**STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS**

**PUBLIC UTILITIES COMMISSION**

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| **IN RE: INVENERGY THERMAL DEVELOPMENT LLC** | **)** | |
| **APPLICATION TO CONSTRUCT AND OPERATE THE** | **)** | **Dkt. 4609** |
| **CLEAR RIVER ENERGY CENTER, BURRILLVILLE,** | **)** | |
| **RHODE ISLAND** | **)** | |

**INVENERGY THERMAL DEVELOPMENT LLC'S REPONSES TO CONSERVATION LAW FOUNDATION'S FIRST DATA REQUEST**

1.1: A copy of the material transmitted by ESS Group on behalf of Invenergy on October 30, 2015 to Doug McVay, R.I. Department of Environmental Management, entitled "Air Dispersion Modeling Report — Clear River Energy Center — Burrillville, Rhode Island."

RESPONSE 1.1: See attached: Air Dispersion Modeling Report — Clear River Energy Center — Burrillville, Rhode Island

RESPONDENT: Michael E. Feinblatt, ESS Group

DATE: April 14, 2016



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October 30, 2015

Mr. Doug McVay
Rhode Island Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, Rhode Island 02908

***Re: Air Dispersion Modeling Report - Clear River Energy Center– Burrillville, Rhode Island***

Dear Mr. McVay:

Enclosed for your review is an Air Dispersion Modeling Report for the Clear River Energy Center, a combined-cycle electric generating facility being proposed by Invenergy Thermal Development, LLC (Invenergy) at the Spectra Energy Algonquin Compressor Station site on Wallum Lake Road (State Route 100) in Burrillville, Rhode Island (the Project or the Facility). The Facility will be a new major stationary source, as it will have the potential to emit 100 tons per year or more of a regulated new source review (NSR) pollutant.

In accordance with RIDEM Air Pollution Control Regulation No. 9, Section 9.5.2, major stationary sources proposed in areas designated as attainment or unclassifiable for any pollutant for which there is a significant net emissions increase at the source must obtain a Major Source Permit. The conditions which must be met for the issuance of a Major Source Permit include a demonstration, by means of air quality modeling, that the allowable emission increases from the proposed source would not cause or contribute to air pollution in violation of any NAAQS or any increase in ambient concentrations exceeding the remaining available PSD increment for the specified air contaminant. The additional impact analyses required by RIDEM's PSD and Air Toxics regulations must also be completed prior to the issuance of a Major Source Permit.

An Air Dispersion Modeling Protocol was submitted to RIDEM on April 20, 2015, which described the procedures to be used for the air quality impact analysis to be completed for the Project. A Major Source Permit Application was submitted for the Project on June 26, 2015. RIDEM conditionally approved the Protocol in a letter dated July 27, 2015. The enclosed Air Dispersion Modeling Report details the air quality impact analysis completed for the Project in accordance with the approved Protocol. As detailed in the enclosed Report, the air quality impact analysis completed for the Project has demonstrated compliance with all of the applicable acceptance criteria of RIDEM APCR No. 9.5.2.

Please contact me at (781) 419-7749 or at mfeinblatt@essgroup.com with any questions you may have about the enclosed Air Dispersion Modeling Report.

Sincerely,

**ESS GROUP, INC.**

Michael E. Feinblatt
Vice President, Energy & Industrial Services

Enclosures

C: John Niland, Invenergy

# Air Dispersion Modeling Report Combined-Cycle Electric Generating Facility

## CLEAR RIVER ENERGY CENTER
## BURRILLVILLE, RHODE ISLAND

**PREPARED FOR:**
Invenergy Thermal Development LLC
One South Wacker Drive
Suite 1900
Chicago, IL 60606

**FOR SUBMITTAL TO:**
Office of Air Resources
Rhode Island Department of Environmental Management
235 Promenade Street
Providence, Rhode Island 02908

**PREPARED BY:**
ESS Group, Inc.
10 Hemingway Drive, 2nd Floor
East Providence, Rhode Island 02915

ESS Project No. I108-011

October 30, 2015

**AIR DISPERSION MODELING REPORT**
**COMBINED-CYCLE ELECTRIC GENERATING FACILITY**

**Clear River Energy Center**
**Burrillville, Rhode Island**

*Prepared For:*

**Invenergy Thermal Development LLC**
One South Wacker Drive
Suite 1900
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*For Submittal To:*

**Office of Air Resources**
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**ESS Project No. I108-011**

**October 30, 2015**

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## 1.0 INTRODUCTION

### 1.1 Background

ESS Group, Inc. (ESS) was contracted by Invenergy Thermal Development LLC (Invenergy) to conduct an air quality impact analysis for the Clear River Energy Center, a combined-cycle electric generating facility being proposed by Invenergy at the Spectra Energy Algonquin Compressor Station site on Wallum Lake Road (State Route 100) in Burrillville, Rhode Island (the Facility).

The Facility will be a new major stationary source, as it will have the potential to emit 100 tons per year or more of a regulated new source review (NSR) pollutant. In accordance with Rhode Island Department of Environmental Management RIDEM Air Pollution Control Regulation No. 9, Section 9.5.2, major stationary sources proposed in areas designated as attainment or unclassifiable for any pollutant for which there is a significant net emissions increase at the source must obtain a Major Source Permit. The conditions which must be met for the issuance of a Major Source Permit include a demonstration, by means of air quality modeling, that the allowable emission increases from the proposed source would not cause or contribute to air pollution in violation of any National Ambient Air Quality Standard (NAAQS) or any increase in ambient concentrations exceeding the remaining available Prevention of Signification Deterioration (PSD) Increment for the specified air contaminant. The additional impact analyses required by RIDEM's PSD and Air Toxics regulations must also be completed prior to the issuance of a Major Source Permit.

The RIDEM "Rhode Island Air Dispersion Modeling Guidelines for Stationary Sources (March 2013 Revision)" (RIDEM, 2013) outlines the accepted procedures for performing modeling analyses in conformance with the EPA Guideline on Air Quality Models (40 CFR 51, Appendix W). To ensure that all modeling analyses subject to the approval of RIDEM are performed in accordance with applicable state and federal guidance, an applicant must submit a modeling protocol prior to conducting the analysis. The protocol describes the input parameters, models, and assumptions that will be used in the analysis.

An Air Dispersion Modeling Protocol was submitted to RIDEM on April 20, 2015, which described the procedures to be used for the air quality impact analysis to be completed for the Project. A Major Source Permit Application was submitted for the Project on June 26, 2015. RIDEM conditionally approved the Protocol in a letter dated July 27, 2015. This Air Dispersion Modeling Report details the air quality impact analysis completed for the Project in accordance with the approved Protocol. As detailed in this Report, the air quality impact analysis completed for the Project has demonstrated compliance with all of the applicable acceptance criteria of RIDEM APCR No. 9.5.2.

### 1.2 Facility Description

The Clear River Energy Center is a combined-cycle electric generating facility being proposed by Invenergy at the Spectra Energy Algonquin Compressor Station site located along Wallum Lake Road in Burrillville, Rhode Island. A site locus map is shown in Figure 1. The preliminary Facility site layout plan is shown in Figure 2. Figure 3 shows the general arrangement of the Facility equipment. A topographic map of the area within 3 km of the proposed Facility location is shown in Figure 4.

The Facility will consist of two advanced class (G-class or above) gas turbines operated in a combined-cycle configuration, each equipped with a heat recovery steam generator (HRSG) with natural fired duct burners, a steam turbine, and an air cooled condenser (ACC). Invenergy will finalize the selection of the vendor for the combustion turbines prior to finalizing the Major Source Permit. Each gas turbine will fire natural gas as a primary fuel and ultra-low sulfur diesel (ULSD) fuel as a backup fuel from on-site storage tanks for limited periods when natural gas is unavailable. The Facility will have a nominal power output at base load of approximately 800-1,080 megawatts (MW) while firing natural gas (with supplementary HRSG duct firing) and 600-930 MW while firing ULSD.

## 1.3 Applicable Regulations

The following RIDEM Air Pollution Control Regulations apply to the proposed project:

- No. 1 – Visible Emissions
- No. 5 – Fugitive Dust
- No. 6 – Opacity Monitors
- No. 7 – Emission of Air Contaminants Detrimental to Person or Property
- No. 8 – Sulfur Content of Fuels
- No. 9 – Air Pollution Control Permits
- No. 10 – Air Pollution Episodes
- No. 11 – Petroleum Liquids Marketing and Storage
- No. 13 – Particulate Emissions from Fossil Fuel Fired Steam or Hot Water Generating Units
- No. 14 – Record Keeping and Reporting
- No. 16 – Operation of Air Pollution Control Systems
- No. 17 – Odors
- No. 22 – Air Toxics
- No. 27 – Control of Nitrogen Oxide Emissions
- No. 28 – Operating Permit Fees
- No. 29 – Operating Permits
- No. 45 – Rhode Island Diesel Anti-Idling Program
- No. 46 – $CO_2$ Budget Trading Program

The following federal Air Pollution Control Regulations apply to the proposed project:

- 40 CFR 50 – National Primary and Secondary Ambient Air Quality Standards
- 40 CFR 52.21 – Prevention of Significant Deterioration of Air Quality
- 40 CFR 60 – Standards of Performance for New Stationary Sources
  - Subpart A – General Provisions
  - Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units
  - Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines
  - Subpart KKKK – Standards of Performance for Stationary Combustion Turbines
  - Appendix B – Performance Specifications
  - Appendix F – Quality Assurance Procedures
- 40 CFR 63 – National Emission Standards for Hazardous Air Pollutants for Source Categories

- Subpart A – General Provisions
- Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines

- 40 CFR 70 & 71 – Operating Permit Program
- 40 CFR 72 – Permits Regulation
- 40 CFR 73 – Acid Rain Program Sulfur Dioxide Allowance System
- 40 CFR 75 – Continuous Emissions Monitoring
- 40 CFR 80 – Regulation of Fuels and Fuel Additives
- 40 CFR 98 – Mandatory Greenhouse Gas Reporting

## 2.0 PROJECT EMISSIONS

The Facility's potential emissions of criteria pollutants are summarized on Table 1. The Facility's potential emissions of non-criteria pollutants are summarized on Table 2. The specifications of each of the Facility emission sources and each emission point are summarized on Table 3. Appendix A contains Facility emissions data summaries.

For the gas turbines/HRSGs, the annual criteria pollutant potential emissions during steady-state operation firing natural gas are based on base load operation with duct firing at 59°F, which will be base operating load on natural gas. The potential emissions during steady-state operation on ULSD are based on base load operation at 10°F for 720 hours per year per unit, as it is expected that ULSD firing will predominately be during the winter months, when natural gas may be diverted for commercial and residential heating uses.

The potential emissions during gas turbine startups and shutdowns are based on startup/shutdown emissions and event duration information provided by the gas turbine manufacturers, and the number of each startup and shutdown events Invenergy expects could occur each year. Appendix A contains a summary of expected startup shutdown events on each fuel per year, including their number, duration, and potential emissions of criteria pollutants.

The potential emissions for the other emission sources are based on their maximum emission rates at full load and their proposed maximum permitted hours of operation per year.

As shown on Table 1, the Facility will be a major source for $NO_X$, CO, VOC, $CO_2$, $PM_{10}$, and $PM_{2.5}$. The Facility will not be a major source of hazardous air pollutants (HAPs), as shown on Table 2.

The Facility stationary emission sources are detailed below. The equipment specifications and emissions information provided in Tables 1, 2 and 3, and in Appendix A, are based on the current Facility design, preliminary equipment and emissions information provided to date by the potential equipment manufacturers, including GE, Siemens and MHI, and the available emission factors. The actual equipment vendors for the Project, the Facility design and layout, the equipment specifications, and the emission rates of each pollutant from each emission source are all subject to change as the Project design advances.

### 2.1 Gas Turbines/HRSGs

The Facility will utilize two gas turbines operated in a combined cycle configuration, each with a duct fired HRSG to generate electricity and to generate steam for a dedicated steam turbine. Based on the preliminary information provided by the manufacturers, each gas turbine will have a maximum heat input rate of approximately 3,393 MMBtu/hr while firing natural gas and approximately 3,507 MMBtu/hr while firing ULSD fuel. Each HRSG will be equipped with a natural gas fired HRSG duct burner with a maximum heat input capacity of approximately 721 MMBtu/hr to provide additional energy for the steam turbine during natural gas firing.

Each GT/HRSG will be equipped with a selective catalytic reduction (SCR) system for $NO_X$ emissions control. Water injection will also be used during ULSD firing for $NO_X$ emissions control. Each HRSG stack will have a maximum stack $NO_X$ concentration of 2.0 parts per million dry by volume at 15 percent oxygen (ppmvd@15%$O_2$) during natural gas firing, and 5.0 ppmvd@15%$O_2$ during ULSD firing during steady-state operation (down to a minimum of 30%-50% load on natural gas and 50% load on ULSD).

Each SCR will utilize $NH_3$ injection for $NO_X$ emissions control. The Facility will include a 40,000 gallon aboveground storage tank of 19% aqueous $NH_3$ for this purpose. The SCR will be designed to achieve a maximum $NH_3$ stack concentration ($NH_3$ slip concentration) of 2.0 pmvd@15%$O_2$ both while firing natural gas and while firing ULSD.

Each GT/HRSG will be equipped with an oxidation catalyst (OC) for the control of CO, VOCs, and organic hazardous air pollutants (HAPs). Each OC will be designed to achieve a maximum stack CO concentration of 2.0 ppmvd@15%$O_2$ while firing natural gas and 5.0 ppmvd@15%$O_2$ while firing ULSD. The maximum VOC stack concentration will be 1.0 ppmvd@15%$O_2$ while firing natural gas without duct firing, 1.7 ppmvd@15%$O_2$ while firing natural gas during duct firing, and 5.0 ppmvd@15%$O_2$ during ULSD firing. Each OC will also reduce organic HAP by at least 90%. The potential emissions of organic HAP emissions from the GT/HRSGs have been estimated using information provided by the potential equipment manufacturers and using emission factors from AP-42.

The emissions of $CO_2$, $SO_2$, $H_2SO_4$, and $PM_{10}$/$PM_{2.5}$ from the GT/HRSGs will be minimized by the use of clean burning, low sulfur, low ash fuels, and by the use of the most efficient gas turbine combustion technology commercially available at this time. The emission rates of $CO_2$, $SO_2$, $H_2SO_4$, and $PM_{10}$/$PM_{2.5}$ from the gas turbines at each operating condition are detailed in Appendix A. The average $CO_2$ emission rates from the GT/HRSGs at base load will be 814 lb/MW-hr (net) while firing natural gas and 1,227 lb/MW-hr (net) while firing ULSD.

The exit height of each GT/HRSG stack will be 200 feet above grade. The GT/HRSG stacks will have an inside diameter of 22 feet. The GT/HRSG stack exhaust flow rates and exit temperatures, and criteria pollutant emission rates over the full range of expected operating conditions, based on preliminary information provided by the manufacturers, are provided in Appendix A. Each HRSG stack will be equipped with a certified continuous emissions monitoring system (CEMS) to monitor compliance with permit emission limits.

The gas turbines will be permitted for unlimited operation on natural gas. Invenergy is proposing to permit the gas turbines to operate for the equivalent total ULSD fuel usage of up to 60 days per year at base load when natural gas is unavailable only. It is expected that the gas turbines will only fire ULSD fuel during the winter months when commercial and residential natural gas usage for heating purposes is at its peak.

## 2.2 Auxiliary Boiler

The Facility will utilize a natural gas fired auxiliary boiler to supply gland sealing steam to the steam turbine, sparging steam to the HRSG steam drums, sparging steam to the ACC condensate tank, and motive steam to establish initial vacuum in the ACC and the steam turbine. The auxiliary boiler is currently designed to provide up to 107,910 lb/hr of steam at 215 psia and 390°F, at a boiler efficiency of approximately 82 percent. Based on the current design, the maximum heat input rate to the natural gas fired auxiliary boiler will be 140.6 MMBtu/hr.

The auxiliary boiler will be equipped with ultra-low $NO_X$ burners and flue gas recirculation (FGR) for emissions control. The exhaust gases from the auxiliary boiler will be vented through a 48-inch diameter exhaust stack at an exit height of 50 feet above grade. The auxiliary boiler will exhaust at 38,067 acfm at 344°F at full load. The criteria pollutant emission rates from the auxiliary boiler at its maximum natural gas firing rate are summarized on Table 1.

The auxiliary boiler will only operate prior to and during gas turbine startup periods and will not operate during normal, steady-state gas turbine operating periods. Invenergy is proposing to permit the auxiliary boiler to operate up to 4,576 hours per year, the equivalent of up to 8 hours per day during weekdays (at night) and through each weekend.

## 2.3 Dew Point Heater

The Facility will utilize a natural gas fired dew point heater to maintain the temperature of the natural gas delivered to the gas turbines at a nominal 50°F above the hydrocarbon dew point of the natural gas. Based on the current design, the dew point heater will have a maximum heat input rate of 15 MMBtu/hr.

The dew point heater will be equipped with an ultra-low $NO_X$ burner and FGR for emissions control. The exhaust gases from the dew point heater will be vented through a 20-inch diameter exhaust stack at an exit height of 35 feet above grade. The dew point heater will exhaust at 7,252 acfm at 1,000°F at full load. The criteria pollutant emission rates from the dew point heater at its maximum natural gas firing rate are summarized on Table 1.

Invenergy is proposing to permit the dew point heater for unlimited operation firing natural gas.

## 2.4 Emergency Diesel Generator

The Facility will utilize a 2 MW emergency diesel generator equipped with a 2,682 horsepower (Hp) engine to manage the combined cycle critical shutdown and maintenance loads during a loss of site power from the grid. Based on the current design, the emergency diesel generator will have a maximum heat input rate of 19.5 MMBtu/hr firing ULSD fuel.

The exhaust gases from the emergency diesel generator will be vented through an 8-inch diameter exhaust stack at an exit height of 35 feet above grade. The emergency diesel generator will exhaust at 15,295 acfm at 752°F at full load. The criteria pollutant emission rates from the emergency diesel generator at its maximum ULSD fuel firing rate are summarized on Table 1.

Invenergy is proposing to only operate the emergency diesel generator when grid power is unavailable and for maintenance and readiness testing for up to 1 hour per week and up to 300 hours per year.

## 2.5 Diesel Fire Pump

The Facility will utilize a 315 BHP diesel engine fire pump. Based on the current design, the diesel fire pump engine will have a maximum heat input rate of 2.1 MMBtu/hr firing ULSD fuel.

The exhaust gases from the diesel fire pump will be vented through a 6-inch diameter exhaust stack at an exit height of 35 feet above grade. The diesel fire pump will exhaust at 1,673 acfm at 865°F at full load. The criteria pollutant emission rates from the diesel fire pump at its maximum ULSD fuel firing rate are summarized on Table 1.

Invenergy is proposing to only operate the fire pump during emergency situations and for maintenance and readiness testing for up to 1 hour per week and up to 300 hours per year.

## 2.6 Fuel Oil Tank

The Facility will include two (2) 2,000,000 gallon aboveground ULSD storage tanks equipped with secondary containment, as required. The potential fugitive VOC emissions (working losses and breathing losses) associated with the ULSD storage tanks at the Facility have been estimated using the EPA's TANKS program.

# 3.0 MODEL SELECTION FACTORS

## 3.1 Land Use

Land use within a 3 kilometer (km) radius of the proposed Facility location was classified according to the method specified in the RIDEM Modeling Guideline (Auer, 1978). Land use classification information contained on the USGS topographic maps of the area (Chepachet and Thompson, RI, quadrangles) was used to assess the urban/rural distribution. Figure 5 presents the percentage breakdown of the various land use categories within 3 km of the Facility location. As shown on Figure 5, nearly 90% of the land use within 3 km is forested area and nearly 96% is associated with rural land uses.

## 3.2 Good Engineering Practice (GEP) Stack Height

US EPA's modeling guidance limits the stack height used in performing dispersion modeling analyses. Each source must be modeled at its actual physical height unless that height exceeds its GEP stack height. If the physical stack height is less than the GEP height, the actual stack height is input to the model and the potential for the plume to be affected by aerodynamic wakes created by nearby buildings must be evaluated in the dispersion modeling analysis. If the actual stack height exceeds its GEP stack height, the GEP stack height must be used in the analysis.

A GEP stack height analysis was performed in accordance with "Guideline for Determination of Good Engineering Practice Stack Height" (US EPA, 1985). A GEP stack height, as measured from the base elevation of the stack, is defined as the greater of 65 meters (213 feet) or the formula height ($H_g$) determined from the following equation:

$$H_g = H + 1.5L$$

Where

$H$ = height of the nearby structure which maximizes $H_g$

$L$ = lesser dimension (height or projected width) of the building

The GEP formula height is based on the "nearby" buildings or building tiers that result in the greatest justifiable height. For the purposes of determining the maximum GEP formula height, "nearby" is limited to five building heights or widths (5L), whichever is less, from the trailing edge (edge closest to the source) of the building.

A GEP stack height analysis was performed for each Facility stack and structure. The eight structures that result in the highest GEP formula height are presented on Table 4. The two air cooled condensers are squat structures with a height of 120 feet above ground, resulting in a formula GEP height of 300 feet. All sources except the fire pump are within the wake region created by one of the air cooled condensers. The controlling GEP structures for the fire pump are the two HRSGs, with a GEP height of 264 feet. As such, building downwash was assessed for all stacks.

## 3.3 Cavity Region

The cavity region created by a building can extend out to a distance of 3L. Cavity impacts need to be analyzed for these lesser downwind distances when the stack height is less than the calculated GEP height. The results of the cavity analysis are presented in Table 5.

Only cavities that reach ambient air (accessible to the public) are required to be evaluated. If a cavity falls entirely within a fenceline or on a facility roof, it may be excluded from consideration. The AERMOD analysis evaluated the impacts of plumes potentially entrapped within the cavity regions of these structures for which there is a potential for the cavities to extend offsite for all applicable modeling scenarios.

## 3.4 Local Topography

Local topography plays a role in the selection of an appropriate dispersion model. Dispersion models can be divided into two categories: (1) those applicable to areas where terrain is less than or equal to the height of the top of the stack (simple terrain), and (2) those applicable to areas where terrain is greater than the top of the stack (complex terrain). The two HRSG stacks have base elevations of approximately 570 above mean sea level. With 200-foot proposed stack heights, nearby terrain at an elevation of 770 feet or more above mean sea level was treated as complex terrain for this analysis. The closest complex terrain is located approximately 4,400 meters to the northwest of the Facility.

## 3.5 Model Selected For Use

The dispersion environment, potential for aerodynamic building downwash effects on ground-level concentrations, and the local topography help to determine the appropriate models for use in a dispersion modeling analysis.

Screening modeling is typically performed with US EPA's AERSCREEN (dated 15181) model. The model is appropriate for assessing concentrations within the cavity region of a building, and also includes algorithms from the US EPA AERMOD model, the preferred refined model for assessing building downwash effects within the wake region.

AERSCREEN is limited to assessing impacts from a single source. In order to evaluate the cumulative impacts from multiple sources, the maximum AERSCREEN impacts from each individual source are combined, regardless of location or meteorological condition. Based on the number of sources modeled for this Facility, the analysis only utilized AERSCREEN to determine the worst-case modeling scenarios for the two gas turbines.

The air dispersion modeling analysis for all Facility sources (and off-site potentially interacting sources) was completed using the refined EPA AERMOD (Version 15181) model. AERMOD was used to calculate maximum 1-hour average ground-level concentrations at all receptor locations, including off-site locations within the cavity region, from which it determined block averages for the other required averaging periods. AERMOD is a refined model that utilizes actual historical meteorological data in the project area, assesses the potential building downwash effects on ground-level concentrations, and estimates concentrations in either simple or complex terrain.

# 4.0 Preliminary Screening Modeling

## 4.1 Operating Parameters

AERSCREEN was applied to determine the worst-case modeling scenarios for the two gas turbines. Screening modeling was performed for the flue gas characteristics associated with each of the operating conditions and ambient temperatures shown in Appendix A for each of the three candidate turbines (GE, MHI and Siemens) while firing natural gas and while firing ULSD. The ambient temperatures represent the expected range of ttemperatures that would be expected throughout a typical operating year. The gas turbines will be designed to operate only in combined-cycle mode so no modeling of gas turbine operation in simple-cycle mode was conducted.

## 4.2 Screening Model Application

The AERSCREEN dispersion model was applied in accordance with the recommendations made in USEPA's "Guideline on Air Quality Models"[1] (USEPA, 1999) to assess the magnitude of maximum pollutant concentrations from the gas turbines over a range of operating loads and ambient temperatures.

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[1] U.S. EPA, 1999. Guideline on Air Quality Models, (Revised) EPA450/12-78-027R, Office of Air Quality Planning and Standards. Research Triangle Park, NC.

AERSCREEN was applied using dispersion parameters based on the site land use characteristics, default meteorology, building downwash, terrain elevations and a 1 gram per second emission rate.

AERSCREEN allows the incorporation of several AERMOD refinements. The population of Burrillville is 15,955, based on the 2010 census data. The HRSG stacks were modeled as both rural and urban sources for the GE operating conditions using AERSCREEN in order to evaluate which setting resulted in the more conservative results, as requested by RIDEM. Modeling the HRSG stacks as rural sources resulted in higher concentrations than the values resulting from modeling them as urban sources for each modeling scenario. As such, subsequent AERSCREEN and AERMOD modeling was conducted with the stacks set as rural sources.

AERSCREEN generates worst-case meteorology through MAKEMET. Default values were used for minimum and maximum temperatures and minimum wind speed. Surface roughness values were based on the predominant land use (rural) near the meteorological tower that was subsequently used for the AERMOD modeling (T. F. Green Airport). MAKEMET was applied for a rural setting with average moisture conditions.

Automated receptor distances were used in AERSCREEN extending out to 50 kilometers. By default, receptors were placed at 25-meter increments out to 5 kilometers, and at 450-meter increments out to 10 kilometers. This distance was sufficient to ensure capture of the maximum concentrations for the determination of the worst-case gas turbine modeling scenarios. AERSCREEN determined the maximum receptor elevations through the application of AERMAP. National Elevation Data (NED) data was input to AERMAP. This data was downloaded from the USGS website (http://seamless.usgs.gov/index.php).

## 4.3 Scaling Factors

The AERSCREEN model calculates 1-hour concentrations at cavity region and simple and complex terrain locations. AERSCREEN provides 3-hour, 24-hour and annual averaging period estimates from the 1-hour values. The 3-hour, 8-hour, 24-hour and annual scaling factors in AERSCREEN are 1.0, 0.9, 0.6, and 0.1, respectively.

## 4.4 Screening Results

AERSCREEN was applied to determine the gas turbine operating conditions which result in the highest predicted ambient air impact concentrations for each fuel, pollutant and averaging period. For each operating scenario, the actual 1-hour average impacts predicted for each pollutant were determined by scaling the unit emission rate (i.e., 1 gram per second) normalized 1-hour concentrations by the maximum actual emission rate. To evaluate annual impacts, only the 59°F cases was modeled, as these cases represent the average meteorological conditions expected over the course of each year.

Table 6 presents the results of the AERSCREEN analysis for the GE turbine. The AERSCREEN results for the MHI and Siemens turbines are presented in Tables 7 and 8, respectively. Normalized concentrations are presented for the GE turbine modeled as both an urban and rural source. As shown in the table, the rural impact values were greater than the urban values for each modeled operating scenario. As such, all sources were modeled as rural sources in all subsequent AERSCREEN and AERMOD modeling runs.

Table 9 presents the summary of the maximum predicted concentrations from all three candidate turbines for each fuel, pollutant and averaging period. As shown in Table 9, the following turbine/operating conditions result in the worst-case pollutant concentrations:

- Short-term $NO_2$ and CO: MHI Case 20 - 100% load at 0°F on ULSD
- Short-term $SO_2$: GE Case 10 - 100% load at 10°F on natural gas

- Short-term PM: GE Case 17 - 100% load at 59°F on ULSD
- Annual $NO_2$: MHI Case 16 - 100% load at 59°F on ULSD with MHI Case 6 - 100% load at 59°F on natural gas
- Annual $SO_2$: GE Case 6 - 100% load at 59°F on natural gas
- Annual PM: GE Case 17 - 100% load at 59°F on ULSD with GE Case 6 - 100% load at 59°F on natural gas

Refined modeling with AERMOD was performed to assess the total ambient pollutant concentrations resulting from the combined emissions from the gas turbines (at the worst-case operating condition for each fuel, pollutant and averaging period), the auxiliary boiler, the dew point heater, the emergency diesel generator, and the diesel fire pump.

## 5.0 MODEL PREPARATION

### 5.1 Meteorological Data

AERMOD was applied using the five most recent years (currently 2010-2014) of hourly meteorological surface data available from T. F. Green Airport in Providence, with concurrent upper air observations from Chatham, MA.

The five years of hourly meteorological data were input to AERMINUTE and AERMET, the meteorological preprocessors for AERMOD. AERMINUTE generates 1-hour wind direction and wind speed values from 1-minute ASOS observations. The hourly averages generated through AERMINUTE can be used to supplement the hourly surface observations.

AERMET allows for the use of sectors to define land use within one kilometer of the meteorological data measurement location, classifying them among urban and rural categories. AERMET was applied using four sectors, as provided by RIDEM (RIDEM, 2015a).

The sectors were input to AERSURFACE, an EPA program to compute surface roughness, albedo and Bowen ratio values to input to AERMET. The program follows EPA guidance presented in the "AERMOD Implementation Guide" (EPA, 2009) in developing the values. Surface roughness values were based on an inverse-distance weighted geometric mean for an upwind distance of one kilometer. Bowen ratio and albedo values were based on an arithmetic mean within a 10-km by 10-km area. The program was applied using average moisture conditions and winter snow cover.

AERMET was applied to generate AERMOD processed meteorological data sets for 2012-2014. Data sets for 2007-2011 have been pre-processed by RIDEM. These data were downloaded from the RIDEM website, www.dem.ri.gov/programs/benviron/air/pdf/metdata.zip. Per RIDEM request (RIDEM, 2015b), the criteria pollutant AERMOD modeling assessment was based on the latest 5-years of available data, 2010-2014. The air toxics modeling was based on the latest five years (2007-2011) of pre-processed meteorological data provided by the OAR.

### 5.2 Land Use

As shown on Figure 5, land use near the facility is predominately rural. At RIDEM's request (RIDEM, 2015b), a comparison between modeling the turbines as rural and urban sources was conducted in the initial AERSCREEN modeling for the GE modeling scenarios. As shown previously, each modeling scenario resulted in higher concentrations when the gas turbines were modeled as rural sources. To be conservative, all Facility sources were modeled as rural sources. The population of Burrillville is 15,955, based on the 2010 estimate from the U. S. Census Bureau (Census Bureau, 2013).

## 5.3 Receptor Grid

A polar receptor grid was centered at the GT/HRSG 1 stack. Receptor coverage extended out to 50 kilometers, as shown in Figures 6 and 7. Receptors were located at:

- 25-meter increments out to 1 kilometer,
- 100-meter increments out to 2 kilometers,
- 200-meter increments out to 5 kilometers,
- 500-meter increments out to 10 kilometers, and
- 1,000-meter increments out to 50 kilometers.

Receptors were placed along the property fenceline at 10-meter increments. On-site locations were not included in the analysis. The maximum terrain elevation and hill height were assigned for each receptor through the application of AERMAP. National Elevation Data (NED) data was input to AERMAP (Version 11103). The data was downloaded from the USGS website (http://seamless.usgs.gov/index.php).

## 5.4 Preliminary Refined Modeling - Significant Impact Determinations

A preliminary refined modeling analysis was conducted using the AERMOD model which evaluates the ambient air impact concentrations resulting from the proposed emissions from the Facility for five years of hourly meteorological data. Each emissions source was modeled at its maximum capacity and proposed allowable operation. The highest total modeled concentration predicted for each pollutant and averaging period was then compared to the corresponding Significant Impact Level (SILs).

On January 22, 2013, the U.S. Court of Appeals for the District of Columbia Circuit Court granted a request from the EPA to vacate and remand to the EPA the portion of the PSD $PM_{2.5}$ rules addressing the SILs for $PM_{2.5}$. According to the EPA's "Guidance for $PM_{2.5}$ Permit modeling", dated May 20, 2014, permitting authorities may not apply the $PM_{2.5}$ SIL provisions in the vacated EPA PSD rules. Permitting authorities have the discretion to select the particular $PM_{2.5}$ SIL values that are used to support a permitting decision, but the values used should be supported by either a permitting record or regulation that supports the use of those values in the particular manner they are used. The RIDEM PSD Rules do not establish SILs for $PM_{2.5}$ to be used to support major source permitting decisions. As such, the modeled Facility $PM_{2.5}$ impacts were not compared to SILs for this analysis.

The results of the significant impact determinations are presented in Table 10. The SILs were exceeded for 1-hour $NO_2$, and 24-hour $PM_{10}$. For these pollutants the project's Significant Impact Area (SIA) was calculated. The SIA is defined as the circular area with a radius extending from the source to the furthest point where a significant impact is predicted to occur. The SIAs are:

- 1-hour $NO_2$: 3.56 kilometers
- 24-hour $PM_{10}$: 1.85 kilometers

Figure 8 includes isopleths of the areas where significant 1-hour $NO_2$ and 24-hour $PM_{10}$ impacts are predicted to occur, and the SIA, which is the circular area with a radius extending 3.56 kilometers from the Facility. As shown on Figure 8, the impact concentrations from the Facility in most of the area within the 3.56 km SIA will actually be below the SILs.

RIDEM requested in the pre-application meeting that the impacts from the Algonquin Compressor Station facility in Burrillville, the Ocean State Power (OSP) facility in Harrisville, and the Tennessee Gas Compressor Station facility in Harrisville, be included in a multi-source modeling analysis for the facility, regardless of whether any SILs were exceeded. No other significant emission sources were identified within the SIA, so the multi-source modeling analysis for the Facility included only these three sources.

The exhaust parameters for these facilities were verified by a file review at RIDEM, and their ambient air impacts were modeled for interaction with the impacts from the Facility for the determination of NAAQS and PSD increment compliance. The Algonquin Compressor Station modeling utilized the modeling input parameters from the August 2015 Minor Source Permit Application submitted to RIDEM for the facility, as these will be the sources in operation when the Facility commences operation. Tables 11a, 11b, and 11c summarize the modeling input parameters used for each of the three sources included in the multi-source modeling analysis for the Facility.

**5.5 Class II Area Impacts**

AERMOD was run with each emission source operating simultaneously, for five years of hourly meteorological data. The annual impacts from the gas turbines were based on the worst-case 59°F operating cases for each fuel, pollutant, and averaging period. For the annual impact modeling, the emission rates from the emergency diesel generator, auxiliary boiler and the diesel fire pump were pro-rated for the number of hours each will be permitted to operate per year.

According to the EPA guidance memo issued on March 1, 2011, compliance demonstrations for the 1-hour $NO_2$ NAAQS should address emission scenarios that can logically be assumed to be relatively continuous or which occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations, providing sufficient discretion for reviewing authorities to not include the emissions from emergency generators or other intermittent sources from 1-hour $NO_2$ compliance demonstrations. In the July 27, 2015 Protocol approval letter, RIDEM stated that intermittent source modeling is not required for this project. Invenergy is proposing to only operate the emergency diesel generator and fire pump when grid power is unavailable and for maintenance and readiness testing for up to 1 hour per week and up to 300 hours per year each. As such, the emissions from the emergency diesel generator and the diesel fire pump were not included in the modeling completed for the Facility.

The EPA guidance memo issued on June 29, 2010 presented a three-tiered approach for 1-hour $NO_2$ NAAQS compliance demonstrations. Tier 1 assumes that all NO emissions are converted to $NO_2$. Tier 2 incorporates the default Ambient Ratio Method (ARM) to estimate $NO_2$ concentrations from $NO_x$ emissions. RIDEM has adopted the recommendation from the EPA guidance memo that a default ARM of 0.80 can be used without further justification. The default ARM is based on the assumption that 80% of the $NO_x$ emissions are converted to $NO_2$. Tier 3 utilizes the Ozone Limiting Method (OLM) or Plume Volume Molar Ratio Method (PVMRM) to predict the conversion of NO to $NO_2$.

For this analysis, the $NO_x$ emission rates from each source were initially modeled to determine potential $NO_2$ concentrations. The Tier 2 default ARM of 0.80 was then applied within AERMOD to convert the modeled $NO_X$ ambient air impact concentrations to $NO_2$ concentrations.

Per the RIDEM Modeling Guidelines, the following modeled values were used for the NAAQS compliance demonstration:

- 1-hour CO: the highest, second-high modeled concentration for each of the five years modeled
- 8-hour CO: the highest, second-high modeled concentration for each of the five years modeled
- 3-hour $SO_2$: the highest, second-high modeled concentration for each of the five years modeled
- 24-hour $SO_2$: the highest, second-high modeled concentration for each of the five years modeled
- Annual $NO_2$: the highest predicted annual average concentration
- Annual $SO_2$: the highest predicted annual average concentration
- 1-hour $NO_2$: the highest average of the $98^{th}$ percentile ($8^{th}$ highest) daily maximum concentrations at each receptor for each of the five years modeled

- 1-hour $SO_2$: the highest average of the 99th percentile (4th highest) daily maximum concentrations at each receptor for each of the five years modeled
- 24-hour $PM_{10}$: the 6th highest predicted concentration for the five years modeled
- Annual $PM_{2.5}$: the highest average of the modeled annual averages at each receptor for the five modeled years
- 24-hour $PM_{2.5}$: the highest average of the maximum modeled 24-hour averages at each receptor across the five years modeled
- 3-month Pb: the maximum 3-month rolling average in the five year period at each receptor

Although representing a much shorter averaging period, the modeled 24-hour value was used to demonstrate compliance with the 3-month rolling average NAAQS for lead.

## 5.6 Class I Area Impacts

Figure 9 shows the location of the facility in relation to the closest designated Class I areas in the region. The closest Class I area is the Lye Brook Wilderness Area in Vermont, whose boundary is located approximately 160 kilometers northwest of the proposed facility location.

AERMOD was applied to determine the possible extent of facility impacts greater than the Class I SILs, out to a maximum distance of 50 kilometers. The Class I analysis used the same modeling inputs and methodology as the Class II AERMOD analysis. Receptors beyond 10 kilometers were located at 1-kilometer increments.

The maximum distances at which the modeled Facility concentrations were greater than the Class I SILs are as follows:

- 3-hour $SO_2$: 1 kilometer
- 24-hour $SO_2$: 3.6 kilometers
- Annual $NO_2$: 3 kilometers
- 24-hr $PM_{10}$: 48 kilometers
- Annual $PM_{10}$: 1.1 kilometers

The maximum modeled facility annual $SO_2$ concentration was less than the Class I SIL.

As shown above, the Facility will not produce any ambient air impacts which exceed a Class I SIL at the nearest or any Class I area.

## 5.7 Background Air Quality

When conducting an air quality impact analysis with respect to NAAQS, the existing background air quality in the absence of the proposed source must be considered in combination with the predicted impacts resulting from the proposed source. When background air quality data is not available for the project area, other representative background data from nearby monitoring stations must be used.

The PSD rules require that the air quality impact analysis include an analysis of ambient air quality in the area that the major stationary source would affect for each pollutant that it would have the potential to emit in a significant amount. The analysis should include four months to a year of ambient air monitoring data gathered during the year preceding application submission. Ambient air monitoring is not required if the emissions increase of the pollutant will cause air quality impacts less than the Significant Monitoring Concentrations (SMC) listed in Section 9.5.2(d)((i) of RIDEM APCR No. 9.

SMCs are listed in Section 9.5.2(d)(i) of APCR Reg. 9 for CO, $NO_X$, $PM_{10}$, and $SO_2$. The maximum modeled facility concentrations are compared to the SMCs in Table 12. As shown on Table 12, the maximum predicted Facility impacts for CO, $NO_X$ and $SO_2$ are all below their respective SMCs. The maximum predicted Facility impact for $PM_{10}$ exceeded the SMC, however, as detailed below, representative background monitoring data is available for $PM_{10}$. There currently is no SMC for $PM_{2.5}$ in RIDEM's PSD rules. The EPA's $PM_{2.5}$ SMC was vacated in a January 22, 2013 ruling by the U.S. Court of Appeals for the District of Columbia (Sierra Club vs. EPA).

The EPA's "Guidance for $PM_{2.5}$ Permit Modeling", May 20, 2014, provides guidance on demonstrating compliance with the $PM_{2.5}$ NAAQS and PSD increments, and reflects the EPA's recommendations for how a major stationary source seeking a PSD permit can demonstrate that it will not cause or contribute to a violation of the NAAQS and PSD increments for $PM_{2.5}$.

According to this EPA guidance, as a result of the recent court decision that vacated the $PM_{2.5}$ SMC, each PSD application must include ambient monitoring data representative of the area of concern. However, these data need not be collected by the applicant if existing data are determined by the permitting authority to represent the air quality in the area of concern over the 12-month period preceding the application's submittal. Historically, the use of background data which is a conservative representation of the ambient air concentrations at the site of the proposed PSD source, have been deemed representative by the EPA and other permitting authorities, because their use provides margin for future area growth.

The background concentrations used for this analysis were the monitoring concentrations recommended for use by RIDEM, as summarized on Table 13. These monitoring concentrations have been determined using monitoring data from the closest ambient air monitors with sufficient monitoring data available for a NAAQS compliance demonstration for the facility, using the most recent ambient air quality monitoring data available (2012-2014) for this area, and are representative or conservative representations of the air quality in the area surrounding the proposed facility, as described below.

Any ambient air impacts resulting from the operation of the adjacent Algonquin Compressor Station or the nearby Tennessee Gas Compressor Station or Ocean State Power facility which could potentially interact with the impacts from the project's emission sources were accounted for in the multi-source modeling analysis required by RIDEM. Therefore, any consideration of the impacts from those facilities when selecting the Facility's background concentrations to be used for this analysis would have double counted their potential impact.

The monitored $NO_2$ background concentrations are from ambient air monitoring data collected by a monitor located on the roof of Rockefeller Library at Brown University in Providence. RIDEM recommends the use of this monitor for modelling all Rhode Island sources.

The monitored CO and $SO_2$ background concentrations are from ambient air monitoring data collected by a monitor located on the roof of a building at the Francis School in East Providence. RIDEM recommends the use of this monitor for modelling all Rhode Island sources for CO and for modelling all Rhode Island sources outside of Bristol County and northern Newport County for $SO_2$.

The monitored $PM_{10}$ and $PM_{2.5}$ background concentrations are from ambient air monitoring data collected by a monitor located in a cleared area surrounded by forest on the W. Alton Jones campus of the University of Rhode Island in West Greenwich. RIDEM recommends the use of this monitor for modelling all Rhode Island sources in a rural area.

The ambient air monitors located at Brown University and at the Francis School are located in densely populated residential neighborhoods with high volumes of vehicular traffic. The ambient air concentrations of $NO_X$, CO, and $SO_2$ at these locations would be expected to be much higher than in the area surrounding the proposed facility, which is rural, lightly populated, and with very low vehicular traffic levels. Thus, the use of data from these monitoring stations for the facility NAAQS demonstration is conservative, and consistent with previous determinations from the EPA and other permitting agencies, provides an additional margin of safety for future ambient air quality concentration increases in the area.

The ambient air monitor at URI is located in a clearing surrounded by dense forested area, with few surrounding residences or local vehicular traffic, which is a very similar setting as the area surrounding the proposed facility site. Because of the similarity of their settings, the monitoring data from this location is clearly representative of the ambient air concentrations in the area surrounding the proposed Facility site.

## 5.8 PSD Increment Analysis

RIDEM requires new major stationary sources to demonstrate that their emissions will not cause or contribute to any increase in ambient concentrations exceeding the available increment for any air contaminant. Increments represent the maximum increase in ambient concentrations allowed for each pollutant over baseline levels, which are established according to the definitions in RIDEM APCR No. 9, Section 9.5.

All of Rhode Island is classified as a Class II area. The Class II PSD Increments are listed in Table III of the RIDEM Modeling Guidelines. No major stationary source is allowed to consume more than 75 percent of the remaining 24-hour increment or 25 percent of the remaining annual increment.

A PSD increment analysis was conducted to determine the available increment for each applicable pollutant and averaging period within the baseline area. RIDEM APCR No. 9, Section 9.5.1 defines the baseline area for sources seeking a major source permit in Rhode Island as the state of Rhode Island.

The major source baseline date is the date for each pollutant when the EPA first promulgated PSD increments for that pollutant. This date is the date after which actual emissions of a pollutant associated with a construction at a major source affect the available PSD increments for that pollutant. The trigger date is the fixed date after which the minor source baseline date may be established. The minor source baseline date is the earliest date after the trigger date on which a complete PSD application is received by the permitting authority for a source within the baseline area.

The major source baseline dates, trigger dates and minor source baseline dates established by the EPA and RIDEM for each pollutant are summarized in the following table.

| Pollutant | Major Source Baseline Date | Trigger Date | Minor Source Baseline Date |
|---|---|---|---|
| $PM/PM_{10}$ | January 6, 1975 | August 7, 1977 | December 3, 1982 |
| $SO_2$ | January 6, 1975 | August 7, 1977 | December 3, 1982 |
| $NO_2$ | February 8, 1988 | February 8, 1988 | August 5, 1988 |
| $PM_{2.5}$ | October 20, 2010 | October 20, 2011 | NA |

The minor source baseline date marks the point in time after which actual emissions changes from all sources affect the available increment. The amount of each PSD increment that has been consumed in a PSD area includes actual emissions increases occurring after the major source baseline date at major stationary sources (from modifications or construction) and actual emissions increases at any incrementing-affecting source after the minor source baseline date.

Normally, an inventory of PSD increment-affecting sources within the project's significant impact area (SIA) would be developed for each pollutant and averaging period. The inventory would include all major stationary sources which had actual emissions changes (from construction or modifications) after the major source baseline date and other increment-affecting sources identified that had changes in emissions after the minor source baseline date. The inventory would be developed using the publicly available information on RIDEM and EPA's web-sites and from file reviews.

RIDEM requested that the NAAQS analysis for the Facility include the modeled impacts from the Algonquin Gas Compressor Station, Ocean State Power and the Tennessee Gas Compressor Station. To be conservative, each of these sources was included in the PSD increment analysis, regardless of whether the source predated the baseline date.

Table 14 presents the results of the PSD increment analysis. Based on the background monitoring data, the full increment is available for each pollutant and averaging period. The available increment was then determined by subtracting the modeled concentrations from the other nearby sources. The remaining increment was then compared to the modeled Facility concentrations, regardless of whether the modeled values are coincident in time and space.

For $PM_{2.5}$, it is assumed that the Facility is submitting the first complete PSD application since the trigger date, so the date the application is submitted was the minor source baseline date. The PSD increment analysis for the Facility could therefore be based on the assumption that the full $PM_{2.5}$ PSD increments are available. The results in Table 14 demonstrate that even when assuming all the nearby sources consume $PM_{2.5}$ increment, the modeled Facility concentration is just less than the available increment. However, the available increment is based on a location that is different from that where the maximum Facility impact is predicted to occur. When the comparison is based on impacts that are coincident in time and space, the modeled Facility impacts account for only 69% of the allowable $PM_{2.5}$ increment. Again, these values are conservative in that the full increment is actually assumed to be available.

The results of the AERMOD analysis conducted for the Facility demonstrate that there will be no increase in the ambient air concentration of any pollutant averaging period which exceeds the allowable percentage of the remaining available increment for that pollutant averaging period. Short term increments (3-hour and 24-hour) were compared to the highest, second-high concentrations modeled because exceedances of the allowable short term increments are allowed once per year.

## 5.9 NAAQS Compliance Analysis

The total modeled values for the Facility emission sources and all off-site emission sources required by RIDEM to be included in the multi-source modeling analysis for the Facility were added to the background concentrations for each pollutant and averaging period to demonstrate compliance with the NAAQS.

The NAAQS compliance determination is summarized on Table 15. As shown on Table 15, the combined modeled pollutant concentrations from the Facility and the nearby interacting sources, when combined with regional background, results in total concentrations that are less than each of the NAAQS. Based on the results of this analysis, the Facility will not cause or contribute to an exceedance of any NAAQS.

## 5.10 Air Toxics Analysis

RIDEM requires new major stationary sources to demonstrate that emissions of both listed and non-listed air toxic contaminants from the stationary source will not cause an impact on the ground level ambient concentration at or beyond the property line in excess of that allowed by RIDEM APCR No. 22. RIDEM APCR No. 22 exempts fuel burning equipment where the air toxics emissions are solely from the combustion of fuel oil or natural gas. However, new major fuel-burning sources that begin operation after April 27, 2004 are not exempt from the regulation.

Table 2 lists the quantity of each RI listed toxic air contaminant which will be emitted from each emission source at the Facility. The ammonia and sulfuric acid emissions from the gas turbines have been estimated based on preliminary information provided by the manufacturers. The metals emissions from gas turbine ULSD usage have been estimated using Siemens Westinghouse's Survey of Ultra-Trace Metals in Gas Turbine Fuels (2004).

All of the other non-criteria pollutant emission rates from each emission source have been estimated using emission factors from the EPA's AP-42 Compilation of Emission Factors. Because the emission factors in AP-42 are primarily based on the results of stack tests conducted 20 or more years ago, and in many cases are based on non-detect stack test results, the use of AP-42 emission factors to estimate the emissions of non-criteria pollutants from the Facility is conservative. Based on the advances in combustion technology and fuel processing since AP-42 was last updated, it is expected that the actual emissions of non-criteria pollutants from the Facility emission sources will be much lower than the values presented in Table 2.

The AERMOD results were applied to each listed air toxic which has the potential to be emitted at a level which exceeds its respective Minimum Quantity from Table III of RDEM APCR No. 22, as shown on Table 16. AERMOD was applied using a 1 gram per second emission rate for each source. The gas turbines were modeled using the full load operating scenario that resulted in the greatest normalized AERSCREEN concentrations. The maximum source impacts for each air toxic were then computed by multiplying the 1 gram per second modeled concentration by the maximum actual source emission rate. The source concentrations were then summed to determine the total Facility impact for each air toxics, regardless of maximum concentrations being coincident in time or space.

As shown on Table 16, the results of the analysis demonstrate that the predicted ambient air impacts from the Facility at or beyond the property line do not exceed any of RIDEM's Acceptable Ambient Levels (AALs) or Calculated Acceptable Ambient Levels (CAALs) developed by RIDEM for any non-listed air toxics.

## 5.11 Human Health Risk Assessment

RIDEM also requires new major stationary sources to conduct any studies required by the Guidelines for Assessing Health Risks from Proposed Air Pollution Sources and meet the criteria therein. The Facility is a major source of air pollutants, excluding emissions caused by firing natural gas, and has a heat input capacity greater than 250 MMBtu/hr. It is therefore a "first tier power plant", as defined in the guideline, and a multi-pathway human health risk assessment must be completed.

A Risk Assessment Protocol for the Facility was submitted to RIDEM on June 26, 2015. RIDEM provided preliminary comments on the Protocol in a letter dated August 11, 2015. RIDEM proposed revisions to the Guideline on August 5, 2015. The public comment period on the proposed revised Guideline ended on September 4, 2015. According to the August 11, 2015 letter, RIDEM comments on the Protocol will be reevaluated and updated as necessary to be consistent with the final Guideline document.

Following receipt of RIDEM's updated comments on the Protocol, a Health Risk Assessment Report will be submitted for the Facility which details the analyses conducted to demonstrate compliance with the revised RIDEM Guideline.

## 5.12 Visibility Impacts

The PSD regulations protect Class I areas, such as wilderness areas and national parks, from plume visibility impacts. Sufficiently large particulate and nitrogen dioxide air emissions can cause visible plumes. When the components of the plume scatter or absorb light, the plume may contrast with the viewing background. The EPA's Workbook for Plume Visual Impact Screening and Analysis (EPA, 1992b), is typically used as guidance for the completion of a visibility impairment analysis for Class I areas.

The Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report, revised 2010, provides initial screening criteria for exempting a source from conducting a visibility analysis for

Class I areas based on the annual emissions from the source and its distance to the nearest Class I area. According to this report, any source located more than 50 km from any Class I area is exempt from the Class I visibility analysis if its total annual emissions of $SO_2$, $NO_X$, $PM_{10}$, and $H_2SO_4$ in tons divided by the distance in kilometers from the source to the nearest Class I area (Q/D factor) is 10 or less.

The total potential annual emissions of $SO_2$, $NO_X$, $PM_{10}$, and $H_2SO_4$ from the facility are approximately 574 tons. The distance from the facility to the nearest Class I area, Lye Brook, is approximately 160 kilometers. The Q/D factor is therefore 3.6. Because the Q/D factor is less than 10, no Class I visibility impairment analysis is required for the Facility.

## 5.13 Impacts to Welfare, Soils and Vegetation

RIDEM requires new major stationary sources to apply the applicable procedures of the Guidelines for Assessing the Welfare Impacts of Proposed Air Pollution Sources and meet the criteria therein. RIDEM also requires new major stationary sources to provide an analysis of the impairment to soils and vegetation that would occur as a result of the source. Both requirements are met by applying the procedures and complying with the screening concentrations in the EPA's A Screening Procedure for the Impacts of Air Pollution on Plants, Soils, and Animals (EPA, 1981).

Such an assessment was conducted for the Facility by adding the applicable predicted ambient air impacts with the background concentrations and comparing the results to the vegetation sensitivity screening levels presented in Table 3.1 of the EPA guidance document. These screening levels represent the minimum levels at which visible damage or growth effects to vegetation may occur. The results of this analysis are presented in Table 17. As shown on Table 17, the predicted impacts from the Facility, when combined with representative background concentrations, will not exceed any of the EPA screening levels.

## 5.14 Impacts from Associated Area Growth

RIDEM requires the new major stationary sources provide an analysis of the air quality impact projected for the area as a result of general commercial, residential, industrial and other growth associated with the source.

The Facility is being proposed to address the need for more efficient and reliable, lower polluting sources of energy production within the state and within the region. The anticipated impact from the project will be lower energy prices and fewer emissions from the energy sector both state-wide and throughout the region. It is not anticipated that the project will directly result in any increase in general commercial, residential, industrial, or other growth within the local area. Therefore, it is expected that the air quality impact projected for the area as a result of such growth will be negligible.

## 5.15 Startup & Shutdown

Modeling was also conducted for hot, warm and cold gas turbine startups and shutdowns while firing both natural gas and ULSD based on the information provided by the manufacturers. Startup/shutdown operations usually take less than an hour. To determine the modeling input parameters (emission rate, exhaust velocity and exhaust temperature), the startup/shutdown condition was blended with the steady state operating condition for the remainder of the hour resulting in the highest pollutant AERSCREEN concentration for that pollutant.

Emissions occurring during the startup/shutdown event were added to the steady state emissions that occur in the remaining portion of the hour. Exhaust temperatures and velocities were based on the time-weighted average values for each hour.

AERSCREEN was then applied to determine the worst-case startup/shutdown condition for each pollutant. The worst-case conditions were determined to be:

- Siemens cold start to partial load for $NO_2$ and CO
- GE shutdown on oil for PM
- GE shutdown on natural gas for $SO_2$

The maximum modeled startup/shutdown $SO_2$ impact concentration was less than that for steady state conditions. As such, refined modeling was not performed to evaluate startup/shutdown $SO_2$ impacts.

The AERMOD analysis detailed in this modeling protocol was also applied to facility startup/shutdown conditions to evaluate potential impacts for CO, $NO_2$ and PM emissions. The modeling demonstrates that the facility will not cause or contribute to an exceedance of the NAAQS during such events. The results of this analysis is presented in Table 18.

### 5.16 Modeling Results & Documentation

Appendix B contains isopleths for each modelled criteria pollutant and averaging period. All relevant modeling files have been provided in Appendix C on a CD-ROM.

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# Tables

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**Table 1. Potential Criteria Pollutant Emissions[1]**

| Emission Source | Units | Gas Turbines/HRSGs/Duct Burners Steady State Operation | | Gas Turbines/HRSGs Startup/Shutdown | | Auxiliary Boiler | Dewpoint Heater | Emergency Generator | Fire Pump | ULSD Tank | Total | Major Source Threshold | Major Source? | Attainment Status | Offsets/Allowances Required |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fuel Type | | Natural Gas | ULSD | Natural Gas | ULSD | Natural Gas | Natural Gas | ULSD | ULSD | | | | | | |
| Emission Controls | | SCR/OC | SCR/OC | SCR/OC | SCR/OC | Ultra-Low NOx/FGR | Ultra-Low NOx/FGR | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Annual Operation (per unit) | hrs/yr | 7,865 | 720 | 155 | 20 | 4,576 | 8,760 | 300 | 300 | | | | | | |
| | | | | | | | | | | | | | | | |
| Maximum Heat Input Per Unit (per Gas Turbine) | MMBtu/hr | 3,393 | 3,507 | | | 140.6 | 15.0 | 19.5 | 2.1 | | | | | | |
| Maximum Heat Input Per Unit (per HRSG) | MMBtu/hr | 721 | 0 | | | | | | | | | | | | |
| Maximum Power Output (total) | MW net | 1,080 | 940 | | | | | | | | | | | | |
| Maximum Engine Output | Hp | | | | | | | 2,682 | 315 | | | | | | |
| | | | | | | | | | | | | | | | |
| Proposed Emissions | per unit | | | | | | | | | | | | | | |
| NOx | ppmvd@15%O2 | 2.0 | 5.0 | | | | | | | | | | | | |
| CO | ppmvd@15%O2 | 2.0 | 5.0 | | | | | | | | | | | | |
| VOC | ppmvd@15%O2 | 1.7 | 5.0 | | | | | | | | | | | | |
| CO2 | lb/MW-hr | 781 | 1,227 | | | | | | | | | | | | |
| SO2 | lb/MMBtu | 0.0017 | 0.0019 | | | | | | | | | | | | |
| PM/PM10/PM2.5 | lb/MMBtu | 0.0053 | 0.020 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Full Load Average Emission Rates | per unit | | | | | | | | | | | | | | |
| NOx | lb/hr | 24.90 | 68.60 | | | 1.55 | 0.16 | 32.23 | 1.88 | | | | | | |
| CO | lb/hr | 15.10 | 41.75 | | | 10.55 | 1.65 | 1.77 | 0.47 | | | | | | |
| VOC | lb/hr | 7.36 | 23.85 | | | 1.12 | 0.12 | 0.65 | 0.07 | | | | | | |
| CO2 | lb/hr | 399,000 | 577,000 | | | 16,591 | 1,770 | 3,206 | 349 | | | | | | |
| SO2 | lb/hr | 5.75 | 6.49 | | | 0.21 | 0.02 | 0.03 | 0.00 | | | | | | |
| PM/PM10/PM2.5 | lb/hr | 18.00 | 69.10 | | | 0.98 | 0.11 | 0.15 | 0.05 | | | | | | |
| | | | | | | | | | | | | | | | |
| Potential Emissions | | | | | | | | | | | | | | | |
| NOx | ton/yr | 195.85 | 49.39 | 27.92 | 4.03 | 3.55 | 0.70 | 4.83 | 0.28 | 0.00 | 286.55 | 50 | Yes | Ozone Nonattainment | 344 |
| CO | ton/yr | 118.77 | 30.06 | 50.05 | 8.90 | 24.14 | 7.23 | 0.27 | 0.07 | 0.00 | 239.48 | 100 | Yes | Attainment | NA |
| VOC | ton/yr | 57.89 | 17.17 | 7.03 | 2.60 | 2.56 | 0.53 | 0.10 | 0.01 | 0.44 | 88.32 | 50 | Yes | Ozone Nonattainment | 106 |
| CO2 | ton/yr | 3,138,251 | 415,440 | 13,062 | 3,592 | 37,960 | 7,753 | 481 | 52 | 0 | 3,616,592 | 100,000 | Yes | No NAAQS | 3,570,346 |
| SO2 | ton/yr | 45.23 | 4.67 | 0.19 | 0.04 | 0.48 | 0.09 | 0.00 | 0.00 | 0.00 | 50.70 | 100 | No | Attainment | NA |
| PM/PM10/PM2.5 | ton/yr | 141.58 | 49.75 | 1.64 | 1.09 | 2.24 | 0.48 | 0.02 | 0.01 | 0.00 | 196.81 | 100 | Yes | Attainment | NA |

[1] Based on preliminary project equipment specifications and emissions estimates. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.

**Table 2. Potential Non-Criteria Pollutant Emissions[1]**

| Emission Source(s): | | Gas Turbines | Gas Turbines | HRSG Duct Burners | Auxiliary Boiler | Dewpoint Heater | Diesel Generator | Fire Pump | Total Facility Potential Emissions | RIDEM APCR No. 22 Minimum Quantity | RIDEM APCR No. 22 Applicability Determination | Total Potential HAP Emissions | Major HAP Source Threshold |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Sources: | Hazardous Air Pollutant (Yes/No) | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | | |
| Fuel Fired: | | Natural Gas | ULSD | Natural Gas | Natural Gas | Natural Gas | ULSD | ULSD | | | | | |
| Maximum Unit Heat Input (MMBtu/hr): | | 3,393 | 3,507 | 721 | 140.6 | 15.0 | 19.5 | 2.1 | | | | | |
| Annual Operation (hrs/yr): | | 8,040 | 720 | 8,040 | 4,576 | 8,760 | 300 | 300 | | | | | |
| | | lb/yr | lb/yr | lb/yr | lb/yr | lb/yr | lb/yr | lb/yr | lb/yr | lb/yr | Yes/No | ton/yr | |
| 1,3-Butadiene | Yes | 2.3 | 8.1 | | | | | 0.0025 | 10 | 3 | Yes | 0.01 | 10 |
| 2-Methylnaphthalene | No | | | 0.027 | 0.0015 | 0.0031 | | | 0.032 | NA | NA | | |
| 3-Methylchloranthrene | No | | | 0.0020 | 0.00011 | 0.00023 | | | 0.0023 | NA | NA | | |
| 7,12-Dimethylbenz(a)anthracene | No | | | 0.018 | 0.0010 | 0.0021 | | | 0.021 | NA | NA | | |
| Acenaphthene | No | | | 0.0020 | 0.0011 | 0.00023 | 0.0027 | 0.0090 | 0.015 | NA | NA | | |
| Acenaphthylene | No | | | 0.0020 | 0.0011 | 0.00023 | 0.0054 | 0.0032 | 0.012 | NA | NA | | |
| Acetaldehyde | Yes | 218 | | | | | 0.15 | 0.48 | 219 | 50 | Yes | 0.11 | 10 |
| Acrolein | Yes | 0.07 | | | | | 0.0046 | 0.0058 | 0.08 | 0.07 | Yes | 0.00 | 10 |
| Ammonia | No | 73,968 | 7,272 | | | | | | 81,240 | 300 | Yes | | |
| Anthracene | No | | | 0.0027 | 0.0015 | 0.00031 | 0.0072 | 0.0012 | 0.013 | NA | NA | | |
| Arsenic | Yes | | 0.23 | 2.3 | 0.13 | 0.0026 | | | 2.7 | 0.02 | Yes | 0.00 | 10 |
| Barium | No | | | 50 | 2.78 | 0.57 | | | 53 | 2,000 | No | | |
| Benz(a)anthracene | No | | | 0.0020 | 0.0011 | 0.00023 | 0.0036 | 0.0011 | 0.0080 | NA | NA | | |
| Benzene | Yes | 65 | 6.1 | 2.4 | 1.3 | 0.27 | 4.5 | 0.59 | 80 | 10 | Yes | 0.04 | 10 |
| Benzo(a)pyrene | No | | | 0.0014 | 0.00076 | 0.00016 | 0.0015 | 0.00012 | 0.0039 | NA | NA | | |
| Benzo(b)fluoranthene | No | | | 0.0020 | 0.0011 | 0.00023 | 0.0065 | 0.000062 | 0.010 | NA | NA | | |
| Benzo(g,h,i)perylene | No | | | 0.0014 | 0.00076 | 0.00016 | 0.0033 | 0.00031 | 0.0059 | NA | NA | | |
| Benzo(k)fluoranthene | No | | | 0.0020 | 0.0011 | 0.00023 | 0.0013 | 0.000098 | 0.0047 | NA | NA | | |
| Beryllium | Yes | | 1.6 | 0.14 | 0.0076 | 0.0016 | | | 1.7 | 0.04 | Yes | 0.00 | 10 |
| Butane | No | | | 2,387 | 1,320 | 271 | | | 3,978 | NA | NA | | |
| Cadmium | Yes | | 0.026 | 13 | 0.69 | 0.14 | | | 14 | 0.07 | Yes | 0.01 | 10 |
| Chromium | Yes | | 11 | 16 | 0.88 | 0.18 | | | 28 | 20,000 | No | 0.01 | 10 |
| Chrysene | No | | | 0.0020 | 0.0011 | 0.00023 | 0.0089 | 0.00022 | 0.012 | NA | NA | | |
| Cobalt | Yes | | | 1.0 | 0.0053 | 0.0011 | | | 1.0 | 0.1 | Yes | 0.00 | 10 |
| Copper | No | | | 10 | 0.54 | 0.11 | | | 11 | 40 | No | | |
| Dibenzo(a,h)anthracene | No | | | 0.0014 | 0.00076 | 0.00016 | 0.0020 | 0.00037 | 0.0047 | NA | NA | | |
| Dichlorobenzene | No | | | 1.4 | 0.76 | 0.16 | | | 2.3 | NA | NA | | |
| Ethane | No | | | 3,524 | 1,960 | 399 | | | 5,883 | NA | NA | | |
| Ethylbenzene | Yes | 175 | | | | | | | 175 | 9,000 | No | 0.09 | 10 |
| Fluoranthene | No | | | 0.0034 | 0.0019 | 0.00039 | 0.0024 | 0.0048 | 0.013 | NA | NA | | |
| Fluorene | No | | | 3.2 | 1.8 | 0.37 | 0.0075 | 0.0018 | 5.4 | NA | NA | | |
| Formaldehyde | Yes | 1,191 | 116 | 85 | 47 | 9.7 | 0.46 | 0.74 | 1,450 | 9 | Yes | 0.72 | 10 |
| Hexane | Yes | | | 2,046 | 1,140 | 232 | | | 3,418 | 20,000 | No | 1.71 | 10 |
| Indeno(1,2,3-cd)pyrene | No | | | 2.1 | 1.2 | 0.24 | 0.0024 | 0.00024 | 3.5 | NA | NA | | |
| Lead | Yes | | 3.9 | 5.7 | 0.32 | 0.0064 | | | 10 | 0.9 | Yes | 0.00 | 10 |
| Manganese | Yes | | 1.4 | 4.3 | 0.24 | 0.0049 | | | 5.9 | 0.2 | Yes | 0.00 | 10 |
| Mercury | Yes | | 0.052 | 3.0 | 0.16 | 0.0034 | | | 3.2 | 0.7 | Yes | 0.00 | 10 |
| Molybdenum | No | | | 13 | 0.69 | 0.14 | | | 14 | 60 | No | | |
| Naphthalene | Yes | 7.1 | 18 | 0.69 | 0.39 | 0.0079 | 0.76 | 0.0053 | 27 | 3 | Yes | 0.01 | 10 |
| Nickel | Yes | | 7.5 | 24 | 1.32 | 0.27 | | | 33 | 0.4 | Yes | 0.02 | 10 |
| Pentane | No | | | 2,955 | 1,640 | 335 | | | 4,930 | NA | NA | | |
| Phenanthrene | No | | | 0.019 | 0.0011 | 0.0022 | 0.24 | 0.0019 | 0.26 | NA | NA | | |
| Propane | No | | | 1,819 | 1,010 | 206 | | | 3,035 | NA | NA | | |
| Propylene | No | | | | | | 16.3 | 1.6 | 18 | 36,500 | No | | |
| Propylene Oxide | Yes | 158 | | | | | | | 158 | 30 | Yes | 0.08 | 10 |
| Pyrene | No | | | 0.0057 | 0.0032 | 0.00064 | 0.0022 | 0.0030 | 0.015 | NA | NA | | |
| Selenium | Yes | | 1.3 | 0.27 | 0.0015 | 0.0031 | | | 1.6 | 2,000 | No | 0.00 | 10 |
| Sulfuric Acid | No | 29,668 | 3,002 | | | | | | 32,670 | 40 | Yes | | |
| Toluene | Yes | 709 | | 3.9 | 2.1 | 0.44 | 1.60 | 0.26 | 717 | 1,000 | No | 0.36 | 10 |
| Vanadium | No | | | 26 | 1.5 | 0.30 | | | 28 | 0.07 | Yes | | |
| Xylenes | Yes | 349 | | | | | 1.10 | 0.18 | 350 | 3,000 | No | 0.18 | 10 |
| Zinc | No | | | 330 | 18.3 | 3.7 | | | 352 | 3,000 | No | | |
| | | | | | | | | | | | Total: | 3.35 | 25 |

[1] Based on preliminary project equipment specifications and emissions estimates. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.

**Table 3. Modeling Input Parameters**

| Emission Source | Units | Gas Turbines/HRSGs/Duct Burners | | | | Auxiliary Boiler | Dewpoint Heater | Emergency Generator | Fire Pump |
|---|---|---|---|---|---|---|---|---|---|
| | | GT/HRSG-1 | | GT/HRSG-2 | | | | | |
| Fuel Type | | Natural Gas | ULSD | Natural Gas | ULSD | Natural Gas | Natural Gas | ULSD | ULSD |
| | | | | | | | | | |
| Annual Operation (per unit) | hrs/yr | 8,040 | 720 | 8,760 | 720 | 4,576 | 8,760 | 300 | 300 |
| | | | | | | | | | |
| Stack Parameters | | | | | | | | | |
| Stack Location | UTM N (Z 19) | 4649568.7 | | 4649527.1 | | 4649470.9 | 4649670.7 | 4649460.6 | 4649420.0 |
| Stack Location | UTM E (Z 19) | 271841.7 | | 271869.9 | | 271874.6 | 271699.0 | 271848.3 | 271946.6 |
| Stack Base Elevation | ft AMSL | 570 | | 570 | | 570 | 570 | 570 | 570 |
| Stack Height | feet | 200.0 | | 200.0 | | 50 | 35 | 35 | 35 |
| Stack Diameter | inches | 264.0 | | 264.0 | | 48 | 20 | 8 | 6 |
| Stack Flow | acfm | see App. A | see App. A | see App. A | see App. A | 38,067 | 7,252 | 15,295 | 1,673 |
| Stack Exit Temperature | deg. F | see App. A | see App. A | see App. A | see App. A | 344 | 1,000 | 752 | 855 |
| | | | | | | | | | |
| Maximum Emission Rate | | | | | | | | | |
| $NO_X$ | lb/hr | see App. A | see App. A | see App. A | see App. A | 1.55 | 0.16 | 32.23 | 1.88 |
| CO | lb/hr | see App. A | see App. A | see App. A | see App. A | 10.55 | 1.65 | 1.77 | 0.47 |
| $SO_2$ | lb/hr | see App. A | see App. A | see App. A | see App. A | 0.21 | 0.020 | 0.031 | 0.0033 |
| $PM/PM_{10}/PM_{2.5}$ | lb/hr | see App. A | see App. A | see App. A | see App. A | 0.98 | 0.11 | 0.15 | 0.054 |
| | | | | | | | | | |
| Maximum Emission Rate | | | | | | | | | |
| $NO_X$ | g/sec | see App. A | see App. A | see App. A | see App. A | 0.20 | 0.020 | 4.06 | 0.24 |
| CO | g/sec | see App. A | see App. A | see App. A | see App. A | 1.33 | 0.21 | 0.22 | 0.059 |
| $SO_2$ | g/sec | see App. A | see App. A | see App. A | see App. A | 0.026 | 0.0025 | 0.0039 | 0.00042 |
| $PM/PM_{10}/PM_{2.5}$ | g/sec | see App. A | see App. A | see App. A | see App. A | 0.12 | 0.014 | 0.019 | 0.0068 |

**Table 4. GEP Stack Height Analysis Summary**

| Structure | Height (ft) | Length (ft) | Width (ft) | Projected Width (ft) | Formula GEP Height (ft) | Stacks > GEP Height | Building Distance from Stack (ft) | | | | | | '5L' Distance (ft) | Stacks within 5L? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ES-1 | ES-2 | FP | Aux Boiler | DP Heater | EG | | |
| Air Cooled Condenser 1 | 120 | 350 | 145 | 378.8 | 300 | None | 390 | 430 | 620 | 390 | 525 | 345 | 600 | All except FP |
| Air Cooled Condenser 2 | 120 | 350 | 145 | 378.8 | 300 | None | 510 | 390 | 660 | 390 | 345 | 570 | 600 | All except FP |
| Heat Recovery Steam Generator 1 | 115 | 75 | 65 | 99.2 | 263.8 | None | 13 | 320 | 260 | 210 | 220 | 125 | 496 | All stacks |
| Heat Recovery Steam Generator 2 | 115 | 75 | 65 | 99.2 | 263.8 | None | 320 | 13 | 330 | 80 | 580 | 480 | 496 | All stacks except DP Heater, EG |
| Steam Turbine Building 1 | 80 | 180 | 150 | 234.3 | 200 | ES-1, ES-2 at GEP | 180 | 330 | 415 | 270 | 530 | 115 | 400 | All except FP, DP Heater |
| Steam Turbine Building 2 | 80 | 180 | 150 | 234.3 | 200 | ES-1, ES-2 at GEP | 330 | 180 | 460 | 185 | 230 | 440 | 400 | All except FP, EG |
| CT Inlet Filter 1 | 80 | 60 | 25 | 65 | 177.5 | ES-1, ES-2 | 200 | 300 | 425 | 220 | 500 | 245 | 325 | All except FP, DP Heater |
| CT Inlet Filter 2 | 80 | 60 | 25 | 65 | 177.5 | ES-1, ES-2 | 450 | 200 | 540 | 295 | 190 | 585 | 325 | All except ES-1, FP, EG |

**Table 5. Cavity Analysis**

| Structure | Height (ft) | Projected Width (ft) | Cavity Height (1.5L) (ft) | Stacks > Cavity Height | Cavity Region Distance (3L) (ft) | Stacks within Cavity Region | Distance from Property Line (ft) | Cavity Extends Offsite? |
|---|---|---|---|---|---|---|---|---|
| Air Cooled Condenser 1 | 120 | 378.8 | 180 | ES-1, ES-2 | 360 | EG | 240 | Yes |
| Air Cooled Condenser 2 | 120 | 378.8 | 180 | ES-1, ES-2 | 360 | DP Heater | 325 | Yes |
| Heat Recovery Steam Generator 1 | 115 | 99.2 | 148.8 | ES-1, ES-2 | 297.6 | All stacks | 140 | Yes |
| Heat Recovery Steam Generator 2 | 115 | 99.2 | 148.8 | ES-1, ES-2 | 297.6 | All stacks except DP Heater, EG | 340 | No |
| Steam Turbine Building 1 | 80 | 234.3 | 120 | ES-1, ES-2 | 240 | ES-1, EG | 115 | Yes |
| Steam Turbine Building 2 | 80 | 234.3 | 120 | ES-1, ES-2 | 240 | ES-2, Aux Boiler, DP Heater | 460 | No |
| CT Inlet Filter 1 | 80 | 65 | 97.5 | ES-1, ES-2 | 195 | No Stacks | 260 | No |
| CT Inlet Filter 2 | 80 | 65 | 97.5 | ES-1, ES-2 | 195 | DP Heater | 510 | No |

**Table 6. Screening Modeling Results - GE Gas Turbines**

| Fuel Type | | Gas | | | | | | | | | | | | | Oil | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Modeling Case | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Amb. Temp (F) | | 90 | 90 | 90 | 90 | 90 | 59 | 59 | 59 | 59 | 10 | 10 | 10 | 10 | 90 | 90 | 59 | 59 | 10 | 10 | 0 | 0 |
| | | Emission Rate (g/sec) | | | | | | | | | | | | | Emission Rate (g/sec) | | | | | | | |
| $NO_X$ | | 3.12 | 2.91 | 2.78 | 2.21 | 1.44 | 3.14 | 2.90 | 2.29 | 1.32 | 3.35 | 3.09 | 2.46 | 1.55 | 7.98 | 4.83 | 8.27 | 5.07 | 8.64 | 5.36 | 8.67 | 5.30 |
| CO | | 1.93 | 1.76 | 1.69 | 1.34 | 1.00 | 1.89 | 1.75 | 1.39 | 0.93 | 2.07 | 1.88 | 1.49 | 1.08 | 1.86 | 1.13 | 1.93 | 1.18 | 2.05 | 1.29 | 2.05 | 1.27 |
| $SO_2$ | | 0.73 | 0.67 | 0.64 | 0.51 | 0.38 | 0.73 | 0.67 | 0.53 | 0.36 | 0.78 | 0.71 | 0.56 | 0.41 | 0.73 | 0.44 | 0.75 | 0.46 | 0.80 | 0.50 | 0.80 | 0.50 |
| $PM/PM_{10}/PM_{2.5}$ | | 2.53 | 1.51 | 1.50 | 1.42 | 1.36 | 2.56 | 1.50 | 1.44 | 1.35 | 2.60 | 1.52 | 1.45 | 1.37 | 8.66 | 8.51 | 8.67 | 8.52 | 8.69 | 8.54 | 8.69 | 8.53 |
| Urban | | 1.213 | 1.2306 | 1.2582 | 1.4017 | 1.6837 | 1.2427 | 1.2454 | 1.3954 | 1.7635 | 1.1935 | 1.1963 | 1.3689 | 1.6576 | 0.9192 | 1.337 | 0.9101 | 1.352 | 0.9154 | 1.3044 | 0.9054 | 1.1337 |
| Rural | | 1.1702 | 1.1875 | 1.215 | 1.3556 | 1.6041 | 1.1994 | 1.202 | 1.3495 | 1.6558 | 1.1505 | 1.1533 | 1.3235 | 1.5875 | 0.9045 | 1.2934 | 0.9005 | 1.3081 | 0.9057 | 1.2615 | 0.8958 | 1.0953 |
| Averaging Period | | Concentration (µg/m3) Modeled @ 1 g/s | | | | | | | | | | | | | Concentration (µg/m3) Modeled @ 1 g/s | | | | | | | |
| 1-hr | | 1.213 | 1.2306 | 1.2582 | 1.4017 | 1.6837 | 1.2427 | 1.2454 | 1.3954 | 1.7635 | 1.1935 | 1.1963 | 1.3689 | 1.6576 | 0.9192 | 1.337 | 0.9101 | 1.352 | 0.9154 | 1.3044 | 0.9054 | 1.1337 |
| 3-hr | | 1.213 | 1.2306 | 1.2582 | 1.4017 | 1.6837 | 1.2427 | 1.2454 | 1.3954 | 1.7635 | 1.1935 | 1.1963 | 1.3689 | 1.6576 | 0.9192 | 1.337 | 0.9101 | 1.352 | 0.9154 | 1.3044 | 0.9054 | 1.1337 |
| 8-hr | | 1.0917 | 1.10754 | 1.13238 | 1.26153 | 1.51533 | 1.11843 | 1.12086 | 1.25586 | 1.58715 | 1.07415 | 1.07667 | 1.23201 | 1.49184 | 0.82728 | 1.2033 | 0.81909 | 1.2168 | 0.82386 | 1.17396 | 0.81486 | 1.02033 |
| 24-hr | | 0.7278 | 0.73836 | 0.75492 | 0.84102 | 1.01022 | 0.74562 | 0.74724 | 0.83724 | 1.0581 | 0.7161 | 0.71778 | 0.82134 | 0.99456 | 0.55152 | 0.8022 | 0.54606 | 0.8112 | 0.54924 | 0.78264 | 0.54324 | 0.68022 |
| Annual | | 0.1213 | 0.12306 | 0.12582 | 0.14017 | 0.16837 | 0.12427 | 0.12454 | 0.13954 | 0.17635 | 0.11935 | 0.11963 | 0.13689 | 0.16576 | 0.09192 | 0.1337 | 0.09101 | 0.1352 | 0.09154 | 0.13044 | 0.09054 | 0.11337 |
| | | Concentration (µg/m3) | | | | | | | | | | | | | Concentration (µg/m3) | | | | | | | |
| $NO_X$ | 1-hr | 3.79 | 3.58 | 3.50 | 3.09 | 2.42 | 3.90 | 3.61 | 3.20 | 2.33 | **4.00** | 3.69 | 3.36 | 2.57 | 7.33 | 6.45 | 7.52 | 6.85 | **7.91** | 6.99 | 7.85 | 6.01 |
| | Annual | | | | | | **0.39** | 0.36 | 0.32 | 0.23 | | | | | | | **0.75** | 0.68 | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| CO | 1-hr | 2.34 | 2.17 | 2.12 | 1.87 | 1.68 | 2.35 | 2.18 | 1.93 | 1.64 | **2.47** | 2.25 | 2.04 | 1.79 | 1.71 | 1.51 | 1.75 | 1.60 | **1.88** | 1.68 | 1.86 | 1.44 |
| | 8-hr | 2.10 | 1.95 | 1.91 | 1.68 | 1.51 | 2.11 | 1.96 | 1.74 | 1.48 | **2.22** | 2.02 | 1.83 | 1.61 | 1.54 | 1.36 | 1.58 | 1.44 | **1.69** | 1.51 | 1.67 | 1.30 |
| | | | | | | | | | | | | | | | | | | | | | | |
| $SO_2$ | 1-hr | 0.89 | 0.83 | 0.81 | 0.71 | 0.64 | 0.91 | 0.83 | 0.73 | 0.63 | **0.93** | 0.85 | 0.77 | 0.68 | 0.67 | 0.59 | 0.68 | 0.62 | **0.73** | 0.65 | 0.72 | 0.56 |
| | 3-hr | 0.89 | 0.83 | 0.81 | 0.71 | 0.64 | 0.91 | 0.83 | 0.73 | 0.63 | **0.93** | 0.85 | 0.77 | 0.68 | 0.67 | 0.59 | 0.68 | 0.62 | **0.73** | 0.65 | 0.72 | 0.56 |
| | 24-hr | 0.53 | 0.50 | 0.49 | 0.43 | 0.38 | 0.55 | 0.50 | 0.44 | 0.38 | **0.56** | 0.51 | 0.46 | 0.41 | 0.40 | 0.35 | 0.41 | 0.37 | **0.44** | 0.39 | 0.43 | 0.34 |
| | Annual | | | | | | **0.09** | 0.08 | 0.07 | 0.06 | | | | | | | **0.07** | 0.06 | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| $PM_{2.5}$ | 24-hr | 1.84 | 1.12 | 1.13 | 1.20 | 1.37 | **1.91** | 1.12 | 1.20 | 1.43 | 1.86 | 1.09 | 1.19 | 1.37 | 4.77 | 6.82 | 4.73 | **6.91** | 4.78 | 6.69 | 4.72 | 5.80 |
| | Annual | | | | | | **0.32** | 0.19 | 0.20 | 0.24 | | | | | | | 0.79 | **1.15** | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| $PM_{10}$ | 24-hr | 1.84 | 1.12 | 1.13 | 1.20 | 1.37 | **1.91** | 1.12 | 1.20 | 1.43 | 1.86 | 1.09 | 1.19 | 1.37 | 4.77 | 6.82 | 4.73 | **6.91** | 4.78 | 6.69 | 4.72 | 5.80 |

Table 7. Screening Modeling Results - MHI Gas Turbines

| Fuel Type | | Gas | | | | | | | | | | | | | Oil | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Modeling Case | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Amb. Temp (F) | | 90 | 90 | 90 | 90 | 90 | 59 | 59 | 59 | 59 | 10 | 10 | 10 | 10 | 90 | 90 | 59 | 59 | 10 | 10 | 0 | 0 |
| | | Emission Rate (g/sec) | | | | | | | | | | | | | Emission Rate (g/sec) | | | | | | | |
| $NO_X$ | | 3.29 | 2.65 | 2.56 | 2.04 | 1.60 | 3.39 | 2.75 | 2.19 | 1.68 | 3.44 | 3.02 | 2.43 | 1.88 | 5.70 | 4.10 | 6.17 | 4.42 | 6.17 | 4.98 | 6.17 | 5.09 |
| CO | | 2.00 | 1.61 | 1.55 | 1.25 | 0.97 | 2.07 | 1.68 | 1.34 | 1.02 | 2.09 | 1.84 | 1.49 | 1.15 | 3.47 | 2.49 | 3.75 | 2.70 | 3.75 | 3.02 | 3.75 | 3.10 |
| $SO_2$ | | 0.29 | 0.23 | 0.23 | 0.18 | 0.14 | 0.29 | 0.24 | 0.19 | 0.15 | 0.30 | 0.26 | 0.21 | 0.16 | 0.44 | 0.33 | 0.48 | 0.35 | 0.48 | 0.39 | 0.48 | 0.40 |
| $PM/PM_{10}/PM_{2.5}$ | | 1.88 | 0.92 | 0.91 | 0.74 | 0.60 | 1.92 | 0.97 | 0.81 | 0.62 | 1.68 | 1.06 | 0.88 | 0.68 | 3.67 | 2.53 | 3.94 | 2.73 | 3.86 | 3.09 | 3.83 | 3.14 |
| Averaging Period | | Concentration (μg/m³) Modeled @ 1 g/s | | | | | | | | | | | | | Concentration (μg/m³) Modeled @ 1 g/s | | | | | | | |
| 1-hr | | 1.4146 | 1.4318 | 1.4593 | 1.6357 | 1.938 | 1.4519 | 1.3965 | 1.5573 | 1.928 | 1.3693 | 1.3228 | 1.464 | 1.8822 | 1.3735 | 1.8616 | 1.3055 | 1.755 | 1.3364 | 1.5858 | 1.343 | 1.5701 |
| 3-hr | | 1.4146 | 1.4318 | 1.4593 | 1.6357 | 1.938 | 1.4519 | 1.3965 | 1.5573 | 1.928 | 1.3693 | 1.3228 | 1.464 | 1.8822 | 1.3735 | 1.8616 | 1.3055 | 1.755 | 1.3364 | 1.5858 | 1.343 | 1.5701 |
| 8-hr | | 1.27314 | 1.28862 | 1.31337 | 1.47213 | 1.7442 | 1.30671 | 1.25685 | 1.40157 | 1.7352 | 1.23237 | 1.19052 | 1.3176 | 1.69398 | 1.23615 | 1.67544 | 1.17495 | 1.5795 | 1.20276 | 1.42722 | 1.2087 | 1.41309 |
| 24-hr | | 0.84876 | 0.85908 | 0.87558 | 0.98142 | 1.1628 | 0.87114 | 0.8379 | 0.93438 | 1.1568 | 0.82158 | 0.79368 | 0.8784 | 1.12932 | 0.8241 | 1.11696 | 0.7833 | 1.053 | 0.80184 | 0.95148 | 0.8058 | 0.94206 |
| Annual | | 0.14146 | 0.14318 | 0.14593 | 0.16357 | 0.1938 | 0.14519 | 0.13965 | 0.15573 | 0.1928 | 0.13693 | 0.13228 | 0.1464 | 0.18822 | 0.13735 | 0.18616 | 0.13055 | 0.1755 | 0.13364 | 0.15858 | 0.1343 | 0.15701 |
| | | Concentration (μg/m³) | | | | | | | | | | | | | Concentration (μg/m³) | | | | | | | |
| $NO_X$ | 1-hr | 4.65 | 3.79 | 3.73 | 3.34 | 3.10 | **4.92** | 3.84 | 3.41 | 3.23 | 4.71 | 4.00 | 3.56 | 3.53 | 7.82 | 7.62 | 8.06 | 7.76 | 8.25 | 7.89 | **8.29** | 7.99 |
| | Annual | | | | | | **0.49** | 0.38 | 0.34 | 0.32 | | | | | | | **0.81** | 0.78 | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| CO | 1-hr | 2.83 | 2.31 | 2.26 | 2.04 | 1.88 | **3.00** | 2.34 | 2.08 | 1.97 | 2.86 | 2.43 | 2.18 | 2.16 | 4.76 | 4.64 | 4.90 | 4.73 | 5.02 | 4.80 | **5.04** | 4.87 |
| | 8-hr | 2.55 | 2.08 | 2.04 | 1.84 | 1.69 | **2.70** | 2.11 | 1.87 | 1.77 | 2.58 | 2.19 | 1.96 | 1.94 | 4.28 | 4.18 | 4.41 | 4.26 | 4.52 | 4.32 | **4.54** | 4.38 |
| | | | | | | | | | | | | | | | | | | | | | | |
| $SO_2$ | 1-hr | 0.41 | 0.32 | 0.33 | 0.29 | 0.27 | **0.42** | 0.33 | 0.29 | 0.29 | 0.41 | 0.35 | 0.31 | 0.31 | 0.61 | 0.61 | 0.63 | 0.62 | 0.640 | 0.62 | **0.643** | 0.63 |
| | 3-hr | 0.41 | 0.32 | 0.33 | 0.29 | 0.27 | **0.42** | 0.33 | 0.29 | 0.29 | 0.41 | 0.35 | 0.31 | 0.31 | 0.61 | 0.61 | 0.63 | 0.62 | 0.640 | 0.62 | **0.643** | 0.63 |
| | 24-hr | 0.25 | 0.19 | 0.20 | 0.17 | 0.16 | **0.25** | 0.20 | 0.18 | 0.17 | 0.25 | 0.21 | 0.19 | 0.18 | 0.36 | 0.37 | 0.38 | 0.37 | 0.384 | 0.37 | **0.386** | 0.38 |
| | Annual | | | | | | **0.04** | 0.03 | 0.03 | 0.03 | | | | | | | **0.06** | 0.06 | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| $PM_{2.5}$ | 24-hr | 1.59 | 0.79 | 0.79 | 0.73 | 0.70 | **1.67** | 0.81 | 0.75 | 0.71 | 1.38 | 0.84 | 0.77 | 0.77 | 3.02 | 2.83 | **3.089** | 2.88 | 3.09 | 2.94 | 3.087 | 2.96 |
| | Annual | | | | | | **0.28** | 0.14 | 0.13 | 0.12 | | | | | | | **0.51** | 0.48 | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| $PM_{10}$ | 24-hr | 1.59 | 0.79 | 0.79 | 0.73 | 0.70 | **1.67** | 0.81 | 0.75 | 0.71 | 1.38 | 0.84 | 0.77 | 0.77 | 3.02 | 2.83 | **3.09** | 2.88 | 3.09 | 2.94 | 3.09 | 2.96 |

**Table 8. Screening Modeling Results - Siemens Gas Turbines**

| Fuel Type | | Gas | | | | | | | | | | | | | Oil | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Modeling Case | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| Amb. Temp (F) | | 90 | 90 | 90 | 90 | 90 | 59 | 59 | 59 | 59 | 10 | 10 | 10 | 10 | 90 | 90 | 59 | 59 | 10 | 10 |
| | | Emission Rate (g/sec) | | | | | | | | | | | | | Emission Rate (g/sec) | | | | | |
| $NO_x$ | | 2.77 | 2.47 | 2.34 | 1.86 | 1.34 | 2.87 | 2.58 | 2.04 | 1.45 | 3.05 | 2.80 | 2.21 | 1.56 | 6.60 | 4.52 | 6.92 | 4.79 | 6.94 | 4.90 |
| CO | | 1.69 | 1.51 | 1.42 | 1.13 | 0.82 | 1.75 | 1.58 | 1.25 | 0.88 | 1.85 | 1.70 | 1.35 | 0.96 | 2.68 | 1.84 | 2.81 | 1.94 | 2.82 | 1.99 |
| $SO_2$ | | 0.56 | 0.50 | 0.48 | 0.38 | 0.28 | 0.58 | 0.53 | 0.42 | 0.30 | 0.62 | 0.57 | 0.45 | 0.33 | 0.52 | 0.36 | 0.55 | 0.38 | 0.55 | 0.39 |
| $PM/PM_{10}/PM_{2.5}$ | | 1.90 | 1.47 | 1.42 | 1.17 | 1.01 | 1.97 | 1.55 | 1.26 | 1.01 | 2.02 | 1.64 | 1.31 | 1.02 | 3.78 | 3.78 | 3.78 | 3.78 | 3.78 | 3.78 |
| Averaging Period | | Concentration (μg/m³) Modeled @ 1 g/s | | | | | | | | | | | | | Concentration (μg/m³) Modeled @ 1 g/s | | | | | |
| 1-hr | | 1.3036 | 1.3317 | 1.3652 | 1.5442 | 1.8362 | 1.3033 | 1.3287 | 1.529 | 1.8357 | 1.2572 | 1.2852 | 1.4961 | 1.7519 | 1.2108 | 1.4657 | 1.1497 | 1.414 | 1.1018 | 1.3715 |
| 3-hr | | 1.3036 | 1.3317 | 1.3652 | 1.5442 | 1.8362 | 1.3033 | 1.3287 | 1.529 | 1.8357 | 1.2572 | 1.2852 | 1.4961 | 1.7519 | 1.2108 | 1.4657 | 1.1497 | 1.414 | 1.1018 | 1.3715 |
| 8-hr | | 1.17324 | 1.19853 | 1.22868 | 1.38978 | 1.65258 | 1.17297 | 1.19583 | 1.3761 | 1.65213 | 1.13148 | 1.15668 | 1.34649 | 1.57671 | 1.08972 | 1.31913 | 1.03473 | 1.2726 | 0.99162 | 1.23435 |
| 24-hr | | 0.78216 | 0.79902 | 0.81912 | 0.92652 | 1.10172 | 0.78198 | 0.79722 | 0.9174 | 1.10142 | 0.75432 | 0.77112 | 0.89766 | 1.05114 | 0.72648 | 0.87942 | 0.68982 | 0.8484 | 0.66108 | 0.8229 |
| Annual | | 0.13036 | 0.13317 | 0.13652 | 0.15442 | 0.18362 | 0.13033 | 0.13287 | 0.1529 | 0.18357 | 0.12572 | 0.12852 | 0.14961 | 0.17519 | 0.12108 | 0.14657 | 0.11497 | 0.1414 | 0.11018 | 0.13715 |
| | | Concentration (μg/m³) | | | | | | | | | | | | | Concentration (μg/m³) | | | | | |
| $NO_x$ | 1-hr | 3.61 | 3.29 | 3.20 | 2.88 | 2.45 | 3.74 | 3.43 | 3.12 | 2.66 | **3.83** | 3.59 | 3.30 | 2.74 | **7.99** | 6.63 | 7.95 | 6.77 | 7.65 | 6.72 |
| | Annual | | | | | | **0.37** | 0.34 | 0.31 | 0.27 | | | | | | | **0.80** | 0.68 | | |
| CO | 1-hr | 2.20 | 2.01 | 1.94 | 1.75 | 1.50 | 2.28 | 2.09 | 1.91 | 1.62 | **2.33** | 2.19 | 2.02 | 1.68 | **3.25** | 2.70 | 3.23 | 2.74 | 3.11 | 2.73 |
| | 8-hr | 1.98 | 1.81 | 1.75 | 1.58 | 1.35 | 2.05 | 1.88 | 1.72 | 1.46 | **2.10** | 1.97 | 1.82 | 1.51 | **2.92** | 2.43 | 2.91 | 2.47 | 2.80 | 2.46 |
| $SO_2$ | 1-hr | 0.73 | 0.67 | 0.65 | 0.59 | 0.51 | 0.76 | 0.70 | 0.64 | 0.55 | **0.78** | 0.73 | 0.68 | 0.57 | **0.630** | 0.53 | 0.627 | 0.54 | 0.60 | 0.54 |
| | 3-hr | 0.73 | 0.67 | 0.65 | 0.59 | 0.51 | 0.76 | 0.70 | 0.64 | 0.55 | **0.78** | 0.73 | 0.68 | 0.57 | **0.630** | 0.53 | 0.627 | 0.54 | 0.60 | 0.54 |
| | 24-hr | 0.44 | 0.40 | 0.39 | 0.35 | 0.31 | 0.46 | 0.42 | 0.38 | 0.33 | **0.47** | 0.44 | 0.41 | 0.34 | **0.378** | 0.32 | 0.376 | 0.32 | 0.36 | 0.32 |
| | Annual | | | | | | **0.08** | 0.07 | 0.06 | 0.06 | | | | | | | **0.06** | 0.05 | | |
| $PM_{2.5}$ | 24-hr | 1.49 | 1.18 | 1.17 | 1.09 | 1.11 | **1.54** | 1.24 | 1.16 | 1.11 | 1.52 | 1.26 | 1.18 | 1.07 | 2.75 | **3.32** | 2.61 | 3.21 | 2.50 | 3.11 |
| | Annual | | | | | | **0.26** | 0.21 | 0.19 | 0.19 | | | | | | | 0.43 | **0.53** | | |
| $PM_{10}$ | 24-hr | 1.49 | 1.18 | 1.17 | 1.09 | 1.11 | **1.54** | 1.24 | 1.16 | 1.11 | 1.52 | 1.26 | 1.18 | 1.07 | 2.75 | **3.32** | 2.61 | 3.21 | 2.50 | 3.11 |

**Table 9. Screening Modeling Results Summary**

| Turbine Manufacturer | | GE | GE | MHI | Siemens | Siemens | GE | GE | GE | MHI | MHI | Siemens | Siemens | Siemens | Siemens |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Modeling Case** | | 6 | 10 | 6 | 6 | 10 | 16 | 17 | 18 | 16 | 20 | 14 | 15 | 16 | 17 |
| **Fuel Type** | | Gas | Gas | Gas | Gas | Gas | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD |
| **Ambient Temperature (F)** | | 59 | 10 | 59 | 59 | 10 | 59 | 59 | 10 | 59 | 0 | 90 | 90 | 59 | 59 |
| $NO_X$ | 1-hr | | 4.00 | 4.92 | | 3.83 | | | 7.91 | | **8.29** | 7.99 | 6.63 | 7.95 | |
| | Annual | 0.39 | | **0.49** | 0.37 | | 0.75 | | | **0.81** | | | | 0.80 | |
| CO | 1-hr | | 2.47 | 3.00 | | 2.33 | | | 1.88 | | **5.04** | 3.25 | | | |
| | 8-hr | | 2.22 | 2.70 | | 2.10 | | | 1.69 | | **4.54** | 2.92 | | | |
| $SO_2$ | 1-hr | | **0.93** | 0.42 | | 0.78 | | | 0.73 | | 0.64 | 0.63 | | | |
| | 3-hr | | **0.93** | 0.42 | | 0.78 | | | 0.73 | | 0.64 | 0.63 | | | |
| | 24-hr | | **0.56** | 0.25 | | 0.47 | | | 0.44 | | 0.39 | 0.38 | | | |
| | Annual | **0.09** | | 0.04 | 0.08 | | **0.07** | | | 0.06 | | | | 0.06 | |
| $PM_{2.5}$ | 24-hr | | 1.91 | 1.67 | 1.54 | | | **6.91** | | 3.09 | | | 3.32 | | |
| | Annual | **0.32** | | 0.28 | 0.26 | | | **1.15** | | 0.51 | | | | | 0.53 |
| $PM_{10}$ | 24-hr | | 1.86 | 1.67 | 1.54 | | | **6.91** | | 3.09 | | | 3.32 | | |

Table 10. AERMOD Modeling Results Summary - Significance Determination

| Pollutant | Averaging Period | Rank | 2010 | 2011 | 2012 | 2013 | 2014 | 5-year Average | Max | Class II SIL | SIA (km) | Class I SIL | SIA (km) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Steady State Operation (turbines, dewpoint heater) | | | | | | | | | | | | | |
| CO | 1-hr | Max | 44 | 41.6 | 45.3 | 42.8 | 38.7 | | 45.3 | 2000 | < SIL | n/a | |
| | 8-hr | Max | 16.7 | 19.3 | 20.1 | 18.1 | 19.5 | | 20.1 | 500 | < SIL | n/a | |
| NO2 | 1-hr | Max | | | | | | 9.9 | 9.9 | 7.8 | 3.56 | n/a | |
| SO2 | 1-hr | Max | | | | | | 1.3 | 1.3 | 7.5 | < SIL | n/a | |
| | 3-hr | Max | 1.26 | 1.35 | 1.45 | 1.39 | 1.36 | | 1.45 | 25 | < SIL | 1 | 1 |
| | 24-hr | Max | 0.79 | 0.61 | 0.66 | 0.88 | 0.73 | | 0.88 | 5 | < SIL | 0.2 | 3.6 |
| PM10 | 24-hr | Max | | | | | | 12 | 12 | 5 | 1.85 | 0.3 | 48 |
| PM2.5 | 24-hr | Max | | | | | | 8.1 | 8.1 | n/a | n/a | n/a | n/a |
| Long-Term Operation (all sources) | | | | | | | | | | | | | |
| NO2 | Annual | Max | 0.9 | 0.76 | 0.82 | 0.92 | 0.86 | | 0.92 | 1 | < SIL | 0.1 | 3 |
| SO2 | Annual | Max | 0.054 | 0.054 | 0.058 | 0.066 | 0.063 | | 0.066 | 1 | < SIL | 0.08 | < SIL |
| PM2.5 | Annual | Max | | | | | | 0.26 | 0.26 | n/a | n/a | n/a | n/a |
| PM10 | Annual | Max | 0.26 | 0.26 | 0.27 | 0.31 | 0.3 | | 0.31 | 1 | < SIL | 0.2 | 1.1 |

**Table 11a. Modeling Input Summary - Algonquin Compressor Station (proposed)**

| Emission Source | Units | AIM Mars 100 (Turbine 6) | Proposed Mars 100 (Turbine 7) | Proposed Taurus 70 (Turbine 8) | Combustion Turbines (E004) | (E005) | Emergency Gen. (E006) | Boiler (B001) |
|---|---|---|---|---|---|---|---|---|
| Fuel Type | | Natural Gas | Natural Gas | Natural Gas | Natural Gas | Natural Gas | Natural Gas | Natural Gas |
| | | | | | | | | |
| Annual Operation | hrs/yr | 8,760 | 8,760 | 8,760 | 8,760 | 8,760 | 500 | 8,760 |
| | | | | | | | | |
| Stack Parameters | | | | | | | | |
| Stack Location | UTM N (Z 19T) | 4649863.1 | 4649843.0 | 4649829.4 | 4649877.8 | 4649882.6 | 4649837.7 | 4649837.7 |
| Stack Location | UTM E (Z 19T) | 271613.8 | 271577.6 | 271551.4 | 271675.1 | 271683.3 | 271668.5 | 271668.5 |
| Stack Base Elevation | ft AMSL | | | | 572.5 | 572.5 | 572.5 | 572.5 |
| Stack Height | feet | 55.14 | 55.14 | 60.23 | 54.5 | 54.5 | 22.0 | 26.0 |
| Stack Diameter | inches | 108.4 | 108.4 | 84.0 | 40.0 | 40.0 | 7.9 | 14.4 |
| Stack Flow | acfm | 794,634 | 794,634 | 518,987 | 99,006 | 99,006 | 15,295 | 38,067 |
| Stack Exit Temperature | deg. F | 899 | 899 | 902 | 841 | 841 | 752 | 344 |
| | | | | | | | | |
| Maximum Emission Rate | | | | | | | | |
| $NO_X$ | lb/hr | 4.69 | 4.69 | 2.98 | 5.80 | 5.80 | 10.84 | 0.55 |
| CO | lb/hr | 0.40 | 0.40 | 0.25 | 7.06 | 7.06 | 7.54 | 0.08 |
| $SO_2$ | lb/hr | 2.020 | 2.020 | 1.280 | 0.035 | 0.035 | 0.0026 | 0.0020 |
| PM | lb/hr | 0.95 | 0.95 | 0.61 | 2.43 | 2.43 | 0.13 | 0.0250 |
| | | | | | | | | |
| Maximum Emission Rate | | | | | | | | |
| $NO_X$ | g/sec | 0.59 | 0.59 | 0.38 | 0.73 | 0.73 | 1.37 | 0.0693 |
| CO | g/sec | 0.05 | 0.05 | 0.03 | 0.89 | 0.89 | 0.95 | 0.0098 |
| $SO_2$ | g/sec | 0.25 | 0.25 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00025 |
| PM/PM10/PM2.5 | g/sec | 0.12 | 0.12 | 0.08 | 0.31 | 0.31 | 0.02 | 0.0031 |

**Table 11b. Modeling Input Summary - Ocean State Power**

| Emission Source | Units | Gas Turbines | | | | | | | | Diesel Gen 1 | Diesel Gen 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | G001 | | G002 | | G003 | | G004 | | G005 | G006 |
| Fuel Type | | Natural Gas | Oil | Natural Gas | Oil | Natural Gas | Oil | Natural Gas | Oil | | |
| | | | | | | | | | | | |
| Annual Operation | hrs/yr | 7,560 | 1,200 | 7,560 | 1,200 | 7,560 | 1,200 | 7,560 | 1,200 | 500 | 500 |
| | | | | | | | | | | | |
| Stack Parameters | | | | | | | | | | | |
| Stack Location | UTM N (Z 19T) | 4654369.3 | | 4654369.3 | | 4654369.3 | | 4654369.3 | | 4654406.3 | 4654299.1 |
| Stack Location | UTM E (Z 19T) | 278949.0 | | 278949.0 | | 278949.0 | | 278949.0 | | 279022.3 | 279094.0 |
| Stack Base Elevation | ft AMSL | 526 | | 526 | | 526 | | 526 | | 529 | 529 |
| Stack Height | feet | 150.0 | | 150.0 | | 150.0 | | 150.0 | | 13.1 | 13.1 |
| Stack Diameter | inches | 189.0 | | 189.0 | | 189.0 | | 189.0 | | 8 | 8 |
| Stack Flow | acfm | 872,600.0 | 766,958.2 | 872,600.0 | 766,958.2 | 872,600.0 | 766,958.2 | 872,600.0 | 766,958.2 | 4,549 | 4,549 |
| Stack Exit Temperature | deg. F | 207.0 | 284.0 | 207.0 | 284.0 | 207.0 | 284.0 | 207.0 | 284.0 | 1,187 | 1,187 |
| | | | | | | | | | | | |
| Maximum Emission Rate | | | | | | | | | | | |
| NOx | lb/hr | 37.40 | 81.60 | 37.40 | 81.60 | 37.40 | 81.60 | 37.40 | 81.60 | 12.04 | 12.04 |
| CO | lb/hr | 46.80 | 81.70 | 46.80 | 81.70 | 46.80 | 81.70 | 46.80 | 81.70 | 0.30 | 0.30 |
| SO2 | lb/hr | 3.10 | 61.54 | 3.10 | 61.54 | 3.10 | 61.54 | 3.10 | 61.54 | 1.14 | 1.14 |
| PM/PM10/PM2.5 | lb/hr | 11.50 | 11.50 | 11.50 | 11.50 | 11.50 | 11.50 | 11.50 | 11.50 | 0.35 | 0.35 |
| | | | | | | | | | | | |
| Maximum Emission Rate | | | | | | | | | | | |
| NOx | g/sec | 4.71 | 10.28 | 4.71 | 10.28 | 4.71 | 10.28 | 4.71 | 10.28 | 1.52 | 1.52 |
| CO | g/sec | 5.90 | 10.29 | 5.90 | 10.29 | 5.90 | 10.29 | 5.90 | 10.29 | 0.04 | 0.04 |
| SO2 | g/sec | 0.39 | 7.75 | 0.39 | 7.75 | 0.39 | 7.75 | 0.39 | 7.75 | 0.14 | 0.14 |
| PM/PM10/PM2.5 | g/sec | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 | 0.04 | 0.04 |

**Table 11c. Modeling Input Summary - RISE Compressor Station**

| Emission Source | Units | Combustion Turbine | Emergency Generator | Hot Water Boiler |
|---|---|---|---|---|
| Fuel Type | | Natural Gas | Natural Gas | Natural Gas |
| | | | | |
| Annual Operation | hrs/yr | 8,760 | 8,760 | 8,760 |
| | | | | |
| Stack Parameters | | | | |
| Stack Location | UTM N (Z 19T) | 4654376.9 | 4654383.1 | 4654383.1 |
| Stack Location | UTM E (Z 19T) | 279179.4 | 279167.9 | 279167.9 |
| Stack Base Elevation | ft AMSL | 506 | 506 | 506 |
| Stack Height | feet | 52.0 | 22.0 | 26.0 |
| Stack Diameter | inches | 74.5 | 7.9 | 14.4 |
| Stack Flow | acfm | 101,640.0 | 15,295 | 38,067 |
| Stack Exit Temperature | deg. F | 859.0 | 752 | 344 |
| | | | | |
| Maximum Emission Rate | | | | |
| $NO_X$ | lb/hr | 6.04 | 2.27 | 0.26 |
| CO | lb/hr | 7.37 | 1.70 | 0.16 |
| $SO_2$ | lb/hr | 0.04 | 0.003 | 0.001 |
| $PM_{10}$ | lb/hr | 0.70 | 0.05 | 0.01 |
| | | | | |
| Maximum Emission Rate | | | | |
| $NO_X$ | g/sec | 0.76 | 0.29 | 0.03 |
| CO | g/sec | 0.93 | 0.21 | 0.02 |
| $SO_2$ | g/sec | 0.01 | 0.00 | 0.00 |
| PM/PM10/PM2.5 | g/sec | 0.09 | 0.01 | 0.00 |

**Table 12. Comparison of Modeled Impacts to the Significant Monitoring Concentrations**

| Pollutant | Averaging Time | SMC ($\mu g/m^3$) | Max. modeled Concentration ($\mu g/m^3$) |
|---|---|---|---|
| Carbon Monoxide | 8-hr | 575 | 46.7 |
| Nitrogen Dioxide | Annual | 14 | 2.37 |
| $PM_{10}$ | 24-hr | 10 | 12.6 |
| Sulfur Dioxide | 24-hr | 13 | 28.7 |
| Lead | 3-month | 0.1 | 0.00185 |
| Mercury | 24-hr | 0.25 | 0.000352 |
| Beryllium | 24-hr | 0.001 | 0.000558 |
| Fluorides | 24-hr | 0.25 | NM |
| Vinyl Chloride | 24-hr | 15 | NM |
| Total Reduced Sulfur | 1-hr | 10 | NM |
| Hydrogen Sulfide | 1-hr | 0.2 | NM |
| Reduced Sulfur Compounds | 1-hr | 10 | NM |

*SMCs are from Section 9.5.2(d)(i) of Rhode Island APCR Reg. 9

**Table 13. Background Concentrations**

| Criteria Pollutant | Averaging Period | Monitoring Location | Background Value ($\mu g/m^3$) | 2012-2014 Monitoring Value |
|---|---|---|---|---|
| $NO_2$ | 1-hour | Rockefeller Library, Brown University (Providence) | 80 | 3-year average of $98^{th}$ percentile of 1-hour daily maxima |
| $NO_2$ | Annual | Rockefeller Library, Brown University (Providence) | 19.7 | highest annual mean |
| CO | 1-hour | Francis School (East Providence) | 2,346 | highest 2nd annual daily high value |
| CO | 8-hour | Francis School (East Providence) | 1,495 | highest 2nd annual daily high value |
| $SO_2$ | 1-hour | Francis School (East Providence) | 123 | 3-year average of $99^{th}$ percentile of 1-hour daily maxima |
| $SO_2$ | 3-hour | Francis School (East Providence) | 200 | highest 2nd annual daily high value |
| $PM_{10}$ | 24-hour | URI W.Alton Jones Campus (W.Greenwich) | 17 | average 2nd annual daily average |
| $PM_{2.5}$ | 24-hour | URI W.Alton Jones Campus (W.Greenwich) | 13.1 | 3-year average of $98^{th}$ percentile |
| $PM_{2.5}$ | Annual | URI W.Alton Jones Campus (W.Greenwich) | 5.17 | 3-year average of annual mean |

* From RIDEM's "Background Criteria Pollutant Air Monitoring Data for Modeling Rhode Island Sources"http://www.dem.ri.gov/programs/benviron/air/pdf/dispdata.pd

Table 14. PSD Increment Analysis

| Pollutant | Averaging Period | Rank | 2010 | 2011 | 2012 | 2013 | 2014 | 5-year Average | Max | NAAQS | Background | Margin | Available Increment | Modeled Nearby Sources | Available Increment | Allowable Increment | % of Allowable Increment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Normal Operation (turbines, dewpoint heater) | | | | | | | | | | | | | | | | | |
| $NO_2$ | Annual | Max | 0.9 | 0.76 | 0.82 | 0.92 | 0.86 | | 0.92 | 100 | 19.7 | 80.3 | 25 | 2 | 23 | 5.75 | 16.00 |
| $SO_2$ | 3-hr | Max | 1.26 | 1.35 | 1.45 | 1.39 | 1.36 | | 1.45 | | | | | | | | |
| | | H2H | 1.22 | 1.11 | 1.43 | 1.35 | 1.35 | | 1.43 | 1300 | 45 | 1255.0 | 512 | 43.4 | 468.6 | 351.45 | 0.41 |
| | 24-hr | Max | 0.79 | 0.61 | 0.66 | 0.88 | 0.73 | | 0.88 | | | | | | | | |
| | | H2H | 0.58 | 0.45 | 0.62 | 0.54 | 0.6 | | 0.62 | 365 | 21 | 344.0 | 91 | 19.3 | 71.7 | 53.775 | 1.15 |
| | Annual | Max | 0.054 | 0.054 | 0.058 | 0.066 | 0.063 | | 0.066 | 80 | 3.69 | 76.3 | 20 | 0.34 | 19.66 | 4.915 | 1.34 |
| $PM_{10}$ | 24-hr | Max | | | | | | 12 | 12 | | | | | | | | |
| | | 6th high | | | | | | 7.1 | 7.1 | 150 | 17 | 133.0 | 30 | 7.6 | 22.4 | 16.8 | 42.26 |
| | Annual | Max | 0.26 | 0.26 | 0.27 | 0.31 | 0.3 | | 0.31 | | | | 17 | 0.59 | 16.41 | 4.1025 | 7.56 |
| $PM_{2.5}$ | 24-hr | Max | | | | | | 8.1 | 8.1 | | | | | | | | |
| | | 98th Percentile | | | | | | 4.35 | 4.35 | 35 | 13.1 | 21.9 | 9 | 3.17 | 5.83 | 4.3725 | 99.49 |
| | Annual | Max | | | | | | 0.26 | 0.26 | 12 | 5.17 | 6.8 | 4 | 0.46 | 3.54 | 0.885 | 29.38 |

Modeled impacts include all nearby sources
Modeled CREC concentrations are compared to modeled nearby source concentrations, regardless of time or space
The 98th percentile 24-hour PM2.5 CREC concentration of 4.35 ug/m3 occurs at a different location from the nearby sources concentration of 3.17 ug/m3.
When looking at co-located concentrations, the maximum PM2.5 CREC concentrations account for 69% of the allowable increment.

**Table 15. NAAQS Compliance Determination**

| Pollutant | Averaging Period | Rank | 2010 | 2011 | 2012 | 2013 | 2014 | 5-year Avg | Max | Background | Total | NAAQS | % NAAQS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Normal Operation (turbines, dewpoint heater) | | | | | | | | | | | | | |
| CO | 1-hr | Max | 64.4 | 59 | 64.5 | 63.9 | 64.5 | | 64.5 | | | | |
| | | H2H | 59.6 | 58.6 | 62.3 | 63.7 | 63.7 | | 63.7 | 2346 | 2409.7 | 40000 | 6.02 |
| | 8-hr | Max | 45.6 | 43.1 | 46.7 | 44.3 | 45 | | 46.7 | | | | |
| | | H2H | 39.4 | 37.6 | 46.7 | 42.5 | 38.7 | | 46.7 | 1495 | 1541.7 | 10000 | 15.42 |
| $NO_2$ | 1-hr | Max | | | | | | 50.5 | 50.5 | | | | |
| | | 98th Percentile | | | | | | 36.2 | 36.2 | 80 | 116.2 | 188 | 61.81 |
| | Annual | Max | 1.86 | 1.55 | 2.05 | 2.37 | 2.28 | | 2.37 | 19.7 | 22.07 | 100 | 22.07 |
| $SO_2$ | 1-hr | Max | | | | | | 46.8 | 46.8 | | | | |
| | | 99th Percentile | | | | | | 40.2 | 40.2 | 123 | 163.2 | 195 | 83.69 |
| | 3-hr | Max | 39.6 | 34.5 | 45.1 | 45.5 | 44.7 | | 45.5 | | | | |
| | | H2H | 33.9 | 33.4 | 44.1 | 43.6 | 43.4 | | 44.1 | 45 | 89.1 | 1300 | 6.85 |
| | 24-hr | Max | 25.1 | 19.1 | 19.5 | 28.7 | 24.3 | | 28.7 | | | | |
| | | H2H | 19.1 | 17.2 | 18.2 | 17.9 | 19.3 | | 19.3 | 21 | 40.3 | 365 | 11.04 |
| | Annual | Max | 0.29 | 0.21 | 0.31 | 0.38 | 0.35 | | 0.38 | 3.69 | 4.07 | 80 | 5.09 |
| $PM_{10}$ | 24-hr | Max | | | | | | 12.6 | 12.6 | | | | |
| | | 6th high | | | | | | 7.6 | 7.6 | 17 | 24.6 | 150 | 16.40 |
| $PM_{2.5}$ | 24-hr | Max | | | | | | 8.6 | 8.6 | | | | |
| | | 98th Percentile | | | | | | 4.8 | 4.8 | 13.1 | 17.9 | 35 | 51.14 |
| | Annual | Max | | | | | | 0.71 | 0.71 | 5.17 | 5.88 | 12 | 49.00 |
| Lead | 24-hr | Max (Toxics) | | | | | | 0.00185 | 0.00185 | 0 | 0.00185 | | |
| | Quarterly | | | | | | | | | | 0.00185 | 0.15 | 1.23 |

Modeled impacts include Algonquin Compressor Station, Ocean State Power and RISE, with the exception of lead.

**Table 16: Air Toxics Modeling Results Summary**

| Emission Source(s): | Gas Turbines | Gas Turbines | HRSG Duct Burners | Auxiliary Boiler | Dewpoint Heater | Diesel Generator | Fire Pump | RIDEM APCR No. 22 Acceptable Ambient Levels | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of Sources: | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | |
| Fuel Fired: | Natural Gas | ULSD | Natural Gas | Natural Gas | Natural Gas | ULSD | ULSD | | | |
| Maximum Unit Heat Input (MMBtu/hr): | 3,393 | 3,507 | 721 | 140.6 | 15.0 | 19.5 | 2.1 | | | |
| Annual Operation (hrs/yr): | 8,040 | 720 | 8,040 | 4,576 | 8,760 | 300 | 300 | 1-hour | 24-hour | Annual |
| Emission Rate: | lb/hr | lb/hr | lb/hr | lb/hr | lb/hr | lb/hr | lb/hr | µg/m³ | µg/m³ | µg/m³ |
| 1,3-Butadiene | 2.92E-04 | 1.12E-02 | | | | | 8.21E-05 | | | 0.03 |
| Acetaldehyde | 2.71E-02 | | | | | 4.91E-04 | 1.61E-03 | | | 0.5 |
| Acrolein | 4.34E-03 | | | | | 1.54E-04 | 1.94E-04 | 0.2 | | 0.02 |
| Ammonia | 9.20E+00 | 1.01E+01 | | | | | | 1,000 | 100 | 70 |
| Arsenic | | 3.24E-04 | 2.83E-04 | 2.76E-05 | 2.94E-06 | | | 0.2 | | 0.0002 |
| Benzene | 8.14E-03 | 8.42E-03 | 2.97E-04 | 2.89E-04 | 3.09E-05 | 1.51E-02 | 1.96E-03 | 30 | 20 | 0.1 |
| Beryllium | | 2.17E-03 | 1.70E-05 | 1.65E-06 | 1.76E-07 | | | | 0.02 | 0.0004 |
| Cadmium | | 3.60E-05 | 1.56E-03 | 1.52E-04 | 1.62E-05 | | | | 0.1 | 0.0006 |
| Cobalt | | | 1.19E-04 | 1.16E-05 | 1.24E-06 | | | | | 0.001 |
| Formaldehyde | 1.48E-01 | 1.62E-01 | 1.06E-02 | 1.03E-02 | 1.10E-03 | 1.54E-03 | 2.48E-03 | 50 | 40 | 0.08 |
| Lead | | 5.39E-03 | 7.07E-04 | 6.89E-05 | 7.35E-06 | | | | | 0.008 |
| Manganese | | 1.98E-03 | 5.37E-04 | 5.24E-05 | 5.59E-06 | | | | 0.05 | 0.04 |
| Mercury | | 7.22E-05 | 3.68E-04 | 3.58E-05 | 3.82E-06 | | | 2 | 0.3 | 0.009 |
| Naphthalene | 8.82E-04 | 2.45E-02 | 8.62E-05 | 8.41E-05 | 8.97E-06 | 2.54E-03 | 1.78E-04 | | 3 | 0.03 |
| Nickel | | 1.04E-02 | 2.97E-03 | 2.89E-04 | 3.09E-05 | | | 6 | 0.2 | 0.004 |
| Propylene Oxide | 1.97E-02 | | | | | | | 3,000 | | 0.3 |
| Sulfuric Acid | 3.69E+00 | 4.17E+00 | | | | | | 100 | | 1 |
| Vanadium | | | 3.25E-03 | 3.17E-04 | 3.38E-05 | | | 0.2 | | |

| Maximum Modeled Impacts (µg/m³/g/sec) | 1-hour | 24-hour | Annual |
|---|---|---|---|
| GT/HRSG-1 & 2 (Natural Gas) | 3.21 | 2.09 | 0.16 |
| GT/HRSG-1 & 2 (ULSD) | 3.08 | 2.00 | 0.15 |
| Auxiliary Boiler | 146.25 | 49.85 | 4.15 |
| Dewpoint Heater | 209.52 | 62.85 | 7.66 |
| Diesel Generator | 195.64 | 47.04 | 6.34 |
| Fire Pump | 440.05 | 214.51 | 17.32 |

| | GT.HRSG firing Natural Gas | | | AAL Compliant? (Yes/No) | | |
|---|---|---|---|---|---|---|
| Maximum Modeled Impacts (µg/m³) | 1-hour | 24-hour | Annual | 1-hour | 24-hour | Annual |
| 1,3-Butadiene | 4.67E-03 | 2.30E-03 | 2.84E-05 | | | Yes |
| Acetaldehyde | 1.12E-01 | 5.36E-02 | 6.25E-04 | | | Yes |
| Acrolein | 1.63E-02 | 7.30E-03 | 9.74E-05 | Yes | | Yes |
| Ammonia | 3.72E+00 | 2.43E+00 | 1.82E-01 | Yes | Yes | Yes |
| Arsenic | 7.01E-04 | 2.71E-04 | 1.60E-05 | Yes | | Yes |
| Benzene | 4.90E-01 | 1.47E-01 | 8.34E-04 | Yes | Yes | Yes |
| Beryllium | 4.19E-05 | 1.62E-05 | 4.23E-06 | | Yes | Yes |
| Cadmium | 3.86E-03 | 1.49E-03 | 8.54E-05 | | Yes | Yes |
| Cobalt | 2.95E-04 | 1.14E-04 | 6.52E-06 | | | Yes |
| Formaldehyde | 4.58E-01 | 1.91E-01 | 7.22E-03 | Yes | Yes | Yes |
| Lead | 1.75E-03 | 6.77E-04 | 4.69E-05 | | | Yes |
| Manganese | 1.33E-03 | 5.15E-04 | 3.24E-05 | | Yes | Yes |
| Mercury | 9.09E-04 | 3.52E-04 | 2.02E-05 | Yes | Yes | Yes |
| Naphthalene | 7.47E-02 | 2.07E-02 | 1.69E-04 | | Yes | Yes |
| Nickel | 7.34E-03 | 2.84E-03 | 1.78E-04 | Yes | Yes | Yes |
| Propylene Oxide | 7.97E-03 | 5.19E-03 | 3.57E-04 | Yes | | Yes |
| Sulfuric Acid | 1.49E+00 | 9.73E-01 | 7.32E-02 | Yes | | Yes |
| Vanadium | 8.05E-03 | 3.12E-03 | 1.78E-04 | Yes | | |

**Table 17. Soils and Vegetation Impact Summary**

| Pollutant | | Averaging Time | Maximum Modeling Results (µg/m³) | | | | | | Background (µg/m³) | Total Impact (µg/m³) | Sensitivity Screening Levels (µg/m³)[1] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2010 | 2011 | 2012 | 2013 | 2014 | Maximum | | | Sensitive | Intermediate | Resistant |
| $SO_2$ | | 1 hr | 1.3 | 1.5 | 1.5 | 1.4 | 1.44 | 1.8 | 123 | 125 | 917 | NA | NA |
| | | 3 hrs | 1.3 | 1.4 | 1.5 | 1.4 | 1.36 | 1.5 | 45 | 46 | 786 | 2,096 | 13,100 |
| | | 1 year | 0.054 | 0.054 | 0.058 | 0.066 | 0.063 | 0.1 | 4 | 4 | 18 | 18 | 18 |
| $NO_2$ | Steady State | 4 hrs | 12.1 | 10.8 | 13.5 | 12.6 | 12.7 | 13.5 | 80 | 94 | 3,760 | 9,400 | 16,920 |
| | | 8 hrs | 9.7 | 9.6 | 12.5 | 11.6 | 11.6 | 12.5 | 80 | 93 | 3,760 | 7,520 | 15,040 |
| | | 1 month | 0.8 | 0.88 | 0.83 | 1.05 | 1.06 | 1.1 | 80 | 81 | 564 | 564 | 564 |
| | | 1 year | 0.9 | 0.76 | 0.82 | 0.92 | 0.86 | 0.9 | 20 | 21 | 94 | 94 | 94 |
| | Emergency | 4 hrs | 474.8 | 493.1 | 511.7 | 493.4 | 412.9 | 511.7 | 80 | 591.7 | 3,760 | 9,400 | 16,920 |
| | | 8 hrs | 378.8 | 436 | 331.1 | 414.4 | 336.7 | 436.0 | 80 | 516.0 | 3,760 | 7,520 | 15,040 |
| | | 1 month | 39.3 | 47 | 35.2 | 57.2 | 39.2 | 57.2 | 80 | 137.2 | 564 | 564 | 564 |
| CO | | 1 hour | 44 | 41.6 | 42.7 | 46.2 | 43.80 | 46.2 | 2,390 | 2,437 | NA | NA | NA |
| | | 8 hrs | | | | | | | 1,528 | | | | |
| | | 24 hrs | 12 | 13.2 | 11 | 12.2 | 14.00 | 14.0 | | | | | |
| | | 1 week | | | | | | 14.0 | 1,528 | 1,542 | 1,800,000 | NA | 18,000,000 |

[1] The Sensitivity Screening Levels are from Table 3.1 of the EPA's "A Screening Procedure for the Impacts of Air Pollution on Plants, Soils and Animals" (EPA, 1980)

**Table 18. Startup/Shutdown NAAQS Compliance Summary**

| Pollutant | Averaging Period | Rank | 2007 | 2008 | 2009 | 2010 | 2011 | 5-year Average | Max | Background | Total | NAAQS | % NAAQS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | 1-hr | Max | 662.3 | 666 | 694.1 | 652.1 | 653.4 | | 694.1 | | | | |
| | | H2H | 656.6 | 660.2 | 657.8 | 635.4 | 641.2 | | 660.2 | 2346 | 3006.2 | 40000 | 7.52 |
| | 8-hr | Max | 570.1 | 516.7 | 622.3 | 566.2 | 592.5 | | 622.3 | | | | |
| | | H2H | 497.7 | 421.4 | 599.9 | 517.9 | 547.2 | | 599.9 | 1495 | 2094.9 | 10000 | 20.95 |
| $NO_2$ | 1-hr | Max | | | | | | 62.7 | 62.7 | | | | |
| | | 98th Percentile | | | | | | 41.4 | 41.4 | 80 | 121.4 | 188 | 64.57 |
| $PM_{10}$ | 24-hr | Max | | | | | | 12.4 | 12.4 | | | | |
| | | 6th high | | | | | | 8.1 | 8.1 | 17 | 25.1 | 150 | 16.73 |
| $PM_{2.5}$ | 24-hr | Max | | | | | | 9.1 | 9.1 | | | | |
| | | 98th Percentile | | | | | | 5.2 | | 13.1 | 13.1 | 35 | 37.43 |

Modeled impacts include Algonquin Compressor Station, Ocean State Power and RISE

# Figures

Path: K:\J108-000 Invenergy\00-mxd\Air Modeling\J108 Figure 1 - Site Location.mxd

Drawing Date: 2015/10/21

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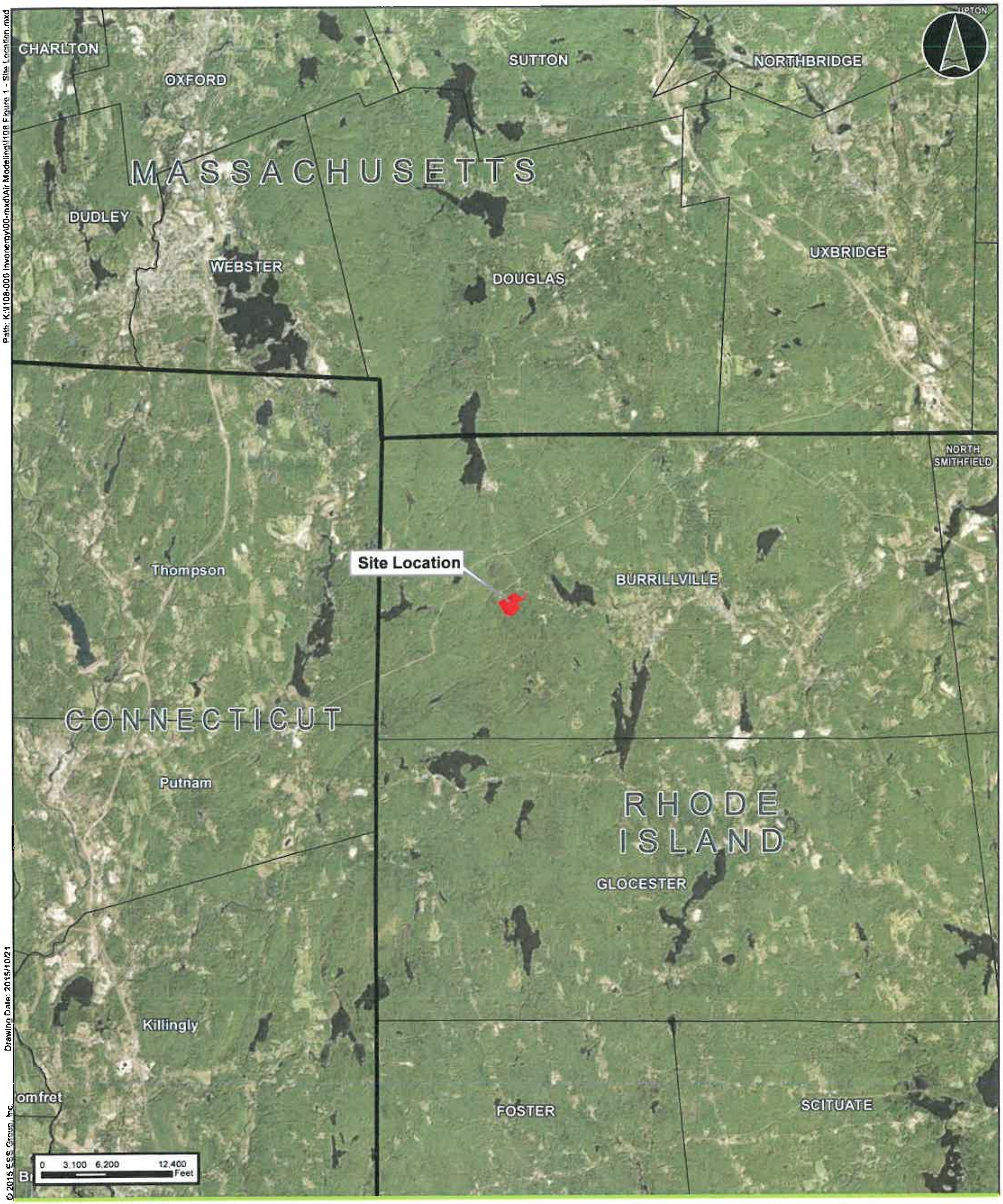



**Clear River Energy Center**

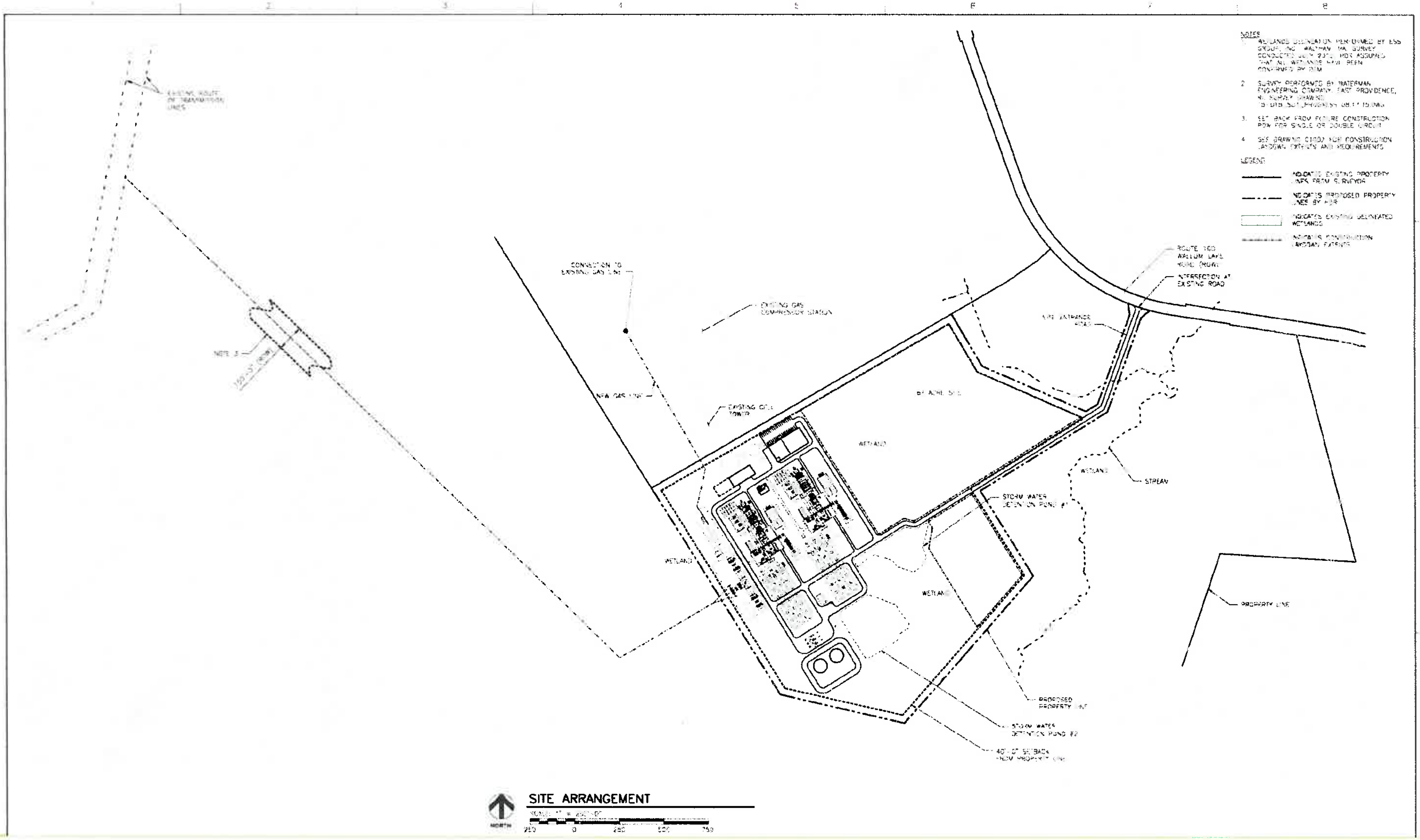
Burrillville, Rhode Island

1 inch = 12,500 feet

Source: 1) ESRI, Imagery, 2014
2) HDR, Site Layout, 2015

**Site Location**

**Figure 1**



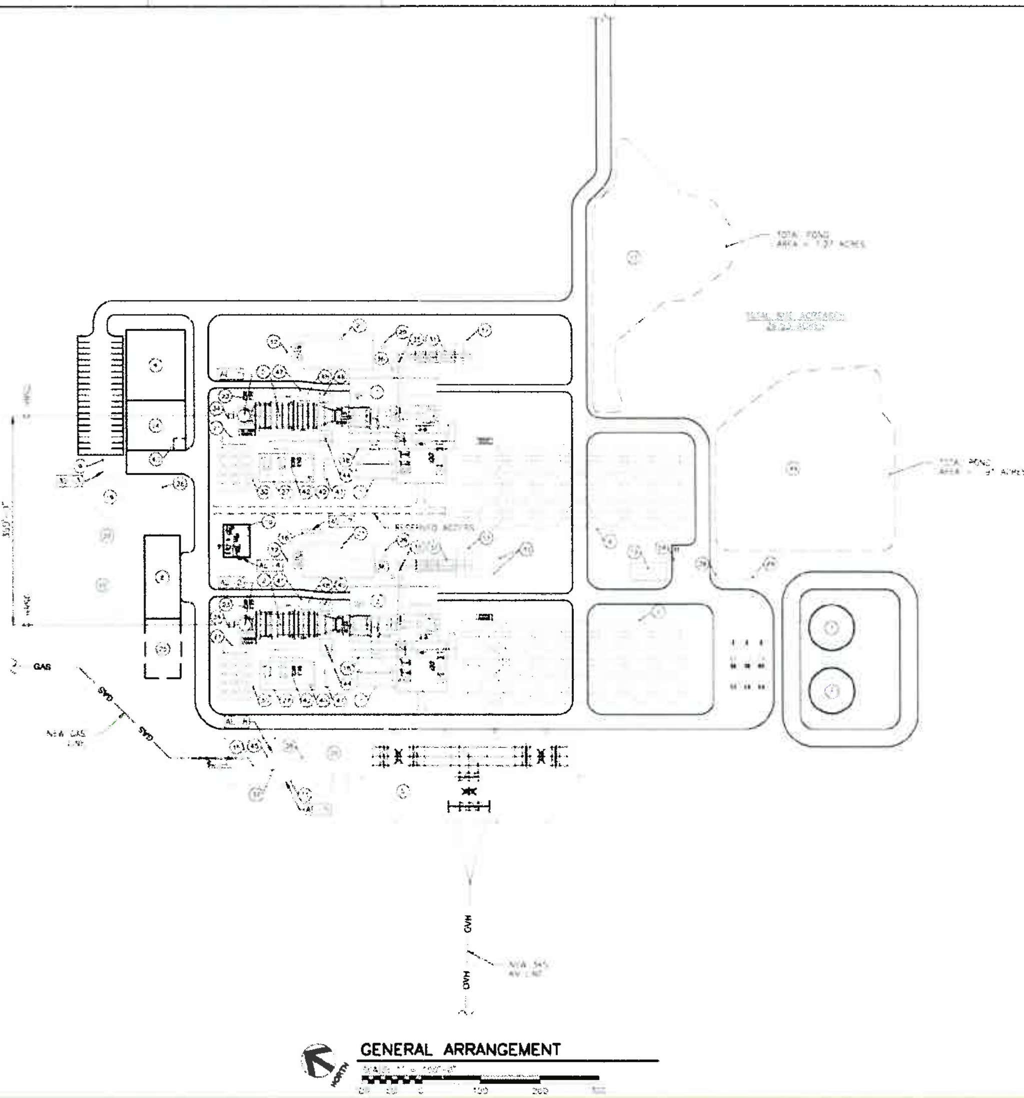

Clear River Energy Center
Burrillville, Rhode Island

Source: HDR
Scale: As Shown



**Site Layout**

**Figure 2**




GENERAL ARRANGEMENT

BUILDING AND EQUIPMENT LIST

| NO. | NAME | SIZE DIMENSIONS (IN FEET) LENGTH | WIDTH | HEIGHT |
|---|---|---|---|---|
| 1 | COMBUSTION TURBINE INLET FILTER | 60 | 37 | 80 |
| 2 | HEAT RECOVERY STEAM GENERATOR | 102 | 44 | 118 |
| 3 | TURBINE BUILDING | [illegible] | 84 | 80 |
| 4 | ADMINISTRATION/CONTROL BUILDING | 140 | 100 | 25 |
| 5 | SWITCHYARD | 367 | 158 | 25 |
| 6 | AIR-COOLED CONDENSER | 350 | 150 | 120 |
| 7 | FUEL OIL STORAGE TANK | 77ø | | 30 |
| 8 | WATER TREATMENT BUILDING | 140 | 40 | 30 |
| 9 | FIRE PUMP BUILDING | 25 | 20 | 15 |
| 10 | AUXILIARY BOILER BUILDING | 54 | 45 | 35 |
| 11 | CTG FUEL GAS DEW POINT HEATER | 40 | 12 | 15 |
| 12 | STORM WATER DETENTION POND #1 | | | |
| 13 | AMMONIA STORAGE TANK | 62 | [illegible] | 12 |
| 14 | WAREHOUSE | 100 | 84 | 25 |
| 15 | FUEL GAS FILTER/SEPARATOR | 10 | 9 | 10 |
| 16 | STAND-BY DIESEL GENERATOR | 32 | 9 | 10 |
| 17 | CEL TRANSFORMER | 46 | 27 | 15 |
| 18 | PIPE RACK | 311 | 15 | 30 |
| 19 | FIRE/SERVICE WATER TANK | 68ø | | 30 |
| 20 | DEMINERALIZED WATER STORAGE TANK | 50ø | | 30 |
| 21 | BOP ELECTRICAL | 41 | 13 | 25 |
| 22 | WASTE WATER TANK | 10ø | | 10 |
| 23 | HRSG LTE RECIRCULATION PUMPS | 16 | 16 | 5 |
| 24 | HYDROGEN TUBE TRAILER | | | 15 |
| 25 | ZLD WATER TREATMENT | 100 | 40 | 30 |
| 26 | OIL STORAGE SHELTER | 30 | 15 | 12 |
| 27 | FEEDWATER PUMP BUILDING | 84 | 42.5 | 25 |
| 28 | GAS COMPRESSOR BUILDING | 56 | [illegible] | [illegible] |
| 29 | OIL WATER SEPARATOR | 24 | 5 | |
| 30 | CCCW HEAT EXCHANGER | [illegible] | [illegible] | 32 |
| 31 | AUX. TRANSFORMERS | [illegible] | 16 | 15 |
| 32 | SUS TRANSFORMERS | 51 | 24 | 12 |
| 33 | 345 KV UNDERGROUND DUCT BANK | | 5 | |
| 34 | CEMS SHELTER | 8 | 8 | 12 |
| 35 | GENERATOR CIRCUIT BREAKER | 24.5 | 9 | 20 |
| 36 | [illegible] | [illegible] | [illegible] | 12 |
| 37 | FUEL GAS FLOW METER | 24 | 6 | [illegible] |
| 38 | FUEL GAS PRESSURE REGULATION | 27 | 11 | 5 |
| 39 | FUEL OIL EQUIPMENT BUILDING | 40 | 20 | 20 |
| 40 | [illegible] | 35 | 9 | 12 |
| 41 | FUEL GAS PERFORMANCE HEATER | 34 | 8.5 | 10 |
| 42 | CCCW PUMPS | 15 | 16 | 5 |
| 43 | WORKSHOP | 20 | 20 | 25 |
| 44 | BLOWDOWN TANK | 10ø | | 10 |
| 45 | LP FUEL GAS DEW POINT HEATER | 16 | 9 | 5 |
| 46 | WATER WASH DRAIN TANK | 11 | 12 | |
| 47 | DUCT BURNER FUEL SKID | 10 | 6.5 | 5 |
| 48 | DUCT BURNER COOLING AIR BLOWER | 12 | 6.5 | 5 |
| 49 | STORM WATER DETENTION POND #2 | | | |

AIR EMISSION SOURCES (COMBUSTION SOURCES)

| NO. | NAME | UTM COORDINATES N | E |
|---|---|---|---|
| AE-1 | HRSG EXHAUST STACK 1 | N4,649,[illegible] | E271,822 |
| AE-2 | HRSG EXHAUST STACK 2 | N4,649,600 | E271,720 |
| AE-3 | FIRE PUMP BUILDING | N4,649,[illegible] | E271,765 |
| AE-4 | AUX. BOILER BUILDING | N4,649,627 | E271,764 |
| AE-5 | CTG FUEL GAS DEW POINT HEATER | N4,649,[illegible] | E271,676 |
| AE-6 | NOT USED | | |
| AE-7 | STAND-BY DIESEL GENERATOR 2 | N4,649,[illegible] | E271,[illegible] |
| AE-8 | LP FUEL GAS DEW POINT HEATER | N4,649,[illegible] | E271,678 |

* UTM COORDINATES ARE FOR ZONE 19 T

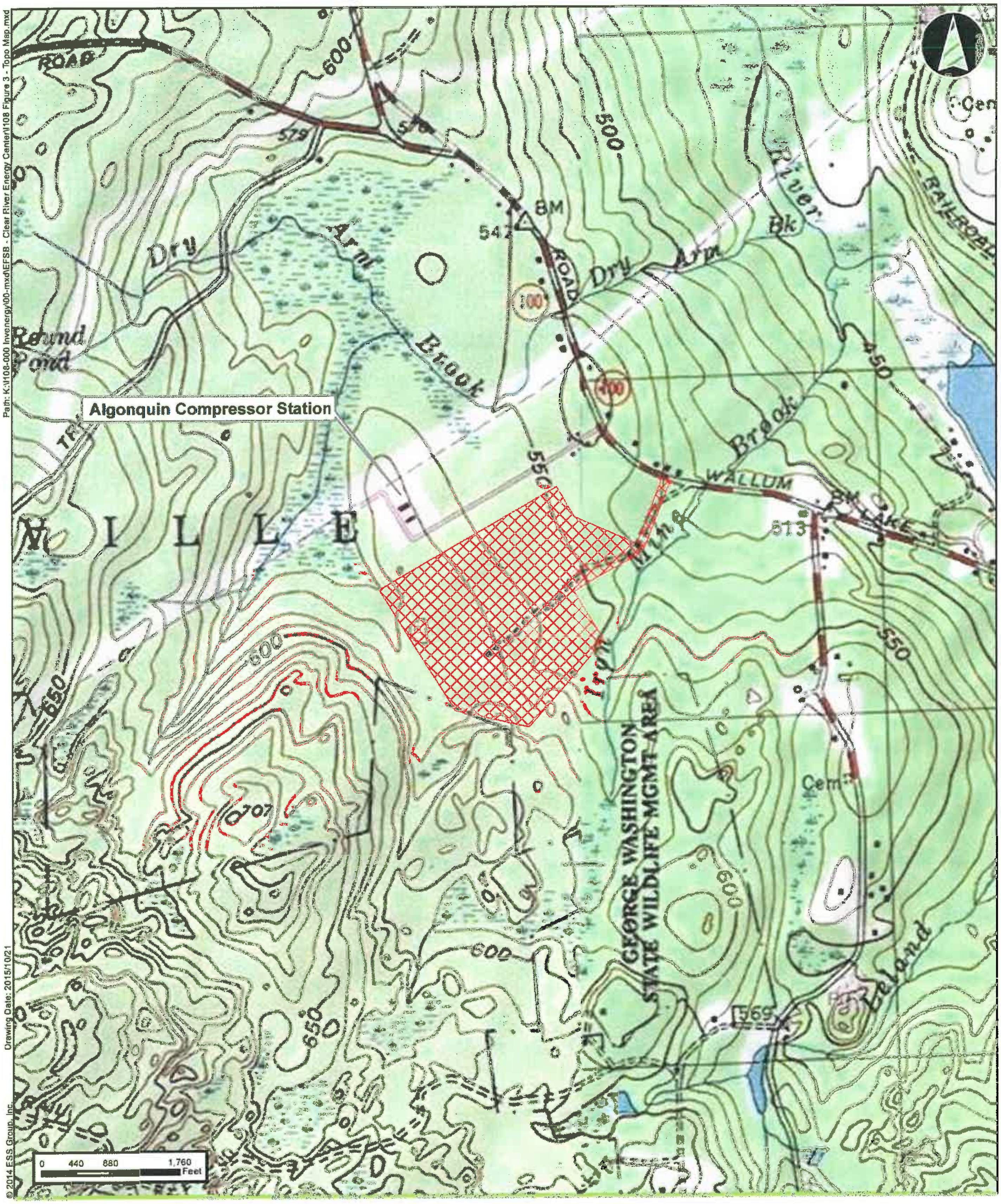
**Clear River Energy Center**
Burrillville, Rhode Island

Source: HDR
Scale: As Shown



**General Arrangement**

**Figure 3**




**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 1,667 feet

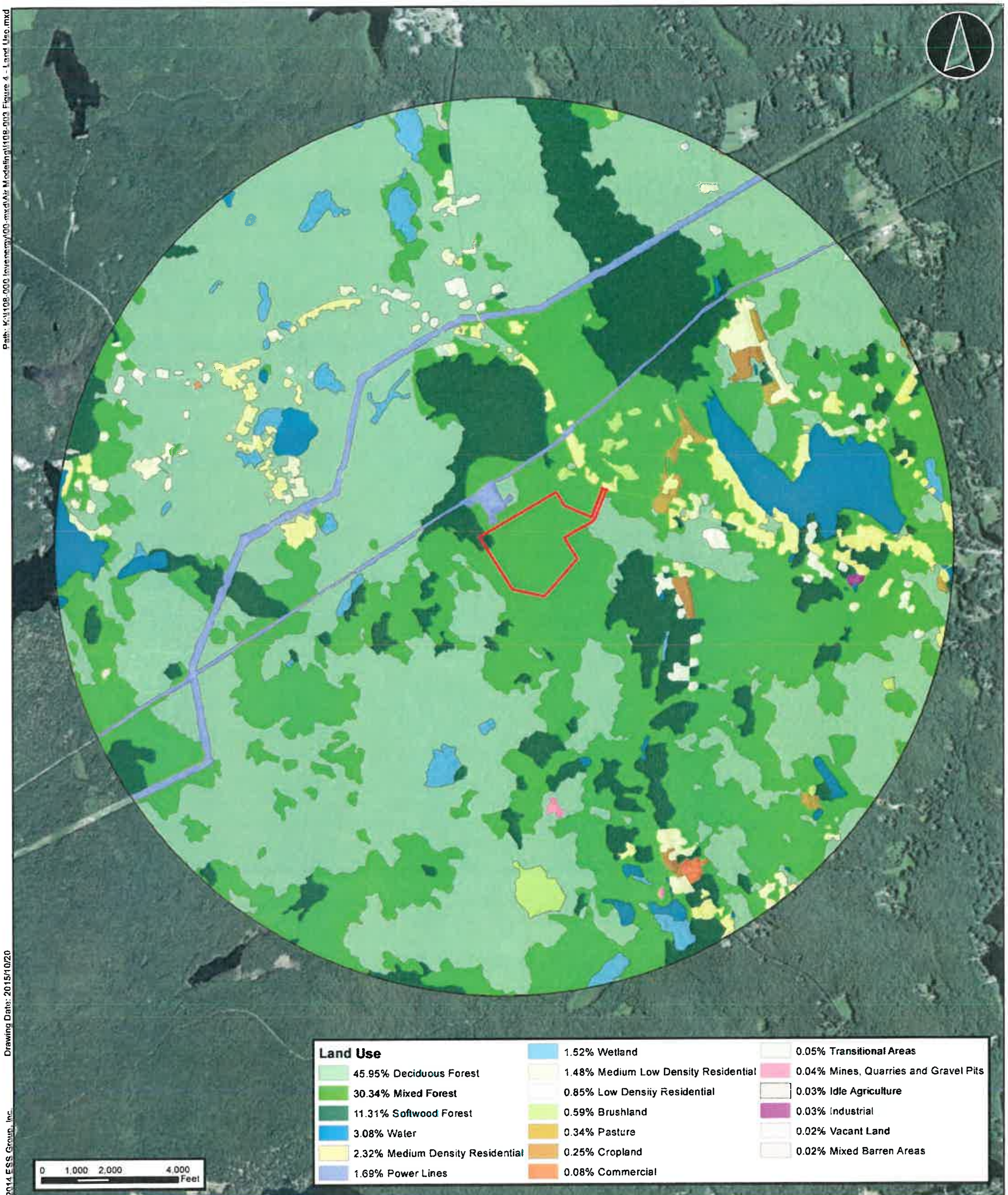
Source: 1) USGS, Topo Map, 2013
2) ESS, Site Location, 2014

**Topographic Map**

**Legend**

Property Line

**Figure 4**




Path: K:\J108-000 Invenergy\00-mxd\Air Modeling\J108-003 Figure 4 - Land Use.mxd

Drawing Date: 2015/10/20



**Clear River Energy Center**

Burrillville, Rhode Island

1 inch = 3,863 feet

Source: 1) RIGIS, Imagery, 2014
2) ESS, Site Location, 2015
3) RIGIS, Land Use, 2011

**Surrounding Land Use (3 km)**

**Figure 5**




Drawing Date: 2015/10/21



ess group
environmental consulting & engineering services

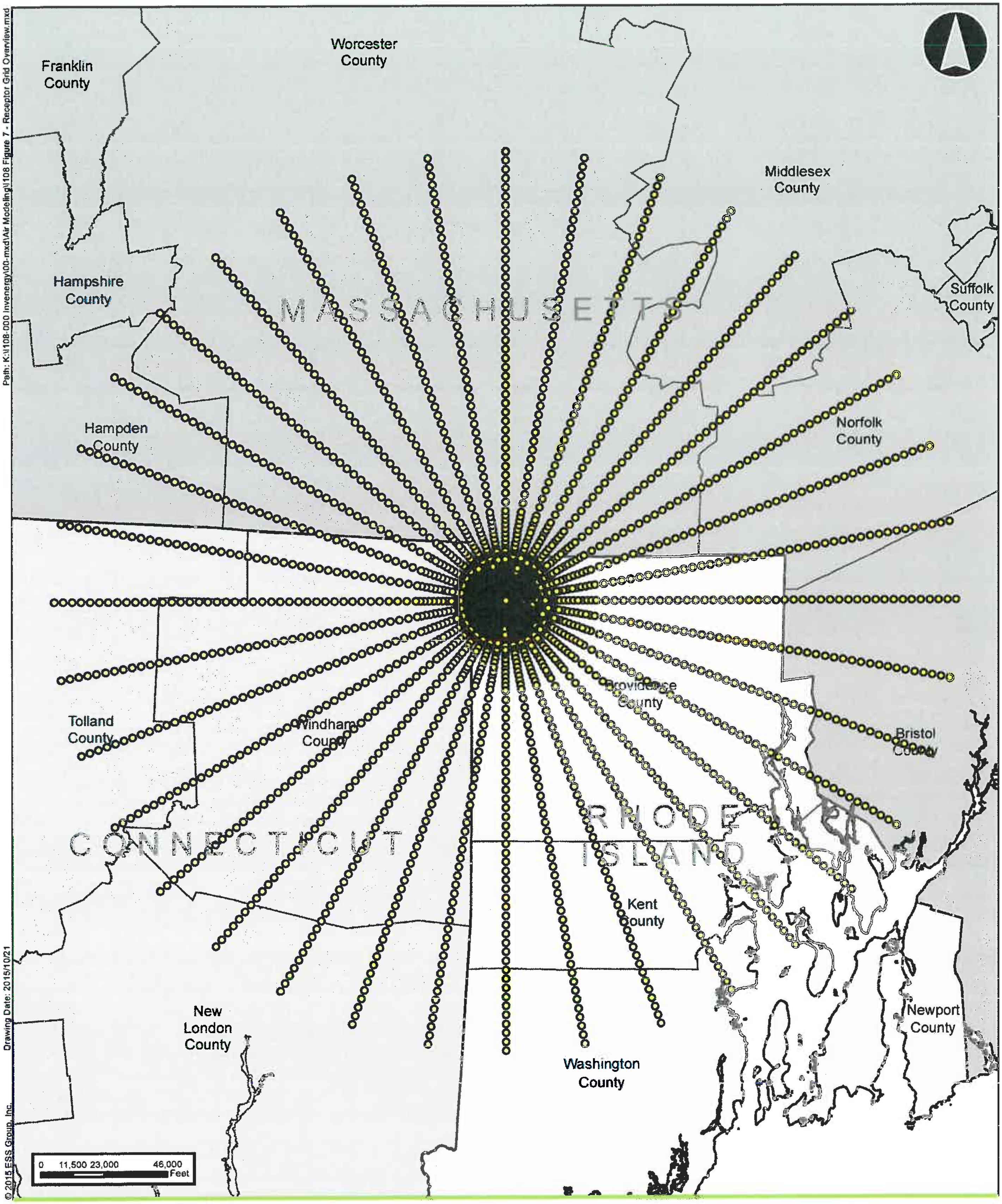
**Clear River Energy Center**
**Burrillville, Rhode Island**

1 inch = 1,000 feet

Source: 1) ESRI, Imagery, 2014
2) HDR, Site Layout, 2015
3) RIGIS, Roads, 2013

**Receptor Grid**

**Figure 6**




**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 47,500 feet

Source: 1) ESRI, Imagery, 2014
2) HDR, Site Layout, 2015
3) RIGIS, Roads, 2013

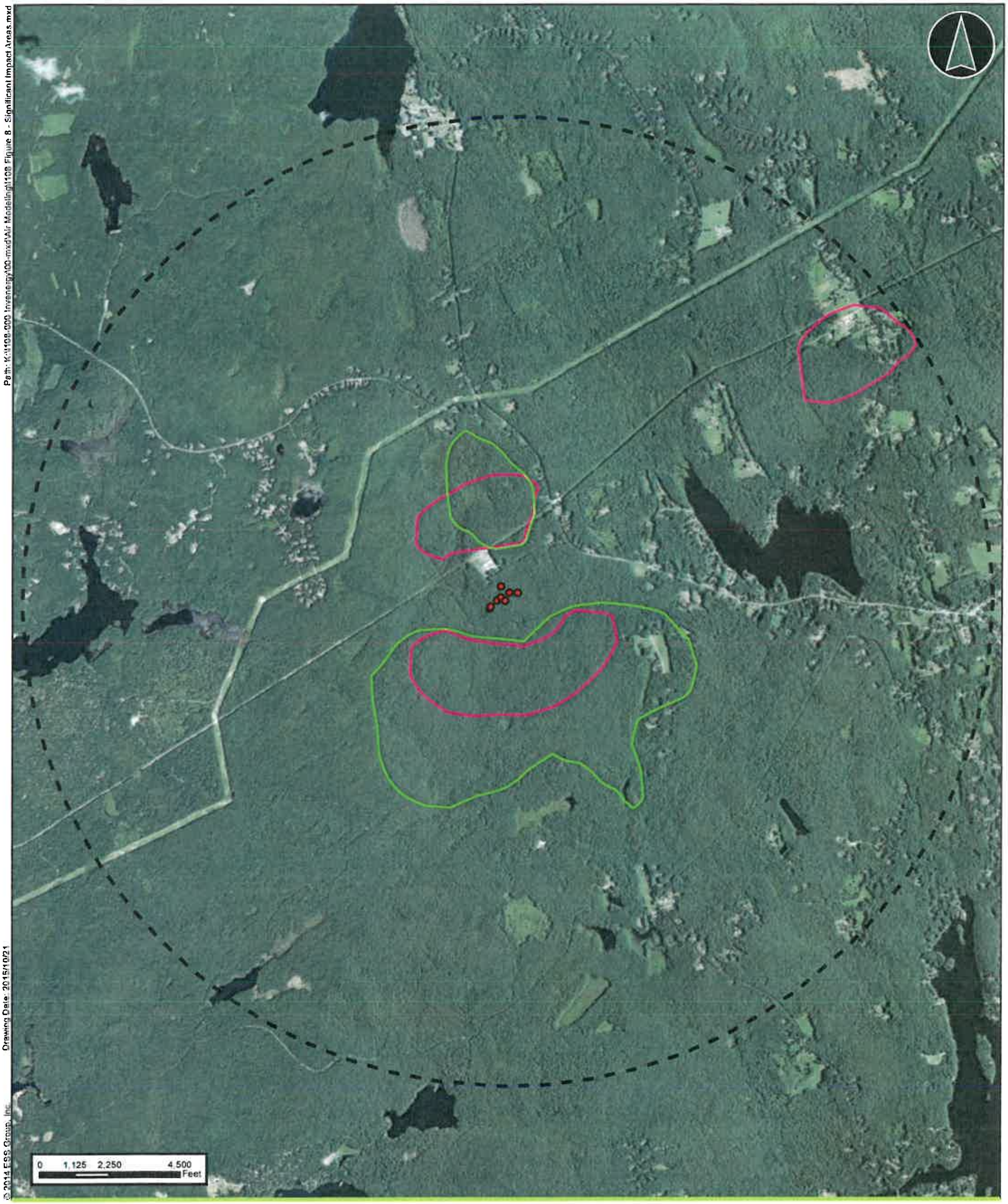
**Receptor Grid Overview**

**Figure 7**

Path: K:\4108-000 Invenergy\00-mxd\Air Modeling\4108 Figure 8 - Significant Impact Areas.mxd

Drawing Date: 2015/10/21






ESS group

**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 4,238 feet

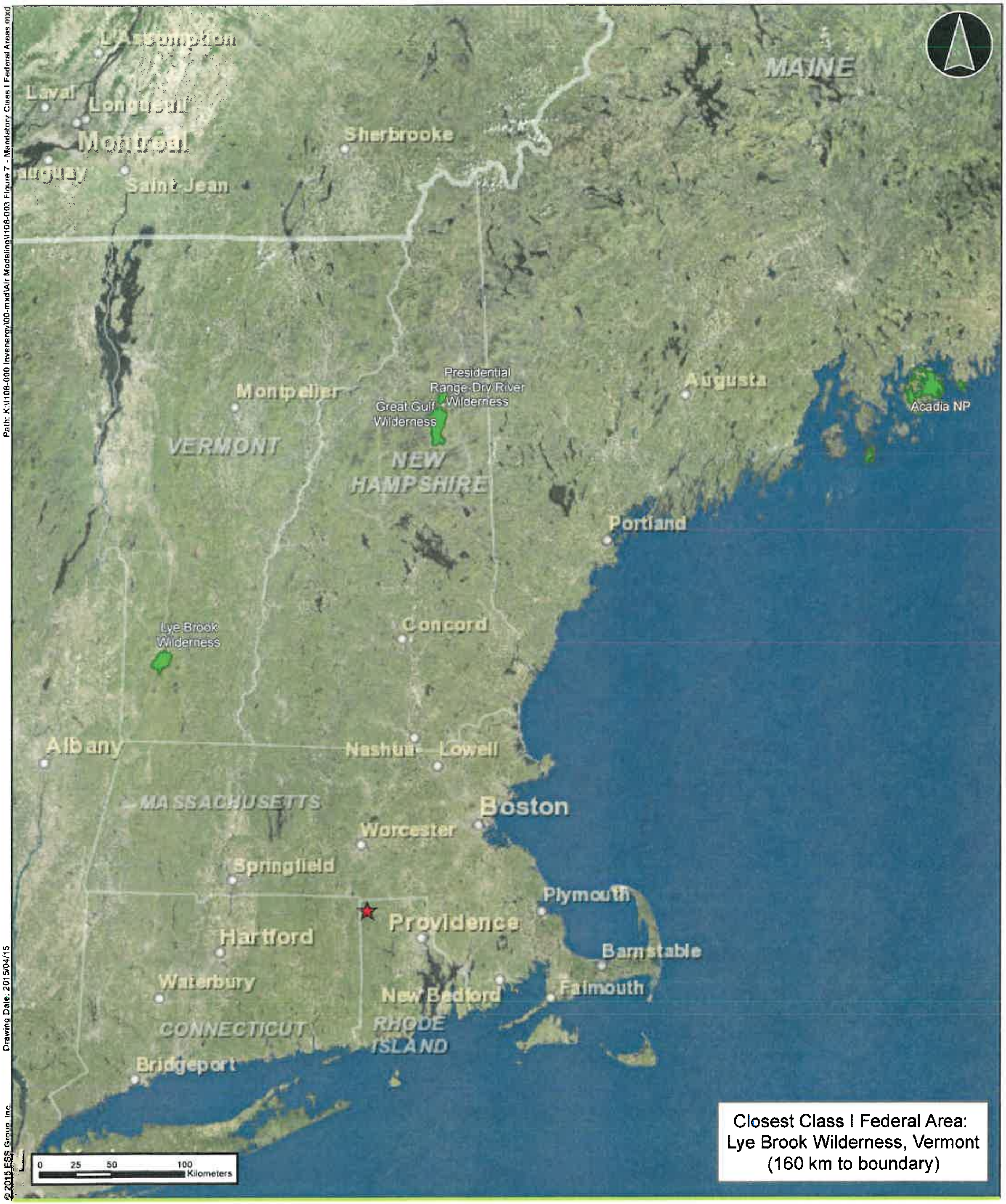
Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014

**Legend**

- Stack Locations
- Significant Impact Area - 3.56km
- 1-hr NO2 - 7.5 ugm3
- 24-hr PM10 - 5 ugm3

**Significant Impact Area**

**Figure 8**




**Invenergy Air Dispersion Modeling Protocol**
Burrillville, Rhode Island

**Mandatory Class I Federal Areas**

1 centimeter = 36 kilometers

Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014
3) National Park Service, Class I Areas, 2015

**Legend**

- Site Location
- Class I Federal Areas

**Figure 9**

# Appendix A

## Emissions Data Summaries

**Table A-1**
**Clear River Energy Center - Burrillville, Rhode Island**
**CT/HRSG Emission Summaries[1]**

| Modeling Case No. | Units | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GE Case No. | | 1 | 4 | 5 | 6 | 7 | 15 | 17 | 18 | 19 | 25 | 27 | 28 | 29 |
| | | | | | | | | | | | | | | |
| Fuel Fired | | 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 |
| Gas Turbine Load | % of Base | 100 | 100 | 100 | 75 | 38 | 100 | 100 | 75 | 30 | 100 | 100 | 75 | 35 |
| | | | | | | | | | | | | | | |
| Ambient Temperature | deg. F | 90 | 90 | 90 | 90 | 90 | 59 | 59 | 59 | 59 | 10 | 10 | 10 | 10 |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| Ambient Relative Humidity | % | 50 | 50 | 50 | 50 | 50 | 60 | 60 | 60 | 60 | 61 | 61 | 61 | 61 |
| | | | | | | | | | | | | | | |
| Duct Burner Firing | % of capacity | 31 | 0 | 0 | 0 | 0 | 34 | 0 | 0 | 0 | 37 | 0 | 0 | 0 |
| Evaporative Cooler Status | On/Off | On | On | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off |
| | | | | | | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 28.11 | 28.14 | 28.20 | 28.22 | 28.27 | 28.29 | 28.33 | 28.35 | 28.42 | 28.38 | 28.42 | 28.43 | 28.49 |
| Stack Flow | lb/hr | 5,757,500 | 5,747,700 | 5,565,000 | 4,645,200 | 3,340,100 | 5,692,300 | 5,681,600 | 4,704,000 | 3,124,800 | 6,066,200 | 6,054,300 | 4,855,200 | 3,444,000 |
| Stack Flow | acfm | 1,638,360 | 1,623,680 | 1,568,723 | 1,308,512 | 939,213 | 1,599,503 | 1,594,243 | 1,318,999 | 874,034 | 1,699,161 | 1,693,441 | 1,359,686 | 960,950 |
| Stack Exit Temperature | deg. F | 184 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 181 | 180 |
| | | | | | | | | | | | | | | |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | lb/hr | 24.8 | 23.1 | 22.1 | 17.5 | 11.4 | 24.9 | 23.0 | 18.2 | 10.5 | 26.6 | 24.5 | 19.5 | 12.3 |
| CO | lb/hr | 15.1 | 14.1 | 13.4 | 10.6 | 6.95 | 15.1 | 14.0 | 11.1 | 6.40 | 16.2 | 14.9 | 11.9 | 7.46 |
| SO2 | lb/hr | 5.74 | 5.35 | 5.10 | 4.04 | 2.64 | 5.75 | 5.33 | 4.21 | 2.44 | 6.14 | 5.68 | 4.50 | 2.83 |
| PM/PM10/PM2.5 | lb/hr | 17.9 | 12.0 | 11.9 | 11.3 | 10.6 | 18.0 | 12.0 | 11.4 | 10.5 | 18.1 | 12.1 | 11.5 | 10.7 |
| | | | | | | | | | | | | | | |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | g/sec | 3.12 | 2.91 | 2.78 | 2.21 | 1.44 | 3.14 | 2.90 | 2.29 | 1.32 | 3.35 | 3.09 | 2.46 | 1.55 |
| CO | g/sec | 1.90 | 1.78 | 1.69 | 1.34 | 0.88 | 1.90 | 1.76 | 1.40 | 0.81 | 2.04 | 1.88 | 1.50 | 0.94 |
| SO2 | g/sec | 0.72 | 0.67 | 0.64 | 0.51 | 0.33 | 0.72 | 0.67 | 0.53 | 0.31 | 0.77 | 0.72 | 0.57 | 0.36 |
| PM/PM10/PM2.5 | g/sec | 2.26 | 1.51 | 1.50 | 1.42 | 1.34 | 2.27 | 1.51 | 1.44 | 1.32 | 2.28 | 1.52 | 1.45 | 1.35 |

| Modeling Case No. | Units | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|
| GE Case No. | | 36 | 37 | 42 | 43 | 48 | 49 | 51 | 52 |
| | | | | | | | | | |
| Fuel Fired | | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD |
| Gas Turbine Load | % of Base | 100 | 50 | 100 | 50 | 100 | 50 | 100 | 50 |
| | | | | | | | | | |
| Ambient Temperature | deg. F | 90 | 90 | 59 | 59 | 10 | 10 | 0 | 0 |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| Ambient Relative Humidity | % | 50 | 50 | 60 | 60 | 61 | 61 | 52 | 52 |
| | | | | | | | | | |
| Duct Burner Firing | % of capacity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Evaporative Cooler Status | On/Off | Off | Off | Off | Off | Off | Off | Off | Off |
| | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 27.99 | 28.14 | 28.11 | 28.23 | 28.20 | 28.32 | 28.21 | 28.38 |
| Stack Flow | lb/hr | 5,865,300 | 3,587,900 | 6,002,900 | 3,684,500 | 6,181,400 | 3,921,800 | 6,188,700 | 4,037,300 |
| Stack Flow | acfm | 1,978,114 | 1,149,749 | 2,015,878 | 1,155,866 | 2,028,357 | 1,228,120 | 2,051,831 | 1,380,003 |
| Stack Exit Temperature | deg. F | 300 | 266 | 300 | 253 | 285 | 254 | 293 | 321 |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | lb/hr | 63.3 | 38.3 | 65.6 | 40.2 | 68.6 | 42.5 | 68.8 | 42.1 |
| CO | lb/hr | 38.5 | 23.3 | 40.0 | 24.5 | 41.8 | 25.8 | 41.8 | 25.8 |
| SO2 | lb/hr | 5.99 | 3.62 | 6.22 | 3.80 | 6.49 | 4.02 | 6.50 | 3.98 |
| PM/PM10/PM2.5 | lb/hr | 68.8 | 67.6 | 68.9 | 67.7 | 69.0 | 67.8 | 69.1 | 67.8 |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | g/sec | 7.98 | 4.83 | 8.27 | 5.07 | 8.64 | 5.36 | 8.67 | 5.30 |
| CO | g/sec | 4.85 | 2.94 | 5.04 | 3.08 | 5.26 | 3.24 | 5.26 | 3.24 |
| SO2 | g/sec | 0.75 | 0.46 | 0.78 | 0.48 | 0.82 | 0.51 | 0.82 | 0.50 |
| PM/PM10/PM2.5 | g/sec | 8.67 | 8.52 | 8.68 | 8.53 | 8.69 | 8.54 | 8.71 | 8.54 |

[1] Based on preliminary project equipment specifications and emissions estimates provided by GE. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.

**Table A-1**
**Clear River Energy Center - Burrillville, Rhode Island**
**CT/HRSG Emission Summaries[1]**

| Modeling Case No. | Units | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MHI Case # | | 1 | 4 | 5 | 6 | 7 | 23 | 25 | 26 | 27 | 41 | 43 | 44 | 45 |
| | | | | | | | | | | | | | | |
| Fuel Fired | | 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 |
| Gas Turbine Load | % of Base | 100 | 100 | 100 | 75 | 50 | 100 | 100 | 75 | 50 | 100 | 100 | 75 | 50 |
| GTs Operating[2] | | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | |
| Ambient Temperature | deg. F | 90 | 90 | 90 | 90 | 90 | 59 | 59 | 59 | 59 | 10 | 10 | 10 | 10 |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| Ambient Relative Humidity | % | 50 | 50 | 50 | 50 | 50 | 60 | 60 | 60 | 60 | 61 | 61 | 61 | 61 |
| | | | | | | | | | | | | | | |
| Duct Burner Firing | % of capacity | 31 | 0 | 0 | 0 | 0 | 34 | 0 | 0 | 0 | 37 | 0 | 0 | 0 |
| Evaporative Cooler Status | On/Off | On | On | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off |
| | | | | | | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 28.11 | 28.14 | 28.20 | 28.22 | 28.27 | 28.29 | 28.33 | 28.35 | 28.42 | 28.38 | 28.42 | 28.43 | 28.49 |
| Stack Flow | lb/hr | 4,507,000 | 4,480,000 | 4,378,000 | 3,646,000 | 2,935,000 | 4,698,000 | 4,671,000 | 3,877,000 | 2,977,000 | 5,041,000 | 5,024,000 | 4,237,000 | 3,202,000 |
| Stack Flow | acfm | 1,278,533 | 1,263,587 | 1,228,334 | 1,015,813 | 804,669 | 1,291,233 | 1,312,719 | 1,082,013 | 811,876 | 1,396,556 | 1,418,432 | 1,192,114 | 873,884 |
| Stack Exit Temperature | deg. F | 182 | 179 | 177 | 173 | 164 | 166 | 181 | 177 | 164 | 173 | 186 | 184 | 166 |
| | | | | | | | | | | | | | | |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | lb/hr | 26.1 | 21.0 | 20.3 | 16.2 | 12.7 | 26.9 | 21.8 | 17.4 | 13.3 | 27.3 | 24.0 | 19.3 | 14.9 |
| CO | lb/hr | 15.9 | 12.8 | 12.3 | 9.9 | 7.70 | 16.4 | 13.3 | 10.6 | 8.10 | 16.6 | 14.6 | 11.8 | 9.10 |
| SO2 | lb/hr | 2.30 | 1.80 | 1.80 | 1.40 | 1.10 | 2.30 | 1.90 | 1.50 | 1.20 | 2.40 | 2.10 | 1.70 | 1.30 |
| PM10 | lb/hr | 14.9 | 7.3 | 7.2 | 5.9 | 4.8 | 15.2 | 7.7 | 6.4 | 4.9 | 13.3 | 8.4 | 7.0 | 5.4 |
| | | | | | | | | | | | | | | |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | g/sec | 3.29 | 2.65 | 2.56 | 2.04 | 1.60 | 3.39 | 2.75 | 2.19 | 1.68 | 3.44 | 3.02 | 2.43 | 1.88 |
| CO | g/sec | 2.00 | 1.61 | 1.55 | 1.25 | 0.97 | 2.07 | 1.68 | 1.34 | 1.02 | 2.09 | 1.84 | 1.49 | 1.15 |
| SO2 | g/sec | 0.29 | 0.23 | 0.23 | 0.18 | 0.14 | 0.29 | 0.24 | 0.19 | 0.15 | 0.30 | 0.26 | 0.21 | 0.16 |
| PM/PM10/PM2.5 | g/sec | 1.88 | 0.92 | 0.91 | 0.74 | 0.60 | 1.92 | 0.97 | 0.81 | 0.62 | 1.68 | 1.06 | 0.88 | 0.68 |

| Modeling Case No. | Units | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|
| MHI Case # | | 10 | 11 | 30 | 31 | 48 | 49 | 57 | 58 |
| | | | | | | | | | |
| Fuel Fired | | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD |
| Gas Turbine Load | % of Base | 100 | 60 | 100 | 60 | 100 | 60 | 100 | 60 |
| GTs Operating[2] | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | |
| Ambient Temperature | deg. F | 90 | 90 | 59 | 59 | 10 | 10 | 0 | 0 |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| Ambient Relative Humidity | % | 50 | 50 | 60 | 60 | 61 | 61 | 52 | 52 |
| | | | | | | | | | |
| Duct Burner Firing | % of capacity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Evaporative Cooler Status | On/Off | Off | Off | Off | Off | Off | Off | Off | Off |
| | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 27.99 | 28.14 | 28.11 | 28.23 | 28.20 | 28.32 | 28.21 | 28.38 |
| Stack Flow | lb/hr | 4,452,000 | 3,009,000 | 4,751,000 | 3,225,000 | 4,601,000 | 3,618,000 | 4,565,000 | 3,683,000 |
| Stack Flow | acfm | 1,294,029 | 836,737 | 1,387,637 | 901,038 | 1,337,511 | 1,020,321 | 1,326,575 | 1,038,067 |
| Stack Exit Temperature | deg. F | 195 | 170 | 201 | 175 | 200 | 183 | 200 | 184 |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | lb/hr | 45.2 | 32.5 | 49.0 | 35.1 | 49.0 | 39.5 | 49.0 | 40.4 |
| CO | lb/hr | 27.5 | 19.80 | 29.8 | 21.40 | 29.8 | 24.0 | 29.8 | 24.6 |
| SO2 | lb/hr | 3.50 | 2.60 | 3.80 | 2.80 | 3.80 | 3.10 | 3.80 | 3.20 |
| PM/PM10/PM2.5 | lb/hr | 29.1 | 20.1 | 31.3 | 21.7 | 30.6 | 24.5 | 30.4 | 24.9 |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | g/sec | 5.70 | 4.10 | 6.17 | 4.42 | 6.17 | 4.98 | 6.17 | 5.09 |
| CO | g/sec | 3.47 | 2.49 | 3.75 | 2.70 | 3.75 | 3.02 | 3.75 | 3.10 |
| SO2 | g/sec | 0.44 | 0.33 | 0.48 | 0.35 | 0.48 | 0.39 | 0.48 | 0.40 |
| PM/PM10/PM2.5 | g/sec | 3.67 | 2.53 | 3.94 | 2.73 | 3.86 | 3.09 | 3.83 | 3.14 |

[1] Based on preliminary project equipment specifications and emissions estimates provided by MHI. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.
[2] All emission rates and stack flow characteristics are on a per stack basis

**Table A-1**
**Clear River Energy Center - Burrillville, Rhode Island**
**CT/HRSG Emission Summaries[1]**

| Modeling Case No. | Units | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Siemens Case # | | 1 | 2 | 3 | 4 | 5 | 8 | 9 | 10 | 11 | 14 | 15 | 16 | 17 |
| | | | | | | | | | | | | | | |
| Fuel Fired | | 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 |
| Gas Turbine Load | % of Base | 100 | 100 | 100 | 75 | 45 | 100 | 100 | 75 | 45 | 100 | 100 | 75 | 45 |
| GTs Operating[2] | | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | |
| Ambient Temperature | deg. F | 90 | 90 | 90 | 90 | 90 | 59 | 59 | 59 | 59 | 10 | 10 | 10 | 10 |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| Ambient Relative Humidity | % | 50 | 50 | 50 | 50 | 50 | 60 | 60 | 60 | 60 | 61 | 61 | 61 | 61 |
| | | | | | | | | | | | | | | |
| Duct Burner Status | On/Off | On | Off | Off | Off | Off | On | Off | Off | Off | On | Off | Off | Off |
| Evaporative Cooler Status | On/Off | On | On | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off |
| | | | | | | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 28.09 | 28.15 | 28.21 | 28.23 | 28.27 | 28.28 | 28.34 | 28.36 | 28.40 | 28.37 | 28.42 | 28.43 | 28.47 |
| Stack Flow | lb/hr | 4,800,209 | 4,786,910 | 4,638,446 | 3,809,426 | 2,996,880 | 5,008,709 | 4,996,248 | 4,047,282 | 3,151,583 | 5,256,687 | 5,245,299 | 4,188,222 | 3,261,498 |
| Stack Flow | acfm | 1,398,763 | 1,377,130 | 1,327,496 | 1,077,730 | 836,118 | 1,432,114 | 1,412,389 | 1,127,365 | 865,606 | 1,505,154 | 1,483,204 | 1,167,411 | 903,553 |
| Stack Exit Temperature | deg. F | 199 | 192 | 190 | 183 | 175 | 191 | 185 | 176 | 168 | 194 | 187 | 178 | 175 |
| | | | | | | | | | | | | | | |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | lb/hr | 22.0 | 19.6 | 18.6 | 14.8 | 10.6 | 22.8 | 20.5 | 16.2 | 11.5 | 24.2 | 22.2 | 17.5 | 12.4 |
| CO | lb/hr | 13.4 | 12.0 | 11.3 | 9.0 | 6.5 | 13.9 | 12.5 | 9.9 | 7.0 | 14.7 | 13.5 | 10.7 | 7.6 |
| SO2 | lb/hr | 4.47 | 3.99 | 3.78 | 3.03 | 2.21 | 4.63 | 4.18 | 3.33 | 2.40 | 4.92 | 4.51 | 3.59 | 2.58 |
| PM10 | lb/hr | 15.1 | 11.7 | 11.3 | 9.3 | 8.0 | 15.6 | 12.3 | 10.0 | 8.0 | 16.0 | 13.0 | 10.4 | 8.1 |
| | | | | | | | | | | | | | | |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | g/sec | 2.77 | 2.47 | 2.34 | 1.86 | 1.34 | 2.87 | 2.58 | 2.04 | 1.45 | 3.05 | 2.80 | 2.21 | 1.56 |
| CO | g/sec | 1.69 | 1.51 | 1.42 | 1.13 | 0.82 | 1.75 | 1.58 | 1.25 | 0.88 | 1.85 | 1.70 | 1.35 | 0.96 |
| SO2 | g/sec | 0.56 | 0.50 | 0.48 | 0.38 | 0.28 | 0.58 | 0.53 | 0.42 | 0.30 | 0.62 | 0.57 | 0.45 | 0.33 |
| PM/PM10/PM2.5 | g/sec | 1.90 | 1.47 | 1.42 | 1.17 | 1.01 | 1.97 | 1.55 | 1.26 | 1.01 | 2.02 | 1.64 | 1.31 | 1.02 |

| Modeling Case No. | Units | 14 | 15 | 16 | 17 | 18 | 19 | | |
|---|---|---|---|---|---|---|---|---|---|
| Siemens Case # | | 6 | 7 | 12 | 13 | 18 | 19 | | |
| | | | | | | | | | |
| Fuel Fired | | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | | |
| Gas Turbine Load | % of Base | 100 | 60 | 100 | 60 | 100 | 60 | | |
| GTs Operating[2] | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | | | | | | | | |
| Ambient Temperature | deg. F | 90 | 90 | 59 | 59 | 10 | 10 | | |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | | |
| Ambient Relative Humidity | % | 50 | 50 | 60 | 60 | 61 | 61 | | |
| | | | | | | | | | |
| Duct Burner Status | On/Off | Off | Off | Off | Off | Off | Off | | |
| Evaporative Cooler Status | On/Off | Off | Off | Off | Off | Off | Off | | |
| | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 28.47 | 28.57 | 28.67 | 28.71 | 28.83 | 28.87 | | |
| Stack Flow | lb/hr | 4,721,117 | 3,527,096 | 5,061,768 | 3,751,624 | 5,350,344 | 3,958,503 | | |
| Stack Flow | acfm | 1,435,623 | 1,053,450 | 1,539,437 | 1,119,916 | 1,627,392 | 1,178,530 | | |
| Stack Exit Temperature | deg. F | 237 | 227 | 242 | 230 | 246 | 232 | | |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | lb/hr | 52.4 | 35.9 | 54.9 | 38.0 | 55.1 | 38.9 | | |
| CO | lb/hr | 21.3 | 14.6 | 22.3 | 15.4 | 22.4 | 15.8 | | |
| SO2 | lb/hr | 4.13 | 2.87 | 4.33 | 3.04 | 4.35 | 3.12 | | |
| PM/PM10/PM2.5 | lb/hr | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | | |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | g/sec | 6.60 | 4.52 | 6.92 | 4.79 | 6.94 | 4.90 | | |
| CO | g/sec | 2.68 | 1.84 | 2.81 | 1.94 | 2.82 | 1.99 | | |
| SO2 | g/sec | 0.52 | 0.36 | 0.55 | 0.38 | 0.55 | 0.39 | | |
| PM/PM10/PM2.5 | g/sec | 3.78 | 3.78 | 3.78 | 3.78 | 3.78 | 3.78 | | |

[1] Based on preliminary project equipment specifications and emissions estimates provided by Siemens. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.
[2] All emission rates and stack flow characteristics are on a per stack basis

Table A-7
Clear River Energy Center - Burrillville, Rhode Island
Non-Criteria Pollutant Emissions Summaries[1]

| Emission Source(s): | Gas Turbine | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Number of Sources: | 2 | | | | | | | |
| Fuel Fired: | Natural Gas | | | | | | | |
| Maximum Unit Heat Input: | 3,393 | MMBtu/hr | | | | | | |
| Annual Operation: | 8,040 | hrs/yr | | | | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Uncontrolled PTE lb/hr | Uncontrolled PTE lb/yr | Control % | Controlled PTE lb/hr | Controlled PTE lb/yr | Reg. 22 MQ lb/yr |
| Ammonia | 0.0027 | lb/MMBtu | 9.2 | 73,968.00 | 0.00% | 9.20E+00 | 73,968 | 300 |
| Sulfuric Acid | 1.1E-03 | lb/MMBtu | 3.69 | 29,647.60 | 0.00% | 3.69E+00 | 29,668 | 40 |
| 1,3-Butadiene | 4.3E-07 | lb/MMBtu | 0.0029 | 23.46 | 90.00% | 2.92E-04 | 2.4 | 3 |
| Acetaldehyde | 4.0E-05 | lb/MMBtu | 0.27 | 2,182.38 | 90.00% | 2.71E-02 | 218 | 50 |
| Acrolein | 6.4E-06 | lb/MMBtu | 0.043 | 349.18 | 90.00% | 4.34E-03 | 35 | 0.07 |
| Benzene | 1.2E-05 | lb/MMBtu | 0.081 | 654.71 | 90.00% | 8.14E-03 | 65 | 10 |
| Ethylbenzene | 3.2E-05 | lb/MMBtu | 0.22 | 1,745.90 | 90.00% | 2.17E-02 | 175 | 9,000 |
| Formaldehyde | 2.2E-04 | lb/MMBtu | 1.48 | 11,924.98 | 90.00% | 1.48E-01 | 1,191 | 9 |
| Naphthalene | 1.3E-06 | lb/MMBtu | 0.009 | 70.93 | 90.00% | 8.82E-04 | 7.1 | 3 |
| PAH | 2.2E-06 | lb/MMBtu | 0.015 | 120.04 | 90.00% | 1.49E-03 | 12 | NA |
| Propylene Oxide | 2.9E-05 | lb/MMBtu | 0.20 | 1,582.24 | 90.00% | 1.97E-02 | 158 | 50 |
| Toluene | 1.3E-04 | lb/MMBtu | 0.88 | 7,092.73 | 90.00% | 8.82E-02 | 709 | 1,000 |
| Xylenes | 6.4E-05 | lb/MMBtu | 0.43 | 3,491.80 | 90.00% | 4.34E-02 | 349 | 3,000 |

| Emission Source(s): | Gas Turbine | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Number of Sources: | 2 | | | | | | | |
| Fuel Fired: | ULSD | | | | | | | |
| Maximum Unit Heat Input: | 3,502 | MMBtu/hr | | | | | | |
| Annual Operation: | 720 | hrs/yr | | | | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Uncontrolled PTE lb/hr | Uncontrolled PTE lb/yr | Control % | Controlled PTE lb/hr | Controlled PTE lb/yr | Reg. 22 MQ lb/yr |
| Ammonia | 0.0029 | lb/MMBtu | 10.1 | 7,272.00 | 0.00% | 1.01E+01 | 7,272 | 300 |
| Sulfuric Acid | 1.2E-03 | lb/MMBtu | 4.17 | 3,002.40 | 0.00% | 4.17E+00 | 3,002 | 40 |
| 1,3-Butadiene | 1.6E-05 | lb/MMBtu | 0.11 | 80.80 | 90.00% | 1.12E-02 | 8.1 | 3 |
| Benzene | 1.2E-05 | lb/MMBtu | 0.084 | 60.60 | 90.00% | 8.42E-03 | 6.1 | 10 |
| Formaldehyde | 2.3E-04 | lb/MMBtu | 1.62 | 1,161.84 | 90.00% | 1.62E-01 | 116 | 9 |
| Naphthalene | 3.5E-05 | lb/MMBtu | 0.25 | 176.75 | 90.00% | 2.45E-02 | 18 | 3 |
| PAH | 4.0E-05 | lb/MMBtu | 0.28 | 202.00 | 90.00% | 2.81E-02 | 20 | NA |
| Arsenic | 4.6E-08 | lb/MMBtu | 0.00 | 0.23 | 0.00% | 3.24E-04 | 0.23 | 0.02 |
| Beryllium | 3.1E-07 | lb/MMBtu | 0.00 | 1.57 | 0.00% | 2.17E-03 | 1.6 | 0.04 |
| Cadmium | 5.1E-09 | lb/MMBtu | 0.00 | 0.03 | 0.00% | 3.60E-05 | 0.026 | 0.07 |
| Chromium | 2.2E-06 | lb/MMBtu | 0.02 | 11.11 | 0.00% | 1.57E-02 | 11 | 20,000 |
| Lead | 7.7E-07 | lb/MMBtu | 0.01 | 3.88 | 0.00% | 5.39E-03 | 3.9 | 0.9 |
| Manganese | 2.8E-07 | lb/MMBtu | 0.00 | 1.42 | 0.00% | 1.98E-03 | 1.4 | 0.2 |
| Mercury | 1.0E-08 | lb/MMBtu | 0.00 | 0.05 | 0.00% | 7.22E-05 | 0.052 | 0.7 |
| Nickel | 1.5E-06 | lb/MMBtu | 0.01 | 7.47 | 0.00% | 1.04E-02 | 7.5 | 0.4 |
| Selenium | 2.6E-07 | lb/MMBtu | 0.00 | 1.29 | 0.00% | 1.80E-03 | 1.3 | 2,000 |

| Emission Source(s): | HRSG Duct Burners | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Number of Sources: | 2 | | | | | | | |
| Fuel Fired: | Natural Gas | | | | | | | |
| Maximum Unit Heat Input: | 721.0 | MMBtu/hr | | | | | | |
| Annual Operation: | 8,040 | hrs/yr | | | | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Uncontrolled PTE lb/hr | Uncontrolled PTE lb/yr | Control % | Controlled PTE lb/hr | Controlled PTE lb/yr | Reg. 22 MQ lb/yr |
| Lead | 4.9E-07 | lb/MMBtu | 7.1E-04 | 5.68 | 0.00% | 7.07E-04 | 5.7 | 0.9 |
| Benzene | 2.1E-06 | lb/MMBtu | 3.0E-03 | 25.87 | 90.00% | 2.97E-04 | 2.4 | 10 |
| Formaldehyde | 7.4E-05 | lb/MMBtu | 1.1E-01 | 852.48 | 90.00% | 1.06E-02 | 85 | 9 |
| Hexane | 1.8E-03 | lb/MMBtu | 2.5E+00 | 20,459.44 | 90.00% | 2.54E-01 | 2,046 | 20,000 |
| Naphthalene | 6.0E-07 | lb/MMBtu | 8.6E-04 | 6.93 | 90.00% | 8.62E-05 | 0.69 | 3 |
| Toluene | 3.3E-06 | lb/MMBtu | 4.8E-03 | 38.65 | 90.00% | 4.81E-04 | 3.9 | 1,000 |
| Arsenic | 2.0E-07 | lb/MMBtu | 2.8E-04 | 2.27 | 0.00% | 2.83E-04 | 2.3 | 0.02 |
| Barium | 4.3E-06 | lb/MMBtu | 6.2E-03 | 50.01 | 0.00% | 6.22E-03 | 50 | 2,000 |
| Beryllium | 1.2E-08 | lb/MMBtu | 1.7E-05 | 0.14 | 0.00% | 1.70E-05 | 0.14 | 0.04 |
| Cadmium | 1.1E-06 | lb/MMBtu | 1.6E-03 | 12.50 | 0.00% | 1.56E-03 | 13 | 0.07 |
| Chromium | 1.4E-06 | lb/MMBtu | 2.0E-03 | 15.91 | 0.00% | 1.98E-03 | 16 | 20,000 |
| Cobalt | 8.2E-08 | lb/MMBtu | 1.2E-04 | 0.95 | 0.00% | 1.19E-04 | 1.0 | 0.1 |
| Copper | 8.3E-07 | lb/MMBtu | 1.2E-03 | 9.66 | 0.00% | 1.20E-03 | 10 | 40 |
| Manganese | 3.7E-07 | lb/MMBtu | 5.4E-04 | 4.32 | 0.00% | 5.37E-04 | 4.3 | 0.2 |
| Mercury | 2.5E-07 | lb/MMBtu | 3.7E-04 | 2.96 | 0.00% | 3.68E-04 | 3.0 | 0.7 |
| Molybdenum | 1.1E-06 | lb/MMBtu | 1.6E-03 | 12.50 | 0.00% | 1.56E-03 | 13 | 60 |
| Nickel | 2.1E-06 | lb/MMBtu | 3.0E-03 | 23.87 | 0.00% | 2.97E-03 | 24 | 0.4 |
| Selenium | 2.4E-08 | lb/MMBtu | 3.4E-05 | 0.27 | 0.00% | 3.39E-05 | 0.27 | 2,000 |
| Vanadium | 2.3E-06 | lb/MMBtu | 3.3E-03 | 26.14 | 0.00% | 3.25E-03 | 26 | 0.07 |
| Zinc | 2.8E-05 | lb/MMBtu | 4.1E-02 | 329.82 | 0.00% | 4.10E-02 | 330 | 3,000 |
| 2-Methylnaphthalene | 2.4E-08 | lb/MMBtu | 3.4E-05 | 0.27 | 90.00% | 3.39E-06 | 0.0273 | NA |
| 3-Methylchloranthrene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| 7,12-Dimethylbenz(a)anthracene | 1.6E-08 | lb/MMBtu | 2.3E-05 | 0.18 | 90.00% | 2.26E-06 | 0.0182 | NA |
| Acenaphthene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Acenaphthylene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Anthracene | 2.4E-09 | lb/MMBtu | 3.4E-06 | 0.03 | 90.00% | 3.39E-07 | 0.0027 | NA |
| Benz(a)anthracene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Benzo(a)pyrene | 1.2E-09 | lb/MMBtu | 1.7E-06 | 0.01 | 90.00% | 1.69E-07 | 0.0014 | NA |
| Benzo(b)fluoranthene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Benzo(g,h,i)perylene | 1.2E-09 | lb/MMBtu | 1.7E-06 | 0.01 | 90.00% | 1.69E-07 | 0.0014 | NA |
| Benzo(k)fluoranthene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Butane | 2.1E-03 | lb/MMBtu | 3.0E+00 | 23,869.34 | 90.00% | 2.97E-01 | 2,387 | NA |
| Chrysene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Dibenzo(a,h)anthracene | 1.2E-09 | lb/MMBtu | 1.7E-06 | 0.01 | 90.00% | 1.70E-07 | 0.0014 | NA |
| Dichlorobenzene | 1.2E-06 | lb/MMBtu | 1.7E-03 | 13.64 | 90.00% | 1.70E-04 | 1.4 | NA |
| Ethane | 3.0E-03 | lb/MMBtu | 4.4E+00 | 35,235.69 | 90.00% | 4.38E-01 | 3,524 | NA |
| Fluoranthene | 2.9E-09 | lb/MMBtu | 4.2E-06 | 0.03 | 90.00% | 4.24E-07 | 0.0034 | NA |
| Fluorene | 2.8E-06 | lb/MMBtu | 4.0E-03 | 32.46 | 90.00% | 4.04E-04 | 3.2 | NA |
| Indeno(1,2,3-cd)pyrene | 1.8E-06 | lb/MMBtu | 2.6E-03 | 20.87 | 90.00% | 2.60E-04 | 2.1 | NA |
| Pentane | 2.6E-03 | lb/MMBtu | 3.7E+00 | 29,552.52 | 90.00% | 3.68E-01 | 2,955 | NA |
| Phenanthrene | 1.7E-08 | lb/MMBtu | 2.4E-05 | 0.19 | 90.00% | 2.40E-06 | 0.019 | NA |
| Propane | 1.6E-03 | lb/MMBtu | 2.3E+00 | 18,185.18 | 90.00% | 2.26E-01 | 1,819 | NA |
| Pyrene | 4.9E-09 | lb/MMBtu | 7.1E-06 | 0.06 | 90.00% | 7.07E-07 | 0.0057 | NA |

| Emission Source(s): | Auxiliary Boiler | | | | |
|---|---|---|---|---|---|
| Number of Sources: | 1 | | | | |
| Fuel Fired: | Natural Gas | | | | |
| Maximum Unit Heat Input: | 140.5 | MMBtu/hr | | | |
| Annual Operation: | 4,576 | hrs/yr | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Potential Emissions lb/hr | Potential Emissions lb/yr | Reg. 22 MQ lb/yr |
| Lead | 4.9E-07 | lb/MMBtu | 6.9E-05 | 3.15E-01 | 0.9 |
| Benzene | 2.1E-06 | lb/MMBtu | 2.9E-04 | 1.32E+00 | 10 |
| Formaldehyde | 7.4E-05 | lb/MMBtu | 1.0E-02 | 4.73E+01 | 9 |
| Hexane | 1.8E-03 | lb/MMBtu | 2.5E-01 | 1.14E+03 | 20,000 |
| Naphthalene | 6.0E-07 | lb/MMBtu | 8.4E-05 | 3.85E-01 | 3 |
| Toluene | 3.3E-06 | lb/MMBtu | 4.7E-04 | 2.14E+00 | 1,000 |
| Arsenic | 2.0E-07 | lb/MMBtu | 2.8E-05 | 1.26E-01 | 0.02 |
| Barium | 4.3E-06 | lb/MMBtu | 6.1E-04 | 2.78E+00 | 2,000 |
| Beryllium | 1.2E-08 | lb/MMBtu | 1.7E-06 | 7.57E-03 | 0.04 |
| Cadmium | 1.1E-06 | lb/MMBtu | 1.5E-04 | 6.94E-01 | 0.07 |
| Chromium | 1.4E-06 | lb/MMBtu | 1.9E-04 | 8.83E-01 | 20,000 |
| Cobalt | 8.2E-08 | lb/MMBtu | 1.2E-05 | 5.30E-02 | 0.1 |
| Copper | 8.3E-07 | lb/MMBtu | 1.2E-04 | 5.36E-01 | 40 |
| Manganese | 3.7E-07 | lb/MMBtu | 5.2E-05 | 2.40E-01 | 0.2 |
| Mercury | 2.5E-07 | lb/MMBtu | 3.6E-05 | 1.64E-01 | 0.7 |
| Molybdenum | 1.1E-06 | lb/MMBtu | 1.5E-04 | 6.94E-01 | 60 |
| Nickel | 2.1E-06 | lb/MMBtu | 2.9E-04 | 1.32E+00 | 0.4 |
| Selenium | 2.4E-08 | lb/MMBtu | 3.3E-06 | 1.51E-02 | 2,000 |
| Vanadium | 2.3E-06 | lb/MMBtu | 3.2E-04 | 1.45E+00 | 0.07 |
| Zinc | 2.8E-05 | lb/MMBtu | 4.0E-03 | 1.83E+01 | 3,000 |
| 2-Methylnaphthalene | 2.4E-08 | lb/MMBtu | 3.3E-06 | 1.51E-02 | NA |
| 3-Methylchloranthrene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| 7,12-Dimethylbenz(a)anthracene | 1.6E-08 | lb/MMBtu | 2.2E-06 | 1.01E-02 | NA |
| Acenaphthene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Acenaphthylene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Anthracene | 2.4E-09 | lb/MMBtu | 3.3E-07 | 1.51E-03 | NA |
| Benz(a)anthracene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Benzo(a)pyrene | 1.2E-09 | lb/MMBtu | 1.7E-07 | 7.57E-04 | NA |
| Benzo(b)fluoranthene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Benzo(g,h,i)perylene | 1.2E-09 | lb/MMBtu | 1.7E-07 | 7.57E-04 | NA |
| Benzo(k)fluoranthene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Butane | 2.1E-03 | lb/MMBtu | 2.9E-01 | 1.32E+03 | NA |
| Chrysene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Dibenzo(a,h)anthracene | 1.2E-09 | lb/MMBtu | 1.7E-07 | 7.57E-04 | NA |
| Dichlorobenzene | 1.2E-06 | lb/MMBtu | 1.7E-04 | 7.57E-01 | NA |
| Ethane | 3.0E-03 | lb/MMBtu | 4.3E-01 | 1.96E+03 | NA |
| Fluoranthene | 2.9E-09 | lb/MMBtu | 4.1E-07 | 1.89E-03 | NA |
| Fluorene | 2.8E-06 | lb/MMBtu | 3.9E-04 | 1.80E+00 | NA |
| Indeno(1,2,3-cd)pyrene | 1.8E-06 | lb/MMBtu | 2.5E-04 | 1.16E+00 | NA |
| Pentane | 2.5E-03 | lb/MMBtu | 3.6E-01 | 1.64E+03 | NA |
| Phenanthrene | 1.7E-08 | lb/MMBtu | 2.3E-06 | 1.07E-02 | NA |
| Propane | 1.6E-03 | lb/MMBtu | 2.2E-01 | 1.01E+03 | NA |
| Pyrene | 4.9E-09 | lb/MMBtu | 6.9E-07 | 3.15E-03 | NA |

| Emission Source(s) | Fire Pump | | | | |
|---|---|---|---|---|---|
| Number of Sources | 1 | | | | |
| Fuel Fired: | ULSD | | | | |
| Maximum Unit Heat Input: | 2.1 | MMBtu/hr | | | |
| Annual Operation: | 300 | hrs/yr | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Potential Emissions lb/hr | Potential Emissions lb/yr | Reg. 22 MQ lb/yr |
| Benzene | 9.33E-04 | lb/MMBtu | 2.0E-03 | 5.88E-01 | 10 |
| Toluene | 4.09E-04 | lb/MMBtu | 8.6E-04 | 2.58E-01 | 1,000 |
| Xylenes | 2.85E-04 | lb/MMBtu | 6.0E-04 | 1.80E-01 | 3,000 |
| Propylene | 2.58E-03 | lb/MMBtu | 5.4E-03 | 1.63E+00 | 36,500 |
| Formaldehyde | 1.18E-03 | lb/MMBtu | 2.5E-03 | 7.43E-01 | 9 |
| Acetaldehyde | 7.67E-04 | lb/MMBtu | 1.6E-03 | 4.83E-01 | 50 |
| Acrolein | 9.25E-05 | lb/MMBtu | 1.9E-04 | 5.83E-02 | 0.07 |
| Naphthalene | 8.48E-05 | lb/MMBtu | 1.8E-04 | 5.34E-02 | 3 |
| 1,3-Butadiene | 3.91E-05 | lb/MMBtu | 8.2E-05 | 2.46E-02 | 3 |
| Acenaphthylene | 5.06E-06 | lb/MMBtu | 1.1E-05 | 3.19E-03 | NA |
| Acenaphthene | 1.42E-06 | lb/MMBtu | 3.0E-06 | 8.95E-04 | NA |
| Fluorene | 2.92E-05 | lb/MMBtu | 6.1E-05 | 1.84E-02 | NA |
| Phenanthrene | 2.94E-05 | lb/MMBtu | 6.2E-05 | 1.85E-02 | NA |
| Anthracene | 1.87E-06 | lb/MMBtu | 3.9E-06 | 1.18E-03 | NA |
| Fluoranthene | 7.61E-06 | lb/MMBtu | 1.6E-05 | 4.79E-03 | NA |
| Pyrene | 4.78E-06 | lb/MMBtu | 1.0E-05 | 3.01E-03 | NA |
| Benz(a)anthracene | 1.68E-06 | lb/MMBtu | 3.5E-06 | 1.06E-03 | NA |
| Chrysene | 3.53E-07 | lb/MMBtu | 7.4E-07 | 2.22E-04 | NA |
| Benzo(b)fluoranthene | 9.91E-08 | lb/MMBtu | 2.1E-07 | 6.24E-05 | NA |
| Benzo(k)fluoranthene | 1.55E-07 | lb/MMBtu | 3.3E-07 | 9.77E-05 | NA |
| Benzo(a)pyrene | 1.88E-07 | lb/MMBtu | 3.9E-07 | 1.18E-04 | NA |
| Indeno(1,2,3-cd)pyrene | 3.75E-07 | lb/MMBtu | 7.9E-07 | 2.36E-04 | NA |
| Dibenz(a,h)anthracene | 5.83E-07 | lb/MMBtu | 1.2E-06 | 3.67E-04 | NA |
| Benzo(g,h,i)perylene | 4.89E-07 | lb/MMBtu | 1.0E-06 | 3.08E-04 | NA |
| PAH | 1.68E-04 | lb/MMBtu | 3.5E-04 | 1.06E-01 | NA |

| Emission Source(s): | Dewpoint Heater | | | | |
|---|---|---|---|---|---|
| Number of Sources: | 1 | | | | |
| Fuel Fired: | Natural Gas | | | | |
| Maximum Unit Heat Input: | 15.0 | MMBtu/hr | | | |
| Annual Operation: | 8,760 | hrs/yr | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Potential Emissions lb/hr | Potential Emissions lb/yr | Reg. 22 MQ lb/yr |
| Lead | 4.9E-07 | lb/MMBtu | 7.4E-06 | 6.44E-02 | 0.9 |
| Benzene | 2.1E-06 | lb/MMBtu | 3.1E-05 | 2.71E-01 | 10 |
| Formaldehyde | 7.4E-05 | lb/MMBtu | 1.1E-03 | 9.66E+00 | 9 |
| Hexane | 1.8E-03 | lb/MMBtu | 2.6E-02 | 2.32E+02 | 20,000 |
| Naphthalene | 6.0E-07 | lb/MMBtu | 9.0E-06 | 7.86E-02 | 3 |
| Toluene | 3.3E-06 | lb/MMBtu | 5.0E-05 | 4.38E-01 | 1,000 |
| Arsenic | 2.0E-07 | lb/MMBtu | 2.9E-06 | 2.58E-02 | 0.02 |
| Barium | 4.3E-06 | lb/MMBtu | 6.5E-05 | 5.67E-01 | 2,000 |
| Beryllium | 1.2E-08 | lb/MMBtu | 1.8E-07 | 1.55E-03 | 0.04 |
| Cadmium | 1.1E-06 | lb/MMBtu | 1.6E-05 | 1.42E-01 | 0.07 |
| Chromium | 1.4E-06 | lb/MMBtu | 2.1E-05 | 1.80E-01 | 20,000 |
| Cobalt | 8.2E-08 | lb/MMBtu | 1.2E-06 | 1.08E-02 | 0.1 |
| Copper | 8.3E-07 | lb/MMBtu | 1.3E-05 | 1.10E-01 | 40 |
| Manganese | 3.7E-07 | lb/MMBtu | 5.6E-06 | 4.90E-02 | 0.2 |
| Mercury | 2.5E-07 | lb/MMBtu | 3.8E-06 | 3.35E-02 | 0.7 |
| Molybdenum | 1.1E-06 | lb/MMBtu | 1.6E-05 | 1.42E-01 | 60 |
| Nickel | 2.1E-06 | lb/MMBtu | 3.1E-05 | 2.71E-01 | 0.4 |
| Selenium | 2.4E-08 | lb/MMBtu | 3.5E-07 | 3.09E-03 | 2,000 |
| Vanadium | 2.3E-06 | lb/MMBtu | 3.4E-05 | 2.96E-01 | 0.07 |
| Zinc | 2.8E-05 | lb/MMBtu | 4.3E-04 | 3.74E+00 | 3,000 |
| 2-Methylnaphthalene | 2.4E-08 | lb/MMBtu | 3.5E-07 | 3.09E-03 | NA |
| 3-Methylchloranthrene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| 7,12-Dimethylbenz(a)anthracene | 1.6E-08 | lb/MMBtu | 2.4E-07 | 2.06E-03 | NA |
| Acenaphthene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Acenaphthylene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Anthracene | 2.4E-09 | lb/MMBtu | 3.5E-08 | 3.09E-04 | NA |
| Benz(a)anthracene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Benzo(a)pyrene | 1.2E-09 | lb/MMBtu | 1.8E-08 | 1.55E-04 | NA |
| Benzo(b)fluoranthene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Benzo(g,h,i)perylene | 1.2E-09 | lb/MMBtu | 1.8E-08 | 1.55E-04 | NA |
| Benzo(k)fluoranthene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Butane | 2.1E-03 | lb/MMBtu | 3.1E-02 | 2.71E+02 | NA |
| Chrysene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Dibenzo(a,h)anthracene | 1.2E-09 | lb/MMBtu | 1.8E-08 | 1.55E-04 | NA |
| Dichlorobenzene | 1.2E-06 | lb/MMBtu | 1.8E-05 | 1.55E-01 | NA |
| Ethane | 3.0E-03 | lb/MMBtu | 4.6E-02 | 3.99E+02 | NA |
| Fluoranthene | 2.9E-09 | lb/MMBtu | 4.4E-08 | 3.86E-04 | NA |
| Fluorene | 2.8E-06 | lb/MMBtu | 4.2E-05 | 3.68E-01 | NA |
| Indeno(1,2,3-cd)pyrene | 1.8E-06 | lb/MMBtu | 2.7E-05 | 2.37E-01 | NA |
| Pentane | 2.5E-03 | lb/MMBtu | 3.8E-02 | 3.35E+02 | NA |
| Phenanthrene | 1.7E-08 | lb/MMBtu | 2.5E-07 | 2.19E-03 | NA |
| Propane | 1.6E-03 | lb/MMBtu | 2.4E-02 | 2.06E+02 | NA |
| Pyrene | 4.9E-09 | lb/MMBtu | 7.4E-08 | 6.44E-04 | NA |

| Emission Source(s): | Emergency Diesel Generator | | | | |
|---|---|---|---|---|---|
| Number of Sources: | 1 | | | | |
| Fuel Fired: | ULSD | | | | |
| Maximum Unit Heat Input: | 19.5 | MMBtu/hr | | | |
| Annual Operation: | 300 | hrs/yr | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Potential Emissions lb/hr | Potential Emissions lb/yr | Reg. 22 MQ lb/yr |
| Benzene | 7.76E-04 | lb/MMBtu | 1.5E-02 | 4.54E+00 | 10 |
| Toluene | 2.81E-04 | lb/MMBtu | 5.5E-03 | 1.64E+00 | 1,000 |
| Xylenes | 1.93E-04 | lb/MMBtu | 3.8E-03 | 1.13E+00 | 3,000 |
| Propylene | 2.79E-03 | lb/MMBtu | 5.4E-02 | 1.63E+01 | 36,500 |
| Formaldehyde | 7.89E-05 | lb/MMBtu | 1.5E-03 | 4.62E-01 | 9 |
| Acetaldehyde | 2.52E-05 | lb/MMBtu | 4.9E-04 | 1.47E-01 | 50 |
| Acrolein | 7.88E-06 | lb/MMBtu | 1.5E-04 | 4.61E-02 | 0.07 |
| Naphthalene | 1.30E-04 | lb/MMBtu | 2.5E-03 | 7.61E-01 | 3 |
| Acenaphthylene | 9.23E-06 | lb/MMBtu | 1.8E-04 | 5.40E-02 | NA |
| Acenaphthene | 4.68E-06 | lb/MMBtu | 9.1E-05 | 2.74E-02 | NA |
| Fluorene | 1.28E-05 | lb/MMBtu | 2.5E-04 | 7.49E-02 | NA |
| Phenanthrene | 4.08E-05 | lb/MMBtu | 8.0E-04 | 2.39E-01 | NA |
| Anthracene | 1.23E-06 | lb/MMBtu | 2.4E-05 | 7.20E-03 | NA |
| Fluoranthene | 4.03E-06 | lb/MMBtu | 7.9E-05 | 2.36E-02 | NA |
| Pyrene | 3.71E-06 | lb/MMBtu | 7.2E-05 | 2.17E-02 | NA |
| Benz(a)anthracene | 6.22E-07 | lb/MMBtu | 1.2E-05 | 3.64E-03 | NA |
| Chrysene | 1.53E-06 | lb/MMBtu | 3.0E-05 | 8.95E-03 | NA |
| Benzo(b)fluoranthene | 1.11E-06 | lb/MMBtu | 2.2E-05 | 6.49E-03 | NA |
| Benzo(k)fluoranthene | 2.18E-07 | lb/MMBtu | 4.3E-06 | 1.28E-03 | NA |
| Benzo(a)pyrene | 2.57E-07 | lb/MMBtu | 5.0E-06 | 1.50E-03 | NA |
| Indeno(1,2,3-cd)pyrene | 4.14E-07 | lb/MMBtu | 8.1E-06 | 2.42E-03 | NA |
| Dibenz(a,h)anthracene | 3.46E-07 | lb/MMBtu | 6.7E-06 | 2.02E-03 | NA |
| Benzo(g,h,i)perylene | 5.56E-07 | lb/MMBtu | 1.1E-05 | 3.25E-03 | NA |
| PAH | 2.12E-04 | lb/MMBtu | 4.1E-03 | 1.24E+00 | NA |

[1] Based on preliminary project equipment specifications and emissions estimates. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.
GT ammonia, formaldehyde and sulfuric acid emission factors are from equipment specifications. Gas turbine distillate oil metals emission factors are from "Survey of Ultra-Trace Metals in Gas Turbine Fuels". All other emission factors are from AP-42.

**Table A-3**
**Clear River Energy Center - Burrillville, Rhode Island**
**CT/HRSG Startup & Shutdown Emission Summaries[1]**

| Parameter | Measurement Units | Cold Start | Warm Start | Hot Start | Shut Down | Cold Start | Warm Start | Hot Start | Shut Down |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Fuel Fired | | Natural Gas | Natural Gas | Natural Gas | Natural Gas | ULSD | ULSD | ULSD | ULSD |
| | | | | | | | | | |
| Event Duration | min/event | 45 | 40 | 30 | 12 | 45 | 7 | 21 | 7 |
| Events per Year | events/yr | 50 | 100 | 250 | 400 | 15 | 45 | 10 | 30 |
| Hours per Year | hrs/yr | 37.5 | 66.7 | 125.0 | 80.0 | 11.3 | 5.3 | 3.5 | 3.5 |
| | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 28.60 | 28.60 | 28.60 | 28.60 | 28.60 | 28.60 | 28.60 | 28.60 |
| Stack Flow | lb/hr | 4,320,000 | 4,320,000 | 4,320,000 | 2,880,000 | 4,680,000 | 4,680,000 | 4,680,000 | 3,420,000 |
| Stack Flow | acfm | 1,163,214 | 1,163,214 | 1,163,214 | 775,476 | 1,260,149 | 1,260,149 | 1,260,149 | 920,878 |
| Stack Exit Temperature | deg. F | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 |
| | | | | | | | | | |
| Emissions | | | | | | | | | |
| NOx | lb/event | 196.0 | 159.0 | 110.0 | 6.6 | 198.0 | 178.0 | 100.0 | 25.0 |
| CO | lb/event | 133.0 | 131.0 | 123.0 | 124.0 | 304.0 | 301.0 | 287.0 | 99.0 |
| PM/PM10/PM2.5 | lb/event | 9.1 | 8.1 | 4.2 | 2.4 | 53.0 | 47.0 | 25.0 | 8.3 |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | lb/hr | 261.3 | 238.5 | 220.0 | 33.0 | 264.0 | 1525.7 | 285.7 | 214.3 |
| CO | lb/hr | 177.3 | 196.5 | 246.0 | 620.0 | 405.3 | 2580.0 | 820.0 | 848.6 |
| PM/PM10/PM2.5 | lb/hr | 12.1 | 12.2 | 8.4 | 12.0 | 70.7 | 402.9 | 71.4 | 71.1 |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | g/sec | 32.93 | 30.05 | 27.72 | 4.16 | 33.26 | 192.24 | 36.00 | 27.00 |
| CO | g/sec | 22.34 | 24.76 | 31.00 | 78.12 | 51.07 | 325.08 | 103.32 | 106.92 |
| PM/PM10/PM2.5 | g/sec | 1.53 | 1.53 | 1.06 | 1.51 | 8.90 | 50.76 | 9.00 | 8.96 |

[1] Based on preliminary project equipment specifications and emissions estimates. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.

# Appendix B

## Modeling Results – Isopleth Figures


Path: K:\1108-000 Invenergy\00-mxd\Air Modeling\1108 Appendix B 1 - 1hr NO2.mxd

Drawing Date: 2015/10/21



ESS group

**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 4,167 feet

Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014

**Legend**

1-Hour NO2

Property Line

**Modeling Result Isopleths (ug/m3)**
**1-Hour NO2**

**Appendix B**
Sheet 1 of 6


Path: K:\I108-000 Invenergy\00-mxd\Air Modeling\I108 Appendix B 2 - Annual NO2.mxd

Drawing Date: 2015/10/21



ESS group
environmental consulting & engineering services

**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 4,167 feet

Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014

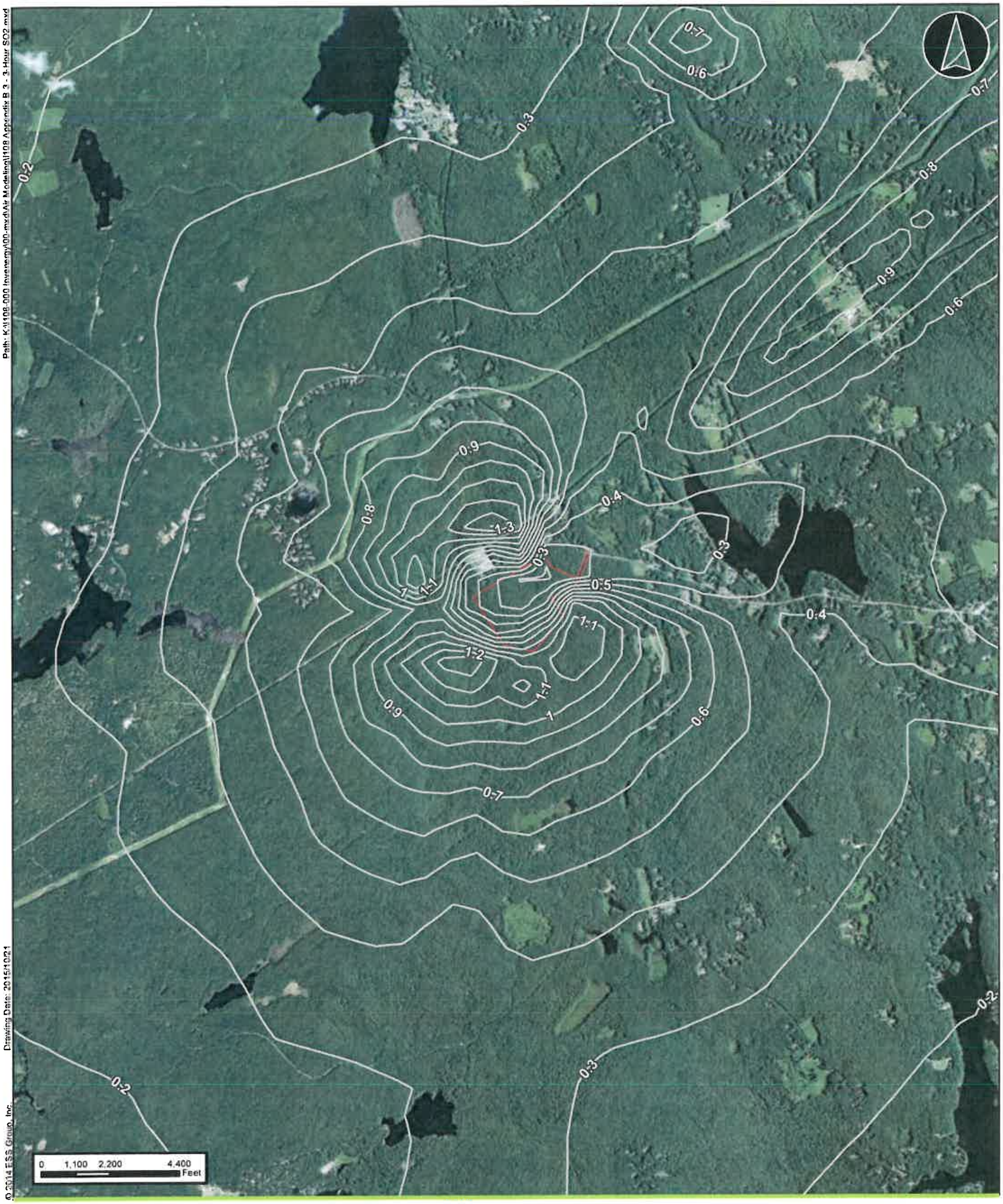
**Legend**

Annual NO2

Property Line

**Modeling Result Isopleths (ug/m3)**
**Annual NO2**

**Appendix B**
Sheet 2 of 6






**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 4,167 feet

Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014

**Legend**

3-Hour SO2

Property Line

**Modeling Result Isopleths (ug/m3)**
**3-Hour SO2**

**Appendix B**
Sheet 3 of 6




**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 4,167 feet

Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014

**Legend**

24-Hour PM10

Property Line

**Modeling Result Isopleths (ug/m3)**
**24-Hour PM10**

**Appendix B**

Sheet 4 of 6


Path: K:\J108-000 Invenergy\00-mxd\Air Modeling\J108 Appendix B 5 - Annual PM10.mxd

Drawing Date: 2015/10/21



**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 4,167 feet

Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014

**Legend**

Annual PM10

Property Line

**Modeling Result Isopleths (ug/m3)**
**Annual PM10**

**Appendix B**
Sheet 5 of 6


**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 4,167 feet

Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014

**Legend**

24-Hour PM2.5

Property Line

**Modeling Result Isopleths (ug/m3)**
**24-Hour PM2.5**

**Appendix B**
Sheet 6 of 6

# Appendix C

## Modeling Files (CD-ROM)

**STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS**

**PUBLIC UTILITIES COMMISSION**

| | | |
|---|---|---|
| **IN RE: INVENERGY THERMAL DEVELOPMENT LLC** | **)** | |
| **APPLICATION TO CONSTRUCT AND OPERATE THE** | **)** | **Dkt. 4609** |
| **CLEAR RIVER ENERGY CENTER, BURRILLVILLE,** | **)** | |
| **RHODE ISLAND** | **)** | |

**INVENERGY THERMAL DEVELOPMENT LLC'S REPONSES TO CONSERVATION LAW FOUNDATION'S FIRST DATA REQUEST**

1.2: A copy of the material transmitted by ESS Group on behalf of Invenergy on June 26, 2015 to Barbara Morin, R.I. Department of Environmental Management, entitled "Health Risk Assessment Protocol — Clear River Energy Center — Burrillville, Rhode Island."

RESPONSE 1.2: See attached: Health Risk Assessment Protocol — Clear River Energy Center — Burrillville, Rhode Island

RESPONDENT: Michael E. Feinblatt, ESS Group

DATE: April 14, 2016

MASSACHUSETTS
100 Fifth Avenue, 5th Floor
Waltham, Massachusetts 02451
781.419.7696

RHODE ISLAND
401 Wampanoag Trail, Suite 400
East Providence, Rhode Island 02915
401.434.5560

VIRGINIA
999 Waterside Drive, Suite 2525
Norfolk, Virginia 23510
757.777.3777

June 26, 2015

Ms. Barbara Morin
Rhode Island Department of Environmental Management
Office of Air Resources
235 Promenade Street
Providence, Rhode Island 02908

***Re: Health Risk Assessment Protocol***
***Clear River Energy Center – Burrillville, Rhode Island***

Dear Ms. Morin:

Enclosed for your review is a Health Risk Assessment Protocol for the Clear River Energy Center, a combined-cycle electric generating facility being proposed by Invenergy Thermal LLC at the Spectra Energy Algonquin Compressor Station site on Wallum Lake Road (State Route 100) in Burrillville, Rhode Island (the Project or the Facility). The Facility will be a new major stationary source, as it will have the potential to emit 50 tons per year or more of nitrogen oxides ($NO_X$) and volatile organic compounds (VOC) and 100 tons per year or more of other regulated new source review (NSR) pollutants (CO, $PM_{10}$ & $PM_{2.5}$).

In accordance with RIDEM Air Pollution Control Regulation (APCR) No. 9, Section 9.5.2, major stationary sources proposed in areas designated as attainment or unclassifiable for any pollutant for which there is a significant net emissions increase at the source must obtain a Major Source Permit. The conditions which must be met for the issuance of a Major Source Permit include a demonstration, by means of air quality modeling, that the allowable emission increases from the proposed source would not cause or contribute to air pollution in violation of any National Ambient Air Quality Standard (NAAQS) or any increase in ambient concentrations exceeding the remaining available increment for the specified air contaminant. The additional impact analyses required by RIDEM's PSD and Air Toxics regulations must also be completed prior to the issuance of a Major Source Permit.

The RIDEM "Rhode Island Air Dispersion Modeling Guidelines for Stationary Sources (March 2013 Revision)" (RIDEM, 2013) outlines the accepted procedures for performing modeling analyses in conformance with the EPA Guideline on Air Quality Models (40 CFR 51, Appendix W). To ensure that all modeling analyses subject to the approval of RIDEM are performed in accordance with applicable state and federal guidance, an applicant must submit a modeling protocol prior to conducting the analysis. The protocol describes the input parameters, models, and assumptions that will be used in the analysis.

An Air Dispersion Modeling Protocol for the Project was submitted to RIDEM on April 20, 2015. The Air Dispersion Modeling Protocol was prepared in accordance with the applicable RIDEM and EPA regulations and guidance, and described the procedures to be used for the air quality impact analysis and the additional impact analyses to be conducted for the Clear River Energy Center Major Source Permit Application.

Section 9.5.2(f) of RIDEM APCR No. 9 requires an applicant for a major source permit in an attainment area to conduct any studies required by the Guidelines for Assessing Health Risks from Proposed Air Pollution Sources (the RIDEM Guideline) and meet the criteria therein. The RIDEM Guideline requires that multi-pathway risk assessments be submitted with all applications to construct, install, or modify resource recovery plants or first tier power plants. It also requires the applicant to submit a detailed protocol to RIDEM for approval prior to the assessment. The protocol must include an outline of the proposed assessment document and specify the methodology to be used to calculate environmental transport, human exposure, and health impacts from the proposed source. It also must include specified site-specific information.

The Facility will be a power plant which will be a major source of air pollution, excluding emissions caused by firing natural gas, and will have a heat input capacity greater than 250 MMBtu/hr. It is therefore a first tier power plant, as defined by the RIDEM Guideline. The enclosed Health Risk Assessment Protocol has been prepared in accordance with the requirements of the RIDEM Guideline and describes the procedures to be used to assess the multi-pathway health risks associated with the emissions from the proposed Clear River Energy Center facility in Burrillville.

Please contact me at (781) 419-7749 or at mfeinblatt@essgroup.com with any questions you may have about the enclosed Health Risk Assessment Protocol.

Sincerely,

**ESS GROUP, INC.**

Michael E. Feinblatt
Practice Leader, Energy & Industrial Services

Enclosures

C: John Niland, Invenergy

# Health Risk Assessment Protocol Combined-Cycle Electric Generating Facility

## CLEAR RIVER ENERGY CENTER
## BURRILLVILLE, RHODE ISLAND

**PREPARED FOR:**
Invenergy Thermal LLC
One South Wacker Drive
Suite 1900
Chicago, IL 60606

**FOR SUBMITTAL TO:**
Office of Air Resources
Rhode Island Department of Environmental Management
235 Promenade Street
Providence, Rhode Island 02908

**PREPARED BY:**
ESS Group, Inc.
10 Hemingway Drive, 2nd Floor
East Providence, Rhode Island 02915

ESS Project No. I108-003.04

June 26, 2015

**HEALTH RISK ASSESSMENT PROTOCOL**
**COMBINED-CYCLE ELECTRIC GENERATING FACILITY**

**Clear River Energy Center**
**Burrillville, Rhode Island**

*Prepared For:*

**Invenergy Thermal LLC**
One South Wacker Drive
Suite 1900
Chicago, Illinois 60606

*For Submittal To:*

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Providence, Rhode Island 02908

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10 Hemingway Drive
2nd Floor
East Providence, Rhode Island 02915

**ESS Project No. I108-003.04**

**June 26, 2015**

## TABLE OF CONTENTS



### TABLES



### FIGURES

## APPENDICES

## 1.0 INTRODUCTION

### 1.1 Background

ESS Group, Inc. (ESS) has been contracted by Invenergy Thermal LLC (Invenergy) to conduct an air quality impact analysis for the Clear River Energy Center, a combined-cycle electric generating facility being proposed by Invenergy at the Spectra Energy Algonquin Compressor Station site on Wallum Lake Road (State Route 100) in Burrillville, Rhode Island (the Project or the Facility).

The Facility will be a new major stationary source, as it will have the potential to emit 50 tons per year or more of nitrogen oxides ($NO_X$) and volatile organic compounds (VOC) and 100 tons per year or more of other regulated new source review (NSR) pollutants (CO, $PM_{10}$ & $PM_{2.5}$). In accordance with RIDEM Air Pollution Control Regulation (APCR) No. 9, Section 9.5.2, major stationary sources proposed in areas designated as attainment or unclassifiable for any pollutant for which there is a significant net emissions increase at the source must obtain a Major Source Permit. The conditions which must be met for the issuance of a Major Source Permit include a demonstration, by means of air quality modeling, that the allowable emission increases from the proposed source would not cause or contribute to air pollution in violation of any National Ambient Air Quality Standard (NAAQS) or any increase in ambient concentrations exceeding the remaining available increment for the specified air contaminant. The additional impact analyses required by RIDEM's PSD and Air Toxics regulations must also be completed prior to the issuance of a Major Source Permit.

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An Air Dispersion Modeling Protocol for the Project was submitted to RIDEM on April 20, 2015. The Air Dispersion Modeling Protocol was prepared in accordance with the applicable RIDEM and EPA regulations and guidance, and described the procedures to be used for the air quality impact analysis and the additional impact analyses to be conducted for the Clear River Energy Center Major Source Permit Application.

Section 9.5.2(f) of RIDEM APCR No. 9 requires an applicant for a major source permit in an attainment area to conduct any studies required by the Guidelines for Assessing Health Risks from Proposed Air Pollution Sources (the RIDEM Guideline) and meet the criteria therein. The RIDEM Guideline requires that multi-pathway risk assessments be submitted with all applications to construct, install, or modify resource recovery plants or first tier power plants. It also requires the applicant to submit a detailed protocol to RIDEM for approval prior to the assessment. The protocol must include an outline of the proposed assessment document and specify the methodology to be used to calculate environmental transport, human exposure, and health impacts from the proposed source. It also must include specified site-specific information.

The Facility will be a power plant which will be a major source of air pollution, excluding emissions caused by firing natural gas, and will have a heat input capacity greater than 250 MMBtu/hr. It is therefore a first tier power plant, as defined by the RIDEM Guideline. This Health Risk Assessment Protocol has been prepared in accordance with the requirements of the RIDEM Guideline and describes the procedures to be used to assess the multi-pathway health risks associated with the emissions from the proposed Clear River Energy Center facility in Burrillville.

Section 2.0 of this protocol describes the Project emission sources and emission points. The scope of the assessment is outlined in Section 3.0. Section 4.0 provides an overview of the assessment methodology to be used. The risk characterization procedures are detailed in Section 5.0. Section 6.0 lists the acceptability criteria which will be used for the assessment. The health risk assessment report is outlined in Section 7.0.

## 1.2 Facility Description

The Clear River Energy Center is a combined-cycle electric generating facility being proposed by Invenergy at the Spectra Energy Algonquin Compressor Station site located along Wallum Lake Road in Burrillville, Rhode Island. An aerial photo of the area surrounding the proposed Facility location is shown in Figure 1. The preliminary Facility site layout plan is shown on Figure 2. A topographic map of the area within 3 km of the proposed Facility location is shown in Figure 3.

The Facility will consist of two advanced class (G-class or above) gas turbines operated in a combined-cycle configuration with two heat recovery steam generators (HRSG) equipped with natural fired duct burners and one steam turbine. Invenergy will finalize the selection of the vendor for the combustion turbines prior to finalizing the Major Source Permit. Each gas turbine will fire natural gas as a primary fuel and ultra-low sulfur diesel (ULSD) fuel as a backup fuel from a 2,000,000 gallon on-site storage tank for limited periods when natural gas is unavailable. The Facility will utilize an air cooled condenser (ACC). The Facility will have a nominal power output at base load of approximately 800-1,080 megawatts (MW) while firing natural gas (with supplementary HRSG duct firing) and 600-930 MW while firing ULSD.

## 1.3 Applicable Regulations

The following RIDEM Air Pollution Control Regulations apply to the proposed Project:

- No. 1 – Visible Emissions
- No. 5 – Fugitive Dust
- No. 6 – Opacity Monitors
- No. 7 – Emission of Air Contaminants Detrimental to Person or Property
- No. 8 – Sulfur Content of Fuels
- No. 9 – Air Pollution Control Permits
- No. 10 – Air Pollution Episodes
- No. 11 – Petroleum Liquids Marketing and Storage
- No. 13 – Particulate Emissions from Fossil Fuel Fired Steam or Hot Water Generating Units
- No. 14 – Record Keeping and Reporting
- No. 16 – Operation of Air Pollution Control Systems
- No. 17 – Odors
- No. 22 – Air Toxics
- No. 27 – Control of Nitrogen Oxide Emissions
- No. 28 – Operating Permit Fees
- No. 29 – Operating Permits
- No. 45 – Rhode Island Diesel Anti-Idling Program

- No. 46 – $CO_2$ Budget Trading Program

The following federal Air Pollution Control Regulations apply to the proposed Project:

- 40 CFR 50 – National Primary and Secondary Ambient Air Quality Standards
- 40 CFR 52.21 – Prevention of Significant Deterioration of Air Quality
- 40 CFR 60 – Standards of Performance for New Stationary Sources
    - Subpart A – General Provisions
    - Subpart Db – Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units
    - Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines
    - Subpart KKKK – Standards of Performance for Stationary Combustion Turbines
    - Appendix B – Performance Specifications
    - Appendix F – Quality Assurance Procedures
- 40 CFR 63 – National Emission Standards for Hazardous Air Pollutants for Source Categories
    - Subpart A – General Provisions
    - Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines
- 40 CFR 70 & 71 – Operating Permits Program
- 40 CFR 72 – Permits Regulation
- 40 CFR 73 – Acid Rain Program Sulfur Dioxide Allowance System
- 40 CFR 75 – Continuous Emissions Monitoring
- 40 CFR 80 – Regulation of Fuels and Fuel Additives
- 40 CFR 89 – Control of Emissions from New and In-Use Nonroad Compression-Ignition Engines
- 40 CFR 98 – Mandatory Greenhouse Gas Reporting

## 2.0 EMISSION SOURCES & EMISSION POINTS

The Facility's potential emissions of criteria pollutants are summarized on Table 1. The Facility stationary emission sources and emission points are detailed below. The specifications of each of the Facility emission sources and each emission point are summarized on Table 2. Appendix A contains emissions data summaries.

The Facility stationary emission sources are detailed below. Appendix A contains emissions data summaries. The equipment specifications and emissions information provided in Tables 1 and 2, and in Appendix A, are based on the current Facility design, preliminary equipment and emissions information provided to date by the potential equipment manufacturers including GE, Siemens and MHI, and the available emission factors. The actual equipment vendors for the Project, the Facility design and layout, the equipment specifications, and the emission rates of each pollutant from each emission source are all subject to change as the Project design advances.

## 2.1 Gas Turbines/HRSGs

The Facility will utilize two gas turbines operated in a combined cycle configuration, each with a duct fired HRSG to generate electricity and to generate steam for the single steam turbine proposed. Based on the preliminary information provided by the manufacturers, each gas turbine will have a maximum heat input rate of approximately 3,393 MMBtu/hr while firing natural gas and approximately 3,507 MMBtu/hr while firing ULSD fuel. Each HRSG will be equipped with a natural gas fired HRSG duct burner with a maximum heat input capacity of approximately 721 MMBtu/hr to provide additional energy for the steam turbine during natural gas firing.

Each GT/HRSG will be equipped with a selective catalytic reduction (SCR) system for $NO_X$ emissions control. Water injection will also be used during ULSD firing for $NO_X$ emissions control. Each HRSG stack will have a maximum stack $NO_X$ concentration of 2.0 parts per million dry by volume at 15 percent oxygen (ppmvd@15%$O_2$) during natural gas firing, and 5.0 ppmvd@15%$O_2$ during ULSD firing during steady-state operation (down to a minimum of 30%-50% load on natural gas and 50% load on ULSD).

Each SCR will utilize $NH_3$ injection for $NO_X$ emissions control. The Facility will include a 40,000 gallon aboveground storage tank of 19% aqueous $NH_3$ for this purpose. The SCR will be designed to achieve a maximum $NH_3$ stack concentration ($NH_3$ slip concentration) of 2.0 pmvd@15%$O_2$ both while firing natural gas and while firing ULSD.

Each GT/HRSG will be equipped with an oxidation catalyst (OC) for the control of CO, VOCs, and organic hazardous air pollutants (HAPs). Each OC will be designed to achieve a maximum stack CO concentration of 2.0 ppmvd@15%$O_2$ while firing natural gas and 5.0 ppmvd@15%$O_2$ while firing ULSD. The maximum VOC stack concentration will be 1.0 ppmvd@15%$O_2$ while firing natural gas without duct firing, 1.7 ppmvd@15%$O_2$ while firing natural gas during duct firing, and 5.0 ppmvd@15%$O_2$ during ULSD firing. Each OC will also reduce organic HAP by at least 90%. The potential emissions of organic HAP emissions from the GT/HRSGs have been estimated using information provided by the potential equipment manufacturers and using emission factors from AP-42.

The emissions of $CO_2$, $SO_2$, $H_2SO_4$, and $PM_{10}/PM_{2.5}$ from the GT/HRSGs will be minimized by the use of clean burning, low sulfur, low ash fuels, and by the use of the most efficient gas turbine combustion technology commercially available at this time. The emission rates of $CO_2$, $SO_2$, $H_2SO_4$, and $PM_{10}/PM_{2.5}$ from the gas turbines at each operating condition are detailed in Appendix A. The average $CO_2$ emission rates from the GT/HRSGs at base load will be 814 lb/MW-hr while firing natural gas and 1,227 lb/MW-hr while firing ULSD.

The exit height of each GT/HRSG stack will be 200 feet above grade. The GT/HRSG stacks will have an inside diameter of 22 feet. The GT/HRSG stack exhaust flow rates and exit temperatures, and criteria pollutant emission rates over the full range of expected operating conditions, based on preliminary information provided by the manufacturers, are provided in Appendix A. Each HRSG stack will be equipped with a certified continuous emissions monitoring system (CEMS) to monitor compliance with permit emission limits.

The gas turbines will be permitted for unlimited operation on natural gas. Invenergy is proposing to permit the gas turbines to operate for the equivalent total ULSD fuel usage of up to 60 days per year at base load when natural gas is unavailable only. It is expected that the gas turbines will only fire ULSD fuel during the winter months when commercial and residential natural gas usage for heating purposes is at its peak.

## 2.2 Auxiliary Boiler

The Facility will utilize a natural gas fired auxiliary boiler to supply gland sealing steam to the steam turbine, sparging steam to the HRSG steam drums, sparging steam to the ACC condensate tank, and motive steam to establish initial vacuum in the ACC and the steam turbine. The auxiliary boiler is currently designed to provide up to 107,910 lb/hr of steam at 215 psia and 390°F, at a boiler efficiency of approximately 82 percent. Based on the current design, the maximum heat input rate to the natural gas fired auxiliary boiler will be 140.6 MMBtu/hr.

The auxiliary boiler will be located within a building located to the immediate southeast of the GT/HRSGs. It will be equipped with ultra-low $NO_X$ burners and flue gas recirculation (FGR) for emissions control. The exhaust gases from the auxiliary boiler will be vented through a 48-inch diameter exhaust stack at an exit height of 50 feet above grade. The auxiliary boiler will exhaust at 38,067 acfm at 344°F at full load. The criteria pollutant emission rates from the auxiliary boiler at its maximum natural gas firing rate are summarized on Table 1.

The auxiliary boiler will only operate prior to and during gas turbine startup periods and will not operate during normal, steady-state gas turbine operating periods. Invenergy is proposing to permit the auxiliary boiler to operate up to 4,576 hours per year, the equivalent of up to 8 hours per day during weekdays (at night) and through each weekend.

## 2.3 Dew Point Heater

The Facility will utilize a natural gas fired dew point heater to maintain the temperature of the natural gas delivered to the gas turbines at a nominal 50°F above the hydrocarbon dew point of the natural gas. Based on the current design, the dew point heater will have a maximum heat input rate of 15 MMBtu/hr.

The dew point heater will be located northwest of the GT/HRSGs next to the fuel oil storage tank. It will be equipped with an ultra-low $NO_X$ burner and FGR for emissions control. The exhaust gases from the dew point heater will be vented through a 20-inch diameter exhaust stack at an exit height of 35 feet above grade. The dew point heater will exhaust at 7,252 acfm at 1,000°F at full load. The criteria pollutant emission rates from the dew point heater at its maximum natural gas firing rate are summarized on Table 1.

Invenergy is proposing to permit the dew point heater for unlimited operation firing natural gas.

## 2.4 Emergency Diesel Generator

The Facility will utilize a 2 MW emergency diesel generator equipped with a 2,682 horsepower (Hp) engine to manage the combined cycle critical shutdown and maintenance loads during a loss of site power from the grid. Based on the current design, the emergency diesel generator will have a maximum heat input rate of 19.5 MMBtu/hr firing ULSD fuel.

The emergency diesel generator will be located to the immediate southeast of the GT/HRSGs. The exhaust gases from the emergency diesel generator will be vented through an 8-inch diameter exhaust stack at an exit height of 35 feet above grade. The emergency diesel generator will exhaust at 15,295 acfm at 752°F at full load. The criteria pollutant emission rates from the emergency diesel generator at its maximum ULSD fuel firing rate are summarized on Table 1.

Invenergy is proposing to only operate the emergency diesel generator when grid power is unavailable and for maintenance and readiness testing for up to 1 hour per week and up to 300 hours per year.

## 2.5 Diesel Fire Pump

The Facility will utilize a 315 BHP diesel engine fire pump. Based on the current design, the diesel fire pump engine will have a maximum heat input rate of 2.1 MMBtu/hr firing ULSD fuel.

The diesel fire pump will be located in a building southeast of the GT/HRSGs, near the water treatment building. The exhaust gases from the diesel fire pump will be vented through a 6-inch diameter exhaust stack at an exit height of 35 feet above grade. The diesel fire pump will exhaust at 1,673 acfm at 865°F at full load. The criteria pollutant emission rates from the diesel fire pump at its maximum ULSD fuel firing rate are summarized on Table 1.

Invenergy is proposing to only operate the fire pump during emergency situations and for maintenance and readiness testing for up to 1 hour per week and up to 300 hours per year.

## 2.6 Fuel Oil Tank

The Facility will include a 2,000,000 gallon aboveground ULSD storage tank equipped with secondary containment, as required. The potential fugitive VOC emissions (working losses and breathing losses) associated with the ULSD storage tank at the Facility have been estimated using the EPA's TANKS program. Appendix A contains a summary of the results and the data printouts from the TANKS analysis for the ULSD storage tank.

## 3.0 HEALTH RISK ASSESSMENT SCOPE

A multi-pathway human health risk assessment will be conducted for the proposed Clear River Energy Center in Burrillville in accordance with the RIDEM Guideline. The assessment will be focused on the impact to the "most exposed individual" (MEI). The MEI is defined in the RIDEM Guideline as a person living for 70 years, including childhood, at the off-site point at which the predicted ambient air impact from the facility is at its maximum, and whose diet includes a significant portion of foods derived from local sources (local farms and water bodies). According to the RIDEM Guideline, it should be assumed that the drinking water for the MEI is supplied by the maximally impacted drinking water source and that the MEI swims in the maximally impacted recreational water body.

The Facility will be designed for an operational life of 25-30 years. Therefore, the exposure durations assumed for the assessment will be assumed to be within that same time frame.

## 3.1 Sensitive Receptor Locations

The health risks associated with the ambient air impacts from the Facility at sensitive receptors within the project impact area will be assessed. Figure 4 shows all residential neighborhoods, schools, day care centers, hospitals, senior citizen facilities, farms, drinking water sources and bodies of water used for fishing and other recreational activities within 5 miles of the proposed Facility site. Table 4 provides a summary of the sensitive receptors shown on Figure 4 which are within 5 miles of the Facility.

The actual distance from the Facility at which the health risks to sensitive receptors will be assessed will be determined by the results of the air dispersion modeling analysis. All sensitive receptors located within the Significant Impact Area (SIA) of the Facility will be assessed.

## 3.2 Pollutant Selection

The non-criteria pollutant emission rates and annual potential emissions from each Facility emission source are summarized in Appendix A. The ammonia and sulfuric acid emissions from the gas turbines have been estimated based on preliminary information provided by the manufacturers. The metals emissions from gas turbine ULSD usage have been estimated using Siemens Westinghouse's Survey of

Ultra-Trace Metals in Gas Turbine Fuels (2004). The gas turbine formaldehyde emissions have been estimated using the MACT standard for combustion turbines (91 ppb@15%$O_2$) previously proposed by the EPA, but currently stayed by court order.

All of the other non-criteria pollutant emission rates from each emission source have been estimated using emission factors from the EPA's AP-42 Compilation of Emission Factors. Because the emission factors in AP-42 are primarily based on the results of stack tests conducted 20 or more years ago, and in many cases are based on non-detect stack test results, the use of AP-42 emission factors to estimate the emissions of non-criteria pollutants from the Facility should be conservative. Based on the advances in combustion technology and fuel processing since AP-42 was last updated, it is expected that the actual emissions of non-criteria pollutants from the Facility emission sources will be much lower than the values presented in Appendix A.

In an email dated, April 9, 2015, Ms. Barbara Morin of RIDEM requested that this assessment focus on the metals, polycyclic aromatic hydrocarbons (PAH), and persistent bioaccumulative toxins (PBT) which could be emitted from the Facility. Table 3 summarizes the potential emissions of the metals, PAHs, and PBTs which will be included in the assessment, based on the guidance provided by RIDEM, and the available emission factors for each Facility emission source.

## 4.0 HEALTH RISK ASSESSMENT METHODOLOGY

The following sections describe the methodologies which will be used to complete the health risk assessment for the Project.

### 4.1 Air Dispersion Modeling

The health risk assessment will utilize the results of the air dispersion modeling analysis to be conducted in accordance with the Air Dispersion Modeling Protocol previously submitted for the Project. The following is a summary of the modelling procedures to be used, which are further detailed in the modeling protocol:

- The air dispersion modeling will be completed using the EPA's AERMOD refined model.
- Five years of hourly meteorological data will be modeled. The most recent pre-processed surface observations from T.F. Green Airport in Providence available from RIDEM (currently 2007-2011) and concurrent upper air observations from Chatham, MA will be used.
- Approximately 96% of the area within 3 km of the Facility site is rural. All Facility sources will be modeled as rural sources.
- A polar receptor grid will be centered on the GT/HRSG-1 stack. Receptor coverage will extend out to 50 km. Receptors will be located at:
    - 25-meter increments out to 1 km
    - 100-meter increments out to 2 km
    - 200-meter increments out to 5 km
    - 500-meter increments out to 10 km
    - 1,000-meter increments out to 50 km
- Receptors will also be placed along the property fenceline at 10-meter increments and at each of the sensitive receptors within the Project's SIA identified on Table 4. On-site locations will not be included in the analysis.

- The maximum terrain elevation and hill height will be assigned for each receptor through the application of AERMAP. National Elevation Data (NED) data will be input to AERMAP (Version 11103). The data will be downloaded from the USGS website (http://seamless.usgs.gov/index.php).
- AERMOD will be run with each emission source operating simultaneously, for five years of hourly meteorological data. The annual impacts from the gas turbines will be based on the worst-case 59°F operating cases for each fuel, pollutant, and averaging period. The auxiliary boiler will not operate while the gas turbines are in steady-state operation, so its short term impacts will be determined during startup periods only.
- The emergency generator and fire pump will not be included in the 1-hour impact analyses. For the annual impact modeling, the emission rates from the emergency generator and the fire pump will be pro-rated for the number of hours each will be permitted to operate each year.
- The AERMOD results will be applied to each listed air toxic which has the potential to be emitted at a level which exceeds its respective Minimum Quantity from Table III of RDEM APCR No. 22. The results of the analysis will demonstrate that the predicted ambient air impacts from the facility at or beyond the property line do not exceed any of RIDEM's Acceptable Ambient Levels (AALs) or Calculated Acceptable Ambient Levels (CAALs) developed by RIDEM for any non-listed air toxics.
- Isopleth figures will be prepared showing the maximum predicted impact concentrations at each receptor for each averaging period in relation to the sensitive receptors within the Project's SIA identified on Figure 4.

## 4.2 Deposition Modeling

The deposition modeling which will be conducted is described in detail in Section 5.0.

## 4.3 Environmental Transport

The following exposure pathways will be screened for potential significance for this assessment:

- Inhalation of indoor and outdoor air
- Ingestion of soil and dust
- Ingestion of dust on prepared food
- Ingestion of water
- Ingestion of fruits and vegetables from home gardens and area farms
- Ingestion of cow's and mother's milk
- Ingestion of locally grown meat
- Dermal exposure to water, soil, and dust

# 5.0 RISK CHARACTERIZATION PROCEDURES

As recommended by RIDEM, the California Air Resources Board's Health Risk Assessment Standalone Tool (RAST, Version 2.0) will be used to characterize the health risks associated with the Facility's emissions. The following sections describe the specific procedures and options to be used within the RAST program for the Project health risk assessment.

## 5.1 Pollutant Concentration Data Entry

The AERMOD results will be imported into RAST in the required format. For each pollutant and sensitive receptor location, the average and maximum hourly modeled concentrations will be entered into a spreadsheet, which will then be imported to RAST as a CSV file.

## 5.2 Risk Scenario Selection

### 5.2.1 Analysis Type

The RAST program will be used to assess the following three types of health risks:

- Cancer Risk – cancer health impacts (multi-pathway)
- Chronic Risk – long term non-cancer health impacts (multi-pathway)
- Acute Risk – short term non-cancer impacts (inhalation exposure only)

### 5.2.2 Receptor Types

The following receptor types will be used within RAST:

- For receptors located within residential areas, the Individual Resident receptor type will be used.
- For receptors located at other off-site sensitive areas, the Worker receptor type will be used.

### 5.2.3 Exposure Duration

The Exposure Duration is the number of years the receptor is exposed to facility pollutants. The following Exposure Durations will be used within RAST:

- For receptors located within residential areas, a 30-year exposure, which is used to estimate Tier 1 cancer risk at a residential location, will be used.
- For receptors located at other off-site areas, a 25-year exposure, which is used to estimate cancer risk for off-site workers, will be used.

### 5.2.4 Exposure Pathways

The following exposure pathways will be evaluated using RAST for this assessment:

- All sensitive receptor locations will be evaluated for the inhalation, ingestion of soil, water and dust, and dermal pathways.
- Sensitive receptor locations within residential areas will also be evaluated for ingestion of fruits and vegetables from home gardens and ingestion of mother's milk.
- The sensitive receptor locations at water recreational areas will also be evaluated for ingestion of fish and for dermal exposure to water.

There are no known farms identified within the Project impact area. Therefore, the evaluation of the risks associated with the ingestion of locally raised produce, beef, dairy, or eggs will not be conducted for this assessment.

### 5.2.5 Deposition Rates

The default Uncontrolled Source deposition rate of 0.05 m/s will be used for this assessment. The oxidation catalyst installed on each gas turbine/HRSG will provide control of PAHs. However, the emissions of metals from the gas turbine/HRSGs and the emissions of all metals and PAHs from the other project emission sources will be emitted uncontrolled.

### 5.2.6 Exposure Frequency Adjustments

The following exposure frequency adjustments will be made for this assessment. If a potential adjustment is not listed below, then the default value in RAST will be used.

- For residential receptors, no adjustment will be made for time at residence, as it is assumed that most of the nearby residents go to local schools or work locally, and are thus still exposed when not at home.
- For non-residential receptors, 8-hour breathing rates will be used to reflect worker exposures that are recurring but only for a portion of the day. The breathing rate will based on moderate intensity to cover a broad range of daily activity levels.
- The default exposure frequency for workers of 250 days per year will used to account for time spent away from the exposure site.
- A cold climate setting will be used for dermal exposures. This setting is for areas which have cool temperatures (daily highs less than 65 degrees) for the majority of the year and can receive a considerable amount of fog and rainfall.

## 5.3 Risk Calculation

Once the pollutant concentration data has been input and the risk scenario has been selected for each sensitive receptor, RAST will be run to calculate the associated risks. The risk results will be output by each risk type assessed: Cancer, Chronic, 8-hour, or Acute.

### 5.3.1 Cancer Risk

The cancer risk output will be the pollutant-specific estimated probability of developing cancer based on the pollutant concentration and risk scenario selected.

### 5.3.2 Non-cancer Target Organ Hazard Quotient

The non-cancer hazard quotient (HQ) is the calculated pollutant-specific indicator for the risk of developing an adverse health outcome for different target organ systems. It is based on the pollutant concentration and risk scenario selected, and is calculated using the predefined reference exposure level (REL) of a pollutant, ground level concentration and the exposure duration. If the maximum concentration is below the REL, there is assumed to be no observable adverse health impact to the target organ system. The one hour maximum concentration will be divided by the acute REL to determine an acute HQ for each pollutant.

The following target organ systems will be evaluated for non-cancer adverse health impacts for this assessment:

- Cardiovascular System
- Central Nervous System
- Immune System
- Kidneys

- Gastrointestinal Tract & Liver or Alimentary Tract
- Reproductive System & Developmental
- Respiratory System
- Skin
- Eyes
- Bones & Teeth
- Endocrine System
- Hematological System
- Response to Odors
- General Toxicity

The risk results will be sorted by pollutant to help determine which pollutant contributes the highest risk. The results will also be grouped by pathway. All of the RAST output files will be submitted electronically in the Health Risk Assessment Report.

### 5.3.3 Other Risk Characterization Metrics

The following additional risk characterization metrics will be determined for each assessed pollutant:

- The total dose of each systemic toxicant will be calculated from all exposure routes. The total pollutant-specific doses will be compared to the EPA Risk Reference Doses (RfDs) for each pollutant assessed.
- For pollutants with both oral and inhalation RfDs, the pollutant-specific HQ will be calculated as the sum of the inhalation dose divided by the inhalation RfD and the dose from other routes divided by the oral RfD.
- The systemic hazard index ($HI_{sys}$) will be determined for each systemic non-carcinogenic effect as the ratio of the pollutant dose to the pollutant RfD.
- The irritant hazard index ($HI_{irr}$) will be determined for each pollutant associated with eye, nose, throat or respiratory system irritation as the ratio of the maximum one hour pollutant concentration to the AAL for the pollutant.

## 6.0 ACCEPTABILITY CRITERIA

The results of the Health Risk Assessment conducted for the Project will be evaluated based on the following acceptability criteria:

- The maximum ground level ambient air impacts predicted by the modeling for each of the pollutants included in the assessment must be less than or equal to their corresponding Reg. 22 AALs and any CAALs developed by RIDEM.
- The total calculated dose of each pollutant with oral RfDs but not inhalation RfDs must be less than the corresponding oral RfD for that pollutant.
- The pollutant-specific HQ must be less than unity for each pollutant with both oral and inhalation RfDs.
- The incremental upperbound risk of exposure to each individual carcinogenic pollutant must be less than one in one thousand.
- The $HI_{sys}$ for each applicable effect and the $HI_{irr}$ are less than unity.

- The predicted increase in lead content in any residential area's soil cannot increase by more than 1 ppm.

## 7.0 HEALTH RISK ASSESMENT REPORT OUTLINE

The Health Risk Assessment Report for the facility will include the following:

- A description of the health risk assessment methodology used, including all modeling inputs, assumptions, and risk assessment health risk values used.
- Tables summarizing all assessment results and comparisons of all results with the applicable AALs, CAALs, and other health risk standards.
- Figures showing maps with isopleths of the predicted ambient air impacts from the Facility. A separate figure will be provided showing the highest modeled concentration for the five years modeled at each receptor for the 1-hour, 24-hour, and annual averaging periods. Each isopleth figure will identify the sensitive receptors located within the project impact area.
- Electronic versions and printouts of all AERMOD input and output files and all RAST risk characterization output files.

# Tables

**Table 1**
**Clear River Energy Center - Burrillville, Rhode Island**
**Facility Potential Emissions Summary[1]**

| Emission Source | Units | Gas Turbines/HRSGs/Duct Burners Steady State Operation | | Gas Turbines/HRSGs Startup/Shutdown | | Auxiliary Boiler | Dewpoint Heater | Emergency Generator | Fire Pump | ULSD Tank | Total | Major Source Threshold | Major Source? | Attainment Status | Offsets/Allowances Required |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fuel Type | | Natural Gas | ULSD | Natural Gas | ULSD | Natural Gas | Natural Gas | ULSD | ULSD | | | | | | |
| Emission Controls | | SCR/OC | SCR/OC | SCR/OC | SCR/OC | Ultra-Low NOx/FGR | Ultra-Low NOx/FGR | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Annual Operation (per unit) | hrs/yr | 7,898 | 720 | 131 | 11 | 4,576 | 8,760 | 300 | 300 | | | | | | |
| | | | | | | | | | | | | | | | |
| Maximum Heat Input Per Unit (per Gas Turbine) | MMBtu/hr | 3,393 | 3,507 | | | 140.6 | 15.0 | 19.5 | 2.1 | | | | | | |
| Maximum Heat Input Per Unit (per HRSG) | MMBtu/hr | 721 | 0 | | | | | | | | | | | | |
| Maximum Power Output (total) | MW net | 1,080 | 940 | | | | | | | | | | | | |
| Maximum Engine Output | Hp | | | | | | | 2,682 | 315 | | | | | | |
| | | | | | | | | | | | | | | | |
| Proposed Emissions | per unit | | | | | | | | | | | | | | |
| NOx | ppmvd@15%O2 | 2.0 | 5.0 | | | | | | | | | | | | |
| CO | ppmvd@15%O2 | 2.0 | 5.0 | | | | | | | | | | | | |
| VOC | ppmvd@15%O2 | 1.7 | 5.0 | | | | | | | | | | | | |
| CO2 | lb/MW-hr | 781 | 1,227 | | | | | | | | | | | | |
| SO2 | lb/MMBtu | 0.0017 | 0.0019 | | | | | | | | | | | | |
| PM/PM10/PM2.5 | lb/MMBtu | 0.0053 | 0.020 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| Full Load Average Emission Rates | per unit | | | | | | | | | | | | | | |
| NOx | lb/hr | 24.90 | 68.60 | | | 1.55 | 0.16 | 32.23 | 1.88 | | | | | | |
| CO | lb/hr | 15.10 | 41.75 | | | 10.55 | 1.65 | 1.77 | 0.47 | | | | | | |
| VOC | lb/hr | 7.36 | 23.85 | | | 1.12 | 0.12 | 0.65 | 0.07 | | | | | | |
| CO2 | lb/hr | 399,000 | 577,000 | | | 16,591 | 1,770 | 3,206 | 349 | | | | | | |
| SO2 | lb/hr | 5.75 | 6.49 | | | 0.21 | 0.02 | 0.03 | 0.00 | | | | | | |
| PM/PM10/PM2.5 | lb/hr | 18.00 | 69.1 | | | 0.98 | 0.11 | 0.15 | 0.05 | | | | | | |
| | | | | | | | | | | | | | | | |
| Potential Emissions | | | | | | | | | | | | | | | |
| NOx | ton/yr | 196.67 | 49.39 | 26.97 | 2.76 | 3.55 | 0.70 | 4.83 | 0.28 | 0.00 | 285.15 | 50 | Yes | Ozone Nonattainment | 342 |
| CO | ton/yr | 119.27 | 30.06 | 51.10 | 5.95 | 24.14 | 7.23 | 0.27 | 0.07 | 0.00 | 238.07 | 100 | Yes | Attainment | NA |
| VOC | ton/yr | 58.13 | 17.17 | 7.17 | 1.74 | 2.56 | 0.53 | 0.10 | 0.01 | 0.44 | 87.84 | 50 | Yes | Ozone Nonattainment | 105 |
| CO2 | ton/yr | 3,151,468 | 415,440 | 11,070 | 1,889 | 37,960 | 7,753 | 481 | 52 | 0 | 3,626,113 | 100,000 | Yes | No NAAQS | 3,579,867 |
| SO2 | ton/yr | 45.42 | 4.67 | 0.16 | 0.02 | 0.48 | 0.09 | 0.00 | 0.00 | 0.00 | 50.84 | 100 | No | Attainment | NA |
| PM/PM10/PM2.5 | ton/yr | 142.17 | 49.75 | 1.58 | 0.75 | 2.24 | 0.48 | 0.02 | 0.01 | 0.00 | 197.00 | 100 | Yes | Attainment | NA |

[1] Based on preliminary project equipment specifications and emissions estimates. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.

**Table 2**
**Clear River Energy Center - Burrillville, Rhode Island**
**Modeling Input Summary[1]**

| Emission Source | Units | Gas Turbines/HRSGs/Duct Burners | | | | Auxiliary Boiler | Dewpoint Heater | Emergency Generator | Fire Pump |
|---|---|---|---|---|---|---|---|---|---|
| | | GT/HRSG-1 | | GT/HRSG-2 | | | | | |
| Fuel Type | | Natural Gas | ULSD | Natural Gas | ULSD | Natural Gas | Natural Gas | ULSD | ULSD |
| | | | | | | | | | |
| Annual Operation (per unit) | hrs/yr | 8,040 | 720 | 8,040 | 720 | 4,576 | 8,760 | 300 | 300 |
| | | | | | | | | | |
| Stack Parameters | | | | | | | | | |
| Stack Location | UTM N (Z 19T) | 4649568.7 | | 4649527.1 | | 4649470.9 | 4649670.7 | 4649460.6 | 4649420.0 |
| Stack Location | UTM E (Z 19T) | 271841.7 | | 271869.9 | | 271874.6 | 271699.0 | 271848.3 | 271946.6 |
| Stack Base Elevation | ft AMSL | 570 | | 570 | | 570 | 570 | 570 | 570 |
| Stack Height | feet | 200.0 | | 200.0 | | 50 | 35 | 35 | 35 |
| Stack Diameter | inches | 264.0 | | 264.0 | | 48 | 20 | 8 | 6 |
| Stack Flow | acfm | see App. A | see App. A | see App. A | see App. A | 38,067 | 7,252 | 15,295 | 1,673 |
| Stack Exit Temperature | deg. F | see App. A | see App. A | see App. A | see App. A | 344 | 1,000 | 752 | 855 |
| | | | | | | | | | |
| Maximum Emission Rate | | | | | | | | | |
| NOx | lb/hr | see App. A | see App. A | see App. A | see App. A | 1.55 | 0.16 | 32.23 | 1.88 |
| CO | lb/hr | see App. A | see App. A | see App. A | see App. A | 10.55 | 1.65 | 1.77 | 0.47 |
| SO2 | lb/hr | see App. A | see App. A | see App. A | see App. A | 0.21 | 0.020 | 0.031 | 0.0033 |
| PM/PM10/PM2.5 | lb/hr | see App. A | see App. A | see App. A | see App. A | 0.98 | 0.11 | 0.15 | 0.054 |
| | | | | | | | | | |
| Maximum Emission Rate | | | | | | | | | |
| NOx | g/sec | see App. A | see App. A | see App. A | see App. A | 0.20 | 0.020 | 4.06 | 0.24 |
| CO | g/sec | see App. A | see App. A | see App. A | see App. A | 1.33 | 0.21 | 0.22 | 0.059 |
| SO2 | g/sec | see App. A | see App. A | see App. A | see App. A | 0.026 | 0.0025 | 0.0039 | 0.00042 |
| PM/PM10/PM2.5 | g/sec | see App. A | see App. A | see App. A | see App. A | 0.12 | 0.014 | 0.019 | 0.0068 |

[1] Based on preliminary project equipment specifications and emissions estimates. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.

**Table 3**
**Clear River Energy Center - Burrillville, Rhode Island**
**Health Risk Assessment Pollutant List**

| Emission Source(s): | GT/HRSGs | GT/HRSGs | HRSG Duct Burners | Auxiliary Boiler | Dewpoint Heater | Diesel Generator | Fire Pump | Total Facility Potential Emissions | RIDEM APCR No. 22 Minimum Quantity | RIDEM APCR No. 22 Applicability Determination |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of Sources: | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | |
| Fuel Fired: | Natural Gas | ULSD | Natural Gas | Natural Gas | Natural Gas | ULSD | ULSD | | | |
| Maximum Unit Heat Input (MMBtu/hr): | 3,393 | 3,507 | 721 | 140.6 | 15.0 | 19.5 | 2.1 | | | |
| Annual Operation (hrs/yr): | 8,040 | 720 | 8,040 | 4,576 | 8,760 | 300 | 300 | | | |
| Pollutant | lb/yr | lb/yr | lb/yr | lb/yr | lb/yr | lb/yr | lb/yr | lb/yr | lb/yr | Yes/No |
| Metals | | | | | | | | | | |
| Arsenic | 0.00 | 0.23 | 2.30 | 0.13 | 0.0026 | 0.00 | 0.00 | 2.7 | 0.02 | Yes |
| Barium | 0.00 | 0.00 | 50 | 2.78 | 0.57 | 0.00 | 0.00 | 53 | 2,000 | No |
| Beryllium | 0.00 | 1.6 | 0.14 | 0.0076 | 0.0016 | 0.00 | 0.00 | 1.7 | 0.04 | Yes |
| Cadmium | 0.00 | 0.026 | 13 | 0.69 | 0.14 | 0.00 | 0.00 | 14 | 0.07 | Yes |
| Chromium | 0.00 | 11 | 16 | 0.88 | 0.18 | 0.00 | 0.00 | 28 | 20,000 | No |
| Cobalt | 0.00 | 0.00 | 1.0 | 0.0053 | 0.0011 | 0.00 | 0.00 | 1.0 | 0.1 | Yes |
| Copper | 0.00 | 0.00 | 10 | 0.54 | 0.11 | 0.00 | 0.00 | 11 | 40 | No |
| Lead | 0.00 | 3.9 | 5.7 | 0.32 | 0.0064 | 0.00 | 0.00 | 10 | 0.9 | Yes |
| Manganese | 0.00 | 1.4 | 4.3 | 0.24 | 0.0049 | 0.00 | 0.00 | 5.9 | 0.2 | Yes |
| Mercury | 0.00 | 0.052 | 3.0 | 0.16 | 0.0034 | 0.00 | 0.00 | 3.2 | 0.7 | Yes |
| Molybdenum | 0.00 | 0.00 | 13 | 0.69 | 0.14 | 0.00 | 0.00 | 14 | 60 | No |
| Nickel | 0.00 | 7.5 | 24 | 1.3 | 0.27 | 0.00 | 0.00 | 33 | 0.4 | Yes |
| Selenium | 0.00 | 1.3 | 0.27 | 0.0015 | 0.0031 | 0.00 | 0.00 | 1.6 | 2,000 | No |
| Vanadium | 0.00 | 0.00 | 26 | 1.5 | 0.30 | 0.00 | 0.00 | 28 | 0.07 | Yes |
| Zinc | 0.00 | 0.00 | 330 | 18 | 3.7 | 0.00 | 0.00 | 352 | 3,000 | No |
| PAH/PBT | | | | | | | | | | |
| 2-Methylnaphthalene | 0.00 | 0.00 | 0.027 | 0.0015 | 0.0031 | 0.00 | 0.00 | 0.032 | NA | NA |
| 3-Methylchloranthrene | 0.00 | 0.00 | 0.0020 | 0.00011 | 0.00023 | 0.00 | 0.00 | 0.0023 | NA | NA |
| 7,12-Dimethylbenz(a)anthracene | 0.00 | 0.00 | 0.018 | 0.0010 | 0.0021 | 0.00 | 0.00 | 0.021 | NA | NA |
| Acenaphthene | 0.00 | 0.00 | 0.0020 | 0.0011 | 0.00023 | 0.0027 | 0.0090 | 0.015 | NA | NA |
| Acenaphthylene | 0.00 | 0.00 | 0.0020 | 0.0011 | 0.00023 | 0.0054 | 0.0032 | 0.012 | NA | NA |
| Anthracene | 0.00 | 0.00 | 0.0027 | 0.0015 | 0.00031 | 0.0072 | 0.0012 | 0.013 | NA | NA |
| Benz(a)anthracene | 0.00 | 0.00 | 0.0020 | 0.0011 | 0.00023 | 0.0036 | 0.0011 | 0.0080 | NA | NA |
| Benzo(a)pyrene | 0.00 | 0.00 | 0.0014 | 0.00076 | 0.00016 | 0.0015 | 0.00012 | 0.0039 | NA | NA |
| Benzo(b)fluoranthene | 0.00 | 0.00 | 0.0020 | 0.0011 | 0.00023 | 0.0065 | 0.000062 | 0.010 | NA | NA |
| Benzo(g,h,i)perylene | 0.00 | 0.00 | 0.0014 | 0.00076 | 0.00016 | 0.0033 | 0.00031 | 0.0059 | NA | NA |
| Benzo(k)fluoranthene | 0.00 | 0.00 | 0.0020 | 0.0011 | 0.00023 | 0.0013 | 0.00010 | 0.0047 | NA | NA |
| Chrysene | 0.00 | 0.00 | 0.0020 | 0.0011 | 0.00023 | 0.0089 | 0.00022 | 0.012 | NA | NA |
| Dibenzo(a,h)anthracene | 0.00 | 0.00 | 0.0014 | 0.00076 | 0.00016 | 0.0020 | 0.00037 | 0.0047 | NA | NA |
| Fluoranthene | 0.00 | 0.00 | 0.0034 | 0.0019 | 0.00039 | 0.0024 | 0.0048 | 0.013 | NA | NA |
| Fluorene | 0.00 | 0.00 | 3.2 | 1.8 | 0.37 | 0.0075 | 0.0018 | 5.4 | NA | NA |
| Indeno(1,2,3-cd)pyrene | 0.00 | 0.00 | 2.1 | 1.2 | 0.24 | 0.0024 | 0.00024 | 3.5 | NA | NA |
| Naphthalene | 7.1 | 18 | 0.69 | 0.39 | 0.0079 | 0.76 | 0.0053 | 27 | 3 | Yes |
| Phenanthrene | 0.00 | 0.00 | 0.019 | 0.0011 | 0.0022 | 0.24 | 0.0019 | 0.26 | NA | NA |
| Pyrene | 0.00 | 0.00 | 0.0057 | 0.0032 | 0.00064 | 0.0022 | 0.0030 | 0.015 | NA | NA |

**Table 4**
**Clear River Energy Center - Burrillville, Rhode Island**
**Sensitive Receptor List**

| X_RISP | Y_RISP | ID | Category | NAME | Dist_Ft | Dist_Mi |
|---|---|---|---|---|---|---|
| 260408.63 | 323441.83 | 1 | Neighborhood | Wallum Lake Road | 1,928 | 0.37 |
| 262211.18 | 320528.85 | 2 | Neighborhood | Jackson Schoolhouse Road | 2,228 | 0.42 |
| 254499.87 | 321780.92 | 3 | Neighborhood | Wilson Trail | 2,996 | 0.57 |
| 262492.85 | 322623.86 | 4 | Neighborhood | Wallum Lake Road | 3,147 | 0.60 |
| 263559.49 | 323157.02 | 5 | Neighborhood | Manley Drive | 4,329 | 0.82 |
| 264435.30 | 321755.00 | 6 | Neighborhood | Wallum Lake Road | 4,567 | 0.86 |
| 262384.23 | 314746.00 | 7 | Neighborhood | Jackson Schoolhouse Road | 6,217 | 1.18 |
| 263972.41 | 326000.01 | 8 | Neighborhood | E Wallum Lake Road | 6,289 | 1.19 |
| 257636.76 | 329074.91 | 9 | Neighborhood | Wallum Lake Road | 7,189 | 1.36 |
| 251762.08 | 325901.62 | 10 | Park and Recreation Area | Buck Hill State Management Area | 7,425 | 1.41 |
| 267358.51 | 323163.99 | 11 | Boat Ramp | Wilson Reservoir | 7,767 | 1.47 |
| 249615.59 | 321835.78 | 12 | Boat Ramp | Wakefield Pond | 7,834 | 1.48 |
| 249625.00 | 323250.16 | 13 | Neighborhood | Lee Circle | 8,084 | 1.53 |
| 269674.61 | 321336.19 | 14 | Shore Fishing Access | White Mill Park | 9,705 | 1.84 |
| 267201.98 | 328337.99 | 15 | Neighborhood | Town Farm Road | 10,272 | 1.95 |
| 257679.51 | 333138.93 | 16 | Fire Station | Wallum Lake Fire Department | 11,194 | 2.12 |
| 257086.78 | 333148.09 | 17 | Hospital | Eleanor Slater Hospital Zambarano Unit | 11,293 | 2.14 |
| 271325.22 | 319544.92 | 18 | Place of Worship | Pascoag Community Baptist Church | 11,395 | 2.16 |
| 265418.70 | 331541.61 | 19 | Neighborhood | Town Farm Road | 11,420 | 2.16 |
| 255460.47 | 308973.48 | 20 | Park and Recreation Area | Casimir Pulaski Memorial Recreation Area | 11,628 | 2.20 |
| 262593.92 | 333091.80 | 21 | Neighborhood | East Wallum Lake Road | 11,599 | 2.20 |
| 269637.39 | 314272.60 | 22 | Neighborhood | James Street | 11,596 | 2.20 |
| 271049.52 | 315838.66 | 23 | Neighborhood | Highland Drive | 12,083 | 2.29 |
| 271926.73 | 318328.78 | 24 | Library | Pascoag Public Library | 12,171 | 2.31 |
| 271926.25 | 318126.31 | 25 | Place of Worship | Calvary Episcopal Church | 12,212 | 2.31 |
| 272306.21 | 319036.43 | 26 | School | Community Christian School | 12,429 | 2.35 |
| 272382.74 | 319441.14 | 27 | School | Father Holland Catholic Regional Elementary School | 12,457 | 2.36 |
| 256924.41 | 334417.04 | 28 | Small Boat Launch | Wallum Lake | 12,571 | 2.38 |
| 262124.98 | 307960.43 | 29 | Neighborhood | Olney Keach Road | 12,612 | 2.39 |
| 247321.67 | 328716.26 | 30 | Neighborhood | Buck Hill Road | 12,652 | 2.40 |
| 272592.61 | 316528.51 | 31 | Boat Ramp | Union Pond | 13,277 | 2.51 |
| 272906.62 | 317314.18 | 32 | Place of Worship | New Hope Baptist Church | 13,355 | 2.53 |
| 273247.45 | 318192.62 | 33 | Fire Station | Pascoag Fire Department | 13,494 | 2.56 |
| 244502.61 | 325583.44 | 34 | Neighborhood | Quaddick Town Farm Road | 13,672 | 2.59 |
| 273299.19 | 324059.98 | 35 | Neighborhood | Grove Lane | 13,725 | 2.60 |
| 257885.52 | 306290.41 | 36 | Boat Ramp | Bowdish Reservoir | 14,063 | 2.66 |
| 271697.09 | 328487.90 | 37 | Neighborhood | Hill Road | 14,057 | 2.66 |
| 243177.67 | 317879.93 | 38 | Park and Recreation Area | Quaddick State Park | 14,593 | 2.76 |
| 258457.16 | 336889.26 | 39 | School | Pine Harbor School | 14,869 | 2.82 |
| 258457.16 | 336889.26 | 40 | School | Pine Harbor School | 14,869 | 2.82 |
| 247432.06 | 309694.22 | 41 | Shore Fishing Access | Peck Pond | 14,905 | 2.82 |
| 241156.76 | 315225.40 | 42 | Neighborhood | Quaddick Town Farm Road | 14,978 | 2.84 |
| 252143.93 | 306270.88 | 43 | Neighborhood | South Atlantic Avenue | 15,195 | 2.88 |
| 245082.68 | 330060.99 | 44 | Neighborhood | Quaddick Town Farm Road | 15,251 | 2.89 |
| 255276.18 | 337137.49 | 45 | Reservoir | Wallum Lake Reservoir | 15,578 | 2.95 |
| 268806.19 | 307620.68 | 46 | Boat Ramp | Pascoag Reservoir Fishing Access | 15,665 | 2.97 |
| 249761.66 | 306643.05 | 47 | Boat Ramp | Clarkville Pond | 15,918 | 3.01 |
| 268974.42 | 307004.44 | 48 | Neighborhood | Jackson Schoolhouse Road | 16,264 | 3.08 |
| 257766.41 | 303986.54 | 49 | Boat Ramp | Lake Washington | 16,367 | 3.10 |
| 244947.00 | 332931.00 | 50 | Neighborhood | Quaddick Town Farm Road | 17,196 | 3.26 |
| 266913.78 | 304746.67 | 51 | Neighborhood | Sprague Hill Road | 17,192 | 3.26 |
| 240916.55 | 315347.52 | 52 | Neighborhood | Brandy Hill Road | 17,467 | 3.31 |
| 262070.42 | 302946.04 | 53 | Shore Fishing Access | Burlingame Reservoir | 17,548 | 3.32 |
| 256636.35 | 339479.09 | 54 | Neighborhood | Shore Road | 17,617 | 3.34 |
| 277442.17 | 316668.97 | 55 | Neighborhood | Mowry Street | 17,913 | 3.39 |
| 245515.42 | 334586.52 | 56 | Neighborhood | Starr Road | 17,995 | 3.41 |
| 278316.52 | 322772.82 | 57 | School | William L Callahan School | 18,443 | 3.49 |
| 278358.50 | 322666.83 | 58 | School | Burrillville High School | 18,473 | 3.50 |
| 240903.44 | 311841.31 | 59 | Neighborhood | Quaddick Town Farm Road | 18,923 | 3.58 |
| 252414.15 | 302143.99 | 60 | School | West Glocester Elementary School | 19,004 | 3.60 |
| 273441.55 | 334790.26 | 61 | Shore Fishing Access | Big Round Top | 19,200 | 3.64 |
| 246750.43 | 337100.70 | 62 | Survey Point | MA/CT/RI Tri-state Marker | 19,239 | 3.64 |
| 239381.14 | 328379.88 | 63 | Golf Course | Raceway Golf Club | 19,452 | 3.68 |
| 279376.90 | 322661.25 | 64 | Fire Station | Harrisville Fire Department | 19,485 | 3.69 |
| 279565.74 | 321955.73 | 65 | Place of Worship | Berean Baptist Church | 19,615 | 3.72 |
| 279566.37 | 322259.39 | 66 | School | Austin T Levy School | 19,638 | 3.72 |
| 279461.83 | 323446.34 | 67 | Small Boat Launch | Harrisville | 19,664 | 3.72 |
| 279647.18 | 321858.99 | 68 | School | Harrisville Preschool | 19,691 | 3.73 |
| 279641.92 | 322259.23 | 69 | Place of Worship | First Universalist Church of Burrillville | 19,713 | 3.73 |
| 269201.79 | 338912.26 | 70 | Neighborhood | South Street | 19,675 | 3.73 |
| 274623.88 | 334806.59 | 71 | Shore Fishing Access | Little Round Top | 20,109 | 3.81 |
| 280108.77 | 321493.62 | 72 | Library | Jesse M Smith Memorial Library | 20,134 | 3.81 |
| 278371.43 | 311512.21 | 73 | Neighborhood | South Main Street | 20,553 | 3.89 |
| 280605.78 | 321633.39 | 74 | Small Boat Launch | Mill Pond | 20,637 | 3.91 |
| 278276.86 | 330425.22 | 75 | Neighborhood | Sherman Farm Road | 20,709 | 3.92 |
| 243893.99 | 337158.87 | 76 | Neighborhood | East Thompson Road | 21,002 | 3.98 |
| 241819.51 | 335307.41 | 77 | Fire Station | East Thompson Volunteer Fire Department | 21,105 | 4.00 |
| 269338.09 | 340503.35 | 78 | Cemetery | South Douglas Cemetery | 21,121 | 4.00 |
| 236434.80 | 323603.64 | 79 | Cemetery | Dike Cemetery | 21,130 | 4.00 |
| 239777.40 | 308609.40 | 80 | Cemetery | Munyan Cemetery | 21,553 | 4.08 |
| 280523.84 | 311653.72 | 81 | School | Steere Farm Elementary School | 22,441 | 4.25 |
| 276083.55 | 304868.49 | 82 | Neighborhood | Putnam Pike | 22,566 | 4.27 |
| 282130.68 | 327896.98 | 83 | Beach | YWCA Beach | 23,279 | 4.41 |
| 283186.99 | 326403.94 | 84 | Boat Ramp | Spring Lake | 23,886 | 4.52 |
| 246568.00 | 299250.00 | 85 | Neighborhood | Blood Road | 23,930 | 4.53 |
| 264093.18 | 345491.90 | 86 | Neighborhood | Walnut Street | 23,985 | 4.54 |
| 239692.27 | 304294.47 | 87 | Fire Station | East Putnam Fire Department | 24,240 | 4.59 |
| 284159.64 | 314404.21 | 88 | Golf Course | Crystal Lake Golf Club | 24,978 | 4.73 |
| 284375.71 | 327183.15 | 89 | Beach | Flynns Beach | 25,231 | 4.78 |
| 248752.41 | 296565.55 | 90 | Shore Fishing Access | Mowry Pond | 25,468 | 4.82 |
| 245390.98 | 343556.73 | 91 | Neighborhood | High Street | 25,478 | 4.83 |
| 238912.59 | 339385.27 | 92 | Cemetery | Carpenter Cemetery | 26,022 | 4.93 |
| 284750.73 | 329709.64 | 93 | Beach | Spring Lake Beach | 26,347 | 4.99 |

# Figures

Path: K:\I108-000 Invenergy\00-mxd\I108 Figure 1 - Aerial Photo.mxd

Drawing Date: 2015/06/22




**Clear River Energy Center**

Burrillville, Rhode Island

1 inch = 1,667 feet

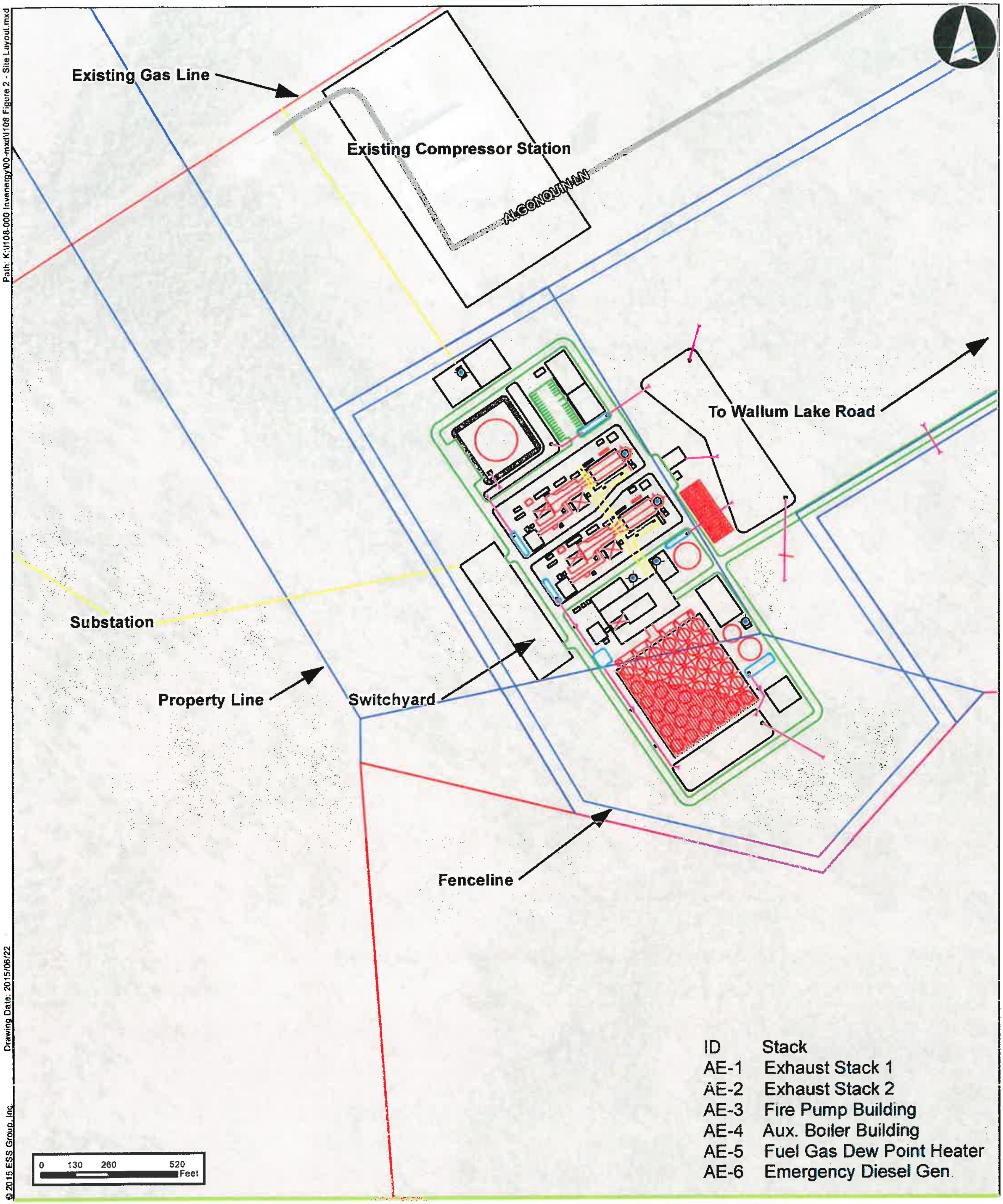
Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014
3) RIGIS, Roads, 2013

**Legend**

Project Area Boundary

**Aerial Photo**

**Figure 1**




Path: K:\I108-000 Invenergy\00-mxd\I108 Figure 2 - Site Layout.mxd

Drawing Date: 2015/06/22



ESS group

**Clear River Energy Center**

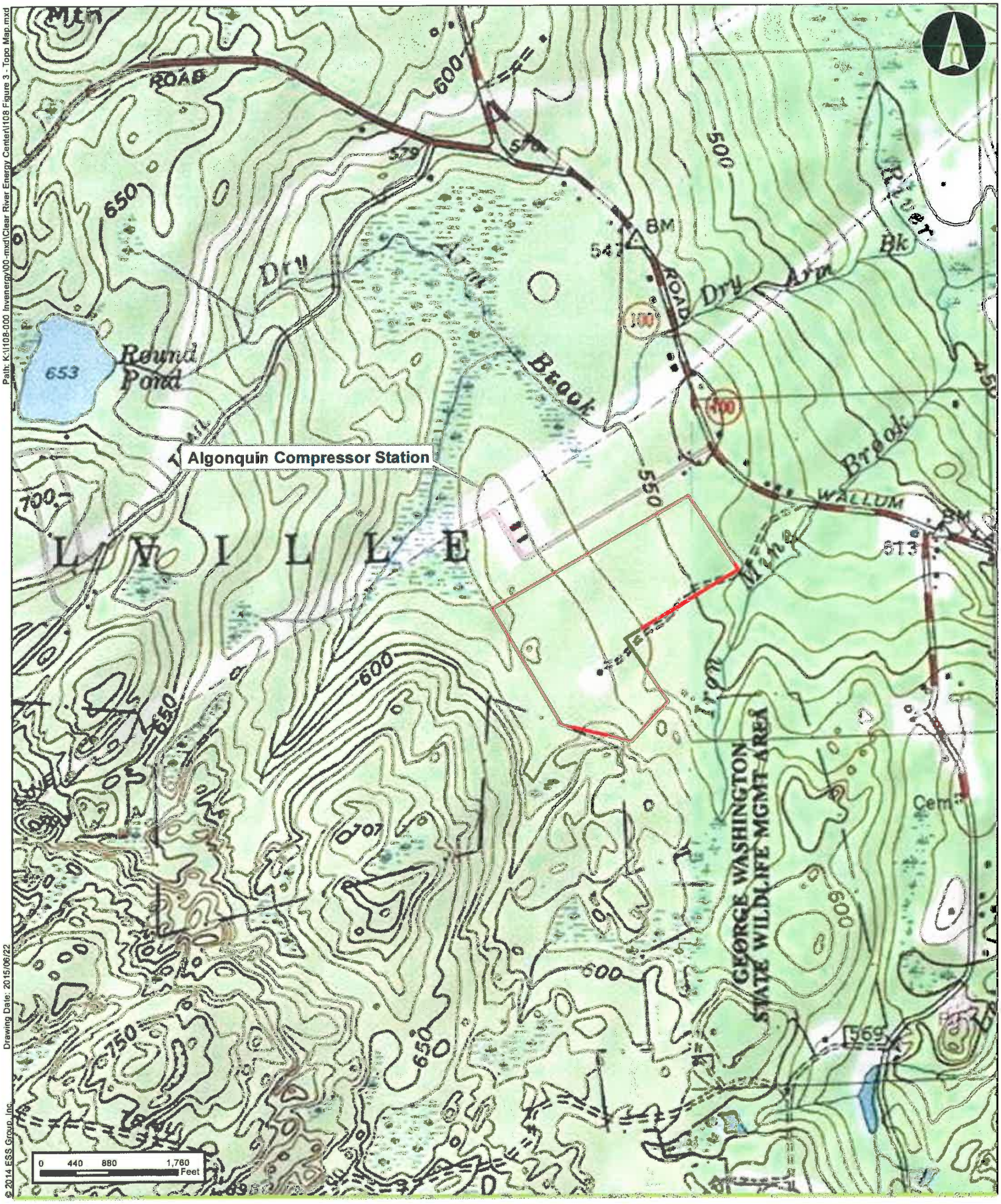
Burrillville, Rhode Island

1 inch = 501 feet

Source: 1) HDR, Site Layout 2/09/15
2) ESS, Site Location, 2014
3) RIGIS, Roads, 2013

**Site Layout**

**Figure 2**




**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 1,667 feet

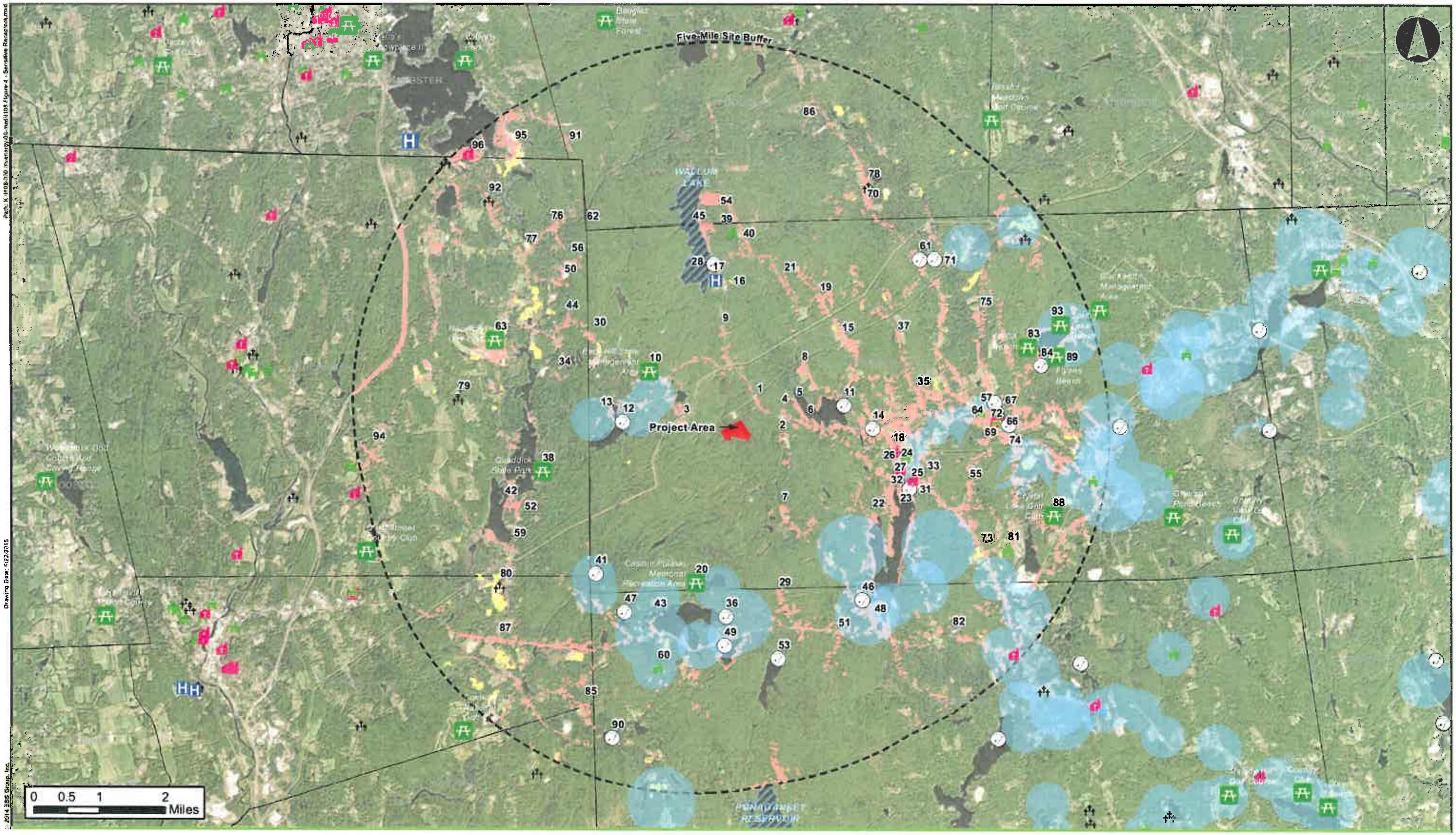
Source: 1) USGS, Topo Map, 2013
2) ESS, Site Location, 2014

**Topographic Map**

**Legend**

Project Area

**Figure 3**




Legend

- Recreational Areas
- Fishing Area
- Cemetery
- Hospital
- Daycare
- Place of Worship
- School
- Drinking Water Reservoir
- Wellhead Protection Area
- Farmland
- Residential Areas

**Clear River Energy Center**
Burrillville, Rhode Island

1 inch = 7,200 feet

Source: 1) ESS, Site Location, 2014; 2) ESRI, Imagery, 2014; 3) OpenStreetMap, Nodes, 2014

**Sensitive Receptors**

**Figure 4**

Drawing Date: 5/22/2015

# Appendix A

# Emissions Data Summaries

**Table A-1**
**Clear River Energy Center - Burrillville, Rhode Island**
**CT/HRSG Emission Summaries[1]**

| Modeling Case No. | Units | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GE Case No. | | 1 | 4 | 5 | 6 | 7 | 15 | 17 | 18 | 19 | 25 | 27 | 23 | 29 |
| Fuel Fired | | 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 |
| Gas Turbine Load | % of Base | 100 | 100 | 100 | 75 | 38 | 100 | 100 | 75 | 30 | 100 | 100 | 75 | 35 |
| Ambient Temperature | deg. F | 90 | 90 | 90 | 90 | 90 | 59 | 59 | 59 | 59 | 10 | 10 | 10 | 10 |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| Ambient Relative Humidity | % | 50 | 50 | 50 | 50 | 50 | 60 | 60 | 60 | 60 | 61 | 61 | 61 | 61 |
| Duct Burner Firing | % of capacity | 31 | 0 | 0 | 0 | 0 | 34 | 0 | 0 | 0 | 37 | 0 | 0 | 0 |
| Evaporative Cooler Status | On/Off | On | On | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off |
| Stack Gas Molecular Weight | lb/lb-mole | 28.11 | 28.14 | 28.20 | 28.22 | 28.27 | 28.29 | 28.33 | 28.35 | 28.42 | 28.38 | 28.42 | 28.43 | 28.49 |
| Stack Flow | lb/hr | 5,757,500 | 5,747,700 | 5,565,000 | 4,645,200 | 3,340,100 | 5,692,300 | 5,681,600 | 4,704,000 | 3,124,800 | 6,066,200 | 6,054,300 | 4,855,200 | 3,444,000 |
| Stack Flow | acfm | 1,636,360 | 1,623,680 | 1,568,723 | 1,308,512 | 939,213 | 1,599,503 | 1,594,243 | 1,318,999 | 874,034 | 1,699,161 | 1,693,441 | 1,359,686 | 960,950 |
| Stack Exit Temperature | deg. F | 184 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 181 | 180 |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | lb/hr | 24.8 | 23.1 | 22.1 | 17.5 | 11.4 | 24.9 | 23.0 | 18.2 | 10.5 | 26.6 | 24.5 | 19.5 | 12.3 |
| CO | lb/hr | 15.1 | 14.1 | 13.4 | 10.6 | 6.95 | 15.1 | 14.0 | 11.1 | 6.40 | 16.2 | 14.9 | 11.9 | 7.46 |
| SO2 | lb/hr | 5.74 | 5.35 | 5.10 | 4.04 | 2.64 | 5.75 | 5.33 | 4.21 | 2.44 | 6.14 | 5.68 | 4.50 | 2.83 |
| PM/PM10/PM2.5 | lb/hr | 17.9 | 12.0 | 11.9 | 11.3 | 10.6 | 18.0 | 12.0 | 11.4 | 10.5 | 18.1 | 12.1 | 11.5 | 10.7 |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | g/sec | 3.12 | 2.91 | 2.78 | 2.21 | 1.44 | 3.14 | 2.90 | 2.29 | 1.32 | 3.35 | 3.09 | 2.46 | 1.55 |
| CO | g/sec | 1.90 | 1.78 | 1.69 | 1.34 | 0.88 | 1.90 | 1.76 | 1.40 | 0.81 | 2.04 | 1.88 | 1.50 | 0.94 |
| SO2 | g/sec | 0.72 | 0.67 | 0.64 | 0.51 | 0.33 | 0.72 | 0.67 | 0.53 | 0.31 | 0.77 | 0.72 | 0.57 | 0.36 |
| PM/PM10/PM2.5 | g/sec | 2.26 | 1.51 | 1.50 | 1.42 | 1.34 | 2.27 | 1.51 | 1.44 | 1.32 | 2.28 | 1.52 | 1.45 | 1.35 |

| Modeling Case No. | Units | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|
| GE Case No. | | 36 | 37 | 42 | 43 | 48 | 49 | 51 | 52 |
| Fuel Fired | | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD |
| Gas Turbine Load | % of Base | 100 | 50 | 100 | 50 | 100 | 50 | 100 | 50 |
| Ambient Temperature | deg. F | 90 | 90 | 59 | 59 | 10 | 10 | 0 | 0 |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| Ambient Relative Humidity | % | 50 | 50 | 60 | 60 | 61 | 61 | 52 | 52 |
| Duct Burner Firing | % of capacity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Evaporative Cooler Status | On/Off | Off | Off | Off | Off | Off | Off | Off | Off |
| Stack Gas Molecular Weight | lb/lb-mole | 27.99 | 28.14 | 28.11 | 28.23 | 28.20 | 28.32 | 28.21 | 28.38 |
| Stack Flow | lb/hr | 5,865,300 | 3,587,900 | 6,002,900 | 3,684,500 | 6,181,400 | 3,921,800 | 6,188,700 | 4,037,300 |
| Stack Flow | acfm | 1,978,114 | 1,149,749 | 2,015,878 | 1,155,866 | 2,028,357 | 1,228,120 | 2,051,831 | 1,380,003 |
| Stack Exit Temperature | deg. F | 300 | 266 | 300 | 253 | 285 | 254 | 293 | 321 |
| Emission Rate | | | | | | | | | |
| NOx | lb/hr | 63.3 | 38.3 | 65.6 | 40.2 | 68.6 | 42.5 | 68.8 | 42.1 |
| CO | lb/hr | 38.5 | 23.3 | 40.0 | 24.5 | 41.8 | 25.8 | 41.8 | 25.8 |
| SO2 | lb/hr | 5.99 | 3.62 | 6.22 | 3.80 | 6.49 | 4.02 | 6.50 | 3.98 |
| PM/PM10/PM2.5 | lb/hr | 68.8 | 67.6 | 68.9 | 67.7 | 69.0 | 67.8 | 69.1 | 67.8 |
| Emission Rate | | | | | | | | | |
| NOx | g/sec | 7.98 | 4.83 | 8.27 | 5.07 | 8.64 | 5.36 | 8.67 | 5.30 |
| CO | g/sec | 4.85 | 2.94 | 5.04 | 3.08 | 5.26 | 3.24 | 5.26 | 3.24 |
| SO2 | g/sec | 0.75 | 0.46 | 0.78 | 0.48 | 0.82 | 0.51 | 0.82 | 0.50 |
| PM/PM10/PM2.5 | g/sec | 8.67 | 8.52 | 8.68 | 8.53 | 8.69 | 8.54 | 8.71 | 8.54 |

[1] Based on preliminary project equipment specifications and emissions estimates provided by GE. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.

**Table A-1**
**Clear River Energy Center - Burrillville, Rhode Island**
**CT/HRSG Emission Summaries[1]**

| Modeling Case No. | Units | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MHI Case # | | 1 | 4 | 5 | 6 | 7 | 23 | 25 | 26 | 27 | 41 | 43 | 44 | 45 |
| | | | | | | | | | | | | | | |
| Fuel Fired | | 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 |
| Gas Turbine Load | % of Base | 100 | 100 | 100 | 75 | 50 | 100 | 100 | 75 | 50 | 100 | 100 | 75 | 50 |
| GTs Operating[2] | | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | |
| Ambient Temperature | deg. F | 90 | 90 | 90 | 90 | 90 | 59 | 59 | 59 | 59 | 10 | 10 | 10 | 10 |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| Ambient Relative Humidity | % | 50 | 50 | 50 | 50 | 50 | 60 | 60 | 60 | 60 | 61 | 61 | 61 | 61 |
| | | | | | | | | | | | | | | |
| Duct Burner Firing | % of capacity | 31 | 0 | 0 | 0 | 0 | 34 | 0 | 0 | 0 | 37 | 0 | 0 | 0 |
| Evaporative Cooler Status | On/Off | On | On | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off |
| | | | | | | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 28.11 | 28.14 | 28.20 | 28.22 | 28.27 | 28.29 | 28.33 | 28.35 | 28.42 | 28.38 | 28.42 | 28.43 | 28.49 |
| Stack Flow | lb/hr | 4,507,000 | 4,480,000 | 4,378,000 | 3,646,000 | 2,935,000 | 4,698,000 | 4,671,000 | 3,877,000 | 2,977,000 | 5,041,000 | 5,024,000 | 4,237,000 | 3,202,000 |
| Stack Flow | acfm | 1,278,533 | 1,263,587 | 1,228,334 | 1,015,813 | 804,669 | 1,291,233 | 1,312,719 | 1,082,013 | 811,876 | 1,396,556 | 1,418,432 | 1,192,114 | 873,884 |
| Stack Exit Temperature | deg. F | 182 | 179 | 177 | 173 | 164 | 166 | 181 | 177 | 164 | 173 | 186 | 184 | 166 |
| | | | | | | | | | | | | | | |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | lb/hr | 26.1 | 21.0 | 20.3 | 16.2 | 12.7 | 26.9 | 21.8 | 17.4 | 13.3 | 27.3 | 24.0 | 19.3 | 14.9 |
| CO | lb/hr | 15.9 | 12.8 | 12.3 | 9.9 | 7.70 | 16.4 | 13.3 | 10.6 | 8.10 | 16.6 | 14.6 | 11.8 | 9.10 |
| SO2 | lb/hr | 2.30 | 1.80 | 1.80 | 1.40 | 1.10 | 2.30 | 1.90 | 1.50 | 1.20 | 2.40 | 2.10 | 1.70 | 1.30 |
| PM10 | lb/hr | 14.9 | 7.3 | 7.2 | 5.9 | 4.8 | 15.2 | 7.7 | 6.4 | 4.9 | 13.3 | 8.4 | 7.0 | 5.4 |
| | | | | | | | | | | | | | | |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | g/sec | 3.29 | 2.65 | 2.56 | 2.04 | 1.60 | 3.39 | 2.75 | 2.19 | 1.68 | 3.44 | 3.02 | 2.43 | 1.88 |
| CO | g/sec | 2.00 | 1.61 | 1.55 | 1.25 | 0.97 | 2.07 | 1.68 | 1.34 | 1.02 | 2.09 | 1.84 | 1.49 | 1.15 |
| SO2 | g/sec | 0.29 | 0.23 | 0.23 | 0.18 | 0.14 | 0.29 | 0.24 | 0.19 | 0.15 | 0.30 | 0.26 | 0.21 | 0.16 |
| PM/PM10/PM2.5 | g/sec | 1.88 | 0.92 | 0.91 | 0.74 | 0.60 | 1.92 | 0.97 | 0.81 | 0.62 | 1.68 | 1.06 | 0.88 | 0.68 |

| Modeling Case No. | Units | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|
| MHI Case # | | 10 | 11 | 30 | 31 | 48 | 49 | 57 | 58 |
| | | | | | | | | | |
| Fuel Fired | | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD |
| Gas Turbine Load | % of Base | 100 | 60 | 100 | 60 | 100 | 60 | 100 | 60 |
| GTs Operating[2] | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | |
| Ambient Temperature | deg. F | 90 | 90 | 59 | 59 | 10 | 10 | 0 | 0 |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| Ambient Relative Humidity | % | 50 | 50 | 60 | 60 | 61 | 61 | 52 | 52 |
| | | | | | | | | | |
| Duct Burner Firing | % of capacity | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Evaporative Cooler Status | On/Off | Off | Off | Off | Off | Off | Off | Off | Off |
| | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 27.99 | 28.14 | 28.11 | 28.23 | 28.20 | 28.32 | 28.21 | 28.38 |
| Stack Flow | lb/hr | 4,452,000 | 3,009,000 | 4,751,000 | 3,225,000 | 4,601,000 | 3,618,000 | 4,565,000 | 3,683,000 |
| Stack Flow | acfm | 1,294,029 | 836,737 | 1,387,637 | 901,038 | 1,337,511 | 1,020,321 | 1,326,575 | 1,038,067 |
| Stack Exit Temperature | deg. F | 195 | 170 | 201 | 175 | 200 | 183 | 200 | 184 |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | lb/hr | 45.2 | 32.5 | 49.0 | 35.1 | 49.0 | 39.5 | 49.0 | 40.4 |
| CO | lb/hr | 27.5 | 19.80 | 29.8 | 21.40 | 29.8 | 24.0 | 29.8 | 24.6 |
| SO2 | lb/hr | 3.50 | 2.60 | 3.80 | 2.80 | 3.80 | 3.10 | 3.80 | 3.20 |
| PM/PM10/PM2.5 | lb/hr | 29.1 | 20.1 | 31.3 | 21.7 | 30.6 | 24.5 | 30.4 | 24.9 |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | g/sec | 5.70 | 4.10 | 6.17 | 4.42 | 6.17 | 4.98 | 6.17 | 5.09 |
| CO | g/sec | 3.47 | 2.49 | 3.75 | 2.70 | 3.75 | 3.02 | 3.75 | 3.10 |
| SO2 | g/sec | 0.44 | 0.33 | 0.48 | 0.35 | 0.48 | 0.39 | 0.48 | 0.40 |
| PM/PM10/PM2.5 | g/sec | 3.67 | 2.53 | 3.94 | 2.73 | 3.86 | 3.09 | 3.83 | 3.14 |

[1] Based on preliminary project equipment specifications and emissions estimates provided by MHI. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.
[2] All emission rates and stack flow characteristics are on a per stack basis

**Table A-1**
**Clear River Energy Center - Burrillville, Rhode Island**
**CT/HRSG Emission Summaries[1]**

| Modeling Case No. | Units | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Siemens Case # | | 1 | 2 | 3 | 4 | 5 | 8 | 9 | 10 | 11 | 14 | 15 | 16 | 17 |
| | | | | | | | | | | | | | | |
| Fuel Fired | | 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 |
| Gas Turbine Load | % of Base | 100 | 100 | 100 | 75 | 45 | 100 | 100 | 75 | 45 | 100 | 100 | 75 | 45 |
| GTs Operating[2] | | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| | | | | | | | | | | | | | | |
| Ambient Temperature | deg. F | 90 | 90 | 90 | 90 | 90 | 59 | 59 | 59 | 59 | 10 | 10 | 10 | 10 |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 |
| Ambient Relative Humidity | % | 50 | 50 | 50 | 50 | 50 | 60 | 60 | 60 | 60 | 61 | 61 | 61 | 61 |
| | | | | | | | | | | | | | | |
| Duct Burner Status | On/Off | On | Off | Off | Off | Off | On | Off | Off | Off | On | Off | Off | Off |
| Evaporative Cooler Status | On/Off | On | On | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off | Off |
| | | | | | | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 28.09 | 28.15 | 28.21 | 28.23 | 28.27 | 28.28 | 28.34 | 28.36 | 28.40 | 28.37 | 28.42 | 28.43 | 28.47 |
| Stack Flow | lb/hr | 4,800,209 | 4,786,910 | 4,638,446 | 3,809,426 | 2,996,880 | 5,008,709 | 4,996,248 | 4,047,282 | 3,151,583 | 5,256,687 | 5,245,299 | 4,188,222 | 3,261,498 |
| Stack Flow | acfm | 1,398,763 | 1,377,130 | 1,327,496 | 1,077,730 | 836,118 | 1,432,114 | 1,412,389 | 1,127,365 | 865,606 | 1,505,154 | 1,483,204 | 1,187,411 | 903,553 |
| Stack Exit Temperature | deg. F | 199 | 192 | 190 | 183 | 175 | 191 | 185 | 176 | 168 | 194 | 187 | 178 | 175 |
| | | | | | | | | | | | | | | |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | lb/hr | 22.0 | 19.6 | 18.6 | 14.8 | 10.6 | 22.8 | 20.5 | 16.2 | 11.5 | 24.2 | 22.2 | 17.5 | 12.4 |
| CO | lb/hr | 13.4 | 12.0 | 11.3 | 9.0 | 6.5 | 13.9 | 12.5 | 9.9 | 7.0 | 14.7 | 13.5 | 10.7 | 7.6 |
| SO2 | lb/hr | 4.47 | 3.99 | 3.78 | 3.03 | 2.21 | 4.63 | 4.18 | 3.33 | 2.40 | 4.92 | 4.51 | 3.59 | 2.58 |
| PM10 | lb/hr | 15.1 | 11.7 | 11.3 | 9.3 | 8.0 | 15.6 | 12.3 | 10.0 | 8.0 | 16.0 | 13.0 | 10.4 | 8.1 |
| | | | | | | | | | | | | | | |
| Emission Rate | | | | | | | | | | | | | | |
| NOx | g/sec | 2.77 | 2.47 | 2.34 | 1.86 | 1.34 | 2.87 | 2.58 | 2.04 | 1.45 | 3.05 | 2.80 | 2.21 | 1.56 |
| CO | g/sec | 1.69 | 1.51 | 1.42 | 1.13 | 0.82 | 1.75 | 1.58 | 1.25 | 0.88 | 1.85 | 1.70 | 1.35 | 0.96 |
| SO2 | g/sec | 0.56 | 0.50 | 0.48 | 0.38 | 0.28 | 0.58 | 0.53 | 0.42 | 0.30 | 0.62 | 0.57 | 0.45 | 0.33 |
| PM/PM10/PM2.5 | g/sec | 1.90 | 1.47 | 1.42 | 1.17 | 1.01 | 1.97 | 1.55 | 1.26 | 1.01 | 2.02 | 1.64 | 1.31 | 1.02 |

| Modeling Case No. | Units | 14 | 15 | 16 | 17 | 18 | 19 | | |
|---|---|---|---|---|---|---|---|---|---|
| Siemens Case # | | 6 | 7 | 12 | 13 | 18 | 19 | | |
| | | | | | | | | | |
| Fuel Fired | | ULSD | ULSD | ULSD | ULSD | ULSD | ULSD | | |
| Gas Turbine Load | % of Base | 100 | 60 | 100 | 60 | 100 | 60 | | |
| GTs Operating[2] | | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | | | | | | | | | |
| Ambient Temperature | deg. F | 90 | 90 | 59 | 59 | 10 | 10 | | |
| Ambient Pressure | psia | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | 14.4 | | |
| Ambient Relative Humidity | % | 50 | 50 | 60 | 60 | 61 | 61 | | |
| | | | | | | | | | |
| Duct Burner Status | On/Off | Off | Off | Off | Off | Off | Off | | |
| Evaporative Cooler Status | On/Off | Off | Off | Off | Off | Off | Off | | |
| | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 28.47 | 28.57 | 28.67 | 28.71 | 28.83 | 28.87 | | |
| Stack Flow | lb/hr | 4,721,117 | 3,527,096 | 5,061,768 | 3,751,624 | 5,350,344 | 3,958,503 | | |
| Stack Flow | acfm | 1,435,623 | 1,053,450 | 1,539,437 | 1,119,916 | 1,627,392 | 1,178,530 | | |
| Stack Exit Temperature | deg. F | 237 | 227 | 242 | 230 | 246 | 232 | | |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | lb/hr | 52.4 | 35.9 | 54.9 | 38.0 | 55.1 | 38.9 | | |
| CO | lb/hr | 21.3 | 14.6 | 22.3 | 15.4 | 22.4 | 15.8 | | |
| SO2 | lb/hr | 4.13 | 2.87 | 4.33 | 3.04 | 4.35 | 3.12 | | |
| PM/PM10/PM2.5 | lb/hr | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | | |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | g/sec | 6.60 | 4.52 | 6.92 | 4.79 | 6.94 | 4.90 | | |
| CO | g/sec | 2.68 | 1.84 | 2.81 | 1.94 | 2.82 | 1.99 | | |
| SO2 | g/sec | 0.52 | 0.36 | 0.55 | 0.38 | 0.55 | 0.39 | | |
| PM/PM10/PM2.5 | g/sec | 3.78 | 3.78 | 3.78 | 3.78 | 3.78 | 3.78 | | |

[1] Based on preliminary project equipment specifications and emissions estimates provided by Siemens. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.
[2] All emission rates and stack flow characteristics are on a per stack basis

Table A-2
Clear River Energy Center - Burrillville, Rhode Island
Non-Criteria Pollutant Emissions Summaries[1]

| Emission Source(s): | Gas Turbines | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Number of Sources: | 2 | | | | | | | |
| Fuel Fired: | Natural Gas | | | | | | | |
| Maximum Unit Heat Input: | 3,393 | MMBtu/hr | | | | | | |
| Annual Operation: | 8,040 | hrs/yr | | | | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Uncontrolled PTE lb/hr | Uncontrolled PTE lb/yr | Control % | Controlled PTE lb/hr | Controlled PTE lb/yr | Reg. 22 MO lb/yr |
| Ammonia | 0.0037 | lb/MMBtu | 9.1 | 73,968.00 | 0.00% | 9.20E+00 | 73,968 | 370 |
| Sulfuric Acid | 1.1E-03 | lb/MMBtu | 3.69 | 29,667.50 | 0.00% | 3.69E+00 | 29,668 | 40 |
| 1,3-Butadiene | 4.3E-07 | lb/MMBtu | 0.0029 | 23.41 | 90.00% | 2.92E-04 | 2.3 | 3 |
| Acetaldehyde | 4.0E-05 | lb/MMBtu | 0.27 | 2,181.38 | 90.00% | 2.71E-02 | 218 | 50 |
| Acrolein | 6.4E-06 | lb/MMBtu | 0.043 | 349.18 | 90.00% | 4.34E-03 | 35 | 0.07 |
| Benzene | 1.2E-05 | lb/MMBtu | 0.081 | 654.71 | 90.00% | 8.14E-03 | 65 | 10 |
| Ethylbenzene | 3.2E-05 | lb/MMBtu | 0.22 | 1,745.90 | 90.00% | 2.17E-02 | 175 | 9,000 |
| Formaldehyde | 2.2E-04 | lb/MMBtu | 1.48 | 11,914.98 | 90.00% | 1.48E-01 | 1,191 | 9 |
| Naphthalene | 1.3E-06 | lb/MMBtu | 0.009 | 70.93 | 90.00% | 8.82E-04 | 7.1 | 3 |
| PAH | 2.2E-06 | lb/MMBtu | 0.015 | 120.03 | 90.00% | 1.49E-03 | 12 | NA |
| Propylene Oxide | 2.9E-05 | lb/MMBtu | 0.20 | 1,582.22 | 90.00% | 1.97E-02 | 158 | 30 |
| Toluene | 1.3E-04 | lb/MMBtu | 0.88 | 7,092.73 | 90.00% | 8.82E-02 | 709 | 1,000 |
| Xylenes | 6.4E-05 | lb/MMBtu | 0.43 | 3,491.80 | 90.00% | 4.34E-02 | 349 | 3,000 |

| Emission Source(s): | Gas Turbines | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Number of Sources: | 2 | | | | | | | |
| Fuel Fired: | ULSD | | | | | | | |
| Maximum Unit Heat Input: | 3,502 | MMBtu/hr | | | | | | |
| Annual Operation: | 720 | hrs/yr | | | | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Uncontrolled PTE lb/hr | Uncontrolled PTE lb/yr | Control % | Controlled PTE lb/hr | Controlled PTE lb/yr | Reg. 22 MO lb/yr |
| Ammonia | 0.0029 | lb/MMBtu | 10.1 | 7,272.00 | 0.00% | 1.01E+01 | 7,272 | 300 |
| Sulfuric Acid | 1.2E-03 | lb/MMBtu | 4.17 | 3,002.40 | 0.00% | 4.17E+00 | 3,002 | 40 |
| 1,3-Butadiene | 1.6E-05 | lb/MMBtu | 0.11 | 80.80 | 90.00% | 1.12E-02 | 8.1 | 3 |
| Benzene | 1.2E-05 | lb/MMBtu | 0.084 | 60.60 | 90.00% | 8.42E-03 | 6.1 | 10 |
| Formaldehyde | 2.3E-04 | lb/MMBtu | 1.62 | 1,166.64 | 90.00% | 1.62E-01 | 116 | 9 |
| Naphthalene | 3.5E-05 | lb/MMBtu | 0.25 | 176.75 | 90.00% | 2.45E-02 | 18 | 3 |
| PAH | 4.0E-05 | lb/MMBtu | 0.28 | 202.09 | 90.00% | 2.81E-02 | 20 | NA |
| Arsenic | 4.6E-08 | lb/MMBtu | 0.00 | 0.23 | 0.00% | 3.24E-04 | 0.23 | 0.02 |
| Beryllium | 3.1E-07 | lb/MMBtu | 0.00 | 1.57 | 0.00% | 2.17E-03 | 1.6 | 0.04 |
| Cadmium | 5.1E-09 | lb/MMBtu | 0.00 | 0.03 | 0.00% | 3.60E-05 | 0.026 | 0.07 |
| Chromium | 2.2E-06 | lb/MMBtu | 0.02 | 11.11 | 0.00% | 1.57E-02 | 11 | 20,000 |
| Lead | 7.7E-07 | lb/MMBtu | 0.01 | 3.88 | 0.00% | 5.39E-03 | 3.9 | 0.9 |
| Manganese | 2.8E-07 | lb/MMBtu | 0.00 | 1.42 | 0.00% | 1.98E-03 | 1.4 | 0.2 |
| Mercury | 1.0E-08 | lb/MMBtu | 0.00 | 0.05 | 0.00% | 7.22E-05 | 0.052 | 0.7 |
| Nickel | 1.5E-06 | lb/MMBtu | 0.01 | 7.42 | 0.00% | 1.04E-02 | 7.5 | 0.4 |
| Selenium | 2.4E-07 | lb/MMBtu | 0.00 | 1.24 | 0.00% | 1.80E-03 | 1.3 | 2,000 |

| Emission Source(s): | HRSG Duct Burners | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Number of Sources: | 2 | | | | | | | |
| Fuel Fired: | Natural Gas | | | | | | | |
| Maximum Unit Heat Input: | 721.0 | MMBtu/hr | | | | | | |
| Annual Operation: | 8,040 | hrs/yr | | | | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Uncontrolled PTE lb/hr | Uncontrolled PTE lb/yr | Control % | Controlled PTE lb/hr | Controlled PTE lb/yr | Reg. 22 MO lb/yr |
| Lead | 4.9E-07 | lb/MMBtu | 7.1E-04 | 5.68 | 0.00% | 7.07E-04 | 5.7 | 0.9 |
| Benzene | 2.1E-06 | lb/MMBtu | 3.0E-03 | 23.87 | 90.00% | 2.97E-04 | 2.4 | 10 |
| Formaldehyde | 7.4E-05 | lb/MMBtu | 1.1E-01 | 852.48 | 90.00% | 1.06E-02 | 85 | 9 |
| Hexane | 1.8E-03 | lb/MMBtu | 2.5E+00 | 20,459.14 | 90.00% | 2.54E-01 | 2,046 | 20,000 |
| Naphthalene | 6.0E-07 | lb/MMBtu | 8.6E-04 | 6.93 | 90.00% | 8.62E-05 | 0.69 | 3 |
| Toluene | 3.4E-06 | lb/MMBtu | 4.8E-03 | 38.66 | 90.00% | 4.81E-04 | 3.9 | 1,000 |
| Arsenic | 2.0E-07 | lb/MMBtu | 2.8E-04 | 2.27 | 0.00% | 2.83E-04 | 2.3 | 0.02 |
| Barium | 4.4E-06 | lb/MMBtu | 6.2E-03 | 50.01 | 0.00% | 6.22E-03 | 50 | 2,000 |
| Beryllium | 1.2E-08 | lb/MMBtu | 1.7E-05 | 0.14 | 0.00% | 1.70E-05 | 0.14 | 0.04 |
| Cadmium | 1.1E-06 | lb/MMBtu | 1.6E-03 | 12.50 | 0.00% | 1.56E-03 | 13 | 0.07 |
| Chromium | 1.4E-06 | lb/MMBtu | 2.0E-03 | 15.91 | 0.00% | 1.98E-03 | 16 | 20,000 |
| Cobalt | 8.2E-08 | lb/MMBtu | 1.2E-04 | 0.95 | 0.00% | 1.19E-04 | 1.0 | 0.1 |
| Copper | 8.3E-07 | lb/MMBtu | 1.2E-03 | 9.46 | 0.00% | 1.20E-03 | 10 | 40 |
| Manganese | 3.7E-07 | lb/MMBtu | 5.4E-04 | 4.32 | 0.00% | 5.37E-04 | 4.3 | 0.2 |
| Mercury | 2.5E-07 | lb/MMBtu | 3.7E-04 | 2.96 | 0.00% | 3.68E-04 | 3.0 | 0.7 |
| Molybdenum | 1.1E-06 | lb/MMBtu | 1.6E-03 | 12.50 | 0.00% | 1.56E-03 | 13 | 60 |
| Nickel | 2.1E-06 | lb/MMBtu | 3.0E-03 | 23.87 | 0.00% | 2.97E-03 | 24 | 0.4 |
| Selenium | 2.4E-08 | lb/MMBtu | 3.4E-05 | 0.27 | 0.00% | 3.39E-05 | 0.27 | 2,000 |
| Vanadium | 2.3E-06 | lb/MMBtu | 3.3E-03 | 26.14 | 0.00% | 3.25E-03 | 26 | 0.07 |
| Zinc | 2.8E-05 | lb/MMBtu | 4.1E-02 | 329.62 | 0.00% | 4.10E-02 | 330 | 3,000 |
| 2-Methylnaphthalene | 2.4E-08 | lb/MMBtu | 3.4E-05 | 0.27 | 90.00% | 3.39E-06 | 0.0273 | NA |
| 3-Methylchloranthrene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| 7,12-Dimethylbenz(a)anthracene | 1.6E-08 | lb/MMBtu | 2.3E-05 | 0.18 | 90.00% | 2.26E-06 | 0.0182 | NA |
| Acenaphthene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Acenaphthylene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Anthracene | 2.4E-09 | lb/MMBtu | 3.4E-06 | 0.03 | 90.00% | 3.39E-07 | 0.0027 | NA |
| Benz(a)anthracene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Benzo(a)pyrene | 1.2E-09 | lb/MMBtu | 1.7E-06 | 0.01 | 90.00% | 1.70E-07 | 0.0014 | NA |
| Benzo(b)fluoranthene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Benzo(g,h,i)perylene | 1.2E-09 | lb/MMBtu | 1.7E-06 | 0.01 | 90.00% | 1.70E-07 | 0.0014 | NA |
| Benzo(k)fluoranthene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Butane | 2.1E-03 | lb/MMBtu | 3.0E+00 | 23,869.34 | 90.00% | 2.97E-01 | 2,387 | NA |
| Chrysene | 1.8E-09 | lb/MMBtu | 2.5E-06 | 0.02 | 90.00% | 2.54E-07 | 0.0020 | NA |
| Dibenzo(a,h)anthracene | 1.2E-09 | lb/MMBtu | 1.7E-06 | 0.01 | 90.00% | 1.70E-07 | 0.0014 | NA |
| Dichlorobenzene | 1.2E-06 | lb/MMBtu | 1.7E-03 | 13.64 | 90.00% | 1.70E-04 | 1.4 | NA |
| Ethane | 3.0E-03 | lb/MMBtu | 4.4E+00 | 35,235.89 | 90.00% | 4.38E-01 | 3,524 | NA |
| Fluoranthene | 2.9E-09 | lb/MMBtu | 4.2E-06 | 0.03 | 90.00% | 4.24E-07 | 0.0034 | NA |
| Fluorene | 2.8E-06 | lb/MMBtu | 4.0E-03 | 31.86 | 90.00% | 4.04E-04 | 3.2 | NA |
| Indeno(1,2,3-cd)pyrene | 1.8E-06 | lb/MMBtu | 2.6E-03 | 20.87 | 90.00% | 2.60E-04 | 2.1 | NA |
| Pentane | 2.5E-03 | lb/MMBtu | 3.7E+00 | 29,552.52 | 90.00% | 3.68E-01 | 2,955 | NA |
| Phenanthrene | 1.7E-08 | lb/MMBtu | 2.4E-05 | 0.19 | 90.00% | 2.40E-06 | 0.019 | NA |
| Propane | 1.6E-03 | lb/MMBtu | 2.3E+00 | 18,185.18 | 90.00% | 2.26E-01 | 1,819 | NA |
| Pyrene | 4.9E-09 | lb/MMBtu | 7.1E-06 | 0.06 | 90.00% | 7.07E-07 | 0.0057 | NA |

| Emission Source(s): | Auxiliary Boiler | | | | |
|---|---|---|---|---|---|
| Number of Sources: | 1 | | | | |
| Fuel Fired: | Natural Gas | | | | |
| Maximum Unit Heat Input: | 143.6 | MMBtu/hr | | | |
| Annual Operation: | 4,575 | hrs/yr | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Potential Emissions lb/hr | Potential Emissions lb/yr | Reg. 22 MO lb/yr |
| Lead | 4.9E-07 | lb/MMBtu | 6.9E-05 | 3.15E-01 | 0.9 |
| Benzene | 2.1E-06 | lb/MMBtu | 2.9E-04 | 1.32E+00 | 10 |
| Formaldehyde | 7.4E-05 | lb/MMBtu | 1.0E-02 | 4.73E+01 | 9 |
| Hexane | 1.8E-03 | lb/MMBtu | 2.5E-01 | 1.14E+03 | 20,000 |
| Naphthalene | 6.0E-07 | lb/MMBtu | 8.4E-05 | 3.85E-01 | 3 |
| Toluene | 3.4E-06 | lb/MMBtu | 4.7E-04 | 2.14E+00 | 1,000 |
| Arsenic | 2.0E-07 | lb/MMBtu | 2.8E-05 | 1.26E-01 | 0.02 |
| Barium | 4.3E-06 | lb/MMBtu | 6.1E-04 | 2.78E+00 | 2,000 |
| Beryllium | 1.2E-08 | lb/MMBtu | 1.7E-06 | 7.57E-03 | 0.04 |
| Cadmium | 1.1E-06 | lb/MMBtu | 1.5E-04 | 6.94E-01 | 0.07 |
| Chromium | 1.4E-06 | lb/MMBtu | 1.9E-04 | 8.83E-01 | 20,000 |
| Cobalt | 8.2E-08 | lb/MMBtu | 1.2E-05 | 5.30E-02 | 0.1 |
| Copper | 8.3E-07 | lb/MMBtu | 1.2E-04 | 5.36E-01 | 40 |
| Manganese | 3.7E-07 | lb/MMBtu | 5.2E-05 | 2.40E-01 | 0.2 |
| Mercury | 2.5E-07 | lb/MMBtu | 3.6E-05 | 1.64E-01 | 0.7 |
| Molybdenum | 1.1E-06 | lb/MMBtu | 1.5E-04 | 6.94E-01 | 60 |
| Nickel | 2.1E-06 | lb/MMBtu | 2.9E-04 | 1.32E+00 | 0.4 |
| Selenium | 2.4E-08 | lb/MMBtu | 3.3E-06 | 1.51E-02 | 2,000 |
| Vanadium | 2.3E-06 | lb/MMBtu | 3.2E-04 | 1.45E+00 | 0.07 |
| Zinc | 2.8E-05 | lb/MMBtu | 4.0E-03 | 1.83E+01 | 3,000 |
| 2-Methylnaphthalene | 2.4E-08 | lb/MMBtu | 3.4E-06 | 1.51E-02 | NA |
| 3-Methylchloranthrene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| 7,12-Dimethylbenz(a)anthracene | 1.6E-08 | lb/MMBtu | 2.2E-06 | 1.01E-02 | NA |
| Acenaphthene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Acenaphthylene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Anthracene | 2.4E-09 | lb/MMBtu | 3.3E-07 | 1.51E-03 | NA |
| Benz(a)anthracene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Benzo(a)pyrene | 1.2E-09 | lb/MMBtu | 1.7E-07 | 7.57E-04 | NA |
| Benzo(b)fluoranthene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Benzo(g,h,i)perylene | 1.2E-09 | lb/MMBtu | 1.7E-07 | 7.57E-04 | NA |
| Benzo(k)fluoranthene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Butane | 2.1E-03 | lb/MMBtu | 2.9E-01 | 1.32E+03 | NA |
| Chrysene | 1.8E-09 | lb/MMBtu | 2.5E-07 | 1.14E-03 | NA |
| Dibenzo(a,h)anthracene | 1.2E-09 | lb/MMBtu | 1.7E-07 | 7.57E-04 | NA |
| Dichlorobenzene | 1.2E-06 | lb/MMBtu | 1.7E-04 | 7.57E-01 | NA |
| Ethane | 3.0E-03 | lb/MMBtu | 4.3E-01 | 1.94E+03 | NA |
| Fluoranthene | 2.9E-09 | lb/MMBtu | 4.1E-07 | 1.89E-03 | NA |
| Fluorene | 2.8E-06 | lb/MMBtu | 3.9E-04 | 1.77E+00 | NA |
| Indeno(1,2,3-cd)pyrene | 1.8E-06 | lb/MMBtu | 2.5E-04 | 1.16E+00 | NA |
| Pentane | 2.5E-03 | lb/MMBtu | 3.6E-01 | 1.64E+03 | NA |
| Phenanthrene | 1.7E-08 | lb/MMBtu | 2.3E-06 | 1.07E-02 | NA |
| Propane | 1.6E-03 | lb/MMBtu | 2.2E-01 | 1.01E+03 | NA |
| Pyrene | 4.9E-09 | lb/MMBtu | 6.9E-07 | 3.15E-03 | NA |

| Emission Source(s): | Fire Pump | | | | |
|---|---|---|---|---|---|
| Number of Sources: | 1 | | | | |
| Fuel Fired: | ULSD | | | | |
| Maximum Unit Heat Input: | 2.1 | MMBtu/hr | | | |
| Annual Operation: | 300 | hrs/yr | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Potential Emissions lb/hr | Potential Emissions lb/yr | Reg. 22 MO lb/yr |
| Benzene | 9.33E-04 | lb/MMBtu | 2.0E-03 | 5.88E-01 | 10 |
| Toluene | 4.09E-04 | lb/MMBtu | 8.6E-04 | 2.58E-01 | 1,000 |
| Xylenes | 2.85E-04 | lb/MMBtu | 6.0E-04 | 1.80E-01 | 3,000 |
| Propylene | 2.58E-03 | lb/MMBtu | 5.4E-03 | 1.63E+00 | 36,500 |
| Formaldehyde | 1.18E-03 | lb/MMBtu | 2.5E-03 | 7.43E-01 | 9 |
| Acetaldehyde | 7.67E-04 | lb/MMBtu | 1.6E-03 | 4.83E-01 | 50 |
| Acrolein | 9.25E-05 | lb/MMBtu | 1.9E-04 | 5.83E-02 | 0.07 |
| Naphthalene | 8.48E-05 | lb/MMBtu | 1.8E-04 | 5.34E-02 | 3 |
| 1,3-Butadiene | 3.91E-05 | lb/MMBtu | 8.2E-05 | 2.46E-02 | 3 |
| Acenaphthylene | 5.06E-06 | lb/MMBtu | 1.1E-05 | 3.19E-03 | NA |
| Acenaphthene | 1.42E-06 | lb/MMBtu | 3.0E-06 | 8.95E-04 | NA |
| Fluorene | 2.92E-05 | lb/MMBtu | 6.1E-05 | 1.84E-02 | NA |
| Phenanthrene | 2.94E-05 | lb/MMBtu | 6.2E-05 | 1.85E-02 | NA |
| Anthracene | 1.87E-06 | lb/MMBtu | 3.9E-06 | 1.18E-03 | NA |
| Fluoranthene | 7.61E-06 | lb/MMBtu | 1.6E-05 | 4.79E-03 | NA |
| Pyrene | 4.78E-06 | lb/MMBtu | 1.0E-05 | 3.01E-03 | NA |
| Benz(a)anthracene | 1.68E-06 | lb/MMBtu | 3.5E-06 | 1.06E-03 | NA |
| Chrysene | 3.53E-07 | lb/MMBtu | 7.4E-07 | 2.22E-04 | NA |
| Benzo(b)fluoranthene | 9.91E-08 | lb/MMBtu | 2.1E-07 | 6.24E-05 | NA |
| Benzo(k)fluoranthene | 1.55E-07 | lb/MMBtu | 3.3E-07 | 9.77E-05 | NA |
| Benzo(a)pyrene | 1.88E-07 | lb/MMBtu | 3.9E-07 | 1.18E-04 | NA |
| Indeno(1,2,3-cd)pyrene | 3.75E-07 | lb/MMBtu | 7.9E-07 | 2.36E-04 | NA |
| Dibenz(a,h)anthracene | 5.83E-07 | lb/MMBtu | 1.2E-06 | 3.67E-04 | NA |
| Benzo(g,h,i)perylene | 4.89E-07 | lb/MMBtu | 1.0E-06 | 3.08E-04 | NA |
| PAH | 1.68E-04 | lb/MMBtu | 3.5E-04 | 1.06E-01 | NA |

| Emission Source(s): | Dewpoint Heater | | | | |
|---|---|---|---|---|---|
| Number of Sources: | 1 | | | | |
| Fuel Fired: | Natural Gas | | | | |
| Maximum Unit Heat Input: | 15.0 | MMBtu/hr | | | |
| Annual Operation: | 8,760 | hrs/yr | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Potential Emissions lb/hr | Potential Emissions lb/yr | Reg. 22 MO lb/yr |
| Lead | 4.9E-07 | lb/MMBtu | 7.4E-06 | 6.44E-02 | 0.9 |
| Benzene | 2.1E-06 | lb/MMBtu | 3.1E-05 | 2.71E-01 | 10 |
| Formaldehyde | 7.4E-05 | lb/MMBtu | 1.1E-03 | 9.66E+00 | 9 |
| Hexane | 1.8E-03 | lb/MMBtu | 2.6E-02 | 2.32E+02 | 20,000 |
| Naphthalene | 6.0E-07 | lb/MMBtu | 9.0E-06 | 7.86E-02 | 3 |
| Toluene | 3.3E-06 | lb/MMBtu | 5.0E-05 | 4.38E-01 | 1,000 |
| Arsenic | 2.0E-07 | lb/MMBtu | 2.9E-06 | 2.58E-02 | 0.02 |
| Barium | 4.3E-06 | lb/MMBtu | 6.5E-05 | 5.67E-01 | 2,000 |
| Beryllium | 1.2E-08 | lb/MMBtu | 1.8E-07 | 1.55E-03 | 0.04 |
| Cadmium | 1.1E-06 | lb/MMBtu | 1.6E-05 | 1.42E-01 | 0.07 |
| Chromium | 1.4E-06 | lb/MMBtu | 2.1E-05 | 1.80E-01 | 20,000 |
| Cobalt | 8.2E-08 | lb/MMBtu | 1.2E-06 | 1.08E-02 | 0.1 |
| Copper | 8.3E-07 | lb/MMBtu | 1.3E-05 | 1.10E-01 | 40 |
| Manganese | 3.7E-07 | lb/MMBtu | 5.6E-06 | 4.90E-02 | 0.2 |
| Mercury | 2.5E-07 | lb/MMBtu | 3.8E-06 | 3.35E-02 | 0.7 |
| Molybdenum | 1.1E-06 | lb/MMBtu | 1.6E-05 | 1.42E-01 | 60 |
| Nickel | 2.1E-06 | lb/MMBtu | 3.1E-05 | 2.71E-01 | 0.4 |
| Selenium | 2.4E-08 | lb/MMBtu | 3.5E-07 | 3.09E-03 | 2,000 |
| Vanadium | 2.3E-06 | lb/MMBtu | 3.4E-05 | 2.96E-01 | 0.07 |
| Zinc | 2.8E-05 | lb/MMBtu | 4.3E-04 | 3.74E+00 | 3,000 |
| 2-Methylnaphthalene | 2.4E-08 | lb/MMBtu | 3.5E-07 | 3.09E-03 | NA |
| 3-Methylchloranthrene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| 7,12-Dimethylbenz(a)anthracene | 1.6E-08 | lb/MMBtu | 2.4E-07 | 2.06E-03 | NA |
| Acenaphthene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Acenaphthylene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Anthracene | 2.4E-09 | lb/MMBtu | 3.5E-08 | 3.09E-04 | NA |
| Benz(a)anthracene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Benzo(a)pyrene | 1.2E-09 | lb/MMBtu | 1.8E-08 | 1.55E-04 | NA |
| Benzo(b)fluoranthene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Benzo(g,h,i)perylene | 1.2E-09 | lb/MMBtu | 1.8E-08 | 1.55E-04 | NA |
| Benzo(k)fluoranthene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Butane | 2.1E-03 | lb/MMBtu | 3.1E-02 | 2.71E+02 | NA |
| Chrysene | 1.8E-09 | lb/MMBtu | 2.6E-08 | 2.32E-04 | NA |
| Dibenzo(a,h)anthracene | 1.2E-09 | lb/MMBtu | 1.8E-08 | 1.55E-04 | NA |
| Dichlorobenzene | 1.2E-06 | lb/MMBtu | 1.8E-05 | 1.55E-01 | NA |
| Ethane | 3.0E-03 | lb/MMBtu | 4.6E-02 | 3.99E+02 | NA |
| Fluoranthene | 2.9E-09 | lb/MMBtu | 4.4E-08 | 3.86E-04 | NA |
| Fluorene | 2.8E-06 | lb/MMBtu | 4.2E-05 | 3.68E-01 | NA |
| Indeno(1,2,3-cd)pyrene | 1.8E-06 | lb/MMBtu | 2.7E-05 | 2.37E-01 | NA |
| Pentane | 2.5E-03 | lb/MMBtu | 3.8E-02 | 3.35E+02 | NA |
| Phenanthrene | 1.7E-08 | lb/MMBtu | 2.5E-07 | 2.19E-03 | NA |
| Propane | 1.6E-03 | lb/MMBtu | 2.4E-02 | 2.06E+02 | NA |
| Pyrene | 4.9E-09 | lb/MMBtu | 7.4E-08 | 6.44E-04 | NA |

| Emission Source(s): | Emergency Diesel Generator | | | | |
|---|---|---|---|---|---|
| Number of Sources: | 1 | | | | |
| Fuel Fired: | ULSD | | | | |
| Maximum Unit Heat Input: | 19.5 | MMBtu/hr | | | |
| Annual Operation: | 300 | hrs/yr | | | |
| RIDEM APCR No. 22 Air Toxic Chemical | Emission Factor | Measurement Units | Potential Emissions lb/hr | Potential Emissions lb/yr | Reg. 22 MO lb/yr |
| Benzene | 7.76E-04 | lb/MMBtu | 1.5E-02 | 4.54E+00 | 10 |
| Toluene | 2.81E-04 | lb/MMBtu | 5.5E-03 | 1.64E+00 | 1,000 |
| Xylenes | 1.93E-04 | lb/MMBtu | 3.8E-03 | 1.13E+00 | 3,000 |
| Propylene | 2.79E-03 | lb/MMBtu | 5.4E-02 | 1.63E+01 | 36,500 |
| Formaldehyde | 7.89E-05 | lb/MMBtu | 1.5E-03 | 4.62E-01 | 9 |
| Acetaldehyde | 2.52E-05 | lb/MMBtu | 4.9E-04 | 1.47E-01 | 50 |
| Acrolein | 7.88E-06 | lb/MMBtu | 1.5E-04 | 4.61E-02 | 0.07 |
| Naphthalene | 1.30E-04 | lb/MMBtu | 2.5E-03 | 7.61E-01 | 3 |
| Acenaphthylene | 9.23E-06 | lb/MMBtu | 1.8E-04 | 5.40E-02 | NA |
| Acenaphthene | 4.68E-06 | lb/MMBtu | 9.1E-05 | 2.74E-02 | NA |
| Fluorene | 1.28E-05 | lb/MMBtu | 2.5E-04 | 7.49E-02 | NA |
| Phenanthrene | 4.08E-05 | lb/MMBtu | 8.0E-04 | 2.39E-01 | NA |
| Anthracene | 1.23E-06 | lb/MMBtu | 2.4E-05 | 7.20E-03 | NA |
| Fluoranthene | 4.03E-06 | lb/MMBtu | 7.9E-05 | 2.36E-02 | NA |
| Pyrene | 3.71E-06 | lb/MMBtu | 7.2E-05 | 2.17E-02 | NA |
| Benz(a)anthracene | 6.22E-07 | lb/MMBtu | 1.2E-05 | 3.64E-03 | NA |
| Chrysene | 1.53E-06 | lb/MMBtu | 3.0E-05 | 8.95E-03 | NA |
| Benzo(b)fluoranthene | 1.11E-06 | lb/MMBtu | 2.2E-05 | 6.49E-03 | NA |
| Benzo(k)fluoranthene | 2.18E-07 | lb/MMBtu | 4.3E-06 | 1.28E-03 | NA |
| Benzo(a)pyrene | 2.57E-07 | lb/MMBtu | 5.0E-06 | 1.50E-03 | NA |
| Indeno(1,2,3-cd)pyrene | 4.14E-07 | lb/MMBtu | 8.1E-06 | 2.42E-03 | NA |
| Dibenz(a,h)anthracene | 3.46E-07 | lb/MMBtu | 6.7E-06 | 2.02E-03 | NA |
| Benzo(g,h,i)perylene | 5.56E-07 | lb/MMBtu | 1.1E-05 | 3.25E-03 | NA |
| PAH | 2.12E-04 | lb/MMBtu | 4.1E-03 | 1.24E+00 | NA |

[1] Based on preliminary project equipment specifications and emissions estimates. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.
61 ammonia, formaldehyde and sulfuric acid emission factors are from equipment specifications. Gas turbine distillate oil metals emission factors are from "Survey of Ultra-Trace Metals in Gas Turbine Fuels". All other emission factors are from AP-42.

**Table A-3**
**Clear River Energy Center - Burrillville, Rhode Island**
**CT/HRSG Startup & Shutdown Emission Summaries[1]**

| Parameter | Measurement Units | Cold Start | Warm Start | Hot Start | Shut Down | Cold Start | Warm Start | Hot Start | Shut Down |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| Fuel Fired | | Natural Gas | Natural Gas | Natural Gas | Natural Gas | ULSD | ULSD | ULSD | ULSD |
| | | | | | | | | | |
| Event Duration | min/event | 45 | 40 | 21 | 12 | 45 | 40 | 21 | 7 |
| Events per Year | events/yr | 20 | 90 | 300 | 410 | 10 | 10 | 10 | 30 |
| Hours per Year | hrs/yr | 15.0 | 60.0 | 105.0 | 82.0 | 7.5 | 6.7 | 3.5 | 3.5 |
| | | | | | | | | | |
| Stack Gas Molecular Weight | lb/lb-mole | 28.60 | 28.60 | 28.60 | 28.60 | 28.60 | 28.60 | 28.60 | 28.60 |
| Stack Flow | lb/hr | 4,320,000 | 4,320,000 | 4,320,000 | 2,880,000 | 4,680,000 | 4,680,000 | 4,680,000 | 3,420,000 |
| Stack Flow | acfm | 1,163,214 | 1,163,214 | 1,163,214 | 775,476 | 1,260,149 | 1,260,149 | 1,260,149 | 920,878 |
| Stack Exit Temperature | deg. F | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 |
| | | | | | | | | | |
| Emissions | | | | | | | | | |
| NOx | lb/event | 196.0 | 159.0 | 110.0 | 6.6 | 198.0 | 178.0 | 100.0 | 25.0 |
| CO | lb/event | 133.0 | 131.0 | 123.0 | 124.0 | 304.0 | 301.0 | 287.0 | 99.0 |
| PM/PM10/PM2.5 | lb/event | 9.1 | 8.1 | 4.2 | 2.4 | 53.0 | 47.0 | 25.0 | 8.3 |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | lb/hr | 261.3 | 238.5 | 314.3 | 33.0 | 264.0 | 267.0 | 285.7 | 214.3 |
| CO | lb/hr | 177.3 | 196.5 | 351.4 | 620.0 | 405.3 | 451.5 | 820.0 | 848.6 |
| PM/PM10/PM2.5 | lb/hr | 12.1 | 12.2 | 12.0 | 12.0 | 70.7 | 70.5 | 71.4 | 71.1 |
| | | | | | | | | | |
| Emission Rate | | | | | | | | | |
| NOx | g/sec | 32.93 | 30.05 | 39.60 | 4.16 | 33.26 | 33.64 | 36.00 | 27.00 |
| CO | g/sec | 22.34 | 24.76 | 44.28 | 78.12 | 51.07 | 56.89 | 103.32 | 106.92 |
| PM/PM10/PM2.5 | g/sec | 1.53 | 1.53 | 1.51 | 1.51 | 8.90 | 8.88 | 9.00 | 8.96 |

[1] Based on preliminary project equipment specifications and emissions estimates. Equipment vendor selection, equipment specifications, and emission rates are subject to change as the project design advances.

# TANKS 4.0.9d
## Emissions Report - Detail Format
## Tank Indentification and Physical Characteristics

| | |
|---|---|
| **Identification** | |
| User Identification: | Invenergy ULSD Storage Tank |
| City: | Burrillville |
| State: | Rhode Island |
| Company: | Invenergy, LLC |
| Type of Tank: | Vertical Fixed Roof Tank |
| Description: | Invenergy Rhode Island Energy Center Burrillville, Rhode Island |
| **Tank Dimensions** | |
| Shell Height (ft): | 35.00 |
| Diameter (ft): | 120.00 |
| Liquid Height (ft) : | 24.00 |
| Avg. Liquid Height (ft): | 24.00 |
| Volume (gallons): | 2,000,000.00 |
| Turnovers: | 18.42 |
| Net Throughput(gal/yr): | 36,846,720.00 |
| Is Tank Heated (y/n): | N |
| **Paint Characteristics** | |
| Shell Color/Shade: | White/White |
| Shell Condition | Good |
| Roof Color/Shade: | White/White |
| Roof Condition: | Good |
| **Roof Characteristics** | |
| Type: | Dome |
| Height (ft) | 0.00 |
| Radius (ft) (Dome Roof) | 120.00 |
| **Breather Vent Settings** | |
| Vacuum Settings (psig): | -0.03 |
| Pressure Settings (psig) | 0.03 |

Meterological Data used in Emissions Calculations: Providence, Rhode Island (Avg Atmospheric Pressure = 14.7 psia)

**TANKS 4.0.9d**
**Emissions Report - Detail Format**
**Liquid Contents of Storage Tank**

**Invenergy ULSD Storage Tank - Vertical Fixed Roof Tank**
**Burrillville, Rhode Island**

| Mixture/Component | Month | Daily Liquid Surf. Temperature (deg F) Avg. | Min. | Max. | Liquid Bulk Temp (deg F) | Vapor Pressure (psia) Avg. | Min. | Max. | Vapor Mol. Weight. | Liquid Mass Fract. | Vapor Mass Fract. | Mol. Weight | Basis for Vapor Pressure Calculations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distillate fuel oil no. 2 | All | 52.05 | 47.20 | 56.90 | 50.41 | 0.0049 | 0.0041 | 0.0059 | 130.0000 | | | 188.00 | Option 1: VP50 = .0045 VP60 = .0065 |

**TANKS 4.0.9d**
**Emissions Report - Detail Format**
**Detail Calculations (AP-42)**

**Invenergy ULSD Storage Tank - Vertical Fixed Roof Tank**
**Burrillville, Rhode Island**

| Annual Emission Calcaulations | |
|---|---|
| Standing Losses (lb): | 311.7234 |
| Vapor Space Volume (cu ft): | 217,495.8417 |
| Vapor Density (lb/cu ft): | 0.0001 |
| Vapor Space Expansion Factor: | 0.0339 |
| Vented Vapor Saturation Factor: | 0.9950 |
| | |
| Tank Vapor Space Volume: | |
| Vapor Space Volume (cu ft): | 217,495.8417 |
| Tank Diameter (ft): | 120.0000 |
| Vapor Space Outage (ft): | 19.2309 |
| Tank Shell Height (ft): | 35.0000 |
| Average Liquid Height (ft): | 24.0000 |
| Roof Outage (ft): | 8.2309 |
| | |
| Roof Outage (Dome Roof) | |
| Roof Outage (ft): | 8.2309 |
| Dome Radius (ft): | 120.0000 |
| Shell Radius (ft): | 60.0000 |
| | |
| Vapor Density | |
| Vapor Density (lb/cu ft): | 0.0001 |
| Vapor Molecular Weight (lb/lb-mole): | 130.0000 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 0.0049 |
| Daily Avg. Liquid Surface Temp. (deg. R): | 511.7234 |
| Daily Average Ambient Temp. (deg. F): | 50.3917 |
| Ideal Gas Constant R (psia cuft / (lb-mol-deg R)): | 10.731 |
| Liquid Bulk Temperature (deg. R): | 510.0817 |
| Tank Paint Solar Absorptance (Shell): | 0.1700 |
| Tank Paint Solar Absorptance (Roof): | 0.1700 |
| Daily Total Solar Insulation Factor (Btu/sqft day): | 1,228.9982 |
| | |
| Vapor Space Expansion Factor | |
| Vapor Space Expansion Factor: | 0.0339 |
| Daily Vapor Temperature Range (deg. R): | 19.3980 |
| Daily Vapor Pressure Range (psia): | 0.0018 |
| Breather Vent Press. Setting Range(psia): | 0.0600 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 0.0049 |
| Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia): | 0.0041 |
| Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia): | 0.0059 |
| Daily Avg. Liquid Surface Temp. (deg R): | 511.7234 |
| Daily Min. Liquid Surface Temp. (deg R): | 506.8739 |
| Daily Max. Liquid Surface Temp. (deg R): | 516.5729 |
| Daily Ambient Temp. Range (deg. R): | 18.8167 |
| | |
| Vented Vapor Saturation Factor | |
| Vented Vapor Saturation Factor: | 0.9950 |
| Vapor Pressure at Daily Average Liquid: Surface Temperature (psia): | 0.0049 |
| Vapor Space Outage (ft): | 19.2309 |
| | |
| Working Losses (lb): | 560.0602 |
| Vapor Molecular Weight (lb/lb-mole): | 130.0000 |
| Vapor Pressure at Daily Average Liquid Surface Temperature (psia): | 0.0049 |
| Annual Net Throughput (gal/yr.): | 36,846,720.0000 |
| Annual Turnovers: | 18.4234 |
| Turnover Factor: | 1.0000 |
| Maximum Liquid Volume (gal): | 2,000,000.0000 |
| Maximum Liquid Height (ft): | 24.0000 |
| Tank Diameter (ft): | 120.0000 |
| Working Loss Product Factor: | 1.0000 |
| | |
| Total Losses (lb): | 871.7837 |

**TANKS 4.0.9d**
**Emissions Report - Detail Format**
**Individual Tank Emission Totals**

## Emissions Report for: Annual

**Invenergy ULSD Storage Tank - Vertical Fixed Roof Tank**
**Burrillville, Rhode Island**

| | Losses(lbs) | | |
|---|---|---|---|
| Components | Working Loss | Breathing Loss | Total Emissions |
| Distillate fuel oil no. 2 | 560.06 | 311.72 | 871.78 |

**STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS**

**PUBLIC UTILITIES COMMISSION**

| | | |
|---|---|---|
| **IN RE: INVENERGY THERMAL DEVELOPMENT LLC** | **)** | |
| **APPLICATION TO CONSTRUCT AND OPERATE THE** | **)** | **Dkt. 4609** |
| **CLEAR RIVER ENERGY CENTER, BURRILLVILLE,** | **)** | |
| **RHODE ISLAND** | **)** | |

**<u>INVENERGY THERMAL DEVELOPMENT LLC'S REPONSES TO CONSERVATION LAW FOUNDATION'S FIRST DATA REQUEST</u>**

1.3: This Data Request pertains to PowerPoint Slide 21 used by Invenergy at the January 12, 2016 Preliminary Hearing, specifically this sentence: "By displacing older, inefficient plants Clear River is projected to save ratepayers $280 million in cumulative savings between 2019 and 2022."

(a) Please confirm that the cumulate savings referred to pertain to: (1) the value of energy, not capacity or ancillary services; (ii) ratepayers in the Rhode Island load zone, not rest of pool; and (iii) the ISO-NE Capacity Commitment Periods 10, 11 and 12.

(b) Explain in detail how the $280 million figure was derived, and provide all work-papers used in the calculations.

(c) Identify all inputs into these calculations derived from outside sources, and identify the outside source(s).

(d) For all inputs that were not derived from outside sources (that is, assumptions made by Invenergy), identify the assumption and explain why Invenergy believes the assumption to be reasonable.

(e) identify the principal person(s) responsible for this calculation.

(f) Identify additional person(s) involved in this calculation and generally the role of each one.

RESPONSE 1.3:[1] (a) The $280 million is the approximate savings to Rhode Island ratepayers in cumulative energy and capacity costs resulting from the participation of Clear River in the energy and capacity markets from 2019 through 2022 (four calendar years). The capacity market savings are realized in Forward Capacity Auctions ("FCA") 10, 11, 12 and 13 (partial year given the FCA 13 delivery year is June 2022 through May 2023).

(b) Invenergy retained PA Consulting Group, Inc. ("PA") to complete the market analysis associated with Clear River. The ratepayer savings analysis is explained in the EFSB Application, in Section 5.0 (Project Benefits) and in Section 7.0 (Need)( Section

[1] Invenergy incorporates the objections to this Data Request, filed on January 15, 2016.

7.2.3 of the EFSB Application -- Analysis of Need – Rhode Island Ratepayer Cost Impact).

The $280 million represents the difference in total capacity and energy costs to Rhode Island-only load resulting from the Clear River capacity addition, as measured by comparing cost results from capacity and energy modeling cases (a) with Clear River starting in 2019; and (b) without Clear River.

- Capacity costs to Rhode Island-only load are allocated by ISO-NE based on the capacity auction clearing price and Rhode Island's share of the system-wide peak demand. Rhode Island's share of the system-wide peak demand is calculated by multiplying Rhode Island's peak demand by (1 + Actual Reserve Margin). This accounts for the excess capacity that ISO-NE procures in the Forward Capacity Market ("FCM") in order to ensure peak demand is met even if outages occur. To calculate any capacity cost savings under ISO-NE's capacity cost allocation methodology, PA started by comparing the annual projected FCM Rest of Pool ("ROP") clearing prices from the "With Clear River" and "Without Clear River" scenarios for auctions starting with FCA 10 (the 2019/2020 delivery year). The difference in clearing prices between the two scenarios in each delivery year was then multiplied by Rhode Island's share of the system-wide peak demand to determine the savings to Rhode Island-only load as a result of Clear River.

- The energy cost to Rhode Island-only load for each case was calculated using projected Rhode Island-area energy prices from PA's fundamental production cost analysis (utilizing the AURORAxmp[2] software and PA's underlying market assumptions) for the two analyzed cases (i.e., "With Clear

[2] The AURORAxmp Electric Market Model, developed by EPIS, Inc.

River" and "Without Clear River").

- Please see the accompanying worksheet calculations.

(c) PA employs a wide range of public and proprietary data to keep its various market models up to date, such that the universe of inputs cannot be easily divulged.

The inputs used by PA are described in the EFSB Application, Section 5.0 (Project Benefits) and in Section 7.0 (Need) (Section 7.2.3 -- Analysis of Need – Rhode Island Ratepayer Cost Impact) and in the documents prepared by PA Consulting and filed with the EFSB.

Key input drivers include the following:

- Peak Energy and Load: "2015-2024 Forecast Report of Capacity, Energy, Loads, and Transmission" ("2015 CELT Report") from ISO-NE;

- Auction Parameters: ISO-NE FCA 10 auction parameters (sourced from ISO-NE website);

- Natural Gas Prices: PA's base case forecast for delivered natural gas prices. Algonquin Citygate pricing is approximately $5.50/MMBtu in 2019, escalating to approximately $7.25/MMBtu by the 2022 timeframe (all figures in nominal dollars, assuming 2.2% per annum inflation rate); and

- RGGI $CO_2$ Prices: PA's base case forecast assumes RGGI pricing averaging approximately $6-7/short ton in the 2019-2021 period (all figures in nominal dollars, assuming 2.2% per annum inflation rate).

**STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS**

**PUBLIC UTILITIES COMMISSION**

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| **IN RE: INVENERGY THERMAL DEVELOPMENT LLC** | **)** | |
| **APPLICATION TO CONSTRUCT AND OPERATE THE** | **)** | **Dkt. 4609** |
| **CLEAR RIVER ENERGY CENTER, BURRILLVILLE,** | **)** | |
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**INVENERGY THERMAL DEVELOPMENT LLC'S REPONSES TO CONSERVATION LAW FOUNDATION'S FIRST DATA REQUEST**

(d) All market assumptions were from PA's independent base case forecast for the ISO-NE market as of the date of the analysis, with the exception of Clear River's unit performance characteristics. The primary variables include the unit's output or capacity, the variable Operation and Maintenance ("O&M ") costs, and unit's heat rate, which were provided to PA by Invenergy. The unit capacity and heat rate were based off of proposals received for the subject equipment and the variable (O&M) costs were based on Invenergy's experience with similar technology and by comparing these costs to our actual costs that we have seen at our other combined cycle facilities.

(e) This calculation was completed by PA, and primarily Ryan Hardy, Mark Repsher, and Mason Smith.

(f) PA has a team of power market experts in its Global Energy and Utilities practice that contributed to this analysis.

RESPONDENT: Ryan Hardy, Mark Repsher, and Mason Smith, of PA Consulting, John Niland of Invenergy

DATE: April 14, 2016

P1
'16/1/27

## Rhode Island Energy Cost Savings from Clear River

*nominal $*

| | | RI Energy Demand (GWh)[1] | | RI Energy Price Differential Resulting from Clear River ($/MWh) | | Energy Cost Savings to RI Ratepayer ($/month) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Calculated as Price "Without CREC" less Price "With CREC"* | | *Calculated as Price Differential (Price "Without CREC" less Price "With CREC") * Rhode Island Energy Demand* | | | |
| **Year** | **Month** | **On Peak** | **Off Peak** | **On Peak** | **Off Peak** | **On Peak** | **Off Peak** | **Total** | |
| 2019 | 1 | 376.12 | 321.03 | 0.00 | 0.00 | $ - | $ - | $ - | |
| 2019 | 2 | 328.87 | 281.34 | 0.00 | 0.00 | $ - | $ - | $ - | |
| 2019 | 3 | 333.22 | 286.64 | 0.00 | 0.00 | $ - | $ - | $ - | |
| 2019 | 4 | 318.79 | 248.48 | 0.00 | 0.00 | $ - | $ - | $ - | |
| 2019 | 5 | 307.42 | 274.49 | 0.00 | 0.00 | $ - | $ - | $ - | |
| 2019 | 6 | 382.92 | 293.28 | 1.81 | 0.75 | $ 692,926 | $ 218,957 | $ 911,883 | *<-- Clear River online in June 2019.* |
| 2019 | 7 | 463.10 | 344.48 | 2.35 | 0.83 | $ 1,087,173 | $ 286,097 | $ 1,373,270 | |
| 2019 | 8 | 383.47 | 345.97 | 2.02 | 0.80 | $ 774,803 | $ 275,878 | $ 1,050,681 | |
| 2019 | 9 | 361.75 | 275.98 | 1.70 | 0.73 | $ 613,756 | $ 201,958 | $ 815,714 | |
| 2019 | 10 | 340.46 | 278.06 | 1.71 | 0.73 | $ 583,345 | $ 202,210 | $ 785,555 | |
| 2019 | 11 | 332.97 | 289.47 | 1.95 | 0.84 | $ 650,385 | $ 243,883 | $ 894,269 | |
| 2019 | 12 | 387.35 | 305.33 | 2.35 | 1.09 | $ 909,631 | $ 334,201 | $ 1,243,831 | |
| 2020 | 1 | 372.06 | 317.55 | 4.16 | 3.11 | $ 1,548,616 | $ 989,137 | $ 2,537,753 | |
| 2020 | 2 | 325.31 | 278.30 | 3.56 | 2.72 | $ 1,158,891 | $ 757,797 | $ 1,916,688 | |
| 2020 | 3 | 329.62 | 283.54 | 2.42 | 1.77 | $ 798,131 | $ 500,567 | $ 1,298,698 | |
| 2020 | 4 | 315.34 | 245.79 | 2.21 | 1.51 | $ 695,676 | $ 370,383 | $ 1,066,059 | |
| 2020 | 5 | 304.10 | 271.53 | 2.25 | 1.49 | $ 685,665 | $ 404,318 | $ 1,089,983 | |
| 2020 | 6 | 378.78 | 290.11 | 2.35 | 1.56 | $ 889,303 | $ 452,314 | $ 1,341,617 | |
| 2020 | 7 | 458.09 | 340.76 | 3.05 | 1.73 | $ 1,395,280 | $ 591,009 | $ 1,986,289 | |
| 2020 | 8 | 379.32 | 342.22 | 2.62 | 1.67 | $ 994,384 | $ 569,899 | $ 1,564,283 | |
| 2020 | 9 | 357.84 | 273.00 | 2.20 | 1.53 | $ 787,695 | $ 417,198 | $ 1,204,894 | |
| 2020 | 10 | 336.78 | 275.05 | 2.22 | 1.52 | $ 748,666 | $ 417,718 | $ 1,166,384 | |
| 2020 | 11 | 329.37 | 286.34 | 2.53 | 1.76 | $ 834,705 | $ 503,806 | $ 1,338,511 | |
| 2020 | 12 | 383.17 | 302.03 | 3.05 | 2.29 | $ 1,167,422 | $ 690,381 | $ 1,857,802 | |
| 2021 | 1 | 368.85 | 314.82 | 5.12 | 2.88 | $ 1,887,228 | $ 907,553 | $ 2,794,781 | |
| 2021 | 2 | 322.51 | 275.90 | 4.38 | 2.52 | $ 1,412,287 | $ 695,294 | $ 2,107,581 | |
| 2021 | 3 | 326.78 | 281.09 | 2.98 | 1.63 | $ 972,645 | $ 459,281 | $ 1,431,926 | |
| 2021 | 4 | 312.63 | 243.67 | 2.71 | 1.39 | $ 847,788 | $ 339,834 | $ 1,187,623 | |
| 2021 | 5 | 301.48 | 269.19 | 2.77 | 1.38 | $ 835,588 | $ 370,970 | $ 1,206,559 | |
| 2021 | 6 | 375.51 | 287.61 | 2.89 | 1.44 | $ 1,083,753 | $ 415,007 | $ 1,498,760 | |
| 2021 | 7 | 454.15 | 337.82 | 3.74 | 1.61 | $ 1,700,364 | $ 542,263 | $ 2,242,627 | |
| 2021 | 8 | 376.05 | 339.28 | 3.22 | 1.54 | $ 1,211,810 | $ 522,894 | $ 1,734,704 | |
| 2021 | 9 | 354.75 | 270.65 | 2.71 | 1.41 | $ 959,928 | $ 382,788 | $ 1,342,717 | |
| 2021 | 10 | 333.88 | 272.68 | 2.73 | 1.41 | $ 912,365 | $ 383,265 | $ 1,295,630 | |
| 2021 | 11 | 326.53 | 283.87 | 3.12 | 1.63 | $ 1,017,217 | $ 462,253 | $ 1,479,470 | |
| 2021 | 12 | 379.86 | 299.43 | 3.75 | 2.12 | $ 1,422,683 | $ 633,438 | $ 2,056,122 | |
| 2022 | 1 | 366.27 | 312.61 | 5.19 | 2.65 | $ 1,899,969 | $ 829,022 | $ 2,728,991 | |
| 2022 | 2 | 320.25 | 273.97 | 4.44 | 2.32 | $ 1,421,822 | $ 635,130 | $ 2,056,952 | |
| 2022 | 3 | 324.49 | 279.13 | 3.02 | 1.50 | $ 979,212 | $ 419,539 | $ 1,398,751 | |
| 2022 | 4 | 310.44 | 241.97 | 2.75 | 1.28 | $ 853,512 | $ 310,428 | $ 1,163,941 | |
| 2022 | 5 | 299.37 | 267.30 | 2.81 | 1.27 | $ 841,229 | $ 338,870 | $ 1,180,100 | |
| 2022 | 6 | 372.88 | 285.60 | 2.93 | 1.33 | $ 1,091,069 | $ 379,097 | $ 1,470,166 | |
| 2022 | 7 | 450.97 | 335.46 | 3.80 | 1.48 | $ 1,711,844 | $ 495,341 | $ 2,207,185 | |
| 2022 | 8 | 373.42 | 336.90 | 3.27 | 1.42 | $ 1,219,991 | $ 477,648 | $ 1,697,640 | |
| 2022 | 9 | 352.27 | 268.75 | 2.74 | 1.30 | $ 966,409 | $ 349,665 | $ 1,316,075 | |
| 2022 | 10 | 331.54 | 270.77 | 2.77 | 1.29 | $ 918,525 | $ 350,101 | $ 1,268,626 | |
| 2022 | 11 | 324.25 | 281.88 | 3.16 | 1.50 | $ 1,024,085 | $ 422,254 | $ 1,446,339 | |
| 2022 | 12 | 377.20 | 297.33 | 3.80 | 1.95 | $ 1,432,289 | $ 578,627 | $ 2,010,916 | |

[1] Source: Rhode Island monthly energy demand sourced from ISO-NE's 2015 Capacity, Energy, Loads, and Transmission Report (CELT Report), and shown net of solar PV and demand response.

## Rhode Island Capacity Cost Savings from Clear River

*nominal $*

| | Demand Figures (MW)[1] | | | | | |
|---|---|---|---|---|---|---|
| | RI Peak Demand | ISO-NE Cleared Capacity | ISO-NE Peak Load | RI Peak Demand (MW), With Reserve Margin Proportionate to ISO Reserve Margin | FCA Rest Of Pool (ROP) Capacity Compensation Differential ($/kW-mo) | Capacity Cost Savings to Ratepayer ($/year) |
| | | | | | *Calculated as ROP calendar year-adjusted capacity price "Without CREC" less the same price "With CREC"* | *Calculated as RI peak demand with reserve margin * ROP capacity price differential projected "With CREC" vs "Without CREC"* |
| **Year** | | | | | | |
| 2019 | 1,859 | 36,789 | 30,230 | 2,262 | $2.56 | $69,558,347 |
| 2020 | 1,856 | 36,877 | 30,575 | 2,239 | $3.59 | $96,403,279 |
| 2021 | 1,861 | 36,948 | 30,900 | 2,225 | $1.74 | $46,434,952 |
| 2022 | 1,863 | 37,038 | 31,230 | 2,209 | $0.22 | $5,914,198 |

[1] Source: Rhode Island and ISO-NE peak demand (MW) figures sourced from ISO-NE's 2015 Capacity, Energy, Loads, and Transmission Report (CELT Report)

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**INVENERGY THERMAL DEVELOPMENT LLC'S REPONSES TO CONSERVATION LAW FOUNDATION'S FIRST DATA REQUEST**

1.4: This Data Request pertains to PowerPoint Slide 24 used by Invenergy at the January 12, 2016 Preliminary Hearing, specifically the figure of ratepayer savings of $258 million in cumulative savings between 2019 and 2022.

(a) Please confirm that the cumulate savings referred to pertain to: (i) capacity payments, not energy or ancillary services; (ii) ratepayers in the Rhode Island load zone, not rest of pool; and (iii) the ISO-NE Capacity Commitment Periods 10, 11 and 12.

(b) Explain in detail how the $258 million figure was derived, and provide all work-papers used in the calculations.

(c) Identify all inputs into these calculations derived from outside sources, and identify the outside source(s).

(d) For all inputs that were not derived from outside sources (that is, assumptions made by Invenergy), identify the assumption and explain why Invenergy believes the assumption to be reasonable.

(e) Identify the principal person(s) responsible for this calculation.

(f) Identify additional person(s) involved in this calculation and generally the role of each one.

RESPONSE 1.4:[3]

(a) The $258 million is the approximate savings to Rhode Island ratepayers in cumulative energy and capacity costs resulting from the participation of Clear River in the energy and capacity market from 2019 through *2021 (three years)* – note that the question here appears to have a typo when listing 2022 as the end date. The capacity market savings are realized in Forward Capacity Auctions 10, 11 and 12 (partial year given the FCA 12 delivery year is June 2021 through May 2022), as stated.

(b) Calculations utilize the same methodology and assumptions outlined in Request 1-3.

[3] Invenergy incorporates herein the objections to this Data Request, filed on January 15, 2016.

**STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS**

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(c) Calculations utilize the same methodology and assumptions outlined in Request 1-3.

(d) Calculations utilize the same methodology and assumptions outlined in Request 1-3.

(e) This calculation was completed by PA, and primarily Ryan Hardy, Mark Repsher, and Mason Smith.

(f) PA has a team of power market experts in its Global Energy and Utilities practice that contributed to this analysis.

RESPONDENT: Ryan Hardy, Mark Repsher, and Mason Smith, of PA Consulting

DATE: April 14, 2016

INVENERGY THERMAL ENERGY
By its Attorneys,

/s/ Nicole M. Verdi____________________

Alan M. Shoer, Esq. (#3248)
Richard R. Beretta, Jr. Esq. (#4313)
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One Citizens Plaza, 8th Floor
Providence, RI 02903-1345
Tel: 401-274-7200
Fax: 401-751-0604
Dated: April 8, 2016

## CERTIFICATE OF SERVICE

I hereby certify that on April 14, 2016, I delivered a true copy of the foregoing responses to Conservation Law Foundation's Data Requests via electronic mail to the parties on the attached service list.

___/s/ Nicole M. Verdi______________________