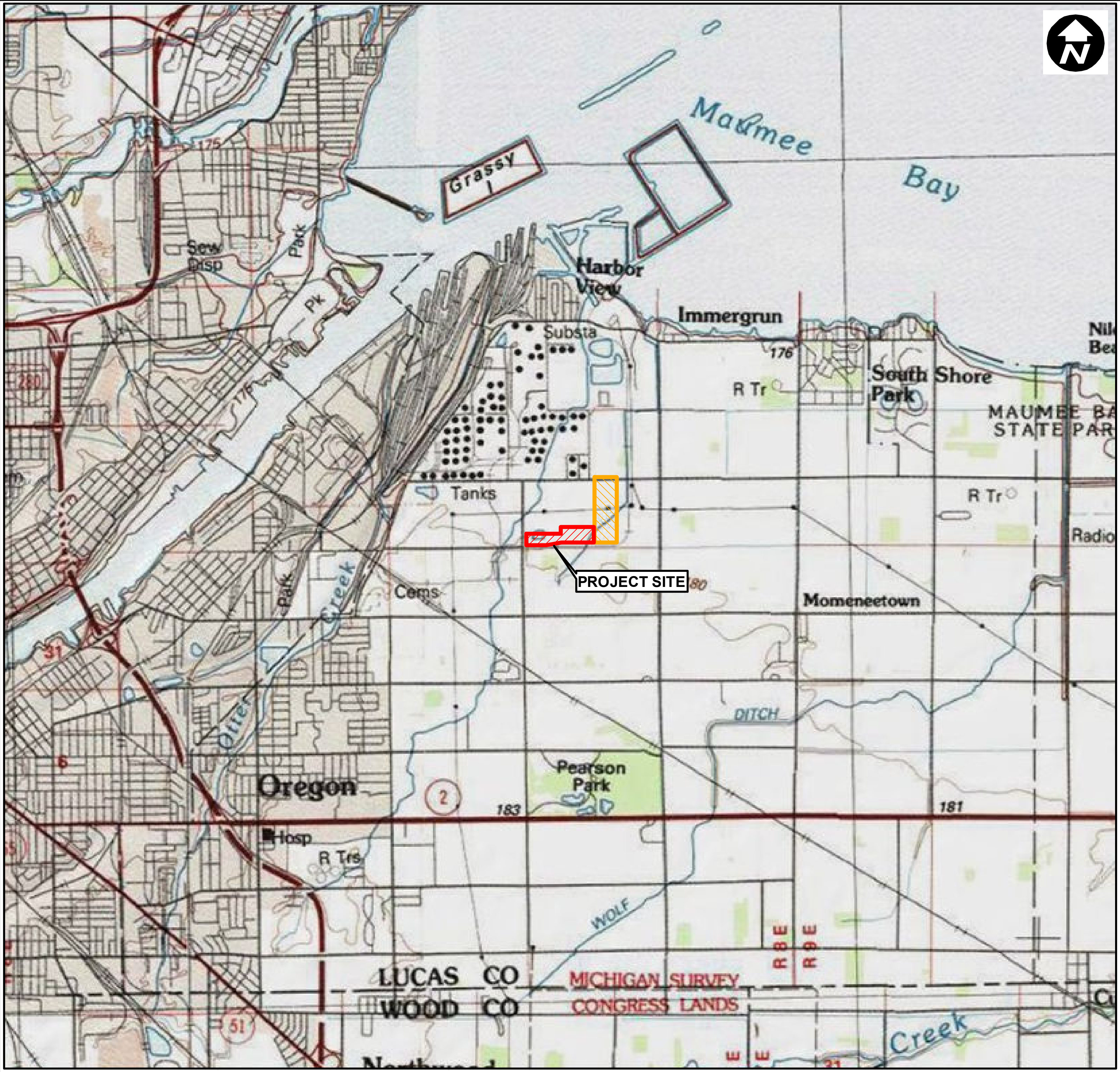
# 1. INTRODUCTION

Oregon Clean Energy, LLC (OCE) is proposing to construct the Oregon Clean Energy Center, a nominal 799-megawatt (MW) (unfired International Organization for Standardization [ISO] conditions) combined cycle gas turbine (CCGT) facility (the Project). OCE proposes to construct the Project within an approximately 30-acre parcel of land located entirely within Lucas County in the City of Oregon, Ohio. The general location of the Project is provided in Figure 1-1. The Project will utilize combined cycle combustion turbine technology in a 2 x 2 x 1 configuration. OCE is requesting a permit-to-install that will allow two optional plant configurations. The turbines being considered for the Project are:

- Option 1 – Two Mitsubishi M501 GAC units; or
- Option 2 – Two Siemens SGT-8000H units.

The permit application is being provided in two volumes to differentiate information associated with the two turbine engines. A two-volume application for the Prevention of Significant Deterioration (PSD) Preconstruction Permit (the PSD Permit Application) was submitted to the Ohio Environmental Protection Agency (Ohio EPA) for review by the Toledo Environmental Services Division (TES) on February 1, 2013 that included information for both Option 1 and Option 2. This document presents dispersion modeling information for the Siemens turbine scenario. The PSD Permit Application (Volume 2) provides a comprehensive description of the Project and its associated emissions. The application also provides a detailed regulatory review and a Best Available Control Technology (BACT)/Best Available Technology (BAT) analysis. This document provides the modeling analyses required for those pollutants triggering PSD review.

Major Project equipment will include two combustion turbine generators (CTGs), two supplementary-fired heat recovery steam generators (HRSGs), one steam turbine generator (STG), a 16-cell mechanical draft wet cooling tower, and associated auxiliary and balance-of-plant equipment and systems. The Project is intended to operate as a base-load facility and is proposed to be available to operate up to 8,760 hours per year, incorporating a range of load conditions. The Project seeks the flexibility to operate with frequent starts in order to meet energy demands.





LUCAS COUNTY, OHIO

**Legend**

- Project Site
- Construction Laydown Parcel

Topographic Base Image Source: ArcGIS Online Services, Access date: 01/04/2013, via ArcGIS v10. This image is not for re-sale or distribution outside of the use of this PDF.

0 0.5 1
Miles
1 inch equals 1 miles

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**OREGON CLEAN ENERGY CENTER, LLC**

***FIGURE 1-1***

**SITE LOCATION MAP**

| Lucas County, Ohio | Date: 01/04/2013 |
|---|---|

City: Chicago Author: MNesta Path: C:\PROJECTS\OCE\MXD\OPSB_20130104\01-1_OCE_ProjectLocation.mxd

Air emissions from the proposed Project primarily consist of products of combustion from the combustion turbines, HRSG duct burners, and ancillary equipment. Pollutants that are regulated under federal and Ohio programs, such as PSD, include: carbon monoxide (CO); nitrogen dioxide ($NO_2$); sulfur dioxide ($SO_2$); total suspended particulates (TSP); particulate matter with a diameter equal to or less than 10 microns ($PM_{10}$); particulate matter with a diameter equal to or less than 2.5 microns ($PM_{2.5}$); volatile organic compounds (VOC); greenhouse gases (GHG); lead (Pb); sulfuric acid mist ($H_2SO_4$); and air toxics. Potential emissions from the proposed Project, on a tons per year (tpy) basis, are presented in Table 1-1.

The Project will employ BACT/BAT for emissions control. In addition to the use of dry low nitrogen oxide ($NO_x$) (DLN) burners, emissions of $NO_x$ will be controlled with selective catalytic reduction (SCR). Emissions of CO and VOC will be controlled with good combustion practices and an oxidation catalyst system.

**Table 1-1: Summary of Proposed Potential Emissions and Applicable Regulatory Thresholds**

| Pollutant | Annual Emissions (tpy) | PSD Major Source Threshold (tpy) | PSD Significant Emission Rate (tpy) | PSD Applies? (Yes/No) |
|---|---|---|---|---|
| $NO_x$ | 193.32 | 100 | 40[a] | Yes |
| VOC | 58.77 | 100 | 40 | Yes |
| CO | 154.53 | 100 | 100 | Yes |
| $PM_{10}$ | 128.26 | 100 | 15 | Yes |
| $PM_{2.5}$ | 123.72 | 100 | 10 | Yes |
| $SO_2$ | 36.87 | 100 | 40 | No |
| $H_2SO_4$ | 13.15 | 100 | 7 | Yes |
| GHGs[b] | 2,884,607 | 100,000 | 75,000 | Yes |
| Pb | 0.00008 | 10 | 0.6 | No |

a. PSD significant emission rate for $NO_2$.
b. GHGs are expressed as carbon dioxide equivalents ($CO_2e$).

# 2. PROJECT DESCRIPTION

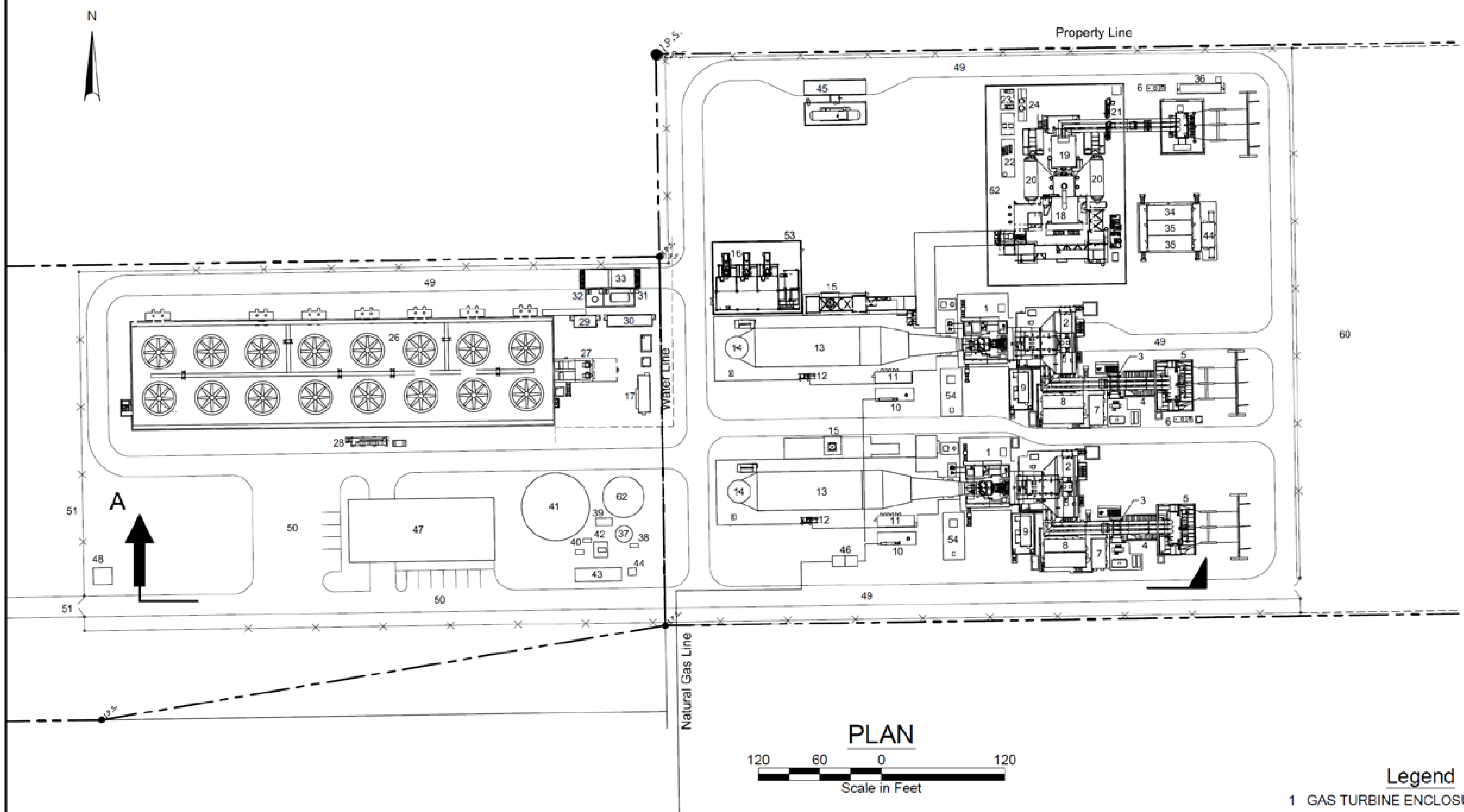
## 2.1 Overview

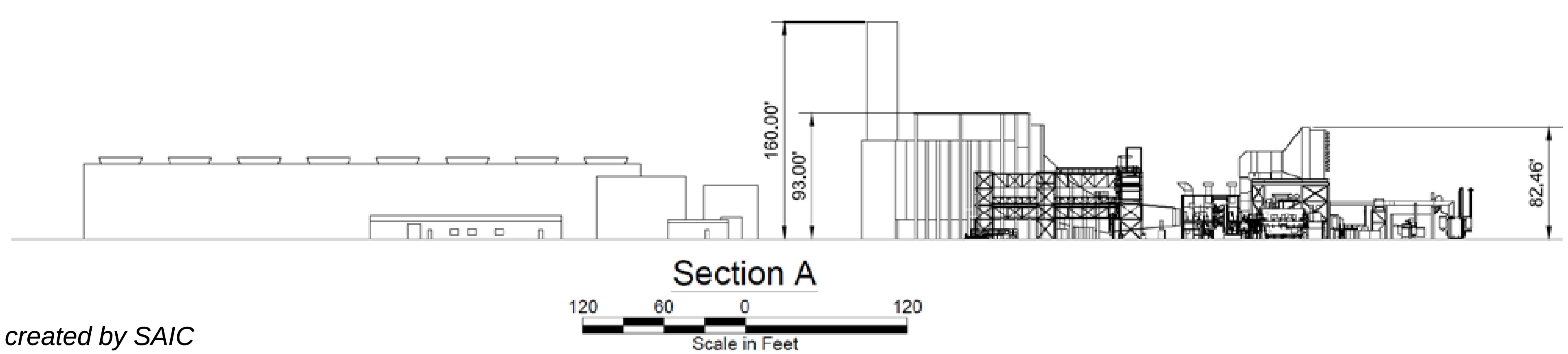
OCE proposes development of a nominal 799-MW electric generating facility (ISO conditions) at an industrially zoned site in the City of Oregon, Ohio. Figure 1-1 presents the proposed Project location on a topographic map. Figure 2-1 provides a site layout of the facility. The facility will be comprised of the following major and ancillary equipment:

- Two CTGs;
- Two HRSGs with supplemental duct firing;
- One STG;
- One 16-cell mechanical draft wet cooling tower;
- One 2,250 kilowatt (kW) emergency diesel generator using ultra-low sulfur diesel (ULSD) fuel; OCE is proposing a permit limit of 500 hours of operation per year;
- One natural gas-fired, 99-million British thermal units (MMBtu) steam production auxiliary boiler; OCE is proposing a permit limit of 2,000 hours of operation per year; and
- One 300-horsepower (hp) fire pump using ULSD fuel; OCE is proposing a permit limit of 500 hours of operation per year.

The Project will be fueled by clean-burning natural gas. A new natural gas lateral will be built and operated to connect with nearby natural gas transmission lines. Electrical interconnection will be to the 345-kilovolt (kV) FirstEnergy transmission line, located just north of the site.

The facility will utilize a 16-cell mechanical draft wet cooling tower with an average consumptive water use of 3-4 million gallons per day. Raw water from the City of Oregon is being proposed for process use. Discharge of wastewater will be to the Oregon sanitary sewer system for treatment at the wastewater treatment plant, located within 1 mile of the site. The cooling tower will be equipped with high efficiency (0.0005%) drift eliminators.

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## Legend

1 GAS TURBINE ENCLOSURE
2 TURBINE AIR INLET FILTER
3 GENERATOR CIRCUIT BREAKER
4 AUXILIARY TRANSFORMER
5 GENERATOR STEP UP TRANSFORMER
6 OIL/WATER SEPARATOR
7 SEE/SFC PACKAGE
8 POWER CONTROL CENTER
9 LUBE OIL SKID
10 FUEL GAS PREHEATER
11 SAMPLING CONTAINER
12 SCR SKID
13 HEAT RECOVERY STEAM GENERATOR
14 HRSG EXHAUST STACK
15 BOILER BLOWDOWN
16 BOILER FEED WATER PUMPS
17 CHEMICAL DOSING CONTAINER
18 STEAM TURBINE
19 ST GENERATOR
20 SURFACE CONDENSER

## Legend (Cont.)

21 VACUUM PUMPS
22 CLOSED COOLING WATER PUMPS
23 SERVICE WATER PUMPS
24 COMPRESSED AIR PACKAGE
26 COOLING TOWER
27 CIRC. WATER PUMPS
28 COOLING TOWER PCC
29 CW CHEMICAL DOSING SYSTEM
30 LABORATORY CONTAINER
31 NaOCL STORAGE TANK
32 SULPHURIC ACID STORAGE TANK
33 CHEMICAL UNLOADING AREA
34 STEAM TURBINE PCC
35 BALANCE OF PLANT PCC
36 EMERGENCY DIESEL GENERATOR
37 DEMIN. WATER STORAGE TANK
38 DEMIN. WATER FORWARDING PUMPS
39 WATER TREATMENT MODULES
40 RAW WATER FORWARDING PUMPS
41 RAW WATER STORAGE TANK
42 FIRE WATER PUMPS
43 WATER TREATMENT AREA PCC
44 LV TRANSFORMER
45 AMMONIA STORAGE/UNLOADING AREA
46 FUEL GAS CONDITIONING/METERING
47 ADMIN./CONTROL RM. WAREHOUSE BUILDING
48 GUARD HOUSE
49 ROAD
50 PARKING AREA
51 FENCE & GATES
52 GENERATION BUILDING (OPTION)
53 BOILER FEEDWATER PUMP ENCLOSURE (OPTION)
54 ROTOR TURNING DEVICE (OPTION)
60 345 kV SWITCHYARD
61 NOT USED
62 POTABLE AND FIRE WATER STORAGE TANK

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**OREGON CLEAN ENERGY CENTER, LLC**

***FIGURE 2-1***

**SITE LAYOUT**

Lucas County, Ohio | Date: 02/05/2013

### 2.2 Site Location

The proposed site consists of an irregularly shaped parcel of land, totaling approximately 30 acres, located entirely within the City of Oregon, Lucas County, Ohio. The site is industrially zoned within the Cedar Point Development Park. Its setting is within a mixed industrial, commercial and agricultural area that is located east of North Lallendorf Road, west of farmland located at 4632 Cedar Point Road, north of the Norfolk Southern Railroad, and south of the John Gradel and Sons' Farms. Access to the site is via North Lallendorf Road. The western edge of the site is transected by Driftmeyer Ditch, while Johlin Ditch transects the eastern portion of the site. Both ditches flow north to Lake Erie, located less than 2 miles north of the site. FirstEnergy-owned transmission lines extend in an east-west direction just to the north of the site.

The site consists of farmland with associated structures, including two single-family dwellings, a garage and a barn. The majority of the parcel is in active agricultural use. Site topography is relatively flat, at an elevation of approximately 588 feet above mean sea level (msl). The final graded elevation will be approximately 590 ft msl. The Maumee River, which flows southwest to northeast to its confluence with Lake Erie, is situated approximately 2 miles northwest of the site.

The Project is located approximately 2 miles south of First Energy's existing Bay Shore coal-fired power plant on Lake Erie. British Petroleum's (BP's) expansive Toledo Refinery is located less than 0.5 mile to the north, beyond the electric transmission corridor. Land uses east and southeast of the site are primarily agricultural, with some residences along the roads which divide the land in a grid-like fashion. A cluster of commercial/industrial uses border the site to the south-southwest, including several manufacturing and warehouse facilities. More densely developed residential areas are located about a mile southwest of the site.

Pearson Park is located approximately 1.5 miles south of the site, Collins Park is 1.5 miles west-southwest of the site, and Maumee Bay State Park is approximately 2 miles east-northeast of the site. Further east-northeast, along the shore of Lake Erie are the Mallard Club Wilderness Area and the Cedar Point National Wildlife Refuge.

### 2.3 Project Emissions

Potential Project emissions are summarized in Table 1-1. Emissions for the primary emission units are discussed in Section 4.4. Detailed presentations of the emissions associated with the Project are provided in the PSD Permit Application. For ease of review, supporting emissions calculations are also provided in Appendix A of this document.

# 3. REGULATORY APPLICABILITY EVALUATION

OCE is requesting approval to construct a nominal 799-MW (ISO conditions) combined cycle electric generating facility at an industrially zoned site in the City of Oregon, Ohio. The Project is considered a new major stationary combustion source under PSD regulations because the potential annual emissions from the facility exceed major source thresholds, as illustrated in Table 1-1.

A comprehensive regulatory review for the Project is provided in the Section 3 of the PSD Permit Application (Volume 2). This section contains an analysis of the applicability of federal and state air quality regulations to the proposed Project as they pertain to dispersion modeling requirements.

## 3.1 PSD New Source Review

OCE is requesting approval to construct a nominal 799-MW (ISO Conditions) combined cycle electric generating facility in the City of Oregon, Lucas County, Ohio. Lucas County is in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants and is, therefore, regulated under the PSD program.

Combined cycle power plants with potential emissions greater than 100 tpy of one or more criteria pollutants are considered new major stationary sources under the PSD program. As shown in Table 1-1, the potential emissions of at least one regulated criteria pollutant will exceed this threshold. As such, the proposed facility is subject to PSD New Source Review. Under the PSD regulations, once a major source threshold is triggered, PSD review must be completed for all pollutants whose potential emissions exceed their respective Significant Emission Rate (SER).

As presented in Table 1-1, OCE has triggered the major source threshold for at least one pollutant. As such, PSD review is required for $NO_x$, CO, VOC, $H_2SO_4$, $PM_{2.5}$, $PM_{10}$ and GHG emissions. Of these pollutants, an ambient air quality impact analysis is required for $NO_x$ (as $NO_2$), CO, $PM_{2.5}$ and $PM_{10.}$ PSD review requirements include application of BACT, an ambient air quality modeling analysis demonstrating compliance with the NAAQS and PSD increments, an analysis of potential impacts to designated PSD Class I areas, and an additional impacts analysis. Ohio has been delegated PSD review authority by the United States Environmental Protection Agency (USEPA).

### 3.1.1 Best Available Control Technology

Pollutants subject to PSD review are required to apply BACT for control of emissions of PSD pollutants. BACT is defined as an emission limitation based on the maximum degree of reduction, on a case-by-case basis, taking into account energy, environmental and economic considerations. A BACT analysis is presented in the PSD Permit Application.

### 3.1.2 Air Quality Impact Analysis

An ambient air quality impact analysis must be performed to demonstrate compliance with NAAQS and PSD increments. Proposed new sources subject to PSD review may not cause or significantly contribute to a violation of the NAAQS. As part of this demonstration, the USEPA has established Significant Impact Levels (SILs) for all of the criteria pollutants. SILs represent concentrations of pollutants that are considered to be insignificant with respect to demonstration of NAAQS compliance. Proposed new sources whose air quality impacts exceed the SILs must complete a cumulative analysis taking into consideration existing background air quality levels and contributions from other sources. In addition to demonstrating compliance with the NAAQS, new sources must comply with PSD increments, which specify the maximum allowable increase in concentration that is allowed to occur in areas meeting the NAAQS for any regulated pollutant.

Table 3-1 presents a summary of the NAAQS, SILs, and PSD increments. The air quality impact analysis for the Project is provided in Section 5 of this document.

### 3.1.1 PSD Class I Area Impact Analysis

PSD regulations require that proposed major sources within 100 kilometers (km) of a PSD Class I area perform an assessment of potential impacts in the PSD Class I area. PSD Class I areas are specifically designated areas of special national or regional value from a natural, scenic, recreational or historic perspective. These areas are administered by the National Park Service (NPS), United States Fish and Wildlife Service (USFWS), or the United States Forest Service (USFS). Federal Land Managers (FLMs) are responsible for evaluating proposed projects' air quality impacts in the Class I areas and may make recommendations to the permitting agency to approve or deny permit applications. The PSD Class I area impact analysis is presented in Section 6.

**Table 3-1: Summary of Primary National Ambient Air Quality Standards**

| Pollutant | Averaging Period | NAAQS micrograms per cubic meter ($\mu g/m^3$)[a] | Class II SIL ($\mu g/m^3$) | Significant Monitoring Concentration (SMC) ($\mu g/m^3$) | Class II PSD Increments ($\mu g/m^3$) |
|---|---|---|---|---|---|
| $SO_2$ | 1-hour | 196[b] | 7.8 | Not yet proposed | -- |
| | 3-hour | 1,300 | 25 | -- | 512 |
| $PM_{10}$ | 24-hour | 150[c] | 5 | 10 | 30 |
| $PM_{2.5}$ | 24-hour | 35[d] | 1.2[e] | 4[e] | 9 |
| | Annual | 12 | 0.3[e] | -- | 4 |
| CO | 1-hour | 40,000 | 2,000 | -- | -- |
| | 8-hour | 10,000 | 500 | 575 | -- |
| $NO_2$ | 1-hour | 188[f] | 7.52 | Not yet proposed | -- |
| | Annual/12 month | 100 | 1 | 14 | 25 |
| Ozone ($O_3$) | 8-hour | 160[g] | -- | -- | -- |
| Pb | 3-month | 0.15[h] | -- | -- | -- |

a. All short-term NAAQS (1-, 3-, 8-, and 24-hr) standards except $O_3$, $PM_{2.5}$ and $PM_{10}$ are not to be exceeded more than once per calendar year. Three-month and annual standards are never to be exceeded.

b. For the 1-hour $SO_2$ NAAQS, compliance is determined using the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor.

c. For 24-hour $PM_{10}$, USEPA uses the 6th highest 24-hour maximum concentration from the last three years of air quality monitoring data to determine a violation of the standards.

d. For 24-hour $PM_{2.5}$, USEPA uses the 98% percentile 24-hour maximum concentration from the last three years of air quality monitoring data to determine a violation of the standard.

e. On January 22, 2013, the United States Court of Appeals for the District of Columbia Circuit issued a ruling that remands and vacates the SILs and SMCs for 24-hour and annual $PM_{2.5}$. The USEPA has not yet issued interim guidance regarding the ruling.

f. For the 1-hour $NO_2$ NAAQS, compliance is determined using the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor.

g. For 8-hour ozone, USEPA uses the average of the annual 4th highest 8-hour daily maximum concentrations from each of the last three years of air quality monitoring data to determine a violation of the standard.

h. The 3-month NAAQS for Pb is a rolling average.

#### 3.1.2 Additional Impact Analyses

Additional impact analyses are also required as part of PSD review. These additional analyses include an assessment of impacts on community growth resulting from the Project and an assessment of impacts to soils and vegetation. The additional impact analyses are presented in Section 6.

The Endangered Species Act of 1973 requires that all federal actions, such as the issuance of PSD permits, not jeopardize the existence of any endangered or threatened species or result in the destruction or adverse modification of the habitat of such species. Section 6.4 provides a discussion on endangered species considered for the Project.

### 3.2 Other Applicable Regulations

Other federal and state regulations applicable to the Project are described in the PSD Permit Application (Volume 2). Of relevance to the Dispersion Modeling Report, Ohio EPA's Air Toxics Policy (Ohio EPA, 1986) requires a modeling evaluation of the ambient impacts of toxic air pollutant (TAP) emissions. This analysis is provided in Section 6.5.

# 4. MODELING PROCEDURES

The methodology used for the modeling presented below is consistent with the guidance provided by the USEPA in the “Guideline on Air Quality Models” (USEPA, 2005); and by the Ohio EPA in “Engineering Guide 69” (Ohio EPA, 2003).

## 4.1 Model Selection

AERMOD (version 12345) was selected to predict ambient concentrations in simple (below stack height), complex (above plume height) and intermediate (between stack height and plume height) terrain. The AERMOD Modeling System includes preprocessor programs (AERMET, AERSURFACE, and AERMAP) to create the required input files for meteorology and receptor terrain elevations. AERMOD is the recommended model in USEPA’s Guideline on Air Quality Models (40 Code of Federal Regulations [CFR] Part 51, Appendix W) (USEPA, 2005). The regulatory default option was used in the modeling for all pollutants, which includes the following commands:

- The elevated terrain algorithms requiring input of terrain height data for receptors and emission sources;
- Stack-tip downwash (building downwash automatically overrides);
- The “calms” processing routines;
- Buoyancy-induced dispersion; and
- The missing meteorological data processing routines.

## 4.2 Receptors

A 5 km x 5 km Cartesian receptor grid with 100-meter (m) spacing between the receptors and a 25 km x 25 km Cartesian grid with a 1,000-m spacing between receptors was used. Fence-line receptors were placed around the property boundary at 25-m spacing.

Receptor elevations were assigned using the USEPA’s AERMAP software tool (version 06341), which is designed to extract elevations from United States Geological Survey (USGS) National Elevation Dataset (NED) data at 1/3 arc second resolution in GeoTIFF format (USGS, 2002). This represents the highest resolution digital terrain data available from the USGS for this geographic area.

AERMAP, the terrain preprocessor for AERMOD, uses interpolation procedures to assign elevations to a receptor:

- For each receptor, the program searches through the NED data index files to determine the two profiles (longitudes or eastings) that straddle the receptor.

- For each of these two profiles, the program then searches through the nodes in the index file to determine which two rows (latitudes or northings) straddle the receptor.

- The program then reads the elevations for these four points. A two-dimensional distance-weighted interpolation is then used to determine the elevation at the receptor location based on the elevations at the four nodes determined above.

The AERMAP files are provided on the compact disc in Appendix D.

### 4.3 Meteorological Data

The AERMOD-ready, five-year meteorological data set obtained from Ohio EPA was used for meteorological inputs. This data set includes hourly surface data from the National Weather Service (NWS) site at Toledo Express Airport and upper air observations from Detroit, Michigan for calendar years 2006 through 2010.

Land use for the area surrounding the Toledo Airport anemometer site was used to estimate surface characteristics (surface roughness, albedo and Bowen ratio). The AERSURFACE processor was used to determine seasonal surface characteristics as a function of wind direction.

### 4.4 Emissions Data and Stack Parameters

The modeling analyses include the following Project sources:

- Two combined cycle combustion turbines with HRSG duct burners (combusting only natural gas);
- An auxiliary boiler (combusting only natural gas); and
- A 16-cell mechanical draft wet cooling system.

The emission rates and stack exit parameters used in the modeling analyses are provided in the following tables: combined cycle units (Table 4-1), turbine start-up events (Table 4-2), and ancillary equipment (Table 4-3). Detailed emission calculations are provided in Appendix A of this report.

#### 4.4.1 Combined Cycle Turbines

Impacts were evaluated for a representative range of steady-state turbine operating scenarios provided by the turbine supplier. The scenarios selected for modeling cover a wide range of temperature, load and supplemental duct firing conditions. The modeled operating scenarios identified in Table 4-1 were selected as being representative of the full range of proposed operating scenarios to ensure model prediction of maximum Project impacts. The minimum load at which the turbine will achieve the guaranteed emission performance varies with ambient temperature. Duct firing is proposed only at full load, with temperature at or above 59 degrees Fahrenheit (°F). Impacts for $PM_{2.5}$ and for $PM_{10}$ were assessed for the turbines (worst case) and the cooling tower.

The auxiliary boiler will not operate when the turbines are running, aside from starts and periodic testing. Peak 1-hour impacts for CO were predicted to occur during warm starts with the auxiliary boiler operating. One-hour impacts of $NO_2$ during cold starts were not considered pursuant to the March 1, 2011 USEPA guidance memorandum entitled "Additional Clarification Regarding Applicability of Appendix W Modeling Guidance for the 1-hour $NO_2$ NAAQS" (USEPA, 2011) which allows intermittent events (like cold starts) to be excluded from modeling for 1-hour $NO_2$. The worst case 1-hour operating scenario for $NO_2$ impacts was determined to be one turbine during a warm start with the auxiliary boiler operating. Shutdown scenarios were not modeled, since the hot, warm, and cold start scenarios were determined to represent worst case. Emissions of $PM_{10}$, $PM_{2.5}$, and $NO_x$ (annual) are highest during steady state scenarios, and impacts for those pollutants were, therefore, not evaluated for start-up and shutdown scenarios. Emissions during start-up scenarios are provided in Table 4-2.

The auxiliary boiler stack runs alongside and at the same height as the north HRSG stack. As per the USEPA criteria for merging plumes (USEPA, 1996), when the north turbine and the auxiliary boiler were both operating, those two stacks were modeled as a single stack, using the diameter, exit velocity and temperature of the HRSG stack. However, when the south turbine and the auxiliary boiler were running, the south HRSG stack and the auxiliary boiler stack were modeled as separate stacks due to their considerable separation. It was determined that the maximum impacts for 1-hour $NO_2$ and CO resulted from operation of the south turbine with the auxiliary boiler during start-up.

**Table 4-1: Stack Parameters and Emission Rates for Each Combustion Turbine [a]**

| | Units | Selected Design Cases | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Case 1 | Case 3 | Case 4 | Case 7 | Case 8 | Case 11 | Case 12 | Case 14 | Case 17 | Case 18 | Case 20 | Case 23 | Case 24 | Case 26 | Case 28 |
| Fuel Type | -- | Nat. gas[b] | Nat. gas | Nat. gas | Nat. gas | Nat. gas | Nat. gas | Nat. gas | Nat. gas | Nat. gas | Nat. gas | Nat. gas | Nat. gas | Nat. gas | Nat. gas | Nat. gas |
| Ambient Temperature | °F | -8 | -8 | 0 | 0 | 30 | 30 | 59 | 59 | 59 | 90 | 90 | 90 | 105 | 105 | 105 |
| Percent Load Rate | % | 100 | 60 | 100 | 60 | 100 | 60 | 100 | 100 | 60 | 100 | 100 | 60 | 100 | 100 | 60 |
| Duct Burner Operation | -- | Off | off | off | off | off | off | on | off | off | on | off | off | on | off | off |
| Stack Diameter | feet | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 |
| Stack Height | feet | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 | 240 |
| Stack Temperature | °K [b] | 359.3 | 347.6 | 359.8 | 347.6 | 358.2 | 347.0 | 353.2 | 357.6 | 347.6 | 353.2 | 358.2 | 349.3 | 353.2 | 357.0 | 350.4 |
| Stack Exit Velocity | m/s [b] | 19.67 | 13.01 | 19.82 | 13.04 | 18.89 | 12.75 | 17.61 | 17.77 | 12.34 | 16.65 | 16.81 | 11.82 | 16.25 | 15.43 | 11.46 |
| $NO_x$ Emission Rate | g/s | 2.77 | 1.89 | 2.77 | 1.89 | 2.65 | 1.77 | 2.65 | 2.52 | 1.64 | 2.52 | 2.27 | 1.51 | 2.52 | 2.02 | 1.39 |
| CO Emission Rate | g/s | 1.64 | 1.14 | 1.64 | 1.14 | 1.64 | 1.14 | 1.64 | 1.51 | 1.01 | 1.51 | 1.39 | 0.88 | 1.51 | 1.26 | 0.88 |
| $PM_{10}/PM_{2.5}$ Emission Rate | g/s | 1.66 | 1.14 | 1.68 | 1.15 | 1.60 | 1.11 | 1.77 | 1.49 | 1.06 | 1.72 | 1.39 | 1.01 | 1.69 | 1.27 | 1.01 |

a. Emission rates are provided in grams per second (g/s) because these are appropriate units for dispersion modeling inputs
b. Nat. gas = natural gas; °K = degrees Kelvin; m/s = meters per second

**Table 4-2: Modeling Inputs for CTG Startup Events**

| Pollutant | Units | Cold Startup [a,b] | Warm Startup [a,c] | Hot Startup [a,c] |
|---|---|---|---|---|
| Duration | minutes | 180 | 98 | 82 |
| Stack Diameter | feet | 22 | 22 | 22 |
| Stack Height | feet | 240 | 240 | 240 |
| Exit Temperature | $^{o}K$ | 349.1 | 351.9 | 351.3 |
| Exit Velocity | m/s | 13.64 | 15.63 | 15.40 |
| $NO_x$ | g/s | 7.90 | 9.96 | 9.69 |
| CO | g/s | 22.95 | 27.10 | 26.67 |

**a.** These events were modeled for start-up of a single turbine. The exit temperature, exit velocity and grams per second (g/s) emission rates reflect the turbine start-up event only. In the modeled start-up events, emissions from the auxiliary boiler were also included.
**b.** Cold start scenario produced the worst case impacts for CO.
**c.** Hot start scenario produced the worst case for impacts for 1-hr average $NO_2$.
**d.** Supporting calculations are included in Appendix A.

### 4.4.2 Ancillary Equipment

For the cooling tower, mass emission rates for $PM_{10}$ and $PM_{2.5}$ are presented in the PSD Permit Application (Volume 2) and were determined based on the following parameters:

- a high efficiency drift rate of 0.0005 percent;
- a maximum dissolved solids content in the recirculating water of 2,030.5 milligrams per liter;
- a water recirculation rate of 322,000 gallons per minute; and
- a particle size distribution as developed by the Electric Power Research Institute (EPRI) and presented in an Air and Waste Management Association (AWMA) publication (AWMA, 2001).

Per the direction of Ohio EPA, the emergency generator and emergency fire pump were not modeled because they operate less than 500 hours per year and are considered intermittent emissions for modeling purposes. Emissions for the ancillary equipment are provided in Table 4-3.

**Table 4-3: Stack Parameters and Emission Rates for Ancillary Equipment**

| | Units | Auxiliary Boiler [a] | Cooling Tower [b] |
|---|---|---|---|
| Fuel Type | -- | Natural Gas | -- |
| Stack Diameter | feet | 4 | 33 |
| Stack Height | feet | 240 | 66 |
| Stack Temperature | $^oK$ | 366.48 | Ambient + 10 $^oK$ |
| Stack Exit Velocity | m/s | 0.17 | 8.45 |
| $NO_x$ | g/s | 0.25 | -- |
| CO | g/s | 0.69 | -- |
| $PM_{10}$ | g/s | 0.10 | 0.0082 |
| $PM_{2.5}$ | g/s | 0.10 | 0.000032 |

**a.** The auxiliary boiler will exhaust through a separate stack adjacent to the north HRSG stack. For modeling, the south HRSG stack and the auxiliary boiler stack were modeled as separate stacks while the north turbine stack and the auxiliary boiler stack are modeled as combined stacks. The emission rates and stack temperature in this table are representative of the auxiliary boiler operating alone.
**b.** The cooling tower emission rates are on a per cell basis. There will be 16 cells in the cooling tower.

## 4.5 Good Engineering Practice Stack Height Analysis

A Good Engineering Practice (GEP) stack height analysis was conducted to determine the allowable stack height credit for modeling and to provide model input information to characterize building wake effects. If a stack is sufficiently close to a large building or other structure, the plume can be entrained in the building's wake. The resulting "downwash" reduces the effective release height and leads to increased ground-level ambient concentrations. Building downwash effects must be evaluated for an AERMOD dispersion model application.

Formula GEP stack height is defined as:

$H_{GEP} = H_B + 1.5L_B$ where:

- $H_{GEP}$ = formula GEP stack height;
- $H_B$ = the building's height above stack base; and
- $L_B$ = the lesser of the building's height or maximum projected width.

A second definition of GEP stack height is "regulatory" GEP stack height. Regulatory GEP stack height is either 65 m or formula GEP stack height, whichever is greater. Sources are not allowed to take credit for stack height above regulatory GEP stack height when modeling to demonstrate compliance with ambient air quality standards.

The USEPA Building Profile Input Program (BPIP) (USEPA, 1995) produces the model input information necessary to account for building wake effects, based on the dimensions of buildings in the vicinity of the stacks. The "PRIME" version of BPIP (BPIPPRM) (Schulman, et al., 1997) is used with AERMOD. The position and height of buildings relative to the stack positions must be evaluated in the GEP analysis. Figure 2-1 presents a site layout of the facility.

Building and stack locations and elevations determined from design drawings were entered into BPIPPRM (version 04274). Table 4-4 summarizes the building and stack inputs for the BPIP analysis. The controlling structures influencing the two turbine stacks are the HRSG structures; the GEP height determined based on the BPIP analysis was 242.5 feet for each turbine stack. The cooling tower cells were also evaluated with BPIPPRIME. The controlling structures influencing these 66-foot stacks (for most wind directions) are the cooling tower building and the north HRSG structure. The stacks and cooling towers are lower than GEP height; therefore, emissions will be subject to predicted building-wake downwash. AERMOD incorporates the effects of downwash for stacks above and below GEP height.

### 4.6 Background Air Quality

The Ohio EPA collects air quality data (ambient air pollutant concentrations) at a number of monitoring locations throughout the state, including Lucas County and the surrounding area. Data collected from air quality monitoring sites are used, in part, to verify attainment of the NAAQS. As defined by the Ohio EPA, background air quality includes pollutant concentrations due to natural sources, nearby sources other than the one(s) under consideration, and unidentified sources. Therefore, background air quality is defined as the ambient air pollutant concentration that exists outside the immediate vicinity of the Project.

For the Project area, the most recent background concentrations for $PM_{2.5}$ and $PM_{10}$ were obtained from the Ohio EPA Annual Air Quality Report for 2011. The background concentrations for $NO_2$ and CO were obtained by contacting Ohio EPA. Table 4-5 identifies the air quality monitors used, and Table 4-6 compares the monitoring data to the ambient air quality standards for the PSD pollutants modeled. Figure 4-1 shows the locations of the monitoring stations.

**Table 4-4: Major Building Structures for the Oregon Clean Energy Center**

| Building | Height (feet) | Length (feet) | Width (feet) | Base Elevation (feet msl) | Influence Distance (feet) | Distance to Stack | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | HRSGN[a] Stack (feet) | HRSGS[b] Stack (feet) | Cooling Tower (feet) |
| | | | | | | | | |
| Turbine building | 70 | 195 | 135 | 590 | 605.5 | 252 | 316.2 | 453 to 812.8 |
| HRSGN[a] | 97 | 122 | 46 | 590 | 530 | 17 | 119 | 223.2 to 582 |
| HRSGS[b] | 97 | 122 | 46 | 590 | 688.9 | 17 | 119 | 233.7 to 594.3 |
| Cooling tower | 60 | 400.3 | 107.5 | 590 | 506 | 178 | 190 | 0 |

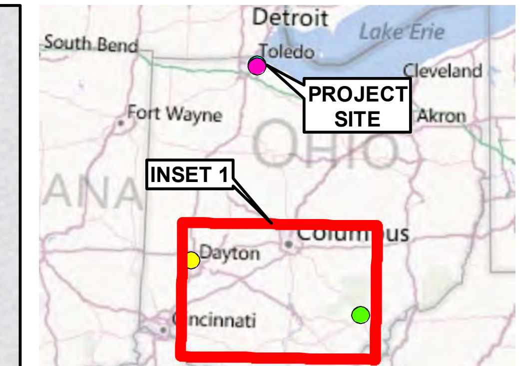
a. HRSGN = Northern HRSG
b. NRSGS = Southern HRSG

**Table 4-5: Background Air Quality Monitoring Stations**

| Pollutant | Station Location | Station ID |
|---|---|---|
| $PM_{10}$ | Lee and Front, Toledo, Lucas County | 39-095-1003 |
| $PM_{2.5}$ | 600 Collins Park, Toledo, Lucas County | 39-095-0028 |
| $NO_2$ | 7760 Blackburn Road, Athens, Athens County | 39-009-0004 |
| CO | 901 W. Fairview, Dayton, Montgomery County | 39-113-0028 |

**Table 4-6: Background Air Quality Data**

| Pollutant | Averaging Period | Background Concentration ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|
| $PM_{10}$ | 24-hour | 86 | 150 |
| $PM_{2.5}$ | 24-hour | 29 | 35 |
| | Annual | 11.42 | 12 |
| $NO_2$ | Annual | 5.9 | 99.7 |
| | 1-hour | 37.79 | 188 |
| CO | 1-hour | 1,484 | 40,000 |
| | 8-hour | 1,142 | 10,000 |


FULL GEOGRAPHIC EXTENT OF AIR MONITORING FEATURES

**Legend**

Project Site

Air Quality Monitoring Stations (Elevation - ft)

- CO (957)
- NO2 (902)
- PM10 (590)
- PM2.5 (595)

(Provided by Ohio EPA, Central Office)

Topographic Base Image Source: ArcGIS Online Services, Access date: 12/26/2012, via ArcGIS v. 10. This image is not for re-sale or distribution outside of the use of this PDF.

0 1 2
Miles

1 inch equals 1 miles

ARCADIS

**OREGON CLEAN ENERGY CENTER**

***FIGURE 4-1***

**BACKGROUND AIR QUALITY MONITORING STATION LOCATIONS**

**Lucas County, Ohio**

City: Chicago Author: MNesta Path: C:\PROJECTS\OCE\MXD\OPSB_20130104\04-1_OCE_AirMonitoring2.mxd

# 5. MODELING RESULTS

The following sections describe the results of air quality modeling for the Project to demonstrate compliance with regulatory requirements.

## 5.1 Modeling to Determine Maximum-Impact Operating Conditions

Modeling of the combined cycle units was conducted for several steady-state operating conditions, spanning the range of anticipated turbine loads and ambient temperatures. Duct firing is reflected only at full load, with ambient temperature at or above 59°F. The operating scenarios that were modeled to determine worst-case impacts are presented in Table 4-1. Cold and warm-start scenarios, with the auxiliary boiler, were also modeled to assess potential peak short-term impacts.

## 5.2 Comparison of Predicted Impacts with Significant Impact Levels

Each scenario was modeled for the five-year meteorological period. The scenarios that yielded the highest predicted impacts for each pollutant and averaging time were identified. The maximum predicted impacts from these scenarios were evaluated relative to SILs (shown in Table 3-1), to determine whether cumulative interactive modeling was warranted for any pollutant. The maximum predicted impacts for the Project for each pollutant and averaging time are provided in Table 5-1. Table 5-1 also presents the turbine operating scenario and year of meteorological data that resulted in the worst-case predicted impact. Detailed modeling results for all operating scenarios and applicable pollutants are presented in Appendix B. Plot files depicting the annual and short-term impacts from the Project for the maximum-impact scenarios are provided in Appendix C. AERMOD input and output files are provided on a compact disc included in Appendix D.

The results indicate that the maximum predicted Project impacts are below the SILs for all averaging times for all applicable PSD pollutants (CO, $NO_2$, $PM_{10}$ and $PM_{2.5}$). As described previously, a demonstration that maximum impacts are less than SILs for a given pollutant indicates that the Project will not contribute significantly to any violation of the corresponding NAAQS or PSD increment. If a major source or major modification is predicted to have maximum impacts that are below the SILs, then a cumulative impact modeling analysis is generally not required.

**Table 5-1: Maximum Predicted Impacts**

| | Averaging time | Predicted impact (μg/m³) | Controlling Scenario | Year | SIL (μg/m³) | SMC (μg/m³) | PSD Increments |
|---|---|---|---|---|---|---|---|
| $NO_2$ | Annual | 0.068 | Case 24: 100%, 105°F, DB[a] on | 2010 | 1.0 | 14 | 25 |
| | 1-hour | 6.96 | Warm Start + Aux. Boiler[b] | 5-year average | 7.52 | Not yet proposed | -- |
| CO | 1-hour | 31.79 | Warm Start + Aux. Boiler | 2010 | 2,000 | -- | -- |
| | 8-hour | 14.84 | Hot Start + Aux. Boiler | 2008 | 500 | 575 | -- |
| $PM_{2.5}$ | 24-hour | 0.61 | Case 24 + Cooling Tower: 100%, 105°F, DB on | 5-year average | 1.2 | 4 | 9 |
| | Annual | 0.04 | Case 24 + Cooling Tower: 100%, 105°F, DB on | 5-year average | 0.3 | -- | 4 |
| $PM_{10}$ | 24-hour | 3.35 | Case 24 + Cooling Tower: 100%, 105°F, DB on | 2006 | 5 | 10 | 30 |

a. DB = Duct Burner
b. Aux. Boiler = Auxiliary Boiler

## 5.3 Comparison of Predicted Impacts with NAAQS

Maximum predicted impacts were added to monitored background concentrations, as presented in Section 4.6. These results are summarized in Table 5-2 and show that the sum of modeled maximum impacts and existing ambient background levels are less than the NAAQS.

**Table 5-2: Maximum Predicted Impacts Added to Monitored Background Concentrations**

| | Averaging Time | Predicted Impact ($\mu g/m^3$) | Background Concentration ($\mu g/m^3$) | Predicted Impact plus Background ($ug/m^3$) | NAAQS |
|---|---|---|---|---|---|
| $NO_2$ | Annual | 0.068 | 5.9 | 5.97 | 99.7 |
| | 1-hour | 6.96 | 37.79 | 44.8 | 188 |
| CO | 1-hour | 31.79 | 1,484 | 1,515.8 | 40,000 |
| | 8-hour | 14.84 | 1,142 | 1,156.8 | 10,000 |
| $PM_{2.5}$ | 24-hour | 0.61 | 29 | 29.6 | 35 |
| | Annual | 0.04 | 11.42 | 11.46 | 12 |
| $PM_{10}$ | 24-hour | 3.35 | 86 | 89.4 | 150 |

### 5.4 Comparison with Significant Monitoring Concentrations

If a new major source or major modification can demonstrate that impacts from a project are less than the SMC (presented in Table 5-1), then the source can be exempted from preconstruction monitoring requirements that might otherwise apply under the PSD program. Modeling to determine Project impacts for comparison to SMCs was conducted as described above.

As indicated in Table 5-1, maximum predicted Project impacts are less than the SMC for $NO_2$, CO, $PM_{10}$ and $PM_{2.5}$ for all relevant averaging times. Consistent with these modeling results, the Project is requesting from Ohio EPA a waiver from preconstruction monitoring requirements.

# 6. ADDITIONAL IMPACTS ANALYSES

## 6.1 PSD Class I Area Impact Analysis

PSD regulations require that proposed major sources within 100 km of a PSD Class I area perform an assessment of potential impacts in the Class I area. PSD Class I areas are specifically designated areas of special national or regional value from a natural, scenic, recreational or historic perspective. These areas are administered by the NPS, USFWS, or the USFS. FLMs are responsible for evaluating proposed projects' air quality impacts in Class I areas and may make recommendations to permitting agencies to approve or deny permit applications.

PSD Class I area impact analyses can consist of:

- An air quality impact analysis;
- A visibility impairment analysis; and
- An analysis of impacts on other air quality related values (AQRVs) such as impacts to flora and fauna, water, and cultural resources.

There are no PSD Class I areas within 100 km of the Project site. The nearest PSD Class I Areas are the Otter Creek and Dolly Sods Wilderness Areas in West Virginia, and the Mammoth Cave National Park in Kentucky both of which are over 400 km from the Project site. Ohio EPA recommends that a screening formula be used to determine if a Class I Area is close enough to warrant analysis. The screening formula, which is found in *The Federal Land Managers AQRV Workgroup (FLAG) Phase I Report – Revised* (FLAG, 2010) indicates that a PSD Class I area analysis is not required if:

$$Q/d \leq 10,$$

where:

- $Q$ is the combined emissions increase from a source of $SO_2$, $NO_x$, $PM_{10}$, and $H_2SO_4$ in tpy based on 24-hour maximum allowable emissions (which are annualized); and

- $d$ is the nearest distance in km to a Class I area from the source.

Table 6-1 presents results of calculations using the screening methodology presented above. The calculations show that "Q/d" is well below 10 for the nearest Class I areas to the proposed source. Accordingly, based on the level of proposed emissions from the Project, the distances to the nearest PSD Class I areas, and the screening calculations, further PSD Class I impact analysis is not required for the Project.

**Table 6-1: "Q/d" Screening Analysis for PSD Class I Areas**

| Class I Area | d, Distance to Class I Area (km) | Criteria Pollutant Emissions (tpy) | | | | Q, Total Emissions (tpy) | Q/d (tpy/km) |
|---|---|---|---|---|---|---|---|
| | | $SO_2$ | $NO_x$ | $PM_{10}$ | $H_2SO_4$ | | |
| Otter Creek | 439 | 36.87 | 193.32 | 128.26 | 13.15 | 371.60 | 0.85 |
| Dolly Sods | 457 | 36.87 | 193.32 | 128.26 | 13.15 | 371.60 | 0.81 |
| Mammoth Cave | 548 | 36.87 | 193.32 | 128.26 | 13.15 | 371.60 | 0.68 |

## 6.2 Growth Analysis

OCE anticipates that 25 new employees will be hired to operate the proposed facility, working in shifts, which will increase long-term jobs within the community. There will be additional short-term local employment during the construction phase of the proposed Project. Short-term employment is expected to reach a peak of 400 workers over a two and half year construction effort.

### 6.2.1 Work Force

During the anticipated construction period associated with the Project, the majority of construction jobs will be filled by local area workers. Due to the large available labor pool in the region, supplemental short-term labor is not likely to require a significant influx of temporary workers relocating to the Oregon area during the construction phase. OCE anticipates that the additional temporary workers during the construction phase will have minimal effect on the environment, but will have a positive effect on the local economy.

For daily operation and maintenance of the Project, OCE anticipates that the required full-time staff will be mostly comprised of nearby residents, and the Project will not result in a significant increase in residential housing demand.

The resulting increase in employment is not anticipated to impact significantly the air quality of the area because the increase represents a small fraction of the regional population and is expected to be met largely from the existing labor pool. Thus, construction and operation of the proposed Project will have a positive impact on the work force in Oregon and the surrounding areas, but its net impact on the environment and to residential resource consumption is anticipated to be insignificant.

#### 6.2.2 Industry

The Project will add a new industry to the area that will provide for economic benefit through primary and secondary effects. However, because much of the growth from the Project will be filled by existing local labor and resources, no new influx of commercial or industrial development that would increase air emissions is anticipated. In addition, the Project is intended to support existing energy needs throughout the regional electricity grid area. OCE does not anticipate any significant corresponding commercial or industrial growth as a result of the additional energy contribution of the Project. Because the commercial and industrial growth resulting from the Project is anticipated to be minimal, air quality impacts resulting from such commercial and industrial growth are also expected to be minimal.

## 6.3 Soils and Vegetation Analysis

PSD review requirements include an analysis to determine the potential air quality impacts on sensitive vegetation or soil types that may be present in the vicinity of a proposed project. Ambient air quality screening levels for sensitive vegetation are provided in USEPA guidance (USEPA, 1980) and in related technical publications.

Maximum predicted Project impacts are compared to relevant screening levels in Tables 6-2, 6-3, 6-4, and 6-5. All predicted Project impacts are well below the vegetation impact threshold levels. The screening analysis and USEPA guidance support the conclusion that the proposed Project will not adversely impact vegetation or soils in the Project surroundings.

**Table 6-2: Predicted Air Quality Impacts Compared to $NO_2$ Vegetation Impact Thresholds**

| Averaging Period | Predicted Project Impact ($\mu g/m^3$) | Threshold for Impact to Vegetation ($\mu g/m^3$) | Applicability |
|---|---|---|---|
| 1-hour | 6.96 (1-hour average) | 66,000[a] | Leaf Injury to plant |
| 2-hour | | 1,130[b] | Affects alfalfa |
| Annual | 0.068 | 100[c] | Protects all vegetation |
| | | 190[d] | Metabolic and growth impact to plants |

a. "Diagnosing Injury Caused by Air Pollution", EPA-68-02-1344,prepared by Applied Science Associates, Inc. under contract to the Air Pollution Training Institute, Research Triangle Park, North Carolina. 1976.

b. "Synergistic Inhibition of Apparent Photosynthesis Rate of Alfalfa by Combinations of $SO_2$ and $NO_2$" Environmental Science and Technology, vol. 8(6): p.574-576, 1975. The limit is based on a concentration in ambient air of 0.6 parts per million (ppm) $NO_2$ (1,130 $\mu g/m^3$) which was found to depress the photosynthesis rate of alfalfa during a 2-hour exposure.

c. Secondary NAAQS ($\mu g/m^3$) which is a limit set to avoid damage to vegetation resulting in economic losses in commercial crops, aesthetic damage to cultivated trees, shrubs, and other ornamentals, and reductions in productivity, species richness, and diversity in natural ecosystems to protect public welfare (Section 109 of the Clean Air Act [CAA]). These thresholds are the most stringent of those found in the literature survey.

d. "Air Quality Criteria for Oxides of Nitrogen," EPA/600/8-91/049aF-cF.3v, Office of Health and Environment Assessment, Environmental Criteria and Assessment Office, USEPA, Research Triangle Park, NC. 1993.

**Table 6-3: Predicted Air Quality Impacts Compared to CO Vegetation Impact Thresholds**

| Averaging Period | Predicted Impact (µg/m$^3$) | Threshold for Impact to Vegetation (µg/m$^3$) | Applicability |
|---|---|---|---|
| 1-hour | 31.79 | 40,000[a] | Protects all vegetation |
| 8-hour | 14.84 (8-hour average) | 10,000[a] | Protects all vegetation |
| Multiple day | | 10,000[b] | No known effects to vegetation |
| 1-week | | 115,000[c] | Effects to some vegetation |
| Multiple week | | 115,000[d] | No effect on various plant species |

a. Secondary NAAQS (µg/m$^3$) which are limits set to avoid damage to vegetation resulting in economic losses in commercial crops, aesthetic damage to cultivated trees, shrubs, and other ornamentals, and reductions in productivity, species richness, and diversity in natural ecosystems to protect public welfare (Section 109 of the CAA). These thresholds are the most stringent of those found in the literature survey.

b. "Air Quality Criteria for Carbon Monoxide," EPA/600/8-90/045F (NTIS PB93-167492), Office of Health and Environment Assessment, Environmental Criteria and Assessment Office, USEPA, Research Triangle Park, NC. 1991. Various CO concentrations were examined; the lowest of these was 10,000 µg/m$^3$. Concentrations this low had no effects to various plant species. For many plant species, concentrations as high as 230,000 µg/m$^3$ caused no effects. The exception was legume seedlings which were found to experience abnormal leaf growth when exposed to CO concentrations of only 27,000 µg/m$^3$. Also related to this family of plants, CO concentrations in the soil of 113,000 µg/m$^3$ were found to inhibit nitrogen fixation. It is clear that ambient CO concentrations as low as 10,000 µg/m$^3$ will not affect vegetation.

c. "Diagnosing Injury Caused by Air Pollution," EPA-68-02-1344, prepared by Applied Science Associates, Inc. under contract to the Air Pollution Training Institute, Research Triangle Park, North Carolina. 1976. A CO concentration of 115,000 µg/m$^3$ was found to affect certain plant species.

d. "Polymorphic Regions in Plant Genomes Detected by an M13 Probe," Zimmerman, P.A., et al. 1989. Genome 32: 824-828. 115,000 µg/m$^3$ was the lowest CO concentration included in this study. This concentration was not found to cause a reduction in growth rate to a variety of plant species.

**Table 6-4: Predicted Air Quality Impacts Compared to Particulate Vegetation Impact Thresholds**

| Averaging Period | Predicted Impact (µg/m$^3$) | Threshold for Impact to Vegetation (µg/m$^3$) | Applicability |
|---|---|---|---|
| 24-hour $PM_{10}$ | 3.35 (24-hour average) | 150[a] | Protects all vegetation |
| Annual $PM_{10}$ | | 50[a] | Protects all vegetation |
| Annual $PM_{10}$ | | 579[b] | Damage to sensitive species (fir tree) |

a. Secondary NAAQS (µg/m$^3$) which are limits set to avoid damage to vegetation resulting in economic losses in commercial crops, aesthetic damage to cultivated trees, shrubs, and other ornamentals, and reductions in productivity, species richness, and diversity in natural ecosystems to protect public welfare (Section 109 of the CAA). These thresholds are the most stringent of those found in the literature survey.

b. "Responses of Plants to Air Pollution," Lerman, S.L., and E.F. Darley. 1975. "Particulates," pp. 141-158 (Chap. 7). In J.B. Mudd and T.T. Kozlowski (eds.). Academic Press. New York, NY. Results of studies conducted indicated concluded that particulate deposition rates of 365 grams per square meter per year (g/m$^2$/yr) caused damage to fir trees, but rates of 274 g/m$^2$/yr and 400 to 600 g/m$^2$/yr did not cause damage to vegetation. 365 g/m$^2$/yr translates to 579 µg/m$^3$, using a worst-case deposition velocity of 2 centimeters per second.

**Table 6-5: Predicted Air Quality Impacts Compared to Formaldehyde Vegetation Impact Thresholds**

| Averaging Period | Predicted Impact ($\mu g/m^3$) | Threshold for Impact to Vegetation ($\mu g/m^3$) | Applicability |
|---|---|---|---|
| Repeated 4.5 hour | 0.078 (1-hour average) | 18[a] | Sensitive species affected |
| 5-hour | | 840[b] | Signs of injury to sensitive species (alfalfa) |
| 5-hour | | 367[c] | Signs of injury to pollen tube length (lily) |
| Repeated 7-hour | | 78[d] | Stimulated shoot growth (beans) |

a. "Formaldehyde-Contaminated Fog Effects on Plant Growth," Barker J.R. & Shimabuku R.A. (1992). In Proceedings of the 85th Annual Meeting and Exhibition, Air and Waste Management Association, pp. 113. 92150.01. Pittsburgh, PA. The authors examined the effects on vegetation grown in fog with formaldehyde concentrations of 18 and 54 $\mu g/m^3$. Exposure rates were 4.5 hours per night, 3 nights/week, for 40 days. The growth rate of rapeseed was found to be affected in this study. However, slash pine grown under the same conditions showed a significant increase in needle and stem growth. No effects were observed in wheat or aspen at test concentrations.

b. "Investigation on Injury to Plants from Air Pollution in the Los Angeles Area." Haagen-Smit AJ, Darley EE, Zaitlin M, Hull H, Noble WM (1952). Plant physiology, 27:18–34. The authors found a 5-hour exposure to 700 parts per billion (ppb) caused mild atypical signs of injury in alfalfa, but no injury to spinach, beets, or oats.

c. "Effects of Exposure to Various Injurious Gases on Germination of Lily Pollen." Masaru N, Syozo F, Saburo K (1976). Environmental pollution, 11:181–188. The authors found a significant reduction of the pollen tube length of lily following a 5-hour exposure to ambient formaldehyde concentrations of 367 ppb.

d. "Formaldehyde exposure affects growth and metabolism of common bean," Mutters RG, Madore M, Bytnerowicz A (1993). Journal of the Air and Waste Management Association, 43:113–116. The authors found that repeated exposure of sensitive plants to ambient formaldehyde concentrations of 78 $\mu g/m^3$ could cause plant shoots to grow faster than the roots. It is pointed out that this effect would not be a problem except for crops growing in a water-starved condition.

### 6.4 Endangered Species

The USFWS and the Ohio Department of Natural Resources (ODNR) were contacted regarding the potential presence of any sensitive natural communities or rare or endangered species in the vicinity of the site. The response letter from ODNR indicated that no records exist in its database of unique ecological attributes or rare or endangered species within 1 mile of the site.

Federally listed endangered and threatened species in Lucas County, Ohio include the Indiana bat (*Myotis sodalis*), Karner blue butterfly (*Lycaeides melissa samuelis*), Kirtland's warbler (*Dendroica kirtlandii*), piping plover (*Charadrius melodus*), rayed bean (*Villosa fabalis*), and the Eastern prairie fringed orchid (*Platanthera leucophaea*). No favorable habitat for these species was observed within the site.

The USFWS correspondence indicated there were no federal wilderness areas, wildlife refuges, or designated critical habitat within the vicinity of the Project area. Additionally, the USFWS indicated that it did not anticipate any impacts to federally listed endangered, threatened or candidates species or their habitats and had no objection to the Project as proposed. Correspondence related to endangered species is presented in Appendix E.

### 6.5 Air Toxics

Ohio EPA's Air Toxics Policy (Ohio EPA, 1986) provides guidelines for evaluating the ambient impacts of TAPs emitted from new or modified sources. The guidelines, outlined in the Department of Air Pollution Control (DAPC) document "*Option A, Review of New Sources of Air Toxic Emissions,*" are:

- Determine if a threshold limit value (TLV) exists for the specific compound, which is emitted from the source.
- Divide the TLV by ten to adjust the standard from the working population to the general public (TLV/10).
- Adjust the standard to account for the duration of the exposure (operating hours of source) of "X" hours per day and "Y" days per week from 8 hours per day and 5 days per week. The following formula is used to obtain the Maximum Acceptable Ground-Level Concentration (MAGLC) or Acceptable Incremental Impact:

$$\frac{TLV}{10} \text{ x } \frac{8}{X} \text{ x } \frac{5}{\mathrm{Y}} = 4\frac{TLV}{XY} = MAGLC$$

For continuous operation, X = 24 hours and Y = 7 days/week. Therefore,

$$\frac{TLV}{10} \text{ x } \frac{8}{24} \text{ x } \frac{5}{7} = \frac{TLV}{42} = MAGLC$$

- Compare the one-hour averaging time ambient pollutant emissions, predicted by an appropriate air dispersion model, with the corresponding MAGLC for compliance with the air toxic's policy.

The American Conference of Governmental Industrial Hygienists (ACGIH) publishes and continuously updates TLVs for a broad range of pollutants. The guidelines in Ohio EPA's Air Toxics Policy were used to evaluate the potential ambient impacts of regulated pollutants from the Project.

Air toxics were modeled only for steady-state turbine operating scenarios. The air toxic emissions were multiplied by modeled normalized concentrations (assuming 1 g/s emission rates). The modeling results and supporting calculations are provided in Appendix B. The auxiliary boiler is operated only during turbine start-up and, therefore, was not included in the modeling. Table 6-6 provides the calculations for determining the MAGLC. The air toxic modeling results are presented in Table 6-7. The resultant ambient impacts of air toxics are well below the MAGLC for each pollutant.

**Table 6-6: MAGLC Calculations for Air Toxics**

| Pollutant | Molecular Weight | ACGIH TLV | | | MAGLC (TLV/42) (µg/m$^3$) |
|---|---|---|---|---|---|
| | | ppm | Milligram per Cubic Meter (mg/m$^3$) | µg/m$^3$) | |
| $H_2SO_4$ | 98.079 | -- | 0.2 | 200 | 4.76 |
| Ammonia | 17.031 | 25 | 17 | 17,000 | 404.8 |
| Formaldehyde | 30.03 | -- | 0.27 | 272.7 | 6.5 |
| Toluene | 92.14 | 20 | 75 | 75,000 | 1,786 |
| Xylenes | 106.16 | 100 | 434 | 434,000 | 10,333 |

**Table 6-7: Air Toxics Modeling Results**

| Pollutant | Averaging Time | Maximum Predicted Impact ($\mu g/m^3$) | Controlling Scenario | MAGLC ($\mu g/m^3$) |
|---|---|---|---|---|
| $H_2SO_4$ | 1-hr | 1.338 | Case 1: 100%, -8°F, no DB | 4.76 |
| Ammonia | 1-hr | 40.326 | Case 18: 100%, 90°F, DB on | 404.8 |
| Formaldehyde | 1-hr | 0.078 | Case 12: 100%, 59°F, DB on | 6.5 |
| Toluene | 1-hr | 0.092 | Case 1: 100%, -8°F, no DB | 1,786 |
| Xylenes | 1-hr | 0.045 | Case 1: 100%, -8°F, no DB | 10,333 |

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# Appendix A: Emissions Calculations and Other Supporting Documentation

# Summary of Annual Emissions
# Oregon Clean Energy

**1/31/2013**

**Max Annual Emissions - facility wide (including startup and shutdown)**

| ***number of CTs*** | ***2*** | **NOx** | **CO** | **VOC** | **SO2** | **PM10** | **PM2.5** | **NH3** | **H2SO4** | **Pb** | **CO2** | **CO2e** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| combustion turbines | tpy | 183.96 | 144.32 | 57.13 | 36.79 | 122.64 | 122.64 | 166.44 | 13.14 | 0.00 | 2867849.74 | 2871693.83 |
| ancillary equipment | tpy | 9.36 | 10.21 | 1.64 | 0.08 | 1.06 | 1.06 | 0.00 | 0.01 | 0.00008 | 12837.66 | 12913.33 |
| cooling tower | tpy | 0.00 | 0.00 | 0.00 | 0.00 | 4.56 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **TOTAL** | **TPY** | **193.32** | **154.53** | **58.77** | **36.87** | **128.26** | **123.72** | **166.44** | **13.15** | **0.00008** | **2,880,687.40** | **2,884,607.16** |

# Summary of Annual Emissions
# Oregon Clean Energy

1/31/2013

## Overall Assumptions

| | | |
|---|---|---|
| number of CTs | 2 | |
| duct burning hours | 8760 | hrs/yr |
| steady state hours per unit | 8760 | |

## Steady State Emissions Data

*Emissions from Siemens issued on 12/21/12*
*Emissions without DuctBurning Case 14 (100% load, 59 F)*
*Emissions with DuctBurning Case 12 (100% load, 90 F)*
*NOx emissions assume SCR*
*CO and VOC assume oxidation catalyst*
*SO2 emissions assume no conversion to SO3 and 0.5 grains/100 SCF*
*H2SO4 emissions provided by vendor and assume 0.5 grains/100 SCF*

***Each Turbine***

| | | NOx | CO | VOC | SO2 | PM10/PM2.5 | NH3 | H2SO4 | CO2 | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|
| Emissions - (Case 14) - No DB | lb/hr | 20 | 12 | 3.4 | 3.90 | 11.8 | 18 | 1.4 | 301814 | 302110 |
| Emissions - (Case 12) - w/DB | lb/hr | 21 | 13 | 5.2 | 4.20 | 14.0 | 19 | 1.5 | 327380 | 327819 |
| Emissions from DB | lb/hr | 1 | 1 | 1.8 | 0.3 | 2.2 | 1 | 0.1 | 25566.5 | 25709.3 |
| Facility operating hours | hr/yr | 8760 | 8760 | 8760 | 8760 | 8760 | 8760 | 8760 | 8760 | 8760 |
| operating hours no DB | hrs/yr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| operating hours with DB | hrs/yr | 8760 | 8760 | 8760 | 8760 | 8760 | 8760 | 8760 | 8760 | 8760 |
| steady state emissions per turbine | tpy | 91.98 | 56.94 | 22.776 | 18.396 | 61.32 | 83.22 | 6.57 | 1433925 | 1435847 |

***Both Turbines***

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| number of turbines | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| total plant emissions emissions - steady state | tpy | 183.96 | 113.88 | 45.55 | 36.79 | 122.64 | 166.44 | 13.14 | 2867849.7 | 2871693.8 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Plant gross output (case 14) | MW | | | | | | | | 817.3 | |
| Plant net output (case 14) | MW | | | | | | | | 797.5 | |
| lbs CO2 per MW-hr gross (case 14) | lb/MW hr | | | | | | | | 739 | |
| lbs CO2 per MW-hr gross (case 14) + 12.8% marg | lb/MW hr | | | | | | | | 833.1 | |

## Summary of Annual Emissions
## Oregon Clean Energy

1/31/2013

### Overall Assumptions

*SU/SD information from Siemens Total Startup & Shutdown Emissions and Fuel Use, Exhaust Mass flow and Temperature dated 1/9/2013*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| cold starts/unit | 50 | number/yr | 3.00 | hours/event | 64 | minimum hours downtime with event | 180 | minutes per event |
| hot starts/unit | 0 | number/yr | 1.37 | hours/event | 0 | minimum hours downtime with event | 82 | minutes per event |
| warm starts/unit | 250 | number/yr | 1.63 | hours/event | 16 | minimum hours downtime with event | 98 | minutes per event |

### Emissions

| | | NOx | CO | VOC | SO2 | PM10/PM2.5 |
|---|---|---|---|---|---|---|
| Emissions per cold start | lbs | 188 | 546 | 168 | 3.6 | 56 |
| Emissions per hot start | lbs | 105 | 289 | 114 | 1.9 | 22 |
| Emissions per warm start | lbs | 129 | 351 | 138 | 2.3 | 26 |
| cold start - duration of event (include downtime) | hrs | 67.00 | 67.00 | 67.00 | 67.00 | 67.00 |
| hot start - duration of event (include downtime) | hrs | 1.37 | 1.37 | 1.37 | 1.37 | 1.37 |
| warm start - duration of event (include downtime) | hrs | 17.63 | 17.63 | 17.63 | 17.63 | 17.63 |
| cold start - avg hourly emissions (including downtime) | lb/hr | 2.81 | 8.15 | 2.51 | 0.05 | 0.836 |
| hot start - avg hourly emissions (including downtime) | lb/hr | 76.83 | 211.46 | 83.41 | 1.4 | 16.098 |
| warm start - avg hourly emissions (including downtime) | lb/hr | 7.32 | 19.91 | 7.83 | 0.13 | 1.47 |
| steady state average hourly | | 21.00 | 13.00 | 5.20 | 4.20 | 14.00 |
| cold start - self correcting? | - | yes | yes | yes | yes | yes |
| hot start - self correcting? | - | no | no | no | yes | no |
| warm start - self correcting? | - | yes | no | no | yes | yes |

### Dispersion Modeling Parameters (per turbine)

| | Exhaust Flow | Exhaust Flow | Temp | Temp | Stack Diameter | Exit Velocity | Exit Velocity |
|---|---|---|---|---|---|---|---|
| | lbm/hr | acfm | F | K | ft | ft/min | m/s |
| Cold Start | 3,780,292 | 1,020,973 | 169.00 | 349.1 | 22 | 2686 | 13.64 |
| Hot Start | 4,240,615 | 1,152,579 | 173.00 | 351.3 | 22 | 3032 | 15.40 |
| Warm Start | 4,297,602 | 1,169,913 | 174.00 | 351.9 | 22 | 3078 | 15.63 |

### Dispersion Modeling Emissions (per turbine)

| | | NOx | CO |
|---|---|---|---|
| Cold Start | g/s | 7.90 | 22.95 |
| Hot Start | g/s | 9.69 | 26.67 |
| Warm Start | g/s | 9.96 | 27.10 |

# Emissions From Ancillary Equipment
## Oregon Clean Energy

**Total Emissions form Ancillary Equipment (tpy)**

| | | NOx | CO | VOC | TSP | SO2 | PM10/ PM2.5 | lead (Pb) | H2SO4 | CO2 | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Auxilliary Boiler | tpy | 1.98 | 5.45 | 0.59 | 0.52 | 0.07 | 0.79 | 0.00 | 5.41E-03 | 11880.00 | 11952.2997 |
| Emergency Generator | tpy | 6.95 | 4.34 | 0.98 | 0.22 | 0.008 | 0.25 | 0.00007391 | 1.64E-04 | 871.04 | 874.1 |
| Emergency Fire Pump | tpy | 0.43 | 0.43 | 0.06 | 0.022 | 0.0008 | 0.025 | 0.00000735 | 1.63E-05 | 86.63 | 86.9 |
| TOTAL | tpy | **9.36** | **10.21** | **1.64** | **0.77** | **0.08** | **1.06** | **0.0000813** | **5.59E-03** | **12,837.66** | **12,913.33** |

**Emissions (lb/hr)**

| | | NOx | CO | VOC | TSP | SO2 | PM10/ PM2.5 | lead (Pb) |
|---|---|---|---|---|---|---|---|---|
| Auxilliary Boiler | | 1.980 | 5.445 | 0.594 | 0.792 | 0.071 | 0.79 | 0.00E+00 |
| Emergency Generator | | 27.791 | 17.346 | 3.927 | 0.882 | 0.032 | 0.99 | 2.96E-04 |
| Emergency Fire Pump | | 1.727 | 1.725 | 0.244 | 0.088 | 0.003 | 0.10 | 2.94E-05 |

**Emissions for Modeling (g/s) - annual average**

| | | NOx | CO | VOC | SO2 | PM10/ PM2.5 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auxilliary Boiler | | 0.057 | 0.157 | 0.0171 | 0.002036 | 0.022804 | *diameter:* | 4.0 ft | *exhaust flow:* | 12,634 acfm | *temperature:* | 200 F | *stack height:* | same as HRSG stack |

**Emissions for Modeling (g/s) - hourly average**

| | | NOx | CO | VOC | SO2 | PM10/ PM2.5 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Auxilliary Boiler | | 0.25 | 0.69 | 0.07 | 0.00892 | 0.10 | *diameter:* | 4.0 ft | *exhaust flow:* | 12,634 acfm | *temperature:* | 200 F | *stack height:* | same as HRSG stack |

**Auxilliary Boiler**

| | | NOx | CO | VOC | TSP | SO2 | PM10/ PM2.5 | | H2SO4 | CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maximum Input Capacity | MMBtu/hr | 99 | 99 | 99 | 99 | 99 | 99 | | 99 | 99 | 99 | 99 | |
| Emission Factor | lb/MMscf | | | | | 0.714 | | | | 120000 | | | |
| Emission Factor | lb/MMBtu | 0.020 | 0.055 | 0.006 | 0.008 | 0.0007 | 0.008 | | 0.00005 | 120.00 | 0.0023 | 0.0022 | |
| Operating Hours per Years | hrs/yr | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | | 2000 | 2000 | 2000 | 2000 | |
| **Potential Emissions** | lb/hr | 1.98 | 5.45 | 0.59 | 0.79 | 0.07 | 0.79 | | 0.005 | 11880.000 | 0.228 | 0.218 | |
| **Potential Emissions** | **tpy** | **1.98** | **5.45** | **0.59** | **0.79** | **0.07** | **0.79** | | **0.005** | **11880.0** | **0.228** | **0.218** | **11952.2997** |

*emission factors for NOx, CO, VOC, PM10/PM2.5 based on emission factors from recent permit (NEC)*
*emissions of SO2 assume a sulfur content in NG of 0.5 gr/100 dscf*
*emissions of H2SO4 assumes a 5% conversion of SO2 --> SO3 (on a molar basis)*
*CO2 Emission Factor from AP-42 Table 1.4-2 (provided in lb/MMscf and converted to lb/MMBtu)*

## Emissions From Ancillary Equipment
### Oregon Clean Energy

**Emergency Generator**

| | | NOx | CO | VOC | TSP | SO2 | PM10/ PM2.5 | lead (Pb) | H2SO4 | CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Power rating | kW | 2250 | 2250 | 2250 | 2250 | 2250 | 2250 | 2250 | 2250 | 2250 | 2250.0 | 2250.0 | |
| Power rating | hp | 3016.6 | 3016.6 | 3016.6 | 3016.6 | 3016.6 | 3016.6 | 3016.6 | 3016.6 | 3016.6 | 3016.5750 | 3016.5750 | |
| emission factor | g/kW hr | 5.61 | 3.5 | 0.79 | 0.18 | | 0.2 | | | | | | |
| emission factor | lb/MMBtu | | | | | | | 1.40E-05 | 3.10E-05 | 165.00 | 8.10E-03 | 0.0013216 | |
| emission factor | g/bhp hr | | | | | 0.0048 | | 4.45E-05 | 9.85E-05 | 5.24E+02 | 2.57E-02 | 4.20E-03 | |
| emissions | lb/hr | 27.791 | 17.346 | 3.927 | 0.882 | 0.032 | 0.991 | 0.0003 | 6.55E-04 | 3484.144 | 0.171 | 0.028 | |
| operating hours per year | hrs/yr | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500.00 | 500.00 | 500.00 | 500.00 | |
| **Potential Emissions** | **tpy** | **6.95** | **4.34** | **0.98** | **0.22** | **0.0079** | **0.25** | **7.39E-05** | **0.0001636** | **871.0** | **0.0428** | **0.0070** | **874.1** |

*emission factors for NOx, CO, VOC and PM10/PM2.5 based on Tier 2 emission standards provided in 40 CFR 89 Subpart B - Table 1.*

*The Tier 2 emission factor for NOx and VOC (non methane hydrocarbons (NMHC)) provided in Subpart B - Table 1 is provided as a combined factor (NOx+NMHC). The breakdown of NOx and NMHC in this total factor was estimated using the Tier 1 factors provided in 40 CFR 89 Subpart B Table 1. For example, the NOx emission factor was determined via the following equation: 6.4 * (9.2/(9.2+1.3))*

*TSP emission factor = 89% of PM-10 emission factor, based on AP-42, Table 3.4-2 distribution of particulate emissions for stationary diesel engines.*

*emission factor for SO2 based on ULSD fuel oil (sulfur content of 15 ppmw or 0.0015 lb/MMBtu) and fuel input ratio of 7000 Btu/hp hr (AP-42 Section 3.3)*

*emission factor for Pb based on AP-42 Section 3.1 (1.4e-5 lb/MMBtu) and fuel input of 7000 Btu/hp hr (AP-42 Section 3.3)*

*emission factor for H2SO4 ( 0.000031 lb/MMBTu) from Page 276 of Toxic air pollutant emission factors - a compilation for selected compounds and sources (EPA, 1990) and fuel input ratio of 7000 Btu/hp*

*emission factor for CO2 (165 lb/MMBtu) from AP-42 Table 3.4-1*

*emission factor for CH4 (0.0081 lb/MMBtu) from AP-42 Table 3.4-1*

*emission factor for N2O (0.6 g/MMBtu) from Climate Registry General Reporting Protocol (GRP) (Emission Factors by Fuel Type and Sector)*

**Emergency Fire Pump**

| | | NOx | CO | VOC | TSP | SO2 | PM10/ PM2.5 | lead (Pb) | H2SO4 | CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Power rating | hp | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | |
| Power rating | kW | 223.8 | 223.8 | 223.8 | 223.8 | 223.8 | 223.8 | 223.8 | 223.8 | 223.8 | 223.8 | 223.8 | |
| emission factor | g/kW hr | 3.50 | 3.5 | 0.50 | 0.18 | | 0.2 | | | | | | |
| | lb/MMBtu | | | | | | | 1.40E-05 | 3.10E-05 | 165.00 | 8.10E-03 | 0.0013216 | |
| emission factor | g/bhp hr | | | | | 0.0048 | | 4.45E-05 | 9.85E-05 | 5.24E+02 | 2.57E-02 | 4.20E-03 | |
| emissions | lb/hr | 1.727 | 1.725 | 0.244 | 0.088 | 0.003 | 0.099 | 2.94E-05 | 6.51E-05 | 3.47E+02 | 1.70E-02 | 2.78E-03 | |
| operating hours per year | hrs/yr | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | |
| **Potential Emissions** | **tpy** | **0.43** | **0.43** | **0.06** | **0.022** | **0.0008** | **0.025** | **7.35E-06** | **1.63E-05** | **86.625** | **0.0042525** | **0.0006938** | **86.9** |

*emission factors for NOx, CO, VOC and PM10/PM2.5 based on post -2009 emission standards provided in 40 CFR 60 Subpart IIII - Table 4*

*The post-2009 emission factor for NOx and VOC (non methane hydrocarbons (NMHC)) provided in Subpart IIII - Table 4 is provided as a combine factor (NOx+NMHC). The breakdown of NOx and NMHC in this total factor was estimated using the Tier 1 factors provided in 40 CFR 89 Subpart B Table 1. For example, the NOx emission factor was determined via the following equation: 0.4 * (9.2/(9.2+1.3))*

*TSP emission factor = 89% of PM-10 emission factor, based on AP-42, Table 3.4-2 distribution of particulate emissions for stationary diesel engines.*

*emission factor for SO2 based on ULSD fuel oil (sulfur content of 15 ppmw or 0.0015 lb/MMBtu) and fuel input ratio of 7000 Btu/hp hr (AP-42 Section 3.3)*

*emission factor for Pb based on AP-42 Section 3.1 (1.4e-5 lb/MMBtu) and fuel input of 7000 Btu/hp hr (AP-42 Section 3.3)*

*emission factor for H2SO4 ( 0.000031 lb/MMBTu) from Toxic air pollutant emission factors - a compilation for selected compounds and sources (EPA, 1990) and fuel input ratio of 7000 Btu/hp*

*emission factor for CO2 (165 lb/MMBtu) from AP-42 Table 3.4-1*

*emission factor for CH4 (0.0081 lb/MMBtu) from AP-42 Table 3.4-1*

*emission factor for N2O (0.6 g/MMBtu) from Climate Registry General Reporting Protocol (GRP) (Emission Factors by Fuel Type and Sector)*

**Emission Factors by Fuel Type and Sector**

| Fuel Type | Sector | $CO_2$ Emission Factor | $CH_4$ Emission Factor | $N_2O$ Emission Factor |
|---|---|---|---|---|
| Natural Gas | Industrial | 0.054 kg/scf | 1 g/MMBtu | 0.1 g/MMBtu |
| Coal | Industrial | 2,054.32 kg/short ton | 11 g/MMBtu | 1.6 g/MMBtu |
| Distillate Fuel | Commercial | 10.13 kg/gallon | 11 g/MMBtu | 0.6 g/MMBtu |

## Estimated Emissions from Cooling Tower
## Oregon Clean Energy
**based on NTE Energy information (12/15/12)**

### Emissions

| | | PM10 | PM2.5 |
|---|---|---|---|
| recirculating water flow | gpm | 322000 | 322000 |
| drift eliminator efficiency | % | 0.0005% | 0.0005% |
| TDS in recirculating water | mg/l | 2030.5 | 2030.5 |
| particle size distribution | % | 63.0% | 0.21% |
| estimated emissions | lb/hr | 1.040 | 0.004 |
| estimated emissions | tpy | 4.56 | 0.018 |
| number of cells | - | 16 | 16 |
| estimated emissions per cell | lb/hr | 0.07 | 0.00025 |
| estimated emissions per cell | g/s | 0.0082 | 0.0000315 |

| Dispersion Modeling Parameters (per cell) | | |
|---|---|---|
| diameter | m | 10 |
| diameter | ft | 33.0 |
| exhaust temperature | K | ambient + 10 K |
| exhaust flow rate | acfm | 1422426.25 |
| exit velocity | ft/min | 1663.1 |
| exit velocity | m/s | 8.45 |

| SITE CONDITIONS: | CASE 1 | CASE 2 | CASE 3 | CASE 4 | CASE 5 | CASE 6 | CASE 7 | CASE 8 | CASE 9 | CASE 10 | CASE 11 | CASE 12 | CASE 13 | CASE 14 | CASE 15 | CASE 16 | CASE 17 | CASE 18 | CASE 19 | CASE 20 | CASE 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FUEL TYPE | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas |
| LOAD LEVEL | 100% | 75% | 60% | 100% | 87% | 75% | 60% | 100% | 94% | 75% | 60% | 100% | 100% | 100% | 100% | 75% | 60% | 100% | 100% | 100% | 100% |
| NET FUEL HEATING VALUE, Btu/lbm (LHV) | 20,981 | 20,981 | 20,981 | 20,981 | 20,981 | 20,981 | 20,981 | 20,981 | 20,981 | 20,981 | 20,981 | 20,981 | 20,981 | 20,981 | 20981 | 20981 | 20981 | 20981 | 20981 | 20981 | 20981 |
| GROSS FUEL HEATING VALUE, Btu/lbm (HHV) | 23,299 | 23,299 | 23,299 | 23,299 | 23,299 | 23,299 | 23,299 | 23,299 | 23,299 | 23,299 | 23,299 | 23,299 | 23,299 | 23,299 | 23299 | 23299 | 23299 | 23299 | 23299 | 23299 | 23299 |
| EVAPORATIVE COOLER STATUS | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | ON | OFF | ON | OFF | OFF | OFF | ON | OFF | ON | OFF |
| DUCT BURNER STATUS | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | ON | ON | OFF | OFF | OFF | OFF | ON | ON | OFF | OFF |
| AMBIENT DRY BULB TEMPERATURE, °F | -8 | -8 | -8 | 0 | 0 | 0 | 0 | 30 | 30 | 30 | 30 | 59 | 59 | 59 | 59 | 59 | 59 | 90 | 90 | 90 | 90 |
| AMBIENT RELATIVE HUMIDITY, % | 187 | 171 | 166 | 188 | 179 | 171 | 166 | 185 | 181 | 170 | 165 | 176 | 175 | 184 | 183 | 171 | 166 | 176 | 172 | 185 | 183 |
| BAROMETRIC PRESSURE, psia | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 |
| GT FUEL FLOW, lb m/hr | 125,657 | 99,067 | 84,796 | 125,823 | 110,626 | 98,933 | 84,596 | 118,669 | 111,909 | 93,955 | 80,447 | 110,899 | 109,337 | 110,922 | 109360 | 87312 | 75019 | 104121 | 99132 | **104132** | 99164 |
| DUCT BURNER FUEL FLOW, lb m/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,397 | 8,725 | 0 | 0 | 0 | 0 | 9918 | 11271 | 0 | 0 |
| | | | | | | | | | | | | | | | | | | | | | |
| Net Power kW | 888,300 | 689,400 | 571,200 | 891,000 | 783,800 | 690,200 | 571,700 | 848,200 | 799,100 | 657,100 | 544,900 | 844,700 | 835,200 | 797,500 | 786,200 | 609,400 | 506,300 | 800,500 | 769,700 | 744,700 | 706,600 |
| Gross Power kW | 908,700 | 708,600 | 589,600 | 911,500 | 803,500 | 709,400 | 590,100 | 868,400 | 819,000 | 676,100 | 563,200 | 865,000 | 855,500 | 817,300 | 805,900 | 628,000 | 524,300 | 820,500 | 789,600 | 764,000 | 725,700 |
| | | | | | | | | | | | | | | | | | | | | | |
| **HRSG STACK EXHAUST GAS** | | | | | | | | | | | | | | | | | | | | | |
| EXHAUST FLOW, lb m/hr | 5,301,328 | 4,116,166 | 3,626,793 | 5,334,977 | 4,635,244 | 4,127,854 | 3,635,469 | 5,101,704 | 4,807,998 | 4,024,805 | 3,557,036 | 4,800,442 | 4,749,089 | 4,792,045 | 4,740,363 | 3,852,114 | 3,428,001 | 4,516,209 | 4,354,679 | 4,506,292 | 4,343,417 |
| HRSG STACK TEMPERATURE, °F | 187 | 171 | 166 | 188 | 179 | 171 | 166 | 185 | 181 | 170 | 165 | 176 | 175 | 184 | 183 | 171 | 166 | 176 | 172 | 185 | 183 |
| OXYGEN, Vol. % | 11.83 | 11.69 | 11.95 | 11.87 | 11.76 | 11.73 | 11.98 | 11.93 | 11.93 | 11.9 | 12.17 | 11.18 | 11.21 | 11.82 | 11.88 | 12.03 | 12.32 | 10.82 | 10.88 | 11.62 | 11.82 |
| CARBON DIOXIDE, Vol. % | 4.15 | 4.21 | 4.1 | 4.13 | 4.18 | 4.19 | 4.08 | 4.07 | 4.07 | 4.08 | 3.96 | 4.33 | 4.33 | 4.04 | 4.02 | 3.96 | 3.83 | 4.37 | 4.39 | 4.01 | 3.96 |
| WATER, Vol. % | 8.29 | 8.42 | 8.19 | 8.29 | 8.39 | 8.42 | 8.19 | 8.51 | 8.51 | 8.54 | 8.29 | 9.89 | 9.73 | 9.31 | 9.13 | 9 | 8.74 | 11.23 | 10.78 | 10.52 | 9.94 |
| NITROGEN, Vol. % | 74.85 | 74.8 | 74.89 | 74.83 | 74.79 | 74.78 | 74.87 | 74.61 | 74.61 | 74.6 | 74.7 | 73.74 | 73.86 | 73.96 | 74.09 | 74.14 | 74.25 | 72.72 | 73.09 | 73 | 73.42 |
| ARGON, Vol. % | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.87 | 0.87 | 0.87 | 0.88 | 0.86 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.85 | 0.86 | 0.86 | 0.86 |
| MOLECULAR WEIGHT | 28.42 | 28.41 | 28.43 | 28.42 | 28.41 | 28.41 | 28.43 | 28.39 | 28.39 | 28.39 | 28.41 | 28.26 | 28.28 | 28.3 | 28.32 | 28.33 | 28.34 | 28.12 | 28.17 | 28.17 | 28.23 |
| | | | | | | | | | | | | | | | | | | | | | |
| **HRSG EXHAUST STACK EMISSIONS WITH 0.2 GRAINS S PER 100 SCF (Based on USEPA Test Methods):** | | | | | | | | | | | | | | | | | | | | | |
| NOX, ppmvd @ 15% O 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.0 | 2.0 | 2.0 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| NOX, lbm/hr as NO2 | 22 | 17 | 15 | 22 | 19 | 17 | 15 | 21 | 20 | 17 | 14 | 21.0 | 21.0 | 20.0 | 19 | 15 | 13 | 20 | 19 | 18 | 17 |
| NH3, ppmvd @ 15% O 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5.0 | 5.0 | 5.0 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| NH3, lbm/hr | 20 | 16 | 14 | 20 | 18 | 16 | 14 | 19 | 18 | 15 | 13 | 19.0 | 19.0 | 18.0 | 18 | 14 | 12 | 19 | 18 | 17 | 16 |
| CO, ppmvd @ 15% O 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.0 | 2.0 | 2.0 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO, lbm/hr | 13 | 11 | 9 | 13 | 12 | 11 | 9 | 13 | 12 | 10 | 9 | 13.0 | 13.0 | 12.0 | 12 | 9 | 8 | 12 | 12 | 11 | 11 |
| VOC, ppmvd @ 15% O 2 as CH4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.9 | 1.9 | 1 | 1 | 1 | 1 | 1.9 | 1.9 | 1 | 1 |
| VOC, lbm/hr as CH4 | 3.9 | 3.1 | 2.6 | 3.9 | 3.4 | 3.1 | 2.6 | 3.7 | 3.5 | 2.9 | 2.5 | 5.2 | 5.3 | 3.4 | 3.4 | 2.7 | 2.3 | 5.6 | 5.9 | 3.2 | 3.1 |
| SO2, lbm/hr | 1.8 | 1.4 | 1.2 | 1.8 | 1.6 | 1.4 | 1.2 | 1.7 | 1.6 | 1.4 | 1.2 | 1.7 | 1.7 | 1.6 | 1.6 | 1.3 | 1.1 | 1.6 | 1.6 | 1.5 | 1.4 |
| H2SO2, lbm/hr | 0.7 | 0.5 | 0.5 | 0.7 | 0.6 | 0.5 | 0.5 | 0.6 | 0.6 | 0.5 | 0.4 | 0.6 | 0.6 | 0.6 | 0.6 | 0.5 | 0.4 | 0.6 | 0.6 | 0.6 | 0.5 |
| PARTICULATES, lbm/hr | 11.9 | 9.3 | 8.2 | 12 | 10.4 | 9.3 | 8.2 | 11.5 | 10.8 | 9.1 | 8 | 12.8 | 12.8 | 10.7 | 10.6 | 8.6 | 8 | 12.4 | 12.5 | 10 | 9.7 |
| | | | | | | | | | | | | | | | | | | | | | |
| **HRSG EXHAUST STACK EMISSIONS WITH 0.3 GRAINS S PER 100 SCF (Based on USEPA Test Methods):** | | | | | | | | | | | | | | | | | | | | | |
| SO2, lbm/hr | 2.7 | 2.1 | 1.8 | 2.7 | 2.4 | 2.1 | 1.8 | 2.5 | 2.4 | 2 | 1.7 | 2.5 | 2.5 | 2.4 | 2.3 | 1.9 | 1.6 | 2.4 | 2.4 | 2.2 | 2.1 |
| H2SO2, lbm/hr | 1 | 0.8 | 0.7 | 1 | 0.9 | 0.8 | 0.7 | 0.9 | 0.9 | 0.7 | 0.6 | 0.9 | 0.9 | 0.9 | 0.9 | 0.7 | 0.6 | 0.9 | 0.9 | 0.8 | 0.8 |
| PARTICULATES, lbm/hr | 12.4 | 9.6 | 8.5 | 12.4 | 10.8 | 9.6 | 8.5 | 11.9 | 11.2 | 9.4 | 8.3 | 13.2 | 13.2 | 11.1 | 11 | 8.9 | 8 | 12.8 | 12.8 | 10.3 | 10 |
| | | | | | | | | | | | | | | | | | | | | | |
| **HRSG EXHAUST STACK EMISSIONS WITH 0.5 GRAINS S PER 100 SCF (Based on USEPA Test Methods):** | | | | | | | | | | | | | | | | | | | | | |
| SO2, lbm/hr | 4.4 | 3.5 | 3 | 4.4 | 3.9 | 3.5 | 3 | 4.2 | 3.9 | 3.3 | 2.8 | 4.2 | 4.2 | 3.9 | 3.9 | 3.1 | 2.7 | 4 | 3.9 | 3.7 | 3.5 |
| H2SO2, lbm/hr | 1.6 | 1.3 | 1.1 | 1.6 | 1.4 | 1.3 | 1.1 | 1.5 | 1.4 | 1.2 | 1 | 1.5 | 1.5 | 1.4 | 1.4 | 1.1 | 1 | 1.5 | 1.4 | 1.3 | 1.3 |
| PARTICULATES, lbm/hr | 13.2 | 10.3 | 9 | 13.3 | 11.6 | 10.3 | 9.1 | 12.7 | 11.9 | 10 | 8.8 | 14 | 13.9 | 11.8 | 11.7 | 9.5 | 8.4 | 13.6 | 13.6 | 11 | 10.7 |

**ARCADIS ADDED CALCULATIONS**

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GT Heat Input (MMBtu/hr) | 2927.7 | 2308.162033 | 1975.662004 | 2931.550077 | 2577.475174 | 2305.039967 | 1971.002204 | 2764.869031 | 2607.367791 | 2189.057545 | 1874.334653 | 2583.835801 | 2547.442763 | 2584.371678 | 2547.97864 | 2034.282288 | 1747.867681 | 2425.915179 | 2309.676468 | 2426.171468 | 2310.422036 |
| Duct Burner Heat Input (MMBtu/hr) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 195.641703 | 203.283775 | 0 | 0 | 0 | 0 | 231.079482 | 262.603029 | 0 | 0 |
| **NOx (lb/MMBtu)** | 0.007514476 | 0.007365168 | 0.007592392 | 0.007504562 | 0.007371555 | 0.007375143 | 0.007610342 | 0.007595296 | 0.007670571 | 0.007765899 | 0.007469317 | 0.0076 | 0.007634347 | 0.0077 | 0.007456891 | 0.007373608 | 0.007437634 | 0.007527302 | 0.007386445 | 0.007419096 | 0.007357963 |
| **CO (lb/MMBtu)** | 0.004440372 | 0.004765697 | 0.004555435 | 0.004434514 | 0.004655719 | 0.004772152 | 0.004566205 | 0.00470185 | 0.004602343 | 0.004568176 | 0.004801704 | 0.0047 | 0.004726024 | 0.0046 | 0.004709616 | 0.004424165 | 0.004577006 | 0.004516381 | 0.004665123 | 0.004533892 | 0.004761035 |
| **VOC (lb/MMBtu)** | 0.001332112 | 0.00134306 | 0.001316015 | 0.001330354 | 0.00131912 | 0.001344879 | 0.001319126 | 0.001338219 | 0.00134235 | 0.001324771 | 0.001333807 | 0.0019 | 0.001926764 | 0.0013 | 0.001334391 | 0.001327249 | 0.001315889 | 0.002107644 | 0.002293685 | 0.00131895 | 0.001341746 |
| **SO2 (lb/MMBtu)** | 0.001502895 | 0.001516358 | 0.001518478 | 0.001500912 | 0.001513109 | 0.001518412 | 0.001522068 | 0.001519059 | 0.001495761 | 0.001507498 | 0.001493863 | 0.0015 | 0.001526869 | 0.0015 | 0.001530625 | 0.001523879 | 0.001544739 | 0.00150546 | 0.001516165 | 0.001525036 | 0.001514875 |
| **H2SO4 (lb/MMBtu)** | 0.000546507 | 0.000563219 | 0.000556775 | 0.000545786 | 0.000543167 | 0.000563982 | 0.000558092 | 0.000542521 | 0.00053694 | 0.000548181 | 0.000533523 | 0.0005 | 0.00054531 | 0.0005 | 0.000549455 | 0.000540731 | 0.000572126 | 0.000564548 | 0.000544264 | 0.000535824 | 0.000562668 |
| **PM10/PM2.5 (lb/MMBtu)** | 0.004508686 | 0.004462425 | 0.004555435 | 0.004536849 | 0.004500528 | 0.004468469 | 0.004616941 | 0.004593346 | 0.00456399 | 0.004568176 | 0.004694999 | 0.0050 | 0.00505321 | 0.0046 | 0.004591875 | 0.004669952 | 0.004805856 | 0.005118565 | 0.005287139 | 0.004533892 | 0.004631189 |
| **NH3 (lb/MMBtu)** | 0.006831342 | 0.006931922 | 0.007086232 | 0.006822329 | 0.006983578 | 0.006941311 | 0.007102985 | 0.006871935 | 0.006903514 | 0.006852264 | 0.006935795 | 0.0068 | 0.006907266 | 0.0070 | 0.007064423 | 0.006882034 | 0.006865508 | 0.007150936 | 0.006997684 | 0.007006924 | 0.006925142 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 Emission Factor- turbine - lb/MMBtu (40 cfr 98) | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 |
| CO2 Emission Factor- duct burner - lb/MMBtu (AP-42) | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 |
| CH4 Emission Factor - turbine - lb/MMBtu (40 CFR 98) | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 |
| CH4 Emission Factor - duct burner - lb/MMBtu (AP-42) | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 |
| N2O Emission Factor - turbine - lb/MMBtu (40 CFR 98) | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 |
| N2O Emission Factor - duct burner - lb/MMBtu (AP-42) | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 |
| **CO2 Emissions lb/hr** | **341907** | **269557** | **230726** | **342359** | **301008** | **269192** | **230182** | **322893** | **304499** | **255647** | **218893** | **327380** | **324334** | **301814** | **297563** | **237572** | **204123** | **314966** | **305973** | **283338** | **269821** |
| CH4 Emissions lb/hr | 6.4 | 5.1 | 4.4 | 6.5 | 5.7 | 5.1 | 4.3 | 6.1 | 5.7 | 4.8 | 4.1 | 6.1 | 6.1 | 5.7 | 5.6 | 4.5 | 3.8 | 5.9 | 5.7 | 5.3 | 5.1 |
| N2O Emissions lb/hr | 0.6 | 0.5 | 0.4 | 0.6 | 0.6 | 0.5 | 0.4 | 0.6 | 0.6 | 0.5 | 0.4 | 1.0 | 1.0 | 0.6 | 0.6 | 0.4 | 0.4 | 1.0 | 1.1 | 0.5 | 0.5 |
| **CO2e Emissions lb/hr** | **342242** | **269821** | **230952** | **342694** | **301303** | **269456** | **230408** | **323210** | **304798** | **255898** | **219107** | **327819** | **324775** | **302110** | **297855** | **237805** | **204323** | **315413** | **306429** | **283616** | **270085** |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| formaldehyde emission factor - turbine (lb/MMBtu) (CARB- CATEF) | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 |
| formaldehyde emission factor - DB (lb/MMBtu) (AP-42, 1.4-3) | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 |
| toluene emission factor - turbine (lb/MMBtu) (AP-42, 3.1-3) | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 |
| toluene emission factor - DB (lb/MMBtu) (AP-42, 1.4-3) | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 |
| xylene emission factor - turbine (lb/MMBtu) (AP-42, 3.1-3) | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 |
| xylene emission factor - DB (lb/MMBtu) (AP-42, 1.4-3) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **formaldehyde emissions (lb/hr)** | 0.322 | 0.254 | 0.217 | 0.322 | 0.284 | 0.254 | 0.217 | 0.304 | 0.287 | 0.241 | 0.206 | 0.300 | 0.296 | 0.284 | 0.280 | 0.224 | 0.192 | 0.285 | 0.275 | 0.267 | 0.254 |
| **toluene emissions (lb/hr)** | 0.381 | 0.300 | 0.257 | 0.381 | 0.335 | 0.300 | 0.256 | 0.359 | 0.339 | 0.285 | 0.244 | 0.337 | 0.332 | 0.336 | 0.331 | 0.264 | 0.227 | 0.316 | 0.301 | 0.315 | 0.300 |
| **xylene emissions (lb/hr)** | 0.187 | 0.148 | 0.126 | 0.188 | 0.165 | 0.148 | 0.126 | 0.177 | 0.167 | 0.140 | 0.120 | 0.165 | 0.163 | 0.165 | 0.163 | 0.130 | 0.112 | 0.155 | 0.148 | 0.155 | 0.148 |

| SITE CONDITIONS: | CASE 22 | CASE 23 | CASE 24 | CASE 25 | CASE 26 | CASE 27 | CASE 28 |
|---|---|---|---|---|---|---|---|
| FUEL TYPE | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas | natural gas |
| LOAD LEVEL | 75% | 60% | 100% | 100% | 100% | 75% | 60% |
| NET FUEL HEATING VALUE, Btu/lbm (LHV) | 20981 | 20981 | 20981 | 20981 | 20981 | 20981 | 20981 |
| GROSS FUEL HEATING VALUE, Btu/lbm (HHV) | 23299 | 23299 | 23299 | 23299 | 23299 | 23299 | 23299 |
| EVAPORATIVE COOLER STATUS | OFF | OFF | ON | OFF | OFF | OFF | OFF |
| DUCT BURNER STATUS | OFF | OFF | ON | ON | OFF | OFF | OFF |
| AMBIENT DRY BULB TEMPERATURE, °F | 90 | 90 | 105 | 105 | 105 | 105 | 105 |
| AMBIENT RELATIVE HUMIDITY, % | 174 | 169 | 176 | 171 | 183 | 175 | 171 |
| BAROMETRIC PRESSURE, psia | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 | 14.387 |
| GT FUEL FLOW, lb m/hr | 79716 | 68714 | 101504 | 92775 | 92823 | 75032 | 65085 |
| DUCT BURNER FUEL FLOW, lb m/hr | 0 | 0 | 10602 | 12895 | 0 | 0 | 0 |
| | | | | | | | |
| Net Power kW | 548,800 | 455,800 | 781,000 | 725,800 | 654,000 | 509,300 | 422,900 |
| Gross Power kW | 566,900 | 473,300 | 800,900 | 745,400 | 672,700 | 527,200 | 440,200 |
| | | | | | | | |
| **HRSG STACK EXHAUST GAS** | | | | | | | |
| EXHAUST FLOW, lb m/hr | 3,637,630 | 3,259,137 | 4,397,117 | 4,164,435 | 4,151,557 | 3,504,193 | 3,146,213 |
| HRSG STACK TEMPERATURE, °F | 174 | 169 | 176 | 171 | 183 | 175 | 171 |
| OXYGEN, Vol. % | 12.16 | 12.46 | 10.62 | 10.81 | 11.92 | 12.27 | 12.54 |
| CARBON DIOXIDE, Vol. % | 3.81 | 3.67 | 4.4 | 4.38 | 3.87 | 3.71 | 3.59 |
| WATER, Vol. % | 9.64 | 9.36 | 11.97 | 11.23 | 10.23 | 9.92 | 9.68 |
| NITROGEN, Vol. % | 73.53 | 73.64 | 72.16 | 72.73 | 73.11 | 73.23 | 73.32 |
| ARGON, Vol. % | 0.86 | 0.86 | 0.85 | 0.85 | 0.86 | 0.86 | 0.86 |
| MOLECULAR WEIGHT | 28.25 | 28.26 | 28.04 | 28.12 | 28.19 | 28.2 | 28.22 |
| | | | | | | | |
| **HRSG EXHAUST STACK EMISSIONS WITH 0.2 GRAINS S I** | | | | | | | |
| NOX, ppmvd @ 15% O 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| NOX, lbm/hr as NO2 | 14 | 12 | 20 | 19 | 16 | 13 | 11 |
| NH3, ppmvd @ 15% O 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| NH3, lbm/hr | 13 | 11 | 18 | 17 | 15 | 12 | 11 |
| CO, ppmvd @ 15% O 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO, lbm/hr | 9 | 7 | 12 | 11 | 10 | 8 | 7 |
| VOC, ppmvd @ 15% O 2 as CH4 | 1 | 1 | 1.9 | 1.9 | 1 | 1 | 1 |
| VOC, lbm/hr as CH4 | 2.5 | 2.1 | 5.8 | 6.4 | 2.9 | 2.3 | 2 |
| SO2, lbm/hr | 1.2 | 1 | 1.6 | 1.5 | 1.3 | 1.1 | 1 |
| H2SO2, lbm/hr | 0.4 | 0.4 | 0.6 | 0.6 | 0.5 | 0.4 | 0.4 |
| PARTICULATES, lbm/hr | 8.1 | 8 | 12.3 | 12.4 | 9.2 | 8 | 8 |
| | | | | | | | |
| **HRSG EXHAUST STACK EMISSIONS WITH 0.3 GRAINS S I** | | | | | | | |
| SO2, lbm/hr | 1.7 | 1.5 | 2.4 | 2.3 | 2 | 1.6 | 1.4 |
| H2SO2, lbm/hr | 0.6 | 0.6 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 |
| PARTICULATES, lbm/hr | 8.4 | 8 | 12.7 | 12.8 | 9.5 | 8 | 8 |
| | | | | | | | |
| **HRSG EXHAUST STACK EMISSIONS WITH 0.5 GRAINS S I** | | | | | | | |
| SO2, lbm/hr | 2.8 | 2.4 | 3.9 | 3.7 | 3.3 | 2.7 | 2.3 |
| H2SO2, lbm/hr | 1 | 0.9 | 1.4 | 1.4 | 1.2 | 1 | 0.9 |
| PARTICULATES, lbm/hr | 8.9 | 8 | 13.4 | 13.5 | 10.1 | 8.5 | 8 |

| **ARCADIS ADDED CALCULATIONS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| GT Heat Input (MMBtu/hr) | 1857.303084 | 1600.967486 | 2364.941696 | 2161.564725 | 2162.683077 | 1748.170568 | 1516.415415 |
| Duct Burner Heat Input (MMBtu/hr) | 0 | 0 | 247.015998 | 300.440605 | 0 | 0 | 0 |
| **NOx (lb/MMBtu)** | 0.007537811 | 0.007495468 | 0.007657092 | 0.007717286 | 0.007398218 | 0.007436345 | 0.007253949 |
| **CO (lb/MMBtu)** | 0.004845736 | 0.004372356 | 0.004594255 | 0.004467903 | 0.004623886 | 0.004576212 | 0.004616149 |
| **VOC (lb/MMBtu)** | 0.001346038 | 0.001311707 | 0.002220557 | 0.002599507 | 0.001340927 | 0.001315661 | 0.0013189 |
| **SO2 (lb/MMBtu)** | 0.001507562 | 0.001499094 | 0.001493133 | 0.00150284 | 0.001525882 | 0.001544472 | 0.001516735 |
| **H2SO4 (lb/MMBtu)** | 0.000538415 | 0.00056216 | 0.000535996 | 0.000568642 | 0.000554866 | 0.000572027 | 0.000593505 |
| **PM10/PM2.5 (lb/MMBtu)** | 0.004791894 | 0.004996978 | 0.005130252 | 0.005483335 | 0.004670125 | 0.004862226 | 0.005275599 |
| **NH3 (lb/MMBtu)** | 0.006999396 | 0.006870845 | 0.006891383 | 0.00690494 | 0.006935829 | 0.006864319 | 0.007253949 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CO2 Emission Factor- turbine - lb/MMBtu (40 cfr 98) | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 | 116.784141 |
| CO2 Emission Factor- duct burner - lb/MMBtu (AP-42) | 141 | 142 | 143 | 144 | 145 | 146 | 147 |
| CH4 Emission Factor - turbine - lb/MMBtu (40 CFR 98) | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 | 0.002202643 |
| CH4 Emission Factor - duct burner - lb/MMBtu (AP-42) | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0023 |
| N2O Emission Factor - turbine - lb/MMBtu (40 CFR 98) | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 | 0.000220264 |
| N2O Emission Factor - duct burner - lb/MMBtu (AP-42) | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 | 0.0022 |
| **CO2 Emissions lb/hr** | **216904** | **186968** | **311511** | **295700** | **252567** | **204159** | **177093** |
| CH4 Emissions lb/hr | 4.1 | 3.5 | 5.8 | 5.5 | 4.8 | 3.9 | 3.3 |
| N2O Emissions lb/hr | 0.4 | 0.4 | 1.1 | 1.1 | 0.5 | 0.4 | 0.3 |
| **CO2e Emissions lb/hr** | **217116** | **187151** | **311962** | **296167** | **252815** | **204359** | **177267** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| formaldehyde emission factor - turbine (lb/MMBtu) (CARB- CATEF) | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 | 0.00011 |
| formaldehyde emission factor - DB (lb/MMBtu) (AP-42, 1.4-3) | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 | 7.89E-05 |
| toluene emission factor - turbine (lb/MMBtu) (AP-42, 3.1-3) | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 | 0.00013 |
| toluene emission factor - DB (lb/MMBtu) (AP-42, 1.4-3) | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 | 3.58E-06 |
| xylene emission factor - turbine (lb/MMBtu) (AP-42, 3.1-3) | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 | 0.000064 |
| xylene emission factor - DB (lb/MMBtu) (AP-42, 1.4-3) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **formaldehyde emissions (lb/hr)** | 0.204 | 0.176 | 0.280 | 0.261 | 0.238 | 0.192 | 0.167 |
| **toluene emissions (lb/hr)** | 0.241 | 0.208 | 0.308 | 0.282 | 0.281 | 0.227 | 0.197 |
| **xylene emissions (lb/hr)** | 0.119 | 0.102 | 0.151 | 0.138 | 0.138 | 0.112 | 0.097 |

**Oregon Clean Energy**

**Dispersion Modeling Parameters (per turbine)** *developed by ARCADIS based on Siemens Data (as provided below)*

| SITE CONDITIONS: | | CASE 1 | CASE 2 | CASE 3 | CASE 4 | CASE 5 | CASE 6 | CASE 7 | CASE 8 | CASE 9 | CASE 10 | CASE 11 | CASE 12 | CASE 13 | CASE 14 | CASE 15 | CASE 16 | CASE 17 | CASE 18 | CASE 19 | CASE 20 | CASE 21 | CASE 22 | CASE 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOAD LEVEL | | 100% | 75% | 60% | 100% | 87% | 75% | 60% | 100% | 94% | 75% | 60% | 100% | 100% | 100% | 100% | 75% | 60% | 100% | 100% | 100% | 100% | 75% | 60% |
| AMBIENT DRY BULB TEMPERATURE, °F | | -8 | -8 | -8 | 0 | 0 | 0 | 0 | 30 | 30 | 30 | 30 | 59 | 59 | 59 | 59 | 59 | 59 | 90 | 90 | 90 | 90 | 90 | 90 |
| EVAPORATIVE COOLER STATUS | | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | ON | OFF | ON | OFF | OFF | OFF | ON | OFF | ON | OFF | OFF | OFF |
| DUCT BURNER STATUS | | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | ON | ON | OFF | OFF | OFF | OFF | ON | ON | OFF | OFF | OFF | OFF |
| exhaust flow rate (scfm) (@77 F) | | 1,221,494 | 948,751 | 835,366 | 1,229,247 | 1,068,396 | 951,445 | 837,364 | 1,176,740 | 1,108,995 | 928,347 | 819,875 | 1,112,346 | 1,099,668 | 1,108,831 | 1,096,097 | 890,396 | 792,085 | 1,051,694 | 1,012,279 | 1,047,522 | 1,007,515 | 843,200 | 755,199 |
| stack gas temperature (K) | | 359.3 | 350.4 | 347.6 | 359.8 | 354.8 | 350.4 | 347.6 | 358.2 | 355.9 | 349.8 | 347.0 | 353.2 | 352.6 | 357.6 | 357.0 | 350.4 | 347.6 | 353.2 | 350.9 | 358.2 | 357.0 | 352.0 | 349.3 |
| stack gas temperature (F) | | 187 | 171 | 166 | 188 | 179 | 171 | 166 | 185 | 181 | 170 | 165 | 176 | 175 | 184 | 183 | 171 | 166 | 176 | 172 | 185 | 183 | 174 | 169 |
| exhaust flow rate (acfm) | | 1,471,707 | 1,114,827 | 973,816 | 1,483,338 | 1,271,331 | 1,117,993 | 976,145 | 1,413,403 | 1,323,773 | 1,089,122 | 954,231 | 1,317,415 | 1,300,353 | 1,329,771 | 1,312,459 | 1,046,257 | 923,362 | 1,245,582 | 1,191,360 | 1,258,197 | 1,206,391 | 995,510 | 884,581 |
| stack diameter (ft) | | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 |
| stack exit velocity (ft/min) | | 3872 | 2933 | 2562 | 3902 | 3344 | 2941 | 2568 | 3718 | 3482 | 2865 | 2510 | 3466 | 3421 | 3498 | 3453 | 2752 | 2429 | 3277 | 3134 | 3310 | 3174 | 2619 | 2327 |
| stack exit velocity (m/s) | | 19.67 | 14.90 | 13.01 | 19.82 | 16.99 | 14.94 | 13.04 | 18.89 | 17.69 | 14.55 | 12.75 | 17.61 | 17.38 | 17.77 | 17.54 | 13.98 | 12.34 | 16.65 | 15.92 | 16.81 | 16.12 | 13.30 | 11.82 |
| NOx emissions (g/s) | | 2.77 | 2.14 | 1.89 | 2.77 | 2.40 | 2.14 | 1.89 | 2.65 | 2.52 | 2.14 | 1.77 | 2.65 | 2.65 | 2.52 | 2.40 | 1.89 | 1.64 | 2.52 | 2.40 | 2.27 | 2.14 | 1.77 | 1.51 |
| CO emissions (g/s) | | 1.64 | 1.39 | 1.14 | 1.64 | 1.51 | 1.39 | 1.14 | 1.64 | 1.51 | 1.26 | 1.14 | 1.64 | 1.64 | 1.51 | 1.51 | 1.14 | 1.01 | 1.51 | 1.51 | 1.39 | 1.39 | 1.14 | 0.88 |
| SO2 emissions (g/s) | | 0.55 | 0.44 | 0.38 | 0.55 | 0.49 | 0.44 | 0.38 | 0.53 | 0.49 | 0.42 | 0.35 | 0.53 | 0.53 | 0.49 | 0.49 | 0.39 | 0.34 | 0.50 | 0.49 | 0.47 | 0.44 | 0.35 | 0.30 |
| PM10/PM2.5 emissions (g/s) | | 1.66 | 1.30 | 1.14 | 1.68 | 1.46 | 1.30 | 1.15 | 1.60 | 1.50 | 1.26 | 1.11 | 1.77 | 1.75 | 1.49 | 1.48 | 1.20 | 1.06 | 1.72 | 1.72 | 1.39 | 1.35 | 1.12 | 1.01 |
| formaldehyde emissions (g/s) | | 0.0406 | 0.0320 | 0.0274 | 0.0407 | 0.0358 | 0.0320 | 0.0273 | 0.0384 | 0.0362 | 0.0304 | 0.0260 | 0.0378 | 0.0374 | 0.0359 | 0.0353 | 0.0282 | 0.0242 | 0.0360 | 0.0347 | 0.0337 | 0.0321 | 0.0258 | 0.0222 |
| toluene emissions (g/s) | | 0.0480 | 0.0378 | 0.0324 | 0.0481 | 0.0423 | 0.0378 | 0.0323 | 0.0453 | 0.0427 | 0.0359 | 0.0307 | 0.0424 | 0.0419 | 0.0424 | 0.0418 | 0.0334 | 0.0287 | 0.0399 | 0.0380 | 0.0398 | 0.0379 | 0.0304 | 0.0262 |
| xylene emissions (g/s) | | 0.0236 | 0.0186 | 0.0159 | 0.0237 | 0.0208 | 0.0186 | 0.0159 | 0.0223 | 0.0210 | 0.0177 | 0.0151 | 0.0209 | 0.0206 | 0.0209 | 0.0206 | 0.0164 | 0.0141 | 0.0196 | 0.0186 | 0.0196 | 0.0186 | 0.0150 | 0.0129 |

**Oregon Clean Energy**
**Dispersion Modeling Parameters (per tu**

| SITE CONDITIONS: | | CASE 24 | CASE 25 | CASE 26 | CASE 27 | CASE 28 |
|---|---|---|---|---|---|---|
| LOAD LEVEL | | 100% | 100% | 100% | 75% | 60% |
| AMBIENT DRY BULB TEMPERATURE, °F | | 105 | 105 | 105 | 105 | 105 |
| EVAPORATIVE COOLER STATUS | | ON | OFF | OFF | OFF | OFF |
| DUCT BURNER STATUS | | ON | ON | OFF | OFF | OFF |
| exhaust flow rate (scfm) (@77 F) | | 1,026,883 | 969,776 | 964,377 | 813,710 | 730,066 |
| stack gas temperature (K) | | 353.2 | 350.4 | 357.0 | 352.6 | 350.4 |
| stack gas temperature (F) | | 176 | 171 | 183 | 175 | 171 |
| exhaust flow rate (acfm) | | 1,216,196 | 1,139,532 | 1,154,738 | 962,208 | 857,861 |
| stack diameter (ft) | | 22 | 22 | 22 | 22 | 22 |
| stack exit velocity (ft/min) | | 3199 | 2998 | 3038 | 2531 | 2257 |
| stack exit velocity (m/s) | | 16.25 | 15.23 | 15.43 | 12.86 | 11.46 |
| NOx emissions (g/s) | | 2.52 | 2.40 | 2.02 | 1.64 | 1.39 |
| CO emissions (g/s) | | 1.51 | 1.39 | 1.26 | 1.01 | 0.88 |
| SO2 emissions (g/s) | | 0.49 | 0.47 | 0.42 | 0.34 | 0.29 |
| PM10/PM2.5 emissions (g/s) | | 1.69 | 1.70 | 1.27 | 1.07 | 1.01 |
| formaldehyde emissions (g/s) | | 0.0353 | 0.0330 | 0.0300 | 0.0243 | 0.0210 |
| toluene emissions (g/s) | | 0.0389 | 0.0356 | 0.0355 | 0.0287 | 0.0249 |
| xylene emissions (g/s) | | 0.0191 | 0.0174 | 0.0175 | 0.0141 | 0.0122 |

# Oregon Clean Energy
Summary of HAP Emissions
Siemens Turbines

| | |
|---|---|
| **Max Individual HAP** | **2.95** |
| **Total HAPs** | **9.87** |

***Summary of HAP Emissions (tpy)***

| Pollutant | HAPs | Turbines + DB | Aux Boiler | Fire Engine | Emer. Gen | Total | Total HAP |
|---|---|---|---|---|---|---|---|
| 1,3-Butadiene | HAP | 0.010 | 0.00 | 0.00 | 0.00 | 0.01 | 0.010 |
| 2-Methylnaphthalene | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Acetaldehyde | HAP | 0.91 | 0.00 | 0.00 | 0.00 | 0.91 | 0.910 |
| Acrolein | HAP | 0.14 | 0.00 | 0.00 | 0.00 | 0.15 | 0.145 |
| Anthracene | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Ammonia | 0 | 166.44 | 0.00 | 0.00 | 0.00 | 166.44 | 0.000 |
| Benzene | HAP | 0.28 | 0.00 | 0.00 | 0.00 | 0.28 | 0.281 |
| Benzo(a)anthracene | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Benzo(a)pyrene | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Butane | 0 | 3.72 | 0.21 | 0.00 | 0.00 | 3.93 | 0.000 |
| Chrysene | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Dibenz(a,h)anthracene | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Ethane | 0 | 5.49 | 0.32 | 0.00 | 0.00 | 5.80 | 0.000 |
| Ethylbenzene | HAP | 0.72 | 0.00 | 0.00 | 0.00 | 0.72 | 0.724 |
| Formaldehyde | HAP | 2.62 | 0.01 | 0.00 | 0.01 | 2.64 | 2.637 |
| Hexane | HAP | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.009 |
| Naphthalene | HAP | 0.03 | 0.00 | 0.00 | 0.00 | 0.03 | 0.031 |
| Pentane | 0 | 4.60 | 0.27 | 0.00 | 0.00 | 4.87 | 0.000 |
| Phenanthrene | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| PAH | HAP | 0.05 | 0.00 | 0.00 | 0.00 | 0.05 | 0.051 |
| Propane | 0 | 2.83 | 0.16 | 0.00 | 0.00 | 3.00 | 0.000 |
| Propylene | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Propylene Oxide | HAP | 0.66 | 0.00 | 0.00 | 0.00 | 0.66 | 0.656 |
| Pyrene | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Sulfuric Acid | 0 | 13.14 | 0.00 | 0.00 | 0.00 | 13.14 | 0.000 |
| Toluene | HAP | 2.95 | 0.00 | 0.00 | 0.00 | 2.95 | 2.951 |
| Xylene (Total) | HAP | 1.45 | 0.00 | 0.00 | 0.00 | 1.45 | 1.450 |
| Arsenic | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Barium | 0 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.000 |
| Beryllium | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Cadmium | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.002 |
| Chromium | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.003 |
| Cobalt | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Copper | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Manganese | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.001 |
| Mercury | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Molybdenum | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Nickel | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.004 |
| Selenium | HAP | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Vanadium | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| Zinc | 0 | 0.05 | 0.00 | 0.00 | 0.00 | 0.05 | 0.000 |

# Oregon Clean Energy

## Summary of Air Toxic Emissions

Siemens Turbines

***Summary of Ohio Air Toxic Emissions (tpy)***

| Pollutant | Ohio Air Toxics | Turbines + DB | Aux Boiler | Fire Pump | Emer. Gen |
|---|---|---|---|---|---|
| 1,3-Butadiene | OH | 0.010 | 0.00E+00 | 2.01E-05 | 2.08E-04 |
| 2-Methylnaphthalene | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Acetaldehyde | OH | 0.905 | 0.00E+00 | 3.94E-04 | 4.07E-03 |
| Acrolein | OH | 0.145 | 0.00E+00 | 4.75E-05 | 4.91E-04 |
| Anthracene | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Ammonia | OH | 166.440 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Benzene | OH | 0.275 | 2.15E-04 | 4.79E-04 | 4.95E-03 |
| Benzo(a)anthracene | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Benzo(a)pyrene | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Butane | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Chrysene | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Dibenz(a,h)anthracene | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Ethane | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Ethylbenzene | OH | 0.724 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Formaldehyde | OH | 2.623 | 7.67E-03 | 6.06E-04 | 6.26E-03 |
| Hexane | OH | 0.008 | 4.70E-04 | 0.00E+00 | 0.00E+00 |
| Naphthalene | OH | 0.031 | 6.24E-05 | 4.36E-05 | 4.50E-04 |
| Pentane | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Phenanthrene | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| PAH | OH | 0.050 | 9.64E-06 | 8.63E-05 | 8.92E-04 |
| Propane | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Propylene | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Propylene Oxide | OH | 0.656 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Pyrene | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Sulfuric Acid | OH | 13.140 | 0.00E+00 | 2.16E-05 | 0.00E+00 |
| Toluene | OH | 2.948 | 3.48E-04 | 2.10E-04 | 2.17E-03 |
| Xylene (Total) | OH | 1.449 | 0.00E+00 | 1.46E-04 | 1.51E-03 |
| Arsenic | OH | 0.000 | 2.05E-05 | 0.00E+00 | 0.00E+00 |
| Barium | OH | 0.008 | 4.50E-04 | 0.00E+00 | 0.00E+00 |
| Beryllium | OH | 0.000 | 1.23E-06 | 0.00E+00 | 0.00E+00 |
| Cadmium | OH | 0.002 | 1.13E-04 | 0.00E+00 | 0.00E+00 |
| Chromium | OH | 0.002 | 1.43E-04 | 0.00E+00 | 0.00E+00 |
| Cobalt | OH | 0.000 | 8.59E-06 | 0.00E+00 | 0.00E+00 |
| Copper | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Manganese | OH | 0.001 | 3.89E-05 | 0.00E+00 | 0.00E+00 |
| Mercury | OH | 0.000 | 2.66E-05 | 0.00E+00 | 0.00E+00 |
| Molybdenum | OH | 0.002 | 1.13E-04 | 0.00E+00 | 0.00E+00 |
| Nickel | OH | 0.004 | 2.15E-04 | 0.00E+00 | 0.00E+00 |
| Selenium | OH | 0.000 | 2.45E-06 | 0.00E+00 | 0.00E+00 |
| Vanadium | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Zinc | 0 | 0.000 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

# Oregon Clean Energy

Air Toxic Emissions
Natural Gas Fired Combustion Turbines
Siemens

| | Units | | ISO with DB<br>Case 12 | ISO no DB<br>Case 14 |
|---|---|---|---|---|
| Ambient Temperature | $^oF$ | | 59 | 59 |
| CTG Percent Load Rate | % | | 100% | 100% |
| CTG Heat Input Capacity | MMBtu/hr, HHV | | 2,584 | 2,617 |
| Duct Burner Input | | | 196 | 0 |
| HHV of natural gas | BTU/SCF | | 968 | 968 |
| number of turbines | | | 2 | 2 |
| annual hours of operation | | | 8,760 | 0 |

**Worst Case Turbines and Duct Burner**

| Air Toxic | lb/MMBTU<br>Turbine Emission Factor | lb/MMBTU<br>DB Emission Factor | ISO - case 12 lb/hr per turbine<br>case 12 - lb/hr per turbine | ISO - Case 14 lb/hr per turbine<br>case 14 - lb/hr per turbine | based on ISO - tons/yr | HAP | HAP tons/yr |
|---|---|---|---|---|---|---|---|
| 1,3-Butadiene | 4.30E-07 | 0.00E+00 | 0.00 | 0.00 | 0.01 | HAP | 0.01 |
| 2-Methylnaphthalene | 0.00E+00 | 2.48E-08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Acetaldehyde | 4.00E-05 | 0.00E+00 | 0.10 | 0.10 | 0.91 | HAP | 0.91 |
| Acrolein | 6.40E-06 | 0.00E+00 | 0.02 | 0.02 | 0.14 | HAP | 0.14 |
| Anthracene | 0.00E+00 | 2.48E-09 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Ammonia | emissions from vendor data | | 19.00 | 18.00 | 166.44 | 0.00 | 0.00 |
| Benzene | 1.20E-05 | 2.17E-06 | 0.03 | 0.03 | 0.28 | HAP | 0.28 |
| Benzo(a)anthracene | 0.00E+00 | 1.86E-09 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Benzo(a)pyrene | 0.00E+00 | 1.24E-09 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Butane | 0.00E+00 | 2.17E-03 | 0.42 | 0.00 | 3.72 | 0.00 | 0.00 |
| Chrysene | 0.00E+00 | 1.86E-09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dibenz(a,h)anthracene | 0.00E+00 | 1.24E-09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Ethane | 0.00E+00 | 3.20E-03 | 0.63 | 0.00 | 5.49 | 0.00 | 0.00 |
| Ethylbenzene | 3.20E-05 | 0.00E+00 | 0.08 | 0.08 | 0.72 | HAP | 0.72 |
| Formaldehyde | 1.10E-04 | 7.75E-05 | 0.30 | 0.29 | 2.62 | HAP | 2.62 |
| Hexane | 0.00E+00 | 4.75E-06 | 0.00 | 0.00 | 0.01 | HAP | 0.01 |
| Naphthalene | 1.30E-06 | 6.30E-07 | 0.00 | 0.00 | 0.03 | HAP | 0.03 |
| Pentane | 0.00E+00 | 2.69E-03 | 0.53 | 0.00 | 4.60 | 0.00 | 0.00 |
| Phenanthrene | 0.00E+00 | 1.76E-08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAH | 2.20E-06 | 9.74E-08 | 0.01 | 0.01 | 0.05 | HAP | 0.05 |
| Propane | 0.00E+00 | 1.65E-03 | 0.32 | 0.00 | 2.83 | 0.00 | 0.00 |
| Propylene | 0.00E+00 | 0.00E+00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Propylene Oxide | 2.90E-05 | 0.00E+00 | 0.07 | 0.08 | 0.66 | HAP | 0.66 |
| Pyrene | 0.00E+00 | 5.17E-09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sulfuric Acid | emissions from vendor data | | 1.50 | 1.40 | 13.14 | 0.00 | 0.00 |
| Toluene | 1.30E-04 | 3.51E-06 | 0.34 | 0.34 | 2.95 | HAP | 2.95 |
| Xylene (Total) | 6.40E-05 | 0.00E+00 | 0.17 | 0.17 | 1.45 | HAP | 1.45 |
| Arsenic | 0.00E+00 | 2.07E-07 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Barium | 0.00E+00 | 4.55E-06 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| Beryllium | 0.00E+00 | 1.24E-08 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Cadmium | 0.00E+00 | 1.14E-06 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Chromium | 0.00E+00 | 1.45E-06 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Cobalt | 0.00E+00 | 8.68E-08 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Copper | 0.00E+00 | 8.78E-07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manganese | 0.00E+00 | 3.93E-07 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Mercury | 0.00E+00 | 2.69E-07 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Molybdenum | 0.00E+00 | 1.14E-06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Nickel | 0.00E+00 | 2.17E-06 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Selenium | 0.00E+00 | 2.48E-08 | 0.00 | 0.00 | 0.00 | HAP | 0.00 |
| Vanadium | 0.00E+00 | 2.38E-06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Zinc | 0.00E+00 | 3.00E-05 | 0.01 | 0.00 | 0.05 | 0.00 | 0.00 |

# Oregon Clean Energy

Air Toxic Emissions

Natural Gas Fired Auxilliary Boiler

| | Units | | Value |
|---|---|---|---|
| Boiler Heat Input | MMBtu/hr, HHV | | 99 |
| number of boilers | | | 1 |
| annual hours of operation | | | 2,000 |
| HHV of natural gas | BTU/SCF | | 968 |

**Emissions Auxilliary Boiler**

| | Emission Factor | Emission Factor | | | | |
|---|---|---|---|---|---|---|
| **Air Toxic** | **lb/MMSCF** | **lb/MMBtu** | **lb/hr** | **ton/yr** | **HAPs** | **HAP ton/yr** |
| 1,3-Butadiene | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| 2-Methylnaphthalene | 2.40E-05 | 2.48E-08 | 2.45E-06 | 2.45E-06 | 0 | 0.00E+00 |
| Acetaldehyde | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Acrolein | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Anthracene | 2.40E-06 | 2.48E-09 | 2.45E-07 | 2.45E-07 | HAP | 2.45E-07 |
| Ammonia | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Benzene | 2.10E-03 | 2.17E-06 | 2.15E-04 | 2.15E-04 | HAP | 2.15E-04 |
| Benzo(a)anthracene | 1.80E-06 | 1.86E-09 | 1.84E-07 | 1.84E-07 | HAP | 1.84E-07 |
| Benzo(a)pyrene | 1.20E-06 | 1.24E-09 | 1.23E-07 | 1.23E-07 | HAP | 1.23E-07 |
| Butane | 2.10E+00 | 2.17E-03 | 2.15E-01 | 2.15E-01 | 0 | 0.00E+00 |
| Chrysene | 1.80E-06 | 1.86E-09 | 1.84E-07 | 1.84E-07 | 0 | 0.00E+00 |
| Dibenz(a,h)anthracene | 1.20E-06 | 1.24E-09 | 1.23E-07 | 1.23E-07 | 0 | 0.00E+00 |
| Ethane | 3.10E+00 | 3.20E-03 | 3.17E-01 | 3.17E-01 | 0 | 0.00E+00 |
| Ethylbenzene | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Formaldehyde | 7.50E-02 | 7.75E-05 | 7.67E-03 | 7.67E-03 | HAP | 7.67E-03 |
| Hexane | 4.60E-03 | 4.75E-06 | 4.70E-04 | 4.70E-04 | HAP | 4.70E-04 |
| Naphthalene | 6.10E-04 | 6.30E-07 | 6.24E-05 | 6.24E-05 | HAP | 6.24E-05 |
| Pentane | 2.60E+00 | 2.69E-03 | 2.66E-01 | 2.66E-01 | 0 | 0.00E+00 |
| Phenanthrene | 1.70E-05 | 1.76E-08 | 1.74E-06 | 1.74E-06 | 0 | 0.00E+00 |
| PAH | 9.43E-05 | 9.74E-08 | 9.64E-06 | 9.64E-06 | HAP | 9.64E-06 |
| Propane | 1.60E+00 | 1.65E-03 | 1.64E-01 | 1.64E-01 | 0 | 0.00E+00 |
| Propylene | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Propylene Oxide | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Pyrene | 5.00E-06 | 5.17E-09 | 5.11E-07 | 5.11E-07 | 0 | 0.00E+00 |
| Sulfuric Acid | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Toluene | 3.40E-03 | 3.51E-06 | 3.48E-04 | 3.48E-04 | HAP | 3.48E-04 |
| Xylene (Total) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Arsenic | 2.00E-04 | 2.07E-07 | 2.05E-05 | 2.05E-05 | HAP | 2.05E-05 |
| Barium | 4.40E-03 | 4.55E-06 | 4.50E-04 | 4.50E-04 | 0 | 0.00E+00 |
| Beryllium | 1.20E-05 | 1.24E-08 | 1.23E-06 | 1.23E-06 | HAP | 1.23E-06 |
| Cadmium | 1.10E-03 | 1.14E-06 | 1.13E-04 | 1.13E-04 | HAP | 1.13E-04 |
| Chromium | 1.40E-03 | 1.45E-06 | 1.43E-04 | 1.43E-04 | HAP | 1.43E-04 |
| Cobalt | 8.40E-05 | 8.68E-08 | 8.59E-06 | 8.59E-06 | HAP | 8.59E-06 |
| Copper | 8.50E-04 | 8.78E-07 | 8.69E-05 | 8.69E-05 | 0 | 0.00E+00 |
| Manganese | 3.80E-04 | 3.93E-07 | 3.89E-05 | 3.89E-05 | HAP | 3.89E-05 |
| Mercury | 2.60E-04 | 2.69E-07 | 2.66E-05 | 2.66E-05 | HAP | 2.66E-05 |
| Molybdenum | 1.10E-03 | 1.14E-06 | 1.13E-04 | 1.13E-04 | 0 | 0.00E+00 |
| Nickel | 2.10E-03 | 2.17E-06 | 2.15E-04 | 2.15E-04 | HAP | 2.15E-04 |
| Selenium | 2.40E-05 | 2.48E-08 | 2.45E-06 | 2.45E-06 | HAP | 2.45E-06 |
| Vanadium | 2.30E-03 | 2.38E-06 | 2.35E-04 | 2.35E-04 | 0 | 0.00E+00 |
| Zinc | 2.90E-02 | 3.00E-05 | 2.97E-03 | 2.97E-03 | 0 | 0.00E+00 |

# Oregon Clean Energy
Air Toxic Emissions

| | Units | Fire Pump |
|---|---|---|
| Maximum Fuel Flow | gal/hr | 15 |
| Heating Value Diesel Fuel | Btu/gal | 137,000 |
| Maximum Heat Input | MMBtu/hr | 2.06 |
| number of engines | | 1 |
| annual hours of operation | | 500 |

**Emissions Fire Pump**

| Air Toxic | Emission Factor lb/MMBtu | lb/hr | ton/yr | HAPs | HAP ton/yr |
|---|---|---|---|---|---|
| 1,3-Butadiene | 3.91E-05 | 8.04E-05 | 2.01E-05 | HAP | 2.01E-05 |
| 2-Methylnaphthalene | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Acetaldehyde | 7.67E-04 | 1.58E-03 | 3.94E-04 | HAP | 3.94E-04 |
| Acrolein | 9.25E-05 | 1.90E-04 | 4.75E-05 | HAP | 4.75E-05 |
| Anthracene | 1.87E-06 | 3.84E-06 | 9.61E-07 | HAP | 9.61E-07 |
| Ammonia | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Benzene | 9.33E-04 | 1.92E-03 | 4.79E-04 | HAP | 4.79E-04 |
| Benzo(a)anthracene | 1.68E-06 | 3.45E-06 | 8.63E-07 | HAP | 8.63E-07 |
| Benzo(a)pyrene | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Butane | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Chrysene | 3.53E-07 | 7.25E-07 | 1.81E-07 | 0 | 0.00E+00 |
| Dibenz(a,h)anthracene | 5.83E-07 | 1.20E-06 | 3.00E-07 | 0 | 0.00E+00 |
| Ethane | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Ethylbenzene | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Formaldehyde | 1.18E-03 | 2.42E-03 | 6.06E-04 | HAP | 6.06E-04 |
| Hexane | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Naphthalene | 8.48E-05 | 1.74E-04 | 4.36E-05 | HAP | 4.36E-05 |
| Pentane | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Phenanthrene | 2.94E-05 | 6.04E-05 | 1.51E-05 | 0 | 0.00E+00 |
| PAH | 1.68E-04 | 3.45E-04 | 8.63E-05 | HAP | 8.63E-05 |
| Propane | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Propylene | 2.58E-04 | 5.30E-04 | 1.33E-04 | 0 | 0.00E+00 |
| Propylene Oxide | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Pyrene | 4.78E-06 | 9.82E-06 | 2.46E-06 | 0 | 0.00E+00 |
| Sulfuric Acid | from vendor info | 8.62E-05 | 2.16E-05 | 0 | 0.00E+00 |
| Toluene | 4.09E-04 | 8.40E-04 | 2.10E-04 | HAP | 2.10E-04 |
| Xylene (Total) | 2.85E-04 | 5.86E-04 | 1.46E-04 | HAP | 1.46E-04 |
| Arsenic | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Barium | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Beryllium | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Cadmium | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Chromium | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Cobalt | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Copper | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Manganese | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Mercury | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Molybdenum | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Nickel | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Selenium | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Vanadium | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Zinc | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |

# Oregon Clean Energy

Air Toxic Emissions

| | Units | |
|---|---|---|
| Maximum Fuel Flow | gal/hr | 155 |
| Heating Value Diesel Fuel | Btu/gal | 137,000 |
| Maximum Heat Input | MMBtu/hr | 21.24 |
| number of engines | | 1 |
| annual hours of operation | | 500 |

**Emissions Emergency Generator**

| Air Toxic | Emission Factor lb/MMBtu | lb/hr | ton/yr | HAPs | HAP ton/yr |
|---|---|---|---|---|---|
| 1,3-Butadiene | 3.91E-05 | 8.30E-04 | 2.08E-04 | HAP | 2.08E-04 |
| 2-Methylnaphthalene | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Acetaldehyde | 7.67E-04 | 1.63E-02 | 4.07E-03 | HAP | 4.07E-03 |
| Acrolein | 9.25E-05 | 1.96E-03 | 4.91E-04 | HAP | 4.91E-04 |
| Anthracene | 1.87E-06 | 3.97E-05 | 9.93E-06 | HAP | 9.93E-06 |
| Ammonia | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Benzene | 9.33E-04 | 1.98E-02 | 4.95E-03 | HAP | 4.95E-03 |
| Benzo(a)anthracene | 1.68E-06 | 3.57E-05 | 8.92E-06 | HAP | 8.92E-06 |
| Benzo(a)pyrene | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Butane | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Chrysene | 3.53E-07 | 7.50E-06 | 1.87E-06 | 0 | 0.00E+00 |
| Dibenz(a,h)anthracene | 5.83E-07 | 1.24E-05 | 3.10E-06 | 0 | 0.00E+00 |
| Ethane | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Ethylbenzene | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Formaldehyde | 1.18E-03 | 2.51E-02 | 6.26E-03 | HAP | 6.26E-03 |
| Hexane | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Naphthalene | 8.48E-05 | 1.80E-03 | 4.50E-04 | HAP | 4.50E-04 |
| Pentane | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Phenanthrene | 2.94E-05 | 6.24E-04 | 1.56E-04 | 0 | 0.00E+00 |
| PAH | 1.68E-04 | 3.57E-03 | 8.92E-04 | HAP | 8.92E-04 |
| Propane | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Propylene | 2.58E-04 | 5.48E-03 | 1.37E-03 | 0 | 0.00E+00 |
| Propylene Oxide | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Pyrene | 4.78E-06 | 1.02E-04 | 2.54E-05 | 0 | 0.00E+00 |
| Sulfuric Acid | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Toluene | 4.09E-04 | 8.69E-03 | 2.17E-03 | HAP | 2.17E-03 |
| Xylene (Total) | 2.85E-04 | 6.05E-03 | 1.51E-03 | HAP | 1.51E-03 |
| Arsenic | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Barium | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Beryllium | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Cadmium | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Chromium | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Cobalt | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Copper | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Manganese | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Mercury | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Molybdenum | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Nickel | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Selenium | 0.00E+00 | 0.00E+00 | 0.00E+00 | HAP | 0.00E+00 |
| Vanadium | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |
| Zinc | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0 | 0.00E+00 |

# Oregon Clean Energy
## Air Toxic Emission Factors

Sources:

| | |
|---|---|
| CTGs: | *AP-42 - Background Document for Section 3.1 - Table 3.1-3 (factors including CO catalyst control* |
| CTGs: | *CARB - CATEF Formaldehyde Emission Factor Database for Natural Gas Fired Turbines with SCI* |
| Duct Burner/Aux Boiler: | *AP-42 Compilation of Emission Factors - Table 1.4-3 and Table 1.4-4* |
| Duct Burner/Aux Boiler: | *Ventura County AB2588 combustion emission factor for external combustion equipment - hexane* |
| Emergency Fire Pump and Emergency Generator: | *AP-42 Compilation of Emission Factors - Table 3.3-2* |

| | AP-42 Full Load Emission Factor lb/MMBtu | AP-42 Emission Factor lb/MMSCF | AP-42 Emission Factor lb/MMBtu | | |
|---|---|---|---|---|---|
| **Air Toxic** | **Full Load CTGs** | **duct burner/ boiler** | **emer. fire pump & emer. generator** | **HAP** | **PAH or POM** |
| 1,3-Butadiene | 4.30E-07 | | 3.91E-05 | HAP | |
| 2-Methylnaphthalene | | 2.40E-05 | | | POM |
| Acetaldehyde | 4.00E-05 | | 7.67E-04 | HAP | |
| Acrolein | 6.40E-06 | | 9.25E-05 | HAP | |
| Anthracene | | 2.40E-06 | 1.87E-06 | HAP | PAH |
| Ammonia | | | | | |
| Benzene | 1.20E-05 | 2.10E-03 | 9.33E-04 | HAP | |
| Benzo(a)anthracene | | 1.80E-06 | 1.68E-06 | HAP | PAH |
| Benzo(a)pyrene | | 1.20E-06 | | HAP | PAH |
| Butane | | 2.10E+00 | | | |
| Chrysene | | 1.80E-06 | 3.53E-07 | | PAH |
| Dibenz(a,h)anthracene | | 1.20E-06 | 5.83E-07 | | PAH |
| Ethane | | 3.10E+00 | | | |
| Ethylbenzene | 3.20E-05 | | | HAP | |
| Formaldehyde | 1.10E-04 | 7.50E-02 | 1.18E-03 | HAP | |
| Hexane | | 4.60E-03 | | HAP | |
| Naphthalene | 1.30E-06 | 6.10E-04 | 8.48E-05 | HAP | PAH |
| Pentane | | 2.60E+00 | | | |
| Phenanthrene | | 1.70E-05 | 2.94E-05 | | PAH |
| PAH | 2.20E-06 | 9.43E-05 | 1.68E-04 | HAP | |
| Propane | | 1.60E+00 | | | |
| Propylene | | | 2.58E-04 | | |
| Propylene Oxide | 2.90E-05 | | | HAP | |
| Pyrene | | 5.00E-06 | 4.78E-06 | | PAH |
| Sulfuric Acid | | | | | |
| Toluene | 1.30E-04 | 3.40E-03 | 4.09E-04 | HAP | |
| Xylene (Total) | 6.40E-05 | | 2.85E-04 | HAP | |
| Arsenic | | 2.00E-04 | | HAP | |
| Barium | | 4.40E-03 | | | |
| Beryllium | | 1.20E-05 | | HAP | |
| Cadmium | | 1.10E-03 | | HAP | |
| Chromium | | 1.40E-03 | | HAP | |
| Cobalt | | 8.40E-05 | | HAP | |
| Copper | | 8.50E-04 | | | |
| Manganese | | 3.80E-04 | | HAP | |
| Mercury | | 2.60E-04 | | HAP | |
| Molybdenum | | 1.10E-03 | | | |
| Nickel | | 2.10E-03 | | HAP | |
| Selenium | | 2.40E-05 | | HAP | |
| Vanadium | | 2.30E-03 | | | |
| Zinc | | 2.90E-02 | | | |

# Appendix B: Modeling Results

## Turbine Stack Parameters Modeled by Operating Case

| Source Parameters | | | | | | | | | Emission Rate (g/s) (1) |
|---|---|---|---|---|---|---|---|---|---|
| Source ID | Source Description | Easting (m) | Northing (m) | Base Elevation (m) | Stack Height (ft) | Temperature (F) | Exit Velocity (m/s) | Stack Diameter (ft) | All Pollutants |
| HRGS_C1 | South Turbine Stack - Case 1 | 296560.7108 | 4615714.433 | 179.832 | 240 | 187 | 19.67 | 22 | 1 |
| HRGN_C1 | NorthTurbine Stack - Case 1 | 296560.9797 | 4615757.313 | 179.832 | 240 | 187 | 19.67 | 22 | 1 |
| HRGS_C3 | South Turbine Stack - Case 3 | 296560.7108 | 4615714.433 | 179.832 | 240 | 166 | 13.01 | 22 | 1 |
| HRGN_C3 | NorthTurbine Stack - Case 3 | 296560.9797 | 4615757.313 | 179.832 | 240 | 166 | 13.01 | 22 | 1 |
| HRGS_C4 | South Turbine Stack - Case 4 | 296560.7108 | 4615714.433 | 179.832 | 240 | 188 | 19.82 | 22 | 1 |
| HRGN_C4 | NorthTurbine Stack - Case 4 | 296560.9797 | 4615757.313 | 179.832 | 240 | 188 | 19.82 | 22 | 1 |
| HRGS_C7 | South Turbine Stack - Case 7 | 296560.7108 | 4615714.433 | 179.832 | 240 | 166 | 13.04 | 22 | 1 |
| HRGN_C7 | NorthTurbine Stack - Case 7 | 296560.9797 | 4615757.313 | 179.832 | 240 | 166 | 13.04 | 22 | 1 |
| HRGS_C8 | South Turbine Stack - Case 8 | 296560.7108 | 4615714.433 | 179.832 | 240 | 185 | 18.89 | 22 | 1 |
| HRGN_C8 | NorthTurbine Stack - Case 8 | 296560.9797 | 4615757.313 | 179.832 | 240 | 185 | 18.89 | 22 | 1 |
| HRGS_C11 | South Turbine Stack - Case 11 | 296560.7108 | 4615714.433 | 179.832 | 240 | 165 | 12.75 | 22 | 1 |
| HRGN_C11 | NorthTurbine Stack - Case 11 | 296560.9797 | 4615757.313 | 179.832 | 240 | 165 | 12.75 | 22 | 1 |
| HRGS_C12 | South Turbine Stack - Case 12 | 296560.7108 | 4615714.433 | 179.832 | 240 | 176 | 17.61 | 22 | 1 |
| HRGN_C12 | NorthTurbine Stack - Case 12 | 296560.9797 | 4615757.313 | 179.832 | 240 | 176 | 17.61 | 22 | 1 |
| HRGS_C14 | South Turbine Stack - Case 14 | 296560.7108 | 4615714.433 | 179.832 | 240 | 184 | 17.77 | 22 | 1 |
| HRGN_C14 | NorthTurbine Stack - Case 14 | 296560.9797 | 4615757.313 | 179.832 | 240 | 184 | 17.77 | 22 | 1 |
| HRGS_C17 | South Turbine Stack - Case 17 | 296560.7108 | 4615714.433 | 179.832 | 240 | 166 | 12.34 | 22 | 1 |
| HRGN_C17 | NorthTurbine Stack - Case 17 | 296560.9797 | 4615757.313 | 179.832 | 240 | 166 | 12.34 | 22 | 1 |
| HRGS_C18 | South Turbine Stack - Case 18 | 296560.7108 | 4615714.433 | 179.832 | 240 | 176 | 16.65 | 22 | 1 |
| HRGN_C18 | NorthTurbine Stack - Case 18 | 296560.9797 | 4615757.313 | 179.832 | 240 | 176 | 16.65 | 22 | 1 |
| HRGS_C20 | South Turbine Stack - Case 20 | 296560.7108 | 4615714.433 | 179.832 | 240 | 185 | 16.81 | 22 | 1 |
| HRGN_C20 | NorthTurbine Stack - Case 20 | 296560.9797 | 4615757.313 | 179.832 | 240 | 185 | 16.81 | 22 | 1 |
| HRGS_C23 | South Turbine Stack - Case 23 | 296560.7108 | 4615714.433 | 179.832 | 240 | 169 | 11.82 | 22 | 1 |
| HRGN_C23 | NorthTurbine Stack - Case 23 | 296560.9797 | 4615757.313 | 179.832 | 240 | 169 | 11.82 | 22 | 1 |
| HRGS_C24 | South Turbine Stack - Case 24 | 296560.7108 | 4615714.433 | 179.832 | 240 | 176 | 16.25 | 22 | 1 |
| HRGN_C24 | NorthTurbine Stack - Case 24 | 296560.9797 | 4615757.313 | 179.832 | 240 | 176 | 16.25 | 22 | 1 |
| HRGS_C26 | South Turbine Stack - Case 26 | 296560.7108 | 4615714.433 | 179.832 | 240 | 183 | 15.43 | 22 | 1 |
| HRGN_C26 | NorthTurbine Stack - Case 26 | 296560.9797 | 4615757.313 | 179.832 | 240 | 183 | 15.43 | 22 | 1 |
| HRGS_C28 | South Turbine Stack - Case 28 | 296560.7108 | 4615714.433 | 179.832 | 240 | 171 | 11.46 | 22 | 1 |
| HRGN_C28 | NorthTurbine Stack - Case 28 | 296560.9797 | 4615757.313 | 179.832 | 240 | 171 | 11.46 | 22 | 1 |

**Notes:**

(1) Modeling is performed at an emission rate of 1 g/s to obtain "unified" modeling impacts.

## Turbine Operation Worst-Case Analysis - Results

| Source Parameters | | Emission Rate (g/s) | | | | | | | | Unified Modeled Impacts (ug/m3)[1] | | | | Scaled Impacts (ug/m3)[1,2] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Source ID | Source Description | PM10/ PM2.5 | NOx | CO | NH3 | Formaldehyde | H2SO4 | Toulene | Xylene | 1-hr | 8-hr | 24-hr | Annual | $PM_{10}$/ $PM_{2.5}$ (24-hr) | $PM_{10}$/ $PM_{2.5}$ (Annual) | NOx (Annual) | $NH_3$ (1-hr) | Formaldehyde (1-hr) | $H_2SO_4$ (1-hr) | Toulene (1-hr) | Xylene (1-hr) |
| HRGS_C1 | South Turbine Stack - Case 1 | 1.66 | 2.77 | 1.64 | 20.00 | 0.04 | 0.70 | 0.05 | 0.02 | 0.958 | 0.395 | 0.169 | 0.011 | 0.568 | 0.036 | 0.060 | 38.226 | 0.078 | 1.338 | 0.092 | 0.045 |
| HRGN_C1 | NorthTurbine Stack - Case 1 | 1.66 | 2.77 | 1.64 | 20.00 | 0.04 | 0.70 | 0.05 | 0.02 | 0.953 | 0.399 | 0.172 | 0.011 | | | | | | | | |
| HRGS_C3 | South Turbine Stack - Case 3 | 1.14 | 1.89 | 1.14 | 14.00 | 0.03 | 0.50 | 0.03 | 0.02 | 1.215 | 0.619 | 0.270 | 0.018 | 0.610 | 0.040 | 0.066 | 33.553 | 0.066 | 1.198 | 0.078 | 0.038 |
| HRGN_C3 | NorthTurbine Stack - Case 3 | 1.14 | 1.89 | 1.14 | 14.00 | 0.03 | 0.50 | 0.03 | 0.02 | 1.182 | 0.612 | 0.267 | 0.018 | | | | | | | | |
| HRGS_C4 | South Turbine Stack - Case 4 | 1.68 | 2.77 | 1.64 | 20.00 | 0.04 | 0.70 | 0.05 | 0.02 | 0.951 | 0.391 | 0.167 | 0.011 | 0.566 | 0.036 | 0.059 | 37.982 | 0.077 | 1.329 | 0.091 | 0.045 |
| HRGN_C4 | NorthTurbine Stack - Case 4 | 1.68 | 2.77 | 1.64 | 20.00 | 0.04 | 0.70 | 0.05 | 0.02 | 0.948 | 0.395 | 0.170 | 0.011 | | | | | | | | |
| HRGS_C7 | South Turbine Stack - Case 7 | 1.15 | 1.89 | 1.14 | 14.00 | 0.03 | 0.50 | 0.03 | 0.02 | 1.214 | 0.617 | 0.269 | 0.018 | 0.615 | 0.040 | 0.066 | 33.522 | 0.065 | 1.197 | 0.077 | 0.038 |
| HRGN_C7 | NorthTurbine Stack - Case 7 | 1.15 | 1.89 | 1.14 | 14.00 | 0.03 | 0.50 | 0.03 | 0.02 | 1.181 | 0.610 | 0.267 | 0.018 | | | | | | | | |
| HRGS_C8 | South Turbine Stack - Case 8 | 1.60 | 2.65 | 1.64 | 19.00 | 0.04 | 0.60 | 0.05 | 0.02 | 0.986 | 0.412 | 0.176 | 0.011 | 0.569 | 0.036 | 0.060 | 37.231 | 0.075 | 1.176 | 0.089 | 0.044 |
| HRGN_C8 | NorthTurbine Stack - Case 8 | 1.60 | 2.65 | 1.64 | 19.00 | 0.04 | 0.60 | 0.05 | 0.02 | 0.974 | 0.415 | 0.179 | 0.011 | | | | | | | | |
| HRGS_C11 | South Turbine Stack - Case 11 | 1.11 | 1.77 | 1.14 | 13.00 | 0.03 | 0.40 | 0.03 | 0.02 | 1.227 | 0.632 | 0.276 | 0.018 | 0.611 | 0.040 | 0.064 | 31.466 | 0.063 | 0.968 | 0.074 | 0.037 |
| HRGN_C11 | NorthTurbine Stack - Case 11 | 1.11 | 1.77 | 1.14 | 13.00 | 0.03 | 0.40 | 0.03 | 0.02 | 1.194 | 0.625 | 0.274 | 0.018 | | | | | | | | |
| HRGS_C12 | South Turbine Stack - Case 12 | 1.77 | 2.65 | 1.64 | 19.00 | 0.04 | 0.60 | 0.04 | 0.02 | 1.049 | 0.454 | 0.196 | 0.013 | 0.695 | 0.045 | 0.067 | 39.346 | 0.078 | 1.243 | 0.088 | 0.043 |
| HRGN_C12 | NorthTurbine Stack - Case 12 | 1.77 | 2.65 | 1.64 | 19.00 | 0.04 | 0.60 | 0.04 | 0.02 | 1.022 | 0.454 | 0.198 | 0.013 | | | | | | | | |
| HRGS_C14 | South Turbine Stack - Case 14 | 1.49 | 2.52 | 1.51 | 18.00 | 0.04 | 0.60 | 0.04 | 0.02 | 1.022 | 0.435 | 0.186 | 0.012 | 0.558 | 0.036 | 0.060 | 36.402 | 0.073 | 1.213 | 0.086 | 0.042 |
| HRGN_C14 | NorthTurbine Stack - Case 14 | 1.49 | 2.52 | 1.51 | 18.00 | 0.04 | 0.60 | 0.04 | 0.02 | 1.000 | 0.436 | 0.189 | 0.012 | | | | | | | | |
| HRGS_C17 | South Turbine Stack - Case 17 | 1.06 | 1.64 | 1.01 | 12.00 | 0.02 | 0.40 | 0.03 | 0.01 | 1.240 | 0.647 | 0.283 | 0.018 | 0.598 | 0.039 | 0.060 | 29.343 | 0.059 | 0.978 | 0.070 | 0.034 |
| HRGN_C17 | NorthTurbine Stack - Case 17 | 1.06 | 1.64 | 1.01 | 12.00 | 0.02 | 0.40 | 0.03 | 0.01 | 1.206 | 0.642 | 0.281 | 0.018 | | | | | | | | |
| HRGS_C18 | South Turbine Stack - Case 18 | 1.72 | 2.52 | 1.51 | 19.00 | 0.04 | 0.60 | 0.04 | 0.02 | 1.075 | 0.477 | 0.204 | 0.013 | 0.704 | 0.046 | 0.067 | 40.326 | 0.076 | 1.273 | 0.085 | 0.042 |
| HRGN_C18 | NorthTurbine Stack - Case 18 | 1.72 | 2.52 | 1.51 | 19.00 | 0.04 | 0.60 | 0.04 | 0.02 | 1.047 | 0.477 | 0.206 | 0.013 | | | | | | | | |
| HRGS_C20 | South Turbine Stack - Case 20 | 1.39 | 2.27 | 1.39 | 17.00 | 0.03 | 0.60 | 0.04 | 0.02 | 1.049 | 0.455 | 0.252 | 0.013 | 0.694 | 0.035 | 0.057 | 35.212 | 0.070 | 1.243 | 0.082 | 0.041 |
| HRGN_C20 | NorthTurbine Stack - Case 20 | 1.39 | 2.27 | 1.39 | 17.00 | 0.03 | 0.60 | 0.04 | 0.02 | 1.022 | 0.455 | 0.249 | 0.013 | | | | | | | | |
| HRGS_C23 | South Turbine Stack - Case 23 | 1.01 | 1.51 | 0.88 | 11.00 | 0.02 | 0.40 | 0.03 | 0.01 | 1.252 | 0.661 | 0.290 | 0.019 | 0.583 | 0.038 | 0.057 | 27.353 | 0.055 | 0.995 | 0.065 | 0.032 |
| HRGN_C23 | NorthTurbine Stack - Case 23 | 1.01 | 1.51 | 0.88 | 11.00 | 0.02 | 0.40 | 0.03 | 0.01 | 1.235 | 0.661 | 0.288 | 0.019 | | | | | | | | |
| HRGS_C24 | South Turbine Stack - Case 24 | 1.69 | 2.52 | 1.51 | 18.00 | 0.04 | 0.60 | 0.04 | 0.02 | 1.086 | 0.487 | 0.209 | 0.014 | 0.708 | 0.046 | 0.069 | 38.593 | 0.076 | 1.286 | 0.083 | 0.041 |
| HRGN_C24 | NorthTurbine Stack - Case 24 | 1.69 | 2.52 | 1.51 | 18.00 | 0.04 | 0.60 | 0.04 | 0.02 | 1.058 | 0.488 | 0.210 | 0.014 | | | | | | | | |
| HRGS_C26 | South Turbine Stack - Case 26 | 1.27 | 2.02 | 1.26 | 15.00 | 0.03 | 0.50 | 0.04 | 0.02 | 1.094 | 0.496 | 0.212 | 0.014 | 0.540 | 0.035 | 0.055 | 32.380 | 0.065 | 1.079 | 0.077 | 0.038 |
| HRGN_C26 | NorthTurbine Stack - Case 26 | 1.27 | 2.02 | 1.26 | 15.00 | 0.03 | 0.50 | 0.04 | 0.02 | 1.065 | 0.497 | 0.211 | 0.014 | | | | | | | | |
| HRGS_C28 | South Turbine Stack - Case 28 | 1.01 | 1.39 | 0.88 | 11.00 | 0.02 | 0.40 | 0.02 | 0.01 | 1.269 | 0.672 | 0.295 | 0.019 | 0.594 | 0.038 | 0.053 | 27.837 | 0.053 | 1.012 | 0.063 | 0.031 |
| HRGN_C28 | NorthTurbine Stack - Case 28 | 1.01 | 1.39 | 0.88 | 11.00 | 0.02 | 0.40 | 0.02 | 0.01 | 1.261 | 0.674 | 0.293 | 0.019 | | | | | | | | |

**Notes:**

(1) Impacts based on modeling at an emission rate of 1 g/s for each turbine stack. The unified impacts are multiplied with the actual emission rates to obtain scaled impacts. See example below:

$PM_{2.5}$/$PM_{10}$ 24-hour Scaled Impacts for Operating Case 1: (1.69 g/s x 0.169 ug/m3) + (1.69 x 0.172 ug/m3) = 0.568 ug/m3

(2) Shaded results represent the maximum impacts for the pollutant/averaging period.

## Modeling Inputs and Results - $PM_{10}$, $PM_{2.5}$, and NOx (Annual)

| Stack Parameters | | | | | | | | | Emission Rate (g/s) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Source ID | Source Description | Easting (m) | Northing (m) | Base Elevation (m) | Stack Height (ft) | Temperature (F) | Exit Velocity (m/s) | Stack Diameter | $PM_{10}$ | $PM_{2.5}$ | NOx (Annual) |
| HRGS_C24 | Case 24 | 296560.71 | 4615714.43 | 179.832 | 240 | 176 | 16.25 | 22 | 1.69 | 1.69 | 2.52 |
| HRGN_C24 | Case 24 | 296560.98 | 4615757.31 | 179.832 | 240 | 176 | 16.25 | 22 | 1.69 | 1.69 | 2.52 |
| CELL1 | Cooling Tower Cells 1 through 16 | 296389.28 | 4615758.47 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL2 | | 296404.77 | 4615758.47 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL3 | | 296419.89 | 4615758.25 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL4 | | 296435.54 | 4615758.04 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL5 | | 296451.20 | 4615758.15 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL6 | | 296466.87 | 4615758.15 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL7 | | 296482.55 | 4615758.09 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL8 | | 296498.15 | 4615758.09 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL9 | | 296498.16 | 4615744.46 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL10 | | 296482.37 | 4615744.40 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL11 | | 296466.87 | 4615744.35 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL12 | | 296451.20 | 4615744.35 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL13 | | 296435.52 | 4615744.35 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL14 | | 296419.90 | 4615744.35 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL15 | | 296404.84 | 4615744.67 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |
| CELL16 | | 296389.11 | 4615744.68 | 179.832 | 66 | 77 | 8.45 | 33 | 0.0082 | 3.15E-05 | -- |

## Results

| Pollutant | Averaging Period | Maximum Impact (ug/m3) | SIL (ug/m3) |
|---|---|---|---|
| $PM_{2.5}$ | 24-hr | 0.61 | 1.2 |
| | Annual | 0.04 | 0.3 |
| $PM_{10}$ | 24-hr | 3.35 | 5 |
| | Annual | 0.59 | 1 |
| NOx | Annual | 0.068 | 1 |

*PM2.5 impacts shown are maximum 1st highest 24-hr and maximum annual results averaged over 5 years

## Startup Controlling Case Analysis

| Stack Parameters | | | | | | | | | Emission Rate (g/s) | | Unified Impacts (ug/m3) | | Scaled Impacts (ug/m3) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Source ID | Source Description | Easting (m) | Northing (m) | Base Elevation (m) | Stack Height (ft) | Temperature (F) | Exit Velocity (m/s) | Stack Diameter (ft) | CO | NOx | 1-hr | 8-hr | CO (1-hr) | CO (8-hr) | NOx (1-hr) |
| HRGS_HS | South Turbine Stack - Hot Start | 296560.71 | 4615714.43 | 179.93 | 240 | 173.00 | 15.40 | 22 | 26.67 | 9.69 | 1.1186 | 0.5172 | 29.831 | 13.793 | 10.838 |
| HRGN_HS | NorthTurbine Stack - Hot Start | 296560.98 | 4615757.31 | 179.93 | 240 | 173.00 | 15.40 | 22 | 26.67 | 9.69 | 1.0888 | 0.5186 | 29.035 | 13.830 | 10.549 |
| HRGS_WS | South Turbine Stack - Warm Start | 296560.71 | 4615714.43 | 179.93 | 240 | 174.00 | 15.63 | 22 | 27.10 | 9.96 | 1.1092 | 0.5084 | 30.061 | 13.779 | 11.048 |
| HRGN_WS | North Turbine Stack - Warm Start | 296560.98 | 4615757.31 | 179.93 | 240 | 174.00 | 15.63 | 22 | 27.10 | 9.96 | 1.0797 | 0.5098 | 29.260 | 13.815 | 10.754 |
| HRGS_CS | South Turbine Stack - Cold Start | 296560.71 | 4615714.43 | 179.93 | 240 | 169.00 | 13.64 | 22 | 22.95 | 7.90 | 1.1850 | 0.5848 | 27.198 | 13.423 | 9.365 |
| HRGN_CS | North Turbine Stack - Cold Start | 296560.98 | 4615757.31 | 179.93 | 240 | 169.00 | 13.64 | 22 | 22.95 | 7.90 | 1.1529 | 0.5816 | 26.462 | 13.349 | 9.111 |

**Notes:**

(1) Shaded results represent the maximum impacts for the pollutant/averaging period.

## CO Modeling Stack Parameters and Results

| Source Parameters | | | | | | | | | Emission Rate (g/s) (1) |
|---|---|---|---|---|---|---|---|---|---|
| **Source ID** | **Source Description** | **Easting (m)** | **Northing (m)** | **Base Elevation (m)** | **Stack Height (ft)** | **Temperature (F)** | **Exit Velocity (m/s)** | **Stack Diameter (ft)** | **CO** |
| HRGS_WS | South Turbine Stack - Warm Start | 296560.71 | 4615714.43 | 179.832 | 240 | 174 | 15.63 | 22 | 27.10 |
| HRGN_WS | NorthTurbine Stack - Warm Start | 296560.9797 | 4615757.31 | 179.832 | 240 | 174 | 15.63 | 22 | 27.79 |
| HRGS_HS | South Turbine Stack - Hot Start | 296560.71 | 4615714.43 | 179.832 | 240 | 173 | 15.40 | 22 | 26.67 |
| HRGN_HS | NorthTurbine Stack - Hot Start | 296560.9797 | 4615757.31 | 179.832 | 240 | 173 | 15.40 | 22 | 27.35 |
| AUXBLR | Auxilliary Boiler | 296560.9797 | 4615757.31 | 179.832 | 240 | 200 | 5.107 | 4 | 0.69 |

(1) Auxilliary boiler emissions are added to the north turbine stack (HRGN_WS and HRGN_HS)

## Results

| Pollutant | Averaging Period | Maximum Impact (ug/m3) | SIL (ug/m3) |
|---|---|---|---|
| CO | 1-hr | 31.79 | 2,000 |
| | 8-hr | 14.84 | 500 |

*Only one turbine will start-up at anytime.

**South turbine stack and the auxilliary boiler stack are modeled as separate stacks; North turbine stack and the auxilliary boiler stack are modeled as combined stacks

## NOx 1-hr Modeling Stack Parameters and Results

| Source Parameters | | | | | | | | | Emission Rate (g/s) (1) |
|---|---|---|---|---|---|---|---|---|---|
| Source ID | Source Description | Easting (m) | Northing (m) | Base Elevation (m) | Stack Height (ft) | Temperature (F) | Exit Velocity (m/s) | Stack Diameter (ft) | NOx |
| HRGS_WS | South Turbine Stack - Warm Start | 296560.71 | 4615714 | 179.832 | 240 | 174 | 15.63 | 22 | 9.96 |
| HRGN_WS | NorthTurbine Stack - Warm Start | 296560.98 | 4615757 | 179.832 | 240 | 174 | 15.63 | 22 | 10.21 |
| AUXBLR | Auxilliary Boiler | 296560.98 | 4615757 | 179.832 | 240 | 200 | 5.107 | 4 | 0.25 |

(1) Auxilliary boiler emissions are added to the north turbine stack (HRGN_WS)

## Results

| Pollutant | Averaging Period | Maximum Impact (ug/m3) | SIL (ug/m3) |
|---|---|---|---|
| NOx | 1-hr | 6.96 | 7.52 |

*Only one turbine will start-up at anytime.

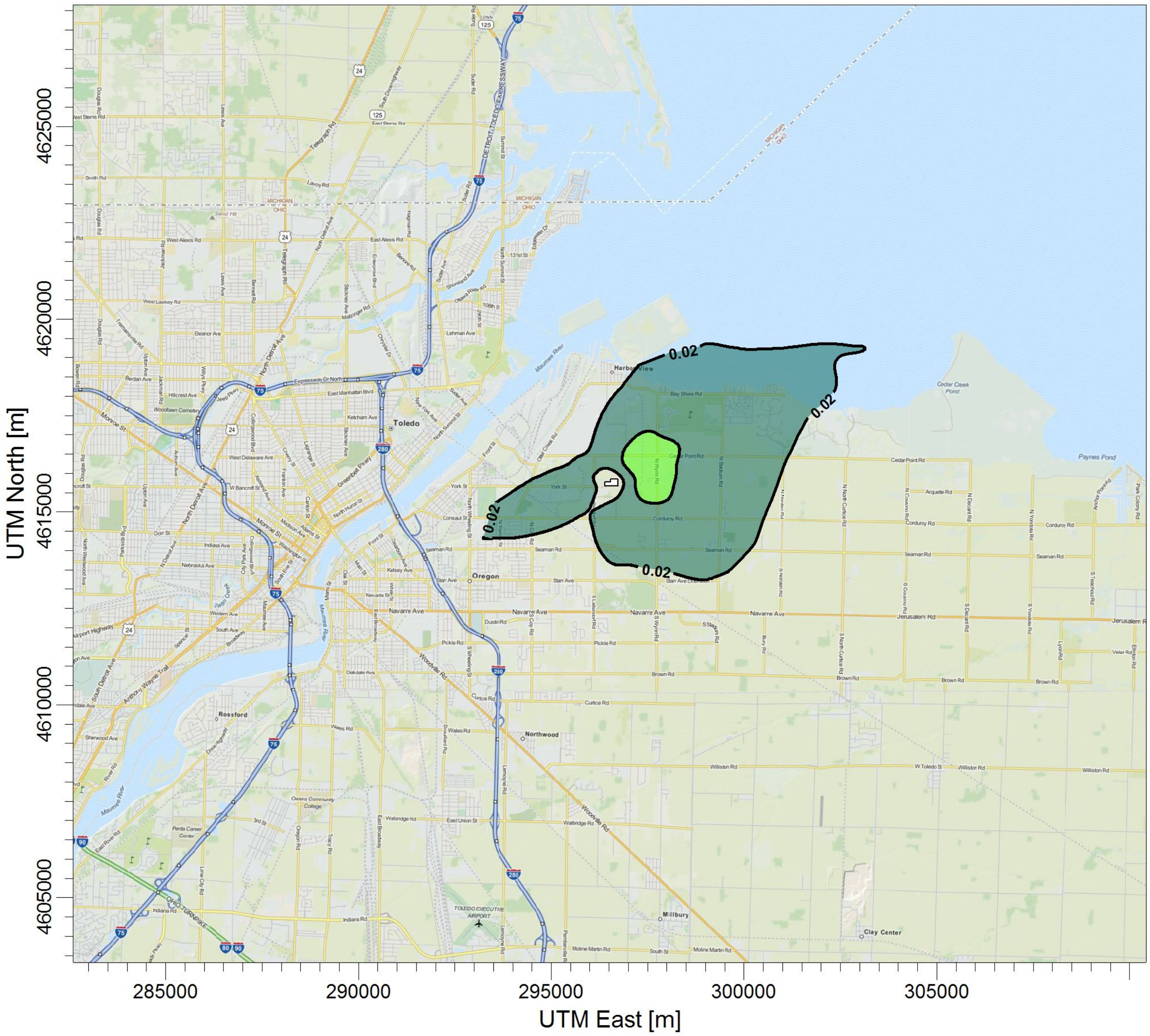
**South turbine stack and the auxilliary boiler stack are modeled as separate stacks; North turbine stack and the auxilliary boiler stack are modeled as combined stacks

***Maximum 1st-Highest 1-hr Results Averaged over 5 Years

# Appendix C: Plots of Maximum-Impact Cases

PROJECT TITLE:

**Worst Case Annual NO2 Impact**
**Annual Average**




PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

ug/m^3

0.02 | 0.05 | 0.10 | 1.00

COMMENTS:

Siemens Layout
2010
SIL: 1.0 ug/m3

Case 24 (100 percent load with duct firing at 105 deg F).

SOURCES:

**21**

COMPANY NAME:

**OREGON CLEAN ENERGY CENTER**

RECEPTORS:

**3324**

MODELER:

**RLK**

ARCADIS

OUTPUT TYPE:

**Concentration**

SCALE: 1:175,000

0 5 km

MAX:

**0.06844 ug/m^3**

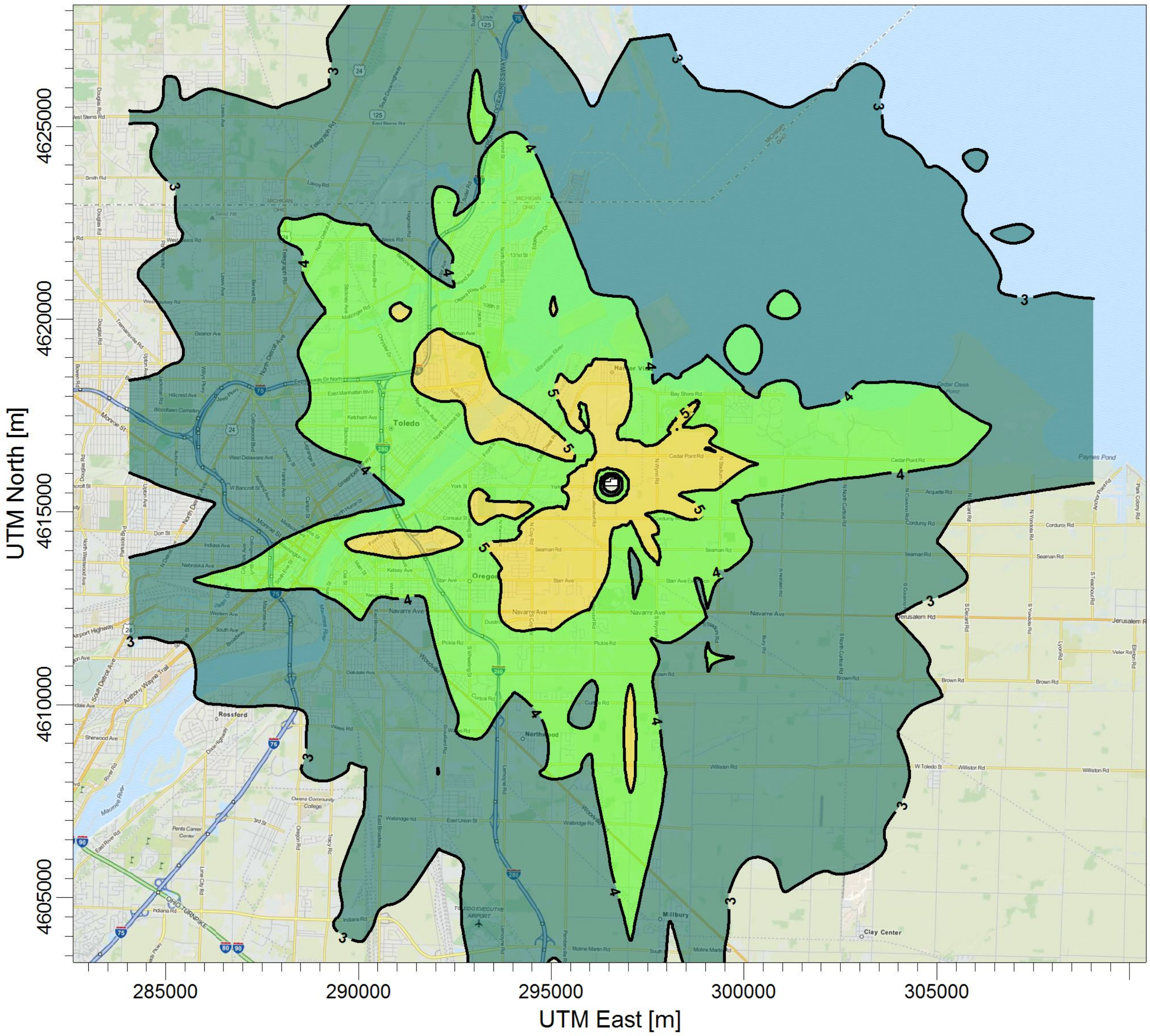
DATE:

**2/6/2013**

PROJECT NO.:

PROJECT TITLE:

**Worst Case 1-Hour NO2 Impact**
**1st Highest Maximum Daily 1-Hour Values Averaged Over 5 Years**



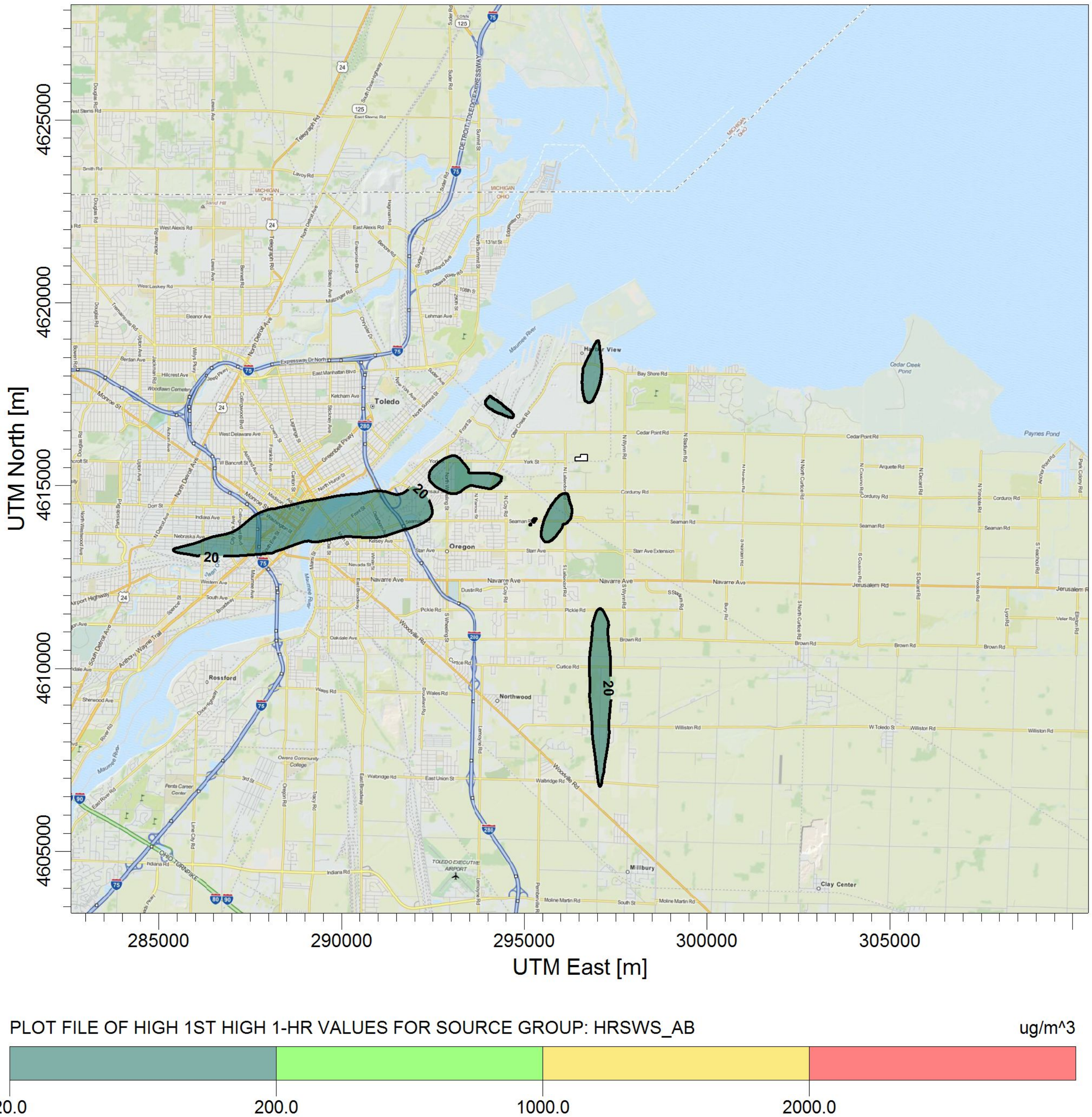

PLOT FILE OF 1ST-HIGHEST MAX DAILY 1-HR VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: HRGS_AB ug/m^3

3.00 4.00 5.00 7.52

| | | | |
|---|---|---|---|
| COMMENTS:<br><br>Siemens Layout<br>2006 - 2010<br>SIL: 7.52 ug/m3<br><br>Warm Start on southern stack with auxiliary boiler. | SOURCES:<br>**21** | COMPANY NAME:<br>**OREGON CLEAN ENERGY CENTER** | |
| | RECEPTORS:<br>**3324** | MODELER:<br>**RLK** | ARCADIS |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:175,000<br>0 — 5 km | |
| | MAX:<br>**6.95795 ug/m^3** | DATE:<br>**2/6/2013** | PROJECT NO.: |

PROJECT TITLE:

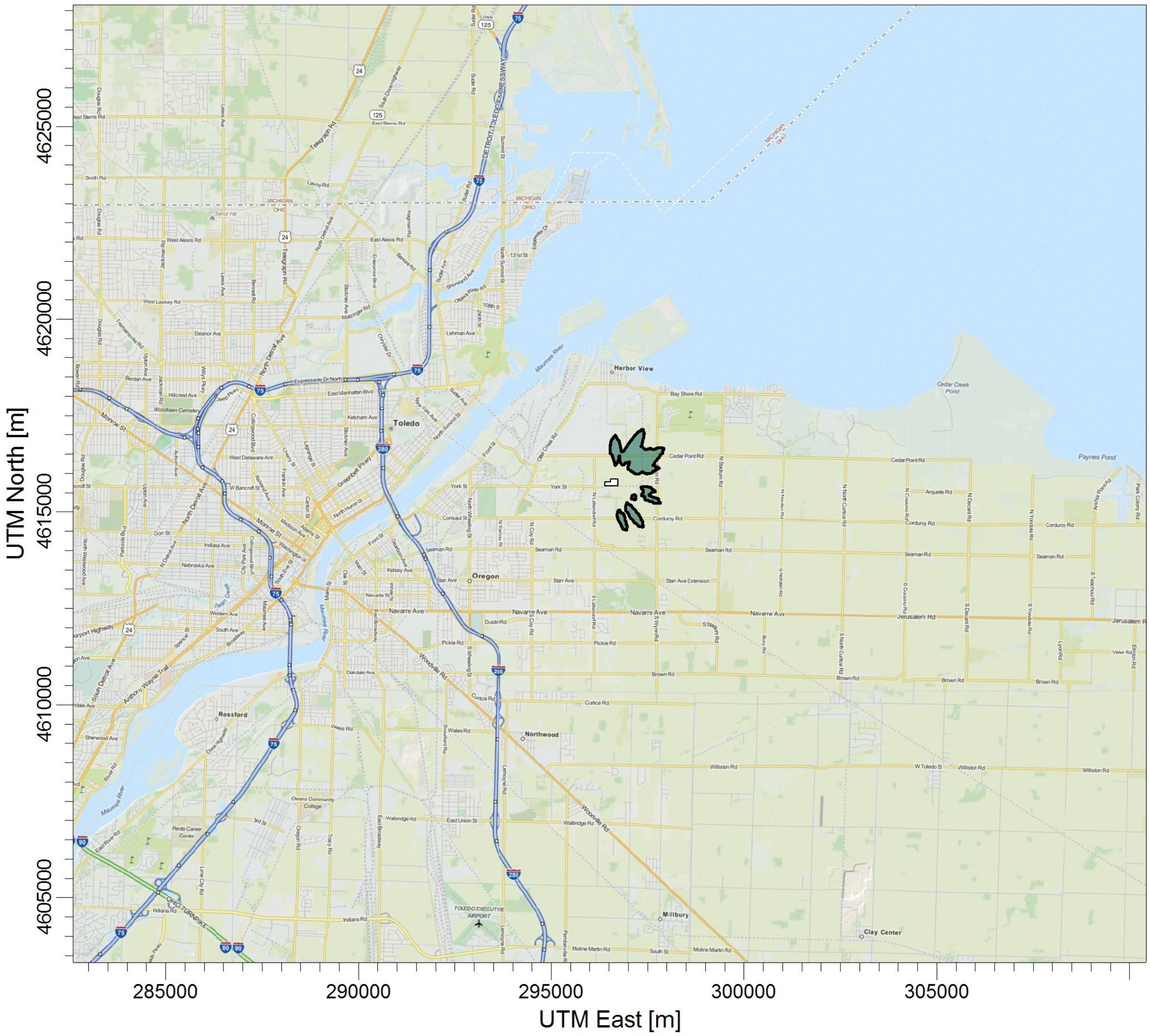
**Worst Case 1-Hour CO Impact**
**Maximum 1-Hour Average**




| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| Siemens Layout<br>2010<br>SIL: 2,000 ug/m3<br><br>Warm Start on southern stack with auxiliary boiler. | **21** | **OREGON CLEAN ENERGY CENTER** | |
| | RECEPTORS:<br>**3324** | MODELER:<br>**RLK** | ARCADIS |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:175,000<br>0 5 km | |
| | MAX:<br>**31.78863 ug/m^3** | DATE:<br>**2/6/2013** | PROJECT NO.: |

PROJECT TITLE:

**Worst Case 8-Hour CO Impact**
**Maximum 8-Hour Average**



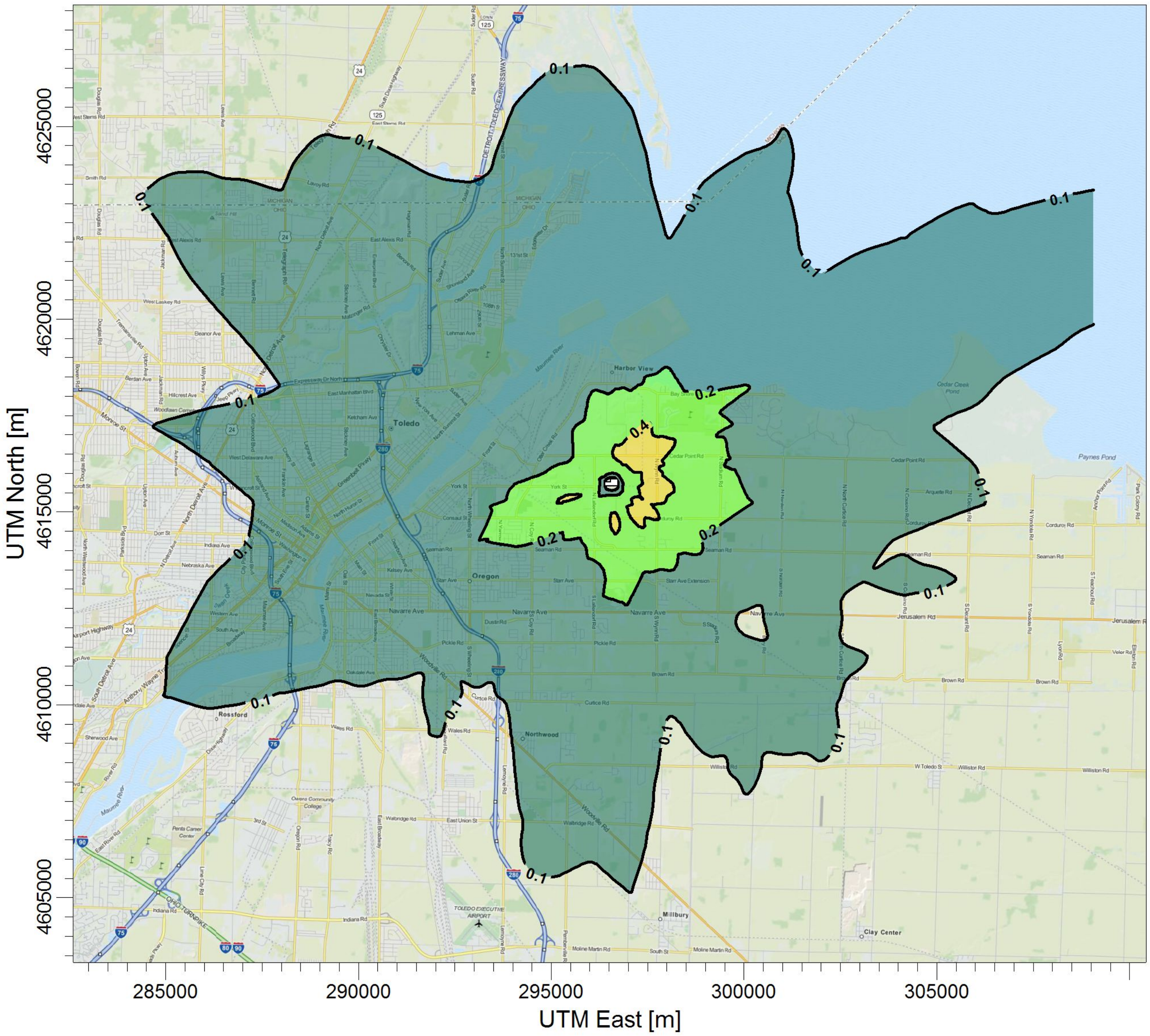

PLOT FILE OF HIGH 1ST HIGH 8-HR VALUES FOR SOURCE GROUP: HRSHS_AB — ug/m^3

10.0 — 50.0 — 100.0 — 500.0

| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| Siemens Layout<br>2008<br>SIL: 500 ug/m3<br><br>Hot Start on southern stack with auxiliary boiler. | **21** | **OREGON CLEAN ENERGY CENTER** | |
| | RECEPTORS:<br>**3324** | MODELER:<br>**RLK** | ARCADIS |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:175,000<br>0 — 5 km | |
| | MAX:<br>**14.83934 ug/m^3** | DATE:<br>**2/6/2013** | PROJECT NO.: |

PROJECT TITLE:

**Worst Case 24-Hour PM2.5 Impact**
**1st Highest Maximum 24-Hour Values Averaged Over 5 Years**




PLOT FILE OF 1ST-HIGHEST MAX DAILY 24-HR VALUES AVERAGED OVER 5 YEARS FOR SOURCE GROUP: ALL ug/m^3

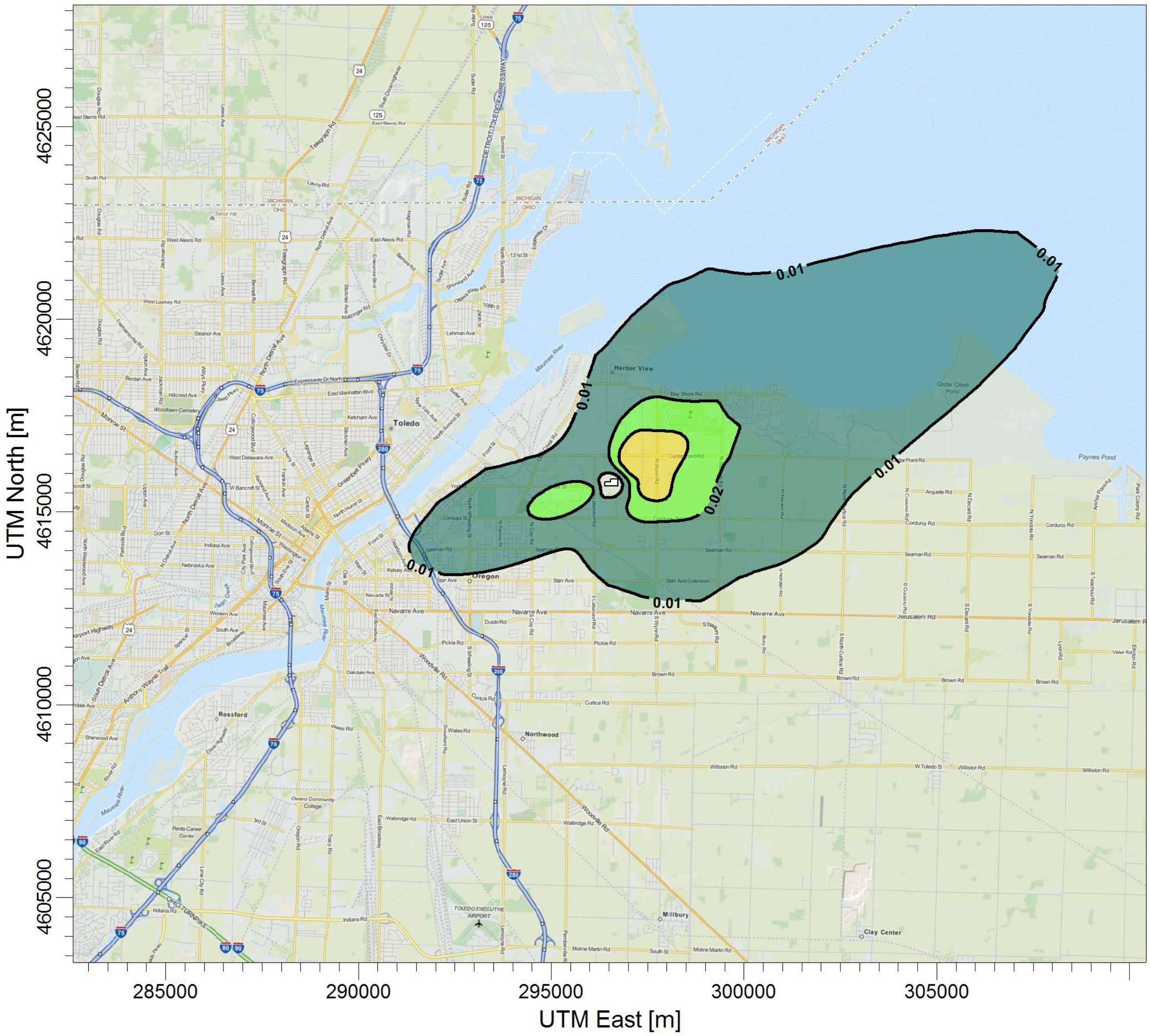
0.1 | 0.2 | 0.4 | 1.2

| | | |
|---|---|---|
| COMMENTS:<br><br>Siemens Layout<br>2006 - 2010<br>SIL: 1.2 ug/m3<br><br>Case 24 (100 percent load with duct firing at 105 deg F) and Cooling Tower. | SOURCES:<br>**21** | COMPANY NAME:<br>**OREGON CLEAN ENERGY CENTER** |
| | RECEPTORS:<br>**3324** | MODELER:<br>**RLK** |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:175,000<br>0 — 5 km |
| | MAX:<br>**0.60858 ug/m^3** | DATE:<br>**2/6/2013** |
| | | PROJECT NO.: |

ARCADIS

PROJECT TITLE:

**Worst Case Annual PM2.5 Impact**
**5 Year Average of Annual Impacts**




PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

ug/m^3

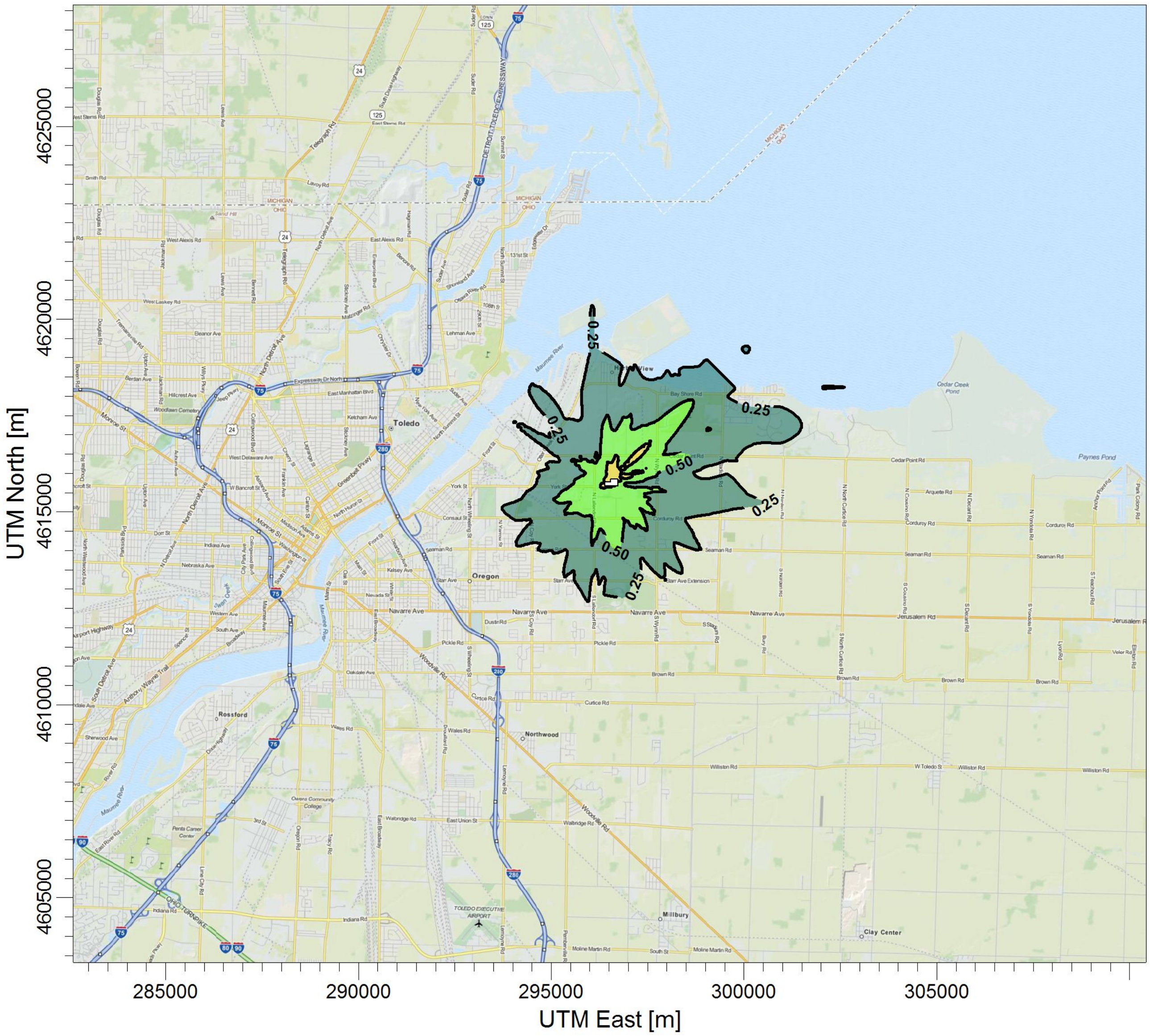
0.01 | 0.02 | 0.03 | 0.30

| | | |
|---|---|---|
| COMMENTS:<br><br>Siemens Layout<br>2006 - 2010<br>SIL: 0.3 ug/m3<br><br>Case 24 (100 percent load with duct firing at 105 deg F) and Cooling Tower. | SOURCES:<br>**21** | COMPANY NAME:<br>**OREGON CLEAN ENERGY CENTER** |
| | RECEPTORS:<br>**3324** | MODELER:<br>**RLK** |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:175,000<br>0 — 5 km |
| | MAX:<br>**0.04421 ug/m^3** | DATE:<br>**2/6/2013** |
| | | PROJECT NO.: |

ARCADIS

PROJECT TITLE:

**Worst Case 24-Hour PM10 Impact**
**1st Highest 24-Hour Average**




PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

0.25 0.50 1.00 5.00

| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| Siemens Layout<br>2010<br>SIL: 5.0 ug/m3<br><br>Case 24 (100 percent load with duct firing at 105 deg F) and Cooling Tower. | **21** | **OREGON CLEAN ENERGY CENTER** | |
| | RECEPTORS:<br>**3324** | MODELER:<br>**RLK** | ARCADIS |
| | OUTPUT TYPE:<br>**Concentration** | SCALE: 1:175,000<br>0 5 km | |
| | MAX:<br>**3.35323 ug/m^3** | DATE:<br>**2/6/2013** | PROJECT NO.: |

**Dispersion Modeling Report**
Oregon Clean Energy Center
Lucas County, OH
Siemens Turbines, Volume 2

# Appendix D: Modeling Files

# Appendix E: Agency Correspondence

**Ohio Division of Wildlife**
*Scott Zody, Chief*
*2045 Morse Rd., Bldg. G*
*Columbus, OH 43229-6693*
*Phone: (614) 265-6300*

September 17, 2012

Lynn Gresock
ARCADIS U.S., Inc.
One Executive Drive, Suite 303
Chelmsford, MA, 01824

Dear Ms. Gresock

After reviewing the Natural Heritage Database, I find the Division of Wildlife has no records of rare or endangered species in the Oregon Clean Energy Center project area, including a one mile radius, at 816 Lallendorf Road, in the City of Oregon, Lucas County, Ohio. We are unaware of any unique ecological sites, geologic features, animal assemblages, scenic rivers, state wildlife areas, nature preserves, parks or forests, national wildlife refuges, parks or forests or other protected natural areas within a one mile radius of the project area.

Our inventory program has not completely surveyed Ohio and relies on information supplied by many individuals and organizations. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area. Although we inventory all types of plant communities, we only maintain records on the highest quality areas.

This letter only represents a review of rare species and natural features data within the Ohio Natural Heritage Database. It does not fulfill coordination under the National Environmental Policy Act (NEPA) or the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S. C. 661 et seq.) and does not supersede or replace the regulatory authority of any local, state or federal agency nor relieve the applicant of the obligation to comply with any local, state or federal laws or regulations.

Please contact me at 614-265-6452 if I can be of further assistance.

Sincerely,

Greg Schneider

Greg Schneider, Administrator
Ohio Natural Heritage Program

# United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614) 416-8993 / FAX (614) 416-8994


October 11, 2012

ARCADIS U.S., Inc.
Attn: Lynn Gresock
1 Executive Drive, Suite 303
Chelmsford, Massachusetts 01824

Reference: Oregon Clean Energy Project – City of Oregon in Lucas County, Ohio

Dear Ms. Gresock,

TAILS # 03E15000-2012-TA-1444

We have received your recent correspondence requesting information about the subject proposal. There are no Federal wilderness areas, wildlife refuges or designated critical habitat within the vicinity of the project area. Based on the information you have provided, at this time we have no objection to the proposed project.

ENDANGERED SPECIES COMMENTS: Due to the project type, size, and location, we do not anticipate any impact on federally listed endangered, threatened, or candidate species, or their habitats. Should the project design change, or during the term of this action, additional information on listed or proposed species or their critical habitat become available, or if new information reveals effects of the action that were not previously considered, consultation with the Service should be initiated to assess any potential impacts.

If you have additional questions or require further assistance with your project proposal, please contact me at the following number (614) 416-8993, x12. I would be happy to discuss the project in further detail with you and provide additional assistance if necessary. In addition, you can find more information on natural resources in Ohio, and a county list of federally threatened and endangered species in Ohio, by visiting our homepage at: http://www.fws.gov/midwest/ohio.

Sincerely,

Jeromy M. Gyzgeto

for Mary Knapp, Ph.D.
Field Supervisor