ADLER POLLOCK & SHEEHAN P.C.

175 Federal Street

January 28, 2016

Via Electronic Mail and Hand Delivery

Ms. Luly Massaro
Division Clerk
Division of Public Utilities and Carriers
89 Jefferson Boulevard
Warwick, RI 02888

Re: Application of Invenergy Thermal Development LLC's Proposal for Clear River Energy Center: Docket No.: SB – 2015-06

Dear Ms. Massaro:

Enclosed please find an original and ten (10) copies of Invenergy's Responses to Conservation Law Foundation's First Data Request for filing in the above-referenced docket.

Very truly yours,

ALAN M. SHOER
ashoer@apslaw.com

Enclosures

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
ENERGY FACILITY SITING BOARD

IN RE: Application of
Invenergy Thermal Development LLC's
Proposal for Clear River Energy Center

Docket No.: SB – 2015-06

INVENERGY'S RESPONSES TO CONSERVATION LAW FOUNDATION'S FIRST DATA REQUESTS

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:	See attached: Air Dispersion Modeling Report — Clear River Energy Center — Burrillville, Rhode Island
RESPONDENT:	Michael E. Feinblatt, ESS Group
DATE:	January 28, 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

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

www.essgroup.com

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, Illinois 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

TABLE OF CONTENTS

SECTION **PAGE**

TABLE OF CONTENTS (CONTINUED)

TABLES

FIGURES

APPENDICES

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.

---

[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 98th percentile (8th 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.

6.0 REFERENCES

Auer, A. H., 1978. Correlation of Land Use and Cover with Meteorological Anomalies, Journal of Applied Meteorology, 17: 636-643.

Census Bureau, 2015, Website www.census.gov.

National Park Service, 2010. Federal Land Managers' Air Quality Related Values Working Group (FLAG) Phase I Report – Revised 2010. Natural Resource Report NPS/NRPC/NRR-2010/32. Natural Resource Program Center.

RIDEM, 2013. Rhode Island Air Dispersion Modeling Guidelines for Stationary Sources, Revised March 2013. Rhode Island Department of Environmental Management.

RIDEM, 2015a. E-mail communication between Wilfredo Lemus, RIDEM and John Purdum, ESS Group. September 15, 2015.

RIDEM, 2015b. Communication between Wilfredo Lemus, RIDEM and Michael Feinblatt, ESS Group. July 27, 2015.

Siemens Westinghouse Power Corporation, 2004. Survey of Ultra-Trace Metals in Gas Turbine Fuels.

US EPA, 1980. A Screening Procedure for the Impacts of Air Pollution on Plants, Soils and Animals, Document Number EPA-450/2-81-078. Office of Air Quality Planning and Standards, Research Triangle Park, NC. December 12, 1980.

US EPA, 1985. Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (revised), Document Number EPA-450/4-80-023R. Office of Air Quality Planning and Standards, Research Triangle Park, NC. June 1985.

US EPA, 2009. AERMOD Implementation Guide. Office of Air Quality Planning and Standards, Research Triangle Park, NC. March 19, 2009.

US EPA, 2010. General Guidance for Implementing the 1-hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO_2 Significant Impact Level. Office of Air Quality Planning and Standards, Research Triangle Park, NC. June 28, 2010.

US EPA, 2010. Guidance Concerning the Implementation of the 1-hour NO_2 NAAQS for the Prevention of Significant Deterioration Program. Office of Air Quality Planning and Standards, Research Triangle Park, NC. June 29, 2010.

US EPA, 2011. Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard. Office of Air Quality Planning and Standards, Research Triangle Park, NC. March 1, 2011.

US EPA, 2014. Guidance for PM2.5 Permit Modeling. Office of Air Quality Planning and Standards, Research Triangle Park, NC. May 20, 2014.

Tables

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):	Hazardous Air Pollutant (Yes/No)	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:		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 ($\mu g/m^3$) Modeled @ 1 g/s													Concentration ($\mu g/m^3$) 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 ($\mu g/m^3$)													Concentration ($\mu g/m^3$)					
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 (µg/m^3)	2012-2014 Monitoring Value
NO_2	1-hour	Rockefeller Library, Brown University (Providence)	80	3-year average of 98th 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 99th 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 98th 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/m^3)						Background (µg/m^3)	Total Impact (µg/m^3)	Sensitivity Screening Levels (µg/m^3)[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)

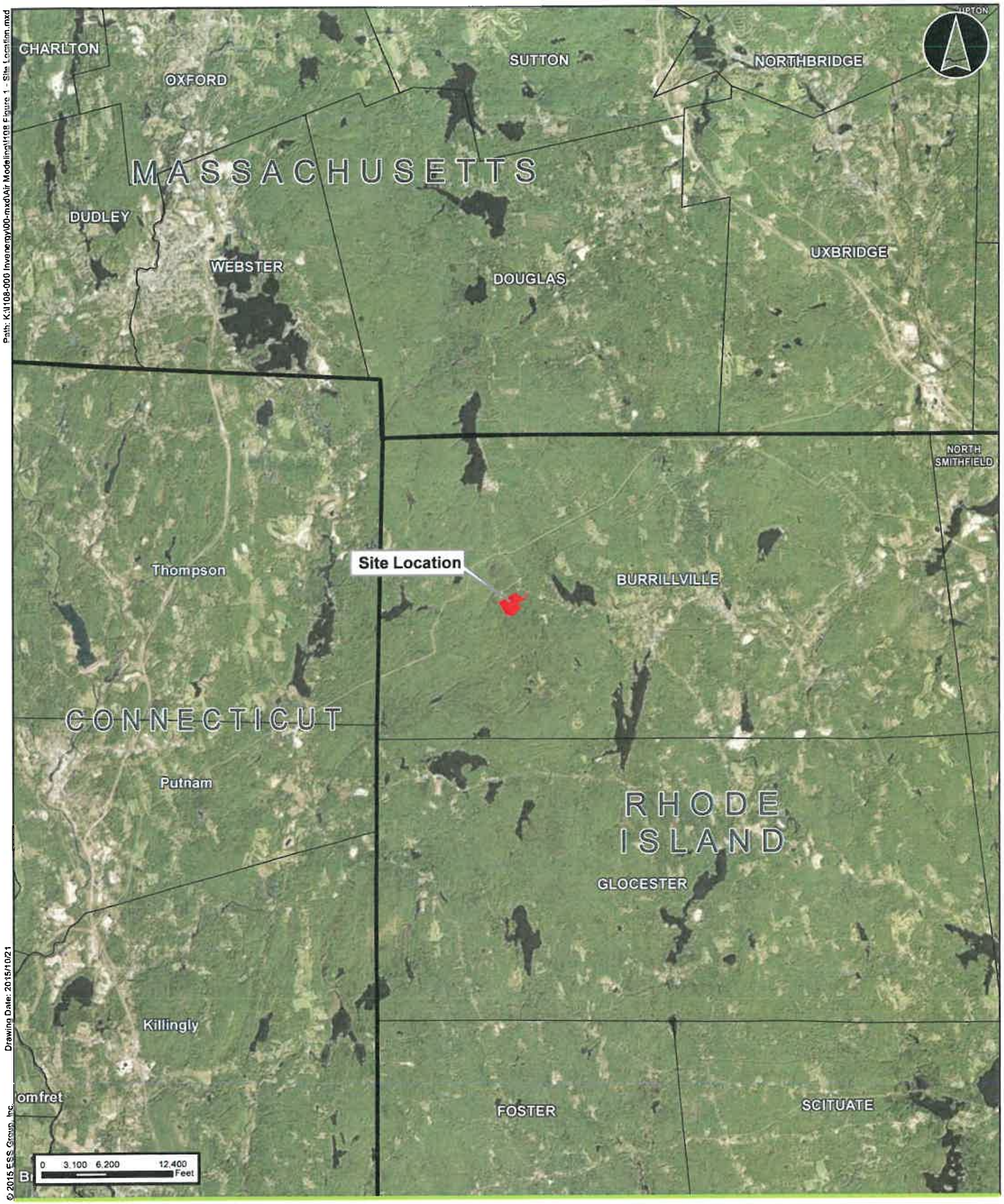
Table 18. Startup/Shutdown NAAQS Compliance Summary

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

www.essgroup.com



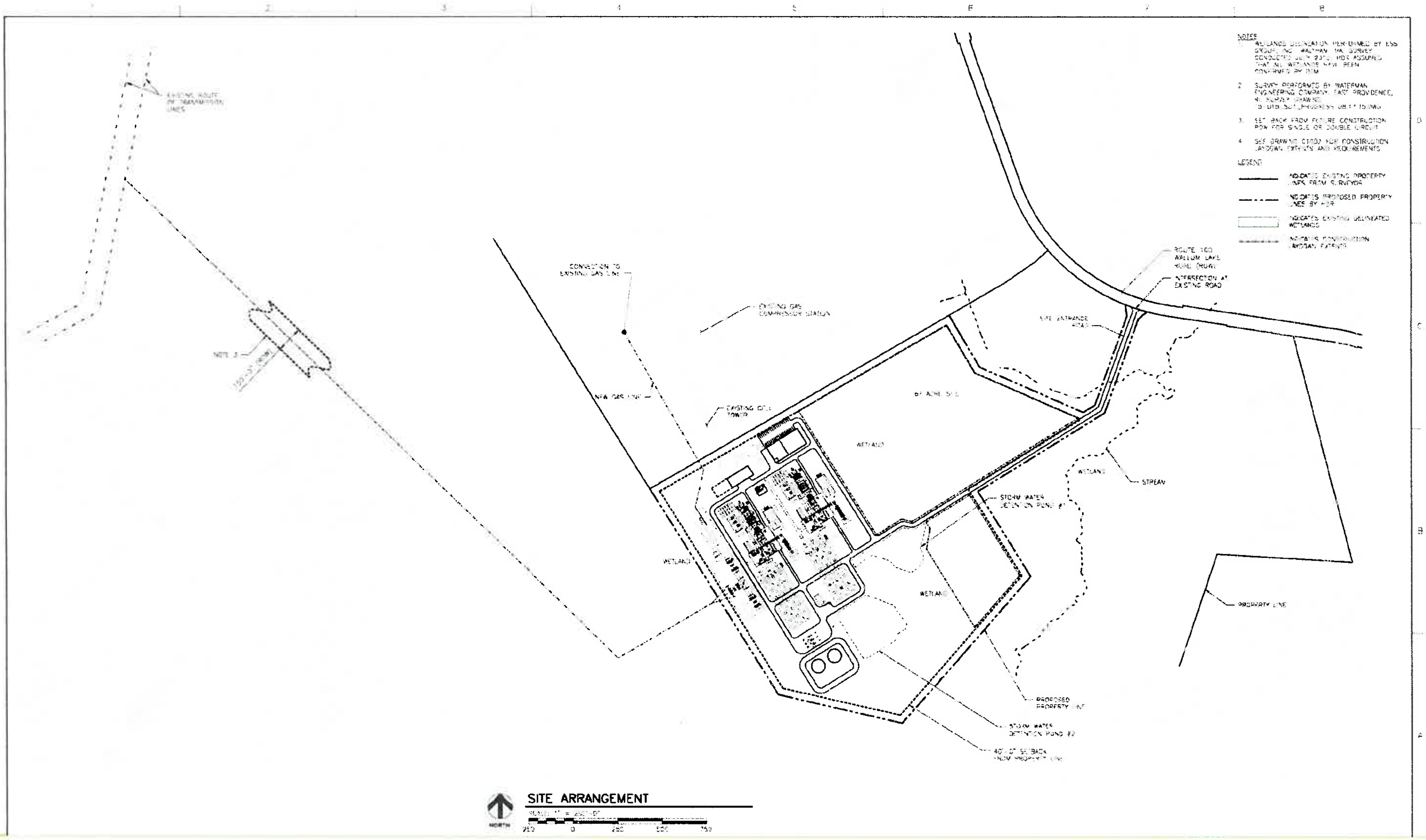
Clear River Energy Center
Burrillville, Rhode Island

1 inch = 12,500 feet

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

Site Location

Figure 1

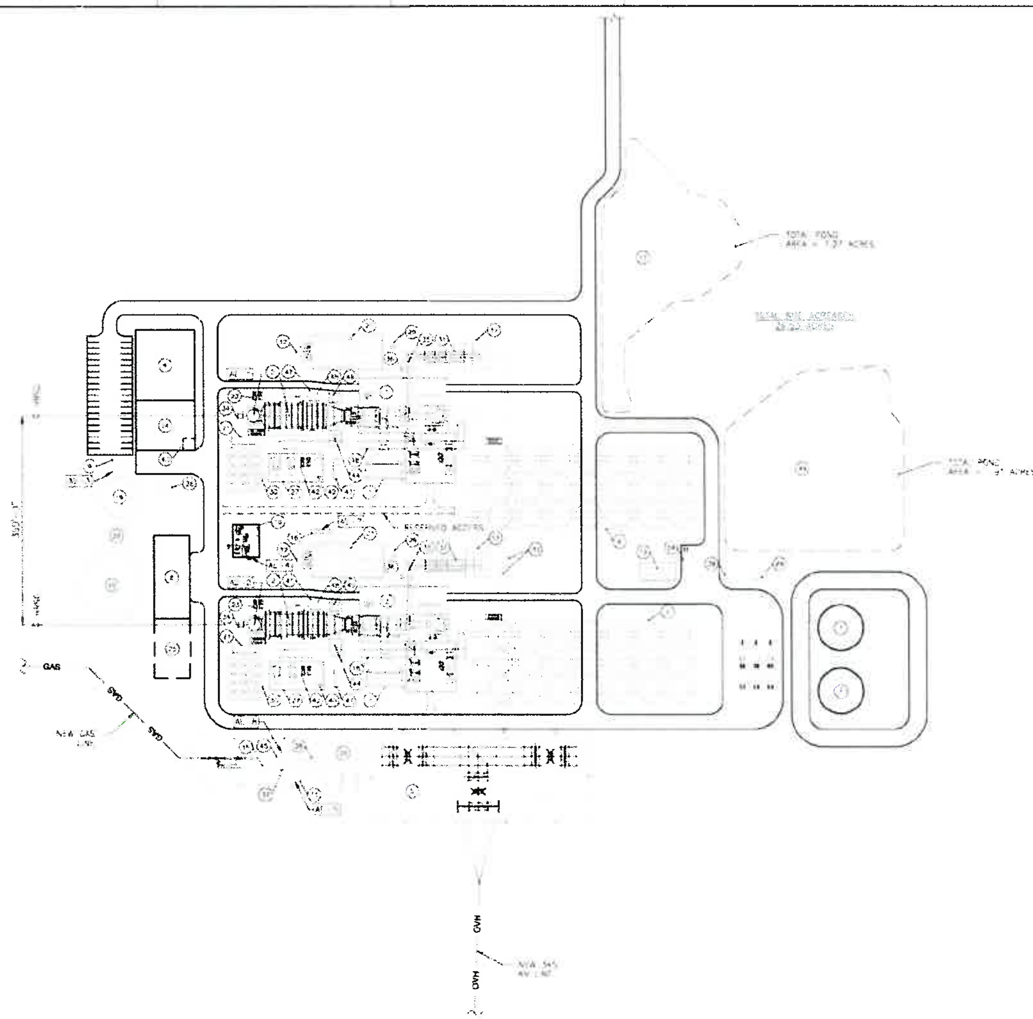


Clear River Energy Center
Burrillville, Rhode Island

Source: HDR
Scale: As Shown

Site Layout

Figure 2



GENERAL ARRANGEMENT

SCALE: 1" = 100'-0"

BUILDING AND EQUIPMENT LIST

NO.	NAME	SIZE DIMENSIONS (IN FEET) LENGTH	WIDTH	HEIGHT
1	COMBUSTION TURBINE INLET FILTER	60	27	80
2	HEAT RECOVERY STEAM GENERATOR	102	44	118
3	TURBINE BUILDING	152	84	80
4	ADMINISTRATION/CONTROL BUILDING	140	100	25
5	SWITCHYARD	367	158	[illegible]
6	AIR-COOLED CONDENSER	356	150	120
7	FUEL OIL STORAGE TANK	77ø		30
8	WATER TREATMENT BUILDING	140	40	35
9	FIRE PUMP BUILDING	25	20	15
10	AUXILIARY BOILER BUILDING	54	45	35
11	CTG FUEL GAS DEW POINT HEATER	45	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	GSU TRANSFORMER	46	27	15
18	PIPE RACK	311	15	30
19	FIRE/SERVICE WATER TANK	68ø		[illegible]
20	DEMINERALIZED WATER STORAGE TANK	[illegible]		[illegible]
21	BOP ELECTRICAL	41	19	25
22	WASTE WATER TANK	[illegible]		[illegible]
23	HRSG LTE RECIRCULATION PUMPS	16	16	5
24	HYDROGEN TUBE TRAILER			[illegible]
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]	[illegible]	15
32	SUS TRANSFORMERS	[illegible]	[illegible]	12
33	345 KV UNDERGROUND DUCT BANK		5	
34	CEMS SHELTER	9	8	12
35	GENERATOR CIRCUIT BREAKER	24.5	9	20
36	[illegible] EXCITATION CONTAINER	[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	[illegible]	[illegible]
40	SAMPLE PANEL ENCLOSURE	31	9	12
41	FUEL GAS PERFORMANCE HEATER	34	8.5	10
42	CCCW PUMPS	[illegible]	[illegible]	[illegible]
43	WORKSHOP	20	20	25
44	BLOWDOWN TANK	10ø		12
45	LP FUEL GAS DEW POINT HEATER	16	9	5
46	WATER WASH DRAIN TANK	11	12	[illegible]
47	DUCT BURNER FUEL SKID	16	8.5	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	N4,649,[illegible]	E271,822
AE-2	HRSG EXHAUST STACK 2	N4,649,600	E271,730
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	N4,648,595	E271,788
AE-8	LP FUEL GAS DEW POINT HEATER	N4,649,[illegible]	E271,678

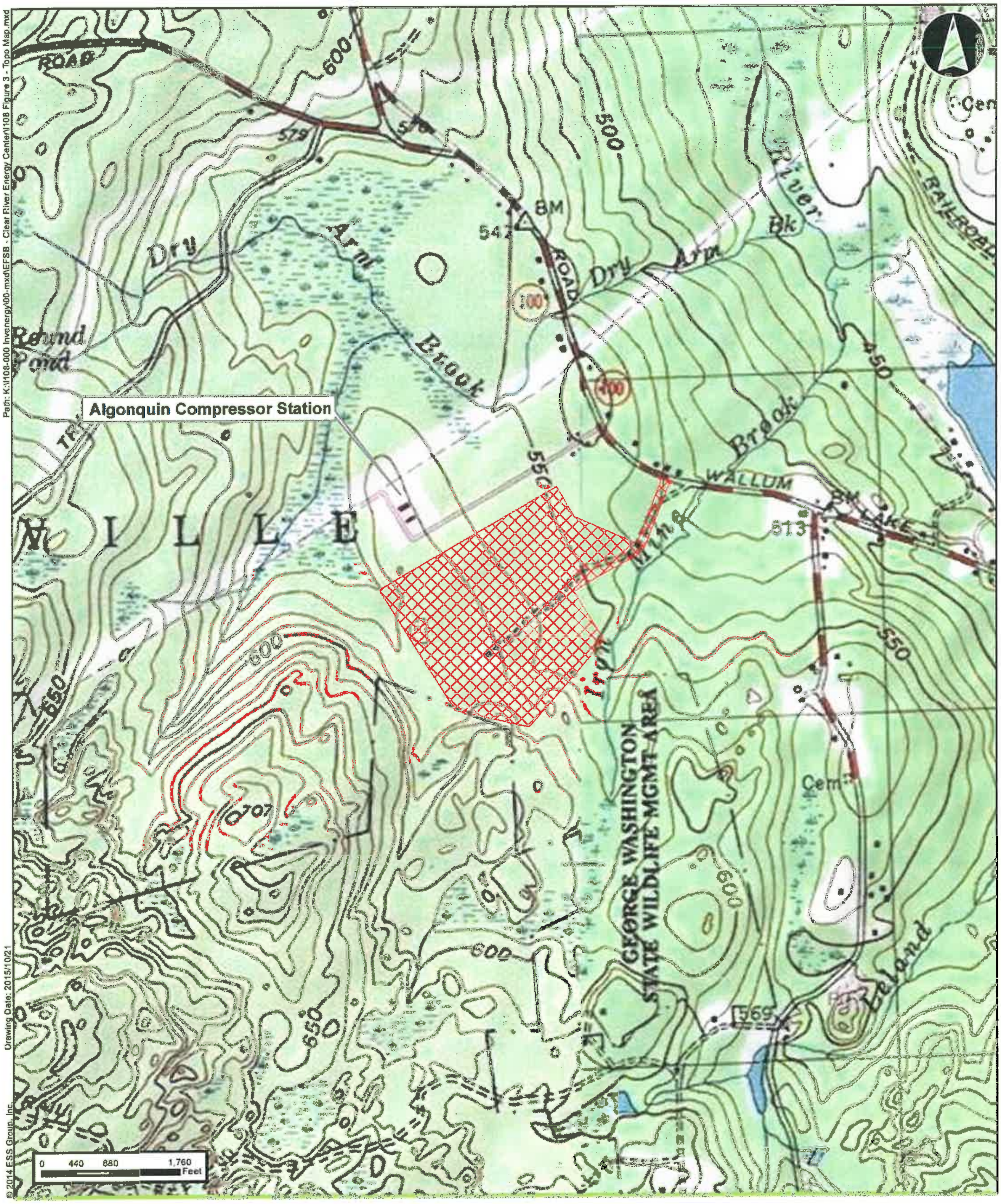
* UTM COORDINATES ARE FOR ZONE 19 [illegible]

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

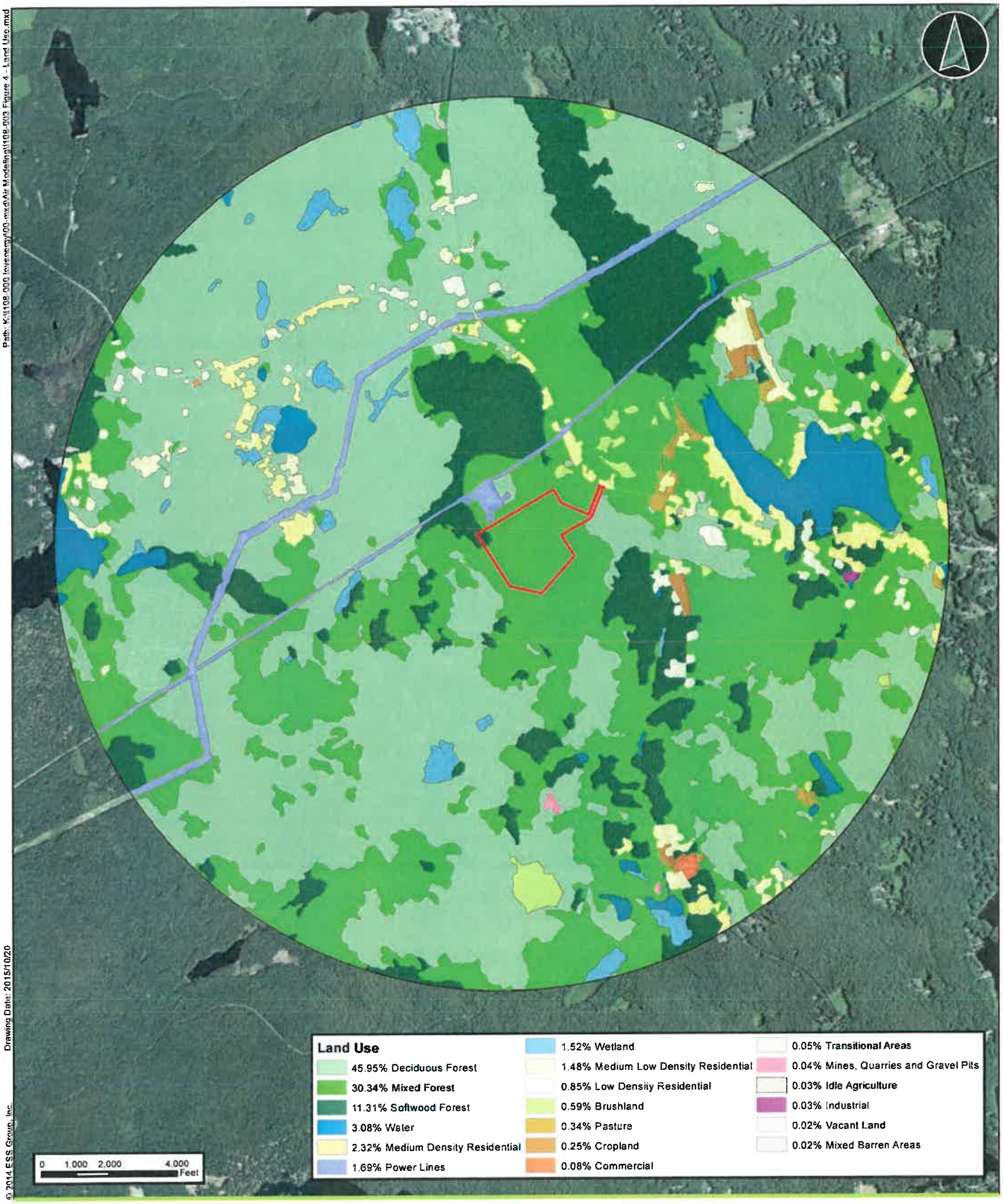
Source: 1) USGS, Topo Map, 2013
2) ESS, Site Location, 2014

Legend

Property Line

Topographic Map

Figure 4



Path: K:\1108-000 Invenergy\00-mxd\Air Modeling\1108-003 Figure 4 - Land Use.mxd

Drawing Date: 2015/10/20

ess group

Clear River Energy Center

Burrillville, Rhode Island

Surrounding Land Use (3 km)

1 inch = 3,863 feet

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

Figure 5

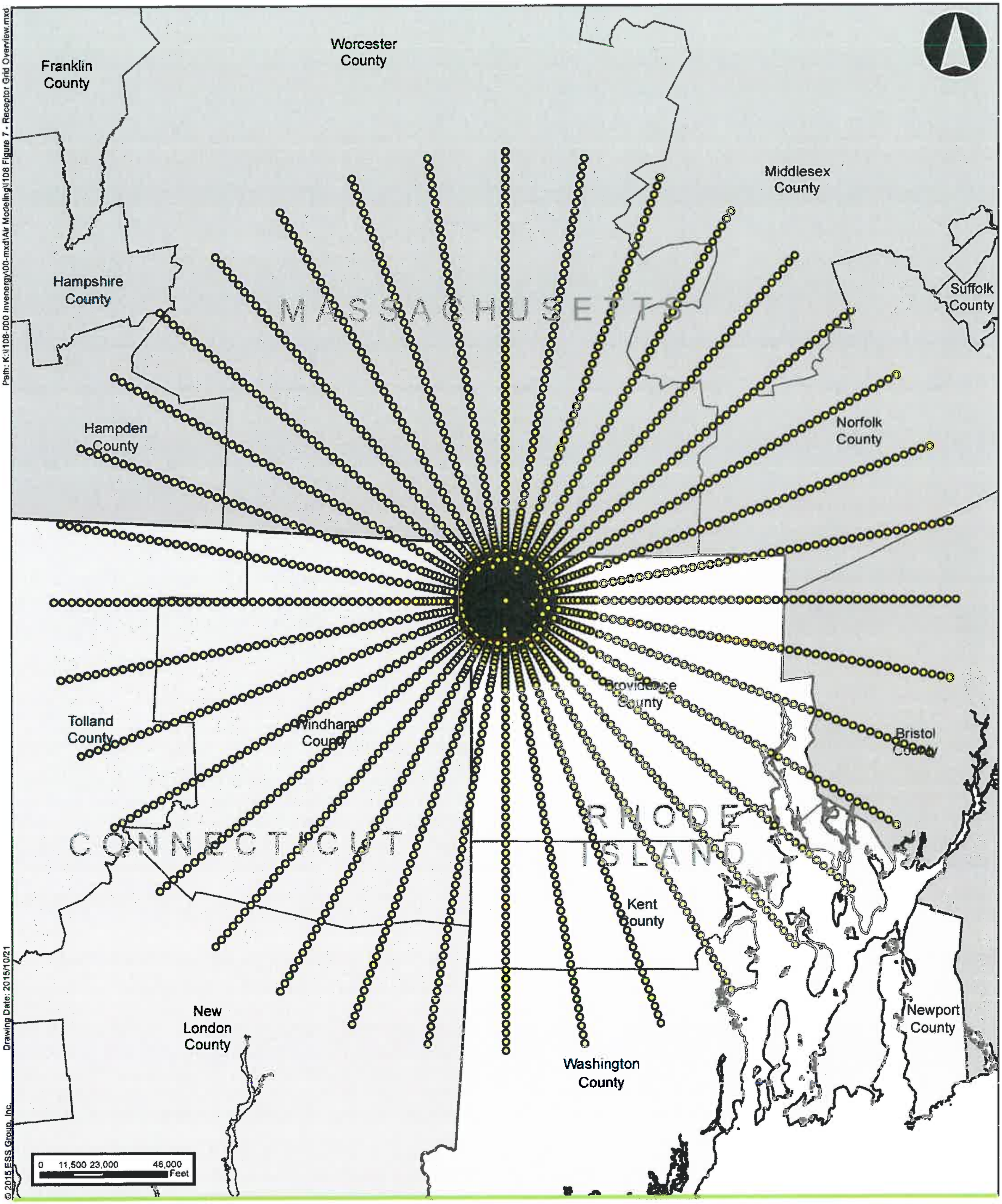
Clear River Energy Center
Burrillville, Rhode Island

1 inch = 1,000 feet

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

Receptor Grid

Figure 6



Path: K:\108-000 Invenergy\00-mxd\Air Modeling\108 Figure 7 - Receptor Grid Overview.mxd

Drawing Date: 2015/10/21

ess group environmental consulting & engineering services

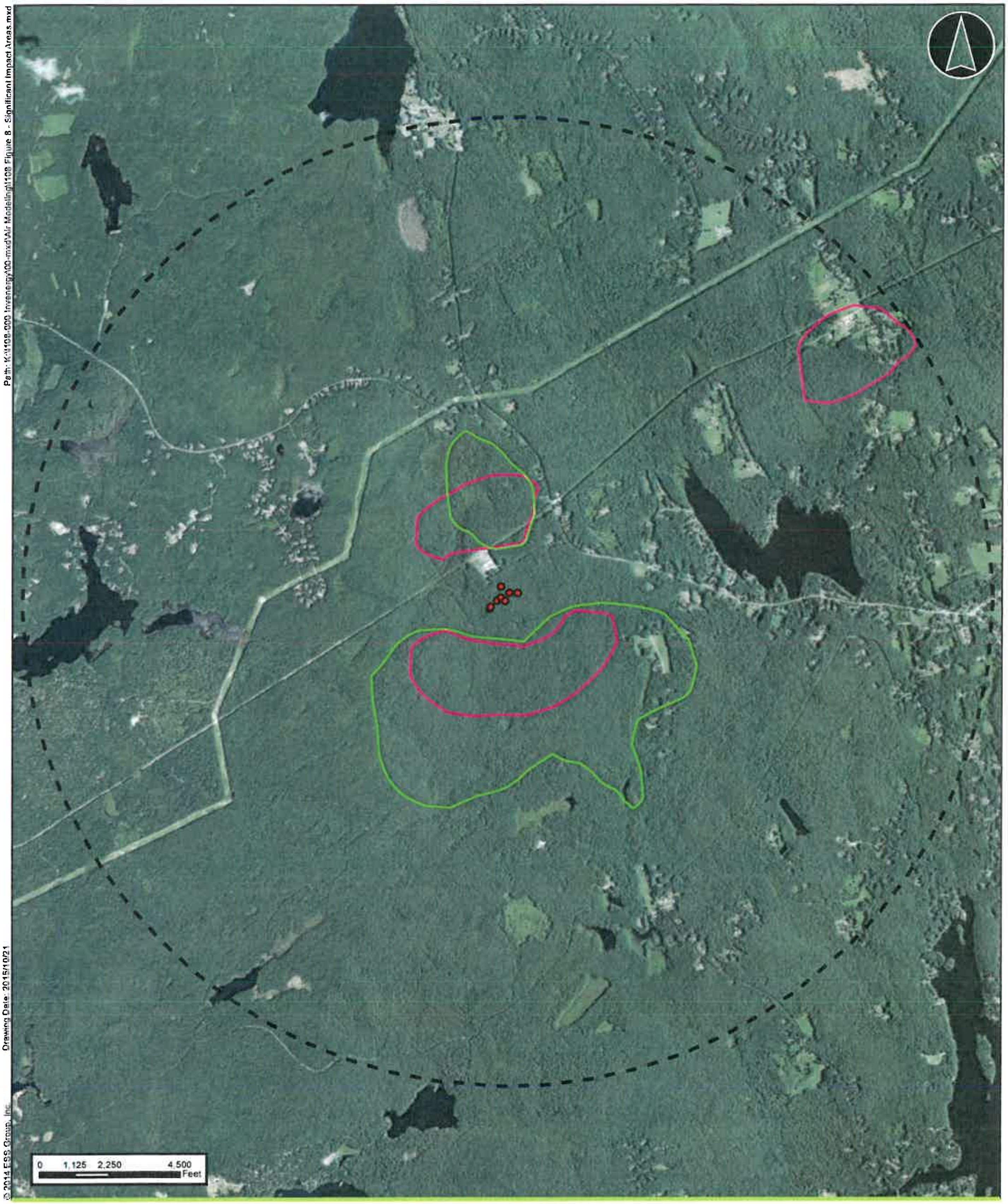
Clear River Energy Center
Burrillville, Rhode Island

Receptor Grid Overview

1 inch = 47,500 feet

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

Figure 7



Clear River Energy Center
Burrillville, Rhode Island

1 inch = 4,238 feet

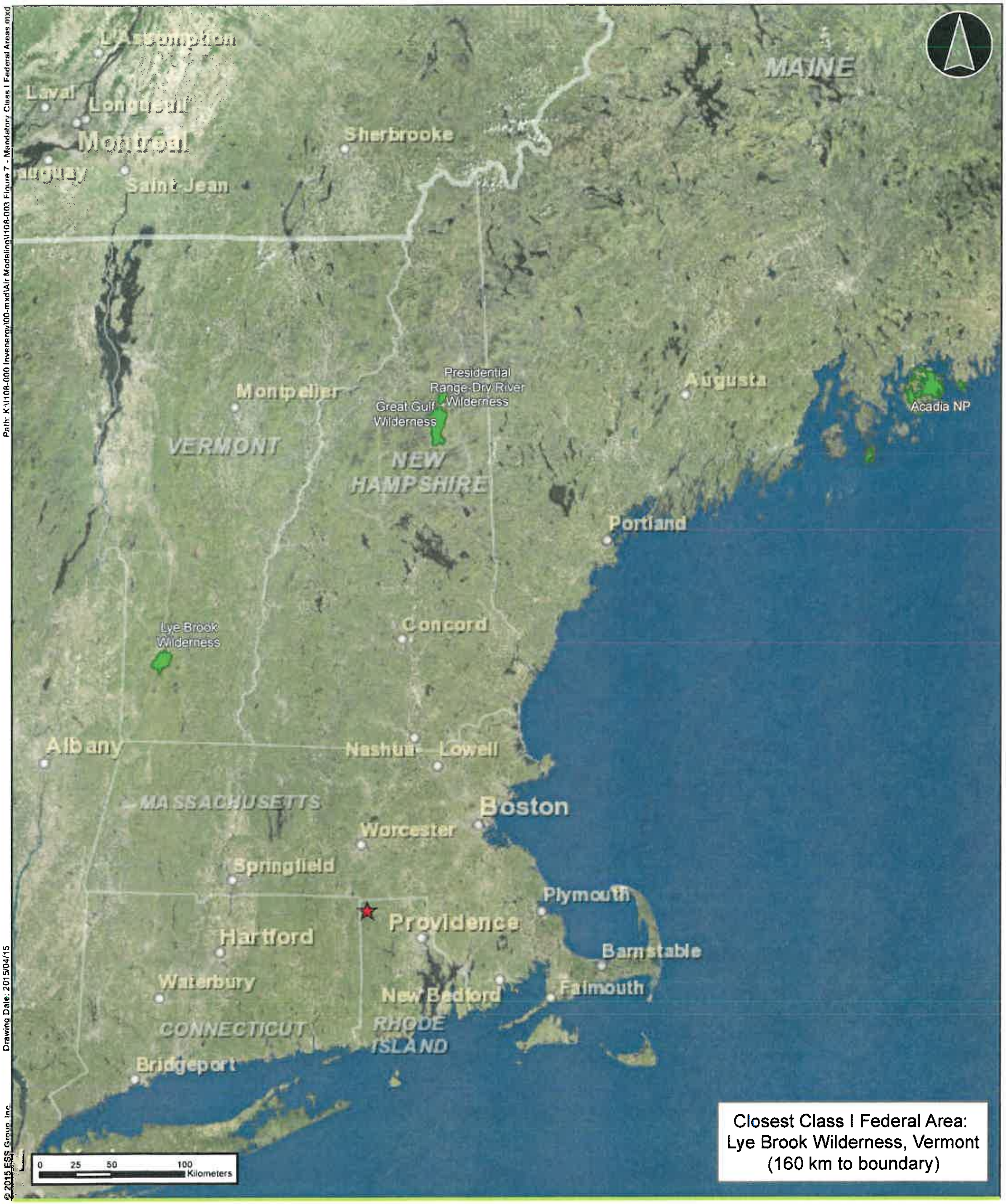
Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014

Legend

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

Significant Impact Area

Figure 8



Path: K:\I108-000 Invenergy\00-mxd\Air Modeling\I108-003 Figure 7 - Mandatory Class I Federal Areas.mxd

Drawing Date: 2015/04/15

ess group

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	29,667.60	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	2.4	3
Acetaldehyde	4.0E-05	lb/MMBtu	0.27	2,187.38	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	11,934.98	90.00%	1.48E-01	1,193	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 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	1,163.64	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	202.00	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	11.31	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	5.78	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%	3.38E-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	35,235.69	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	2.5E-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	18,185.16	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:	4,576	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	3.1E-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	6.93E-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	3.69E-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
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

1-Hour NO2

Property Line

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

Appendix B

Sheet 1 of 6

Path: K:\108-000 Invenergy\00-mxd\Air Modeling\108 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

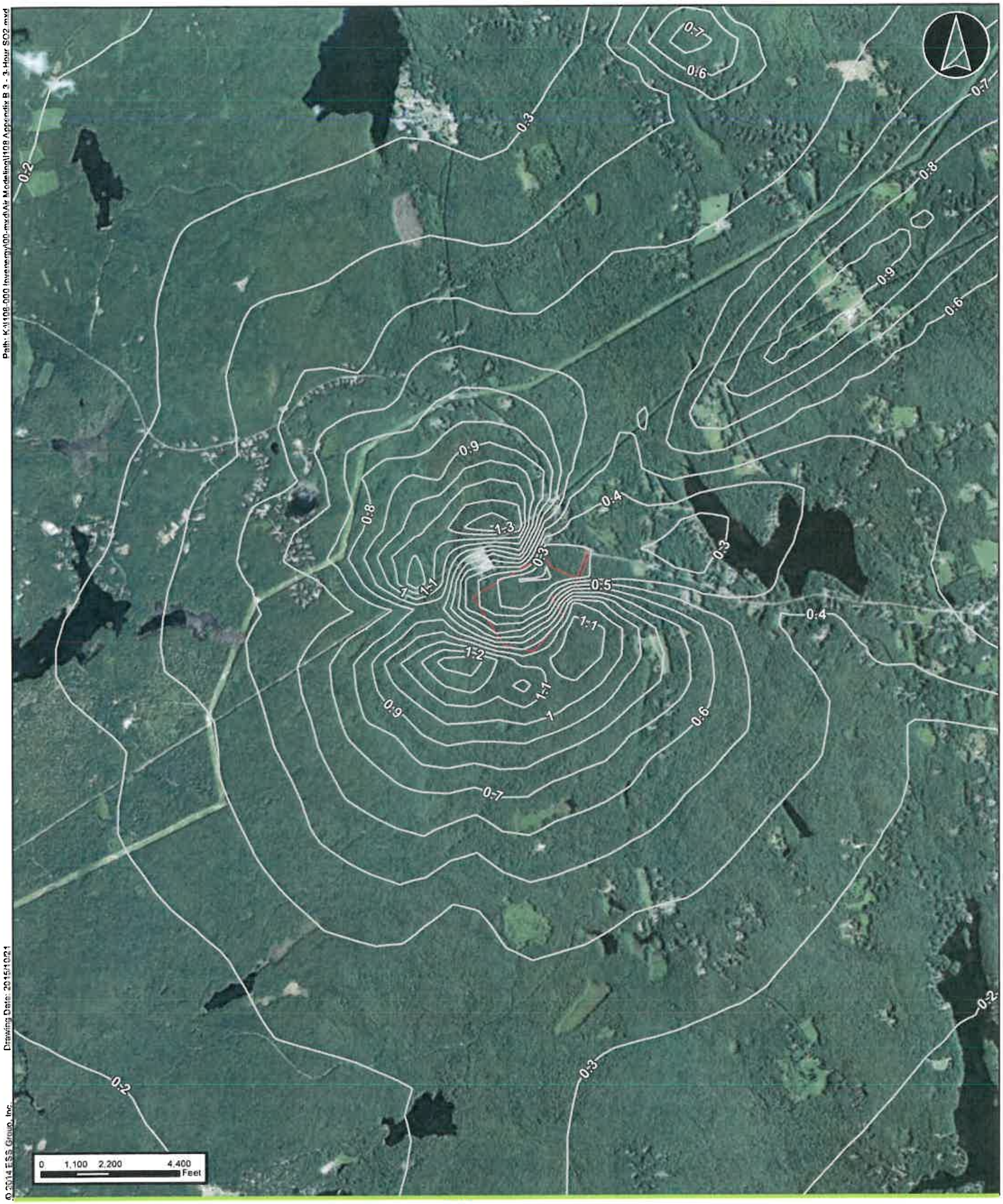
Legend

Annual NO2

Property Line

Modeling Result Isopleths (ug/m3)
Annual NO2

Appendix B
Sheet 2 of 6



Path: K:\108-000 Invenergy\00-mxd\Air Modeling\108 Appendix B 3 - 3-Hour SO2.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

3-Hour SO2

Property Line

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

Appendix B

Sheet 3 of 6

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

24-Hour PM10

Property Line

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

Appendix B

Path: K:\1108-000 Invenergy\00-mxd\Air Modeling\1108 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

Path: K:\108-000 Invenergy\00-mxd\Air Modeling\108 Appendix B 6 - 24-Hour PM25.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

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)

www.essgroup.com

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
ENERGY FACILITY SITING BOARD

IN RE: Application of
Invenergy Thermal Development LLC's
Proposal for Clear River Energy Center

Docket No.: SB – 2015-06

INVENERGY'S RESPONSES TO CONSERVATION LAW FOUNDATION'S FIRST DATA REQUESTS

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:	See attached: Health Risk Assessment Protocol — Clear River Energy Center — Burrillville, Rhode Island
RESPONDENT:	Michael E. Feinblatt, ESS Group
DATE:	January 28, 2016

ESS group

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:

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

ess group

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.

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. 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:\1108-000 Invenergy\00-mxd\1108 Figure 1 - Aerial Photo.mxd

Drawing Date: 2015/06/22

Clear River Energy Center

Burrillville, Rhode Island

1 inch = 1,667 feet

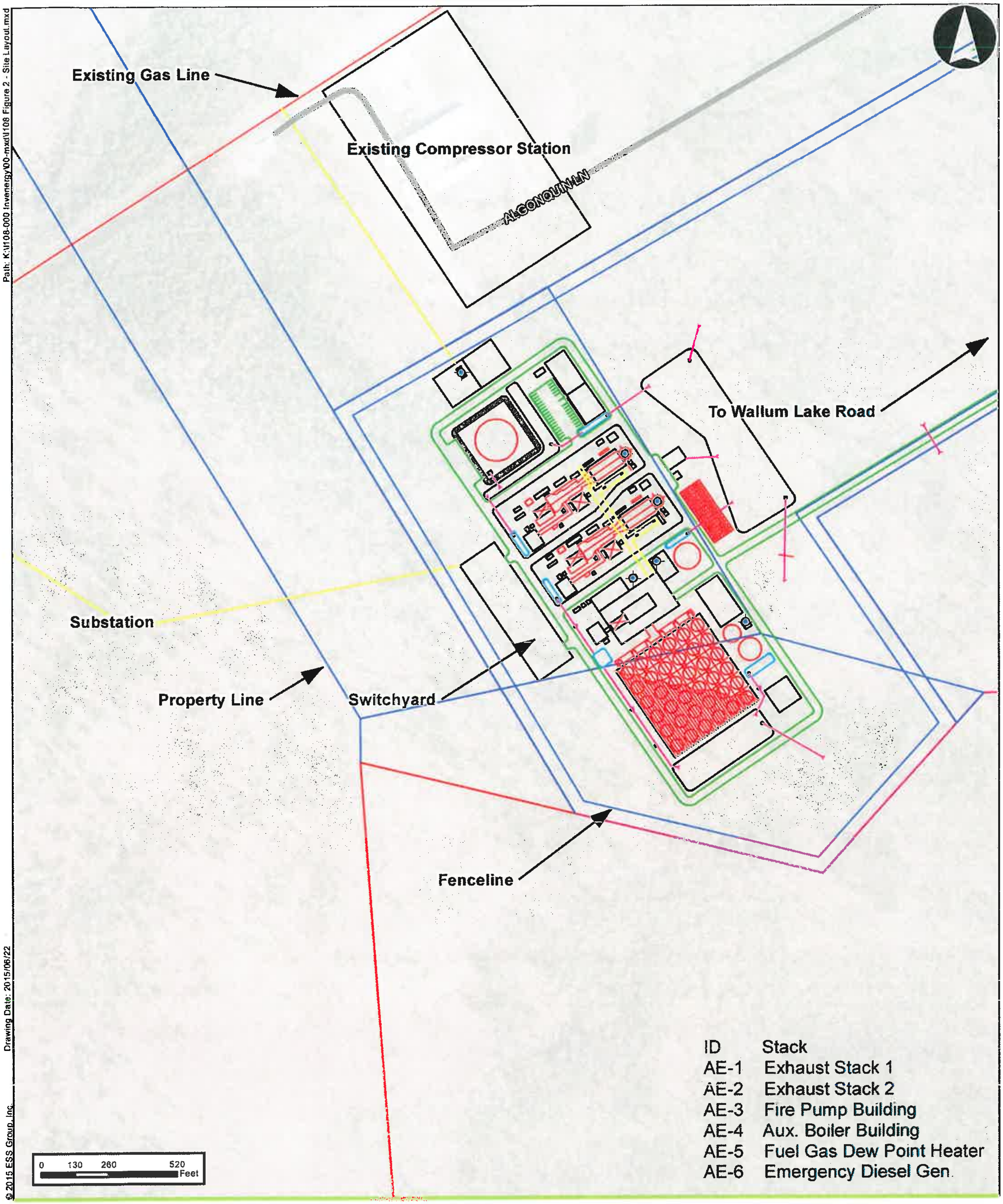
Source: 1) ESRI, Imagery, 2014
2) ESS, Site Location, 2014
3) RIGIS, Roads, 2013

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

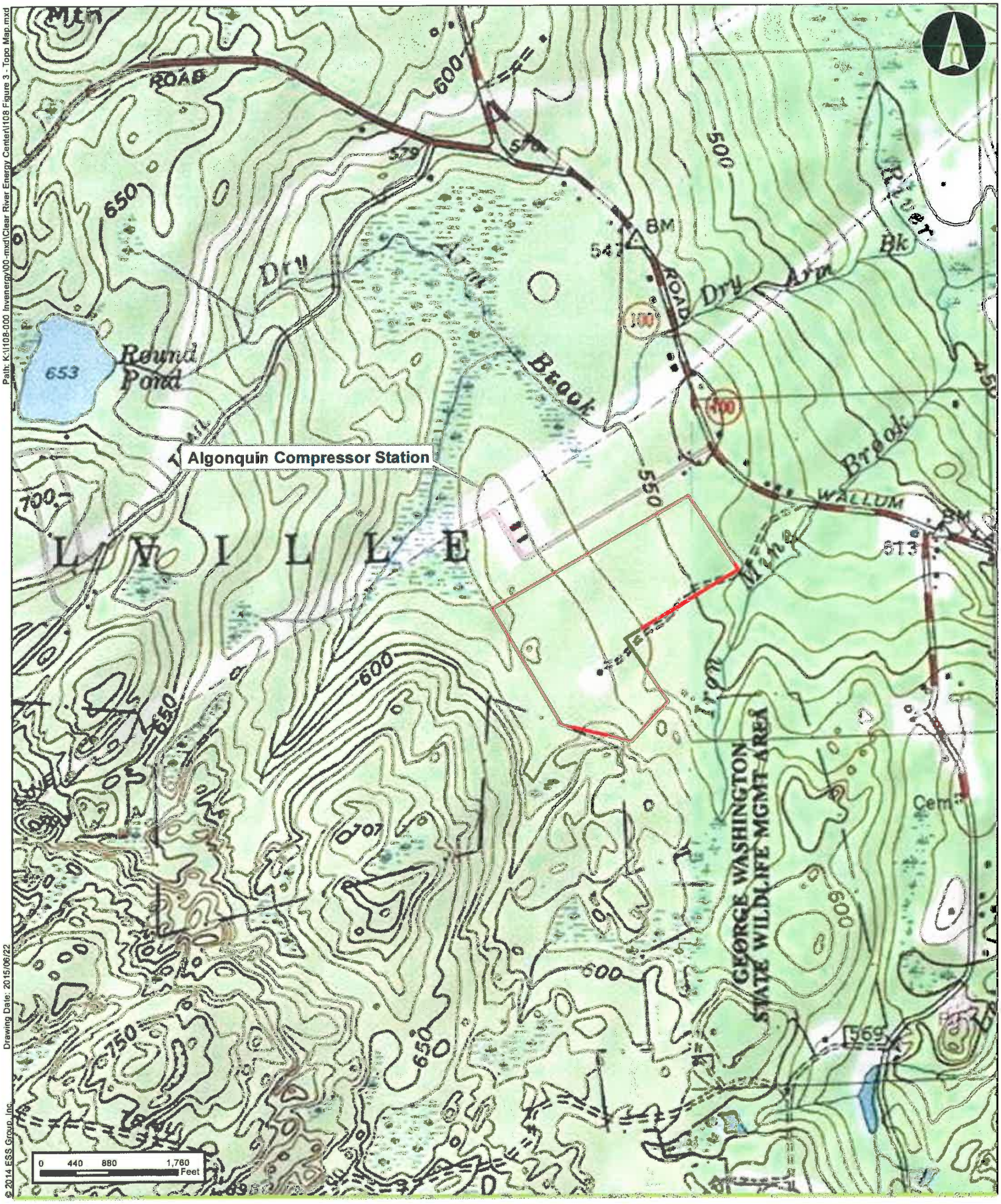
Clear River Energy Center
Burrillville, Rhode Island

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

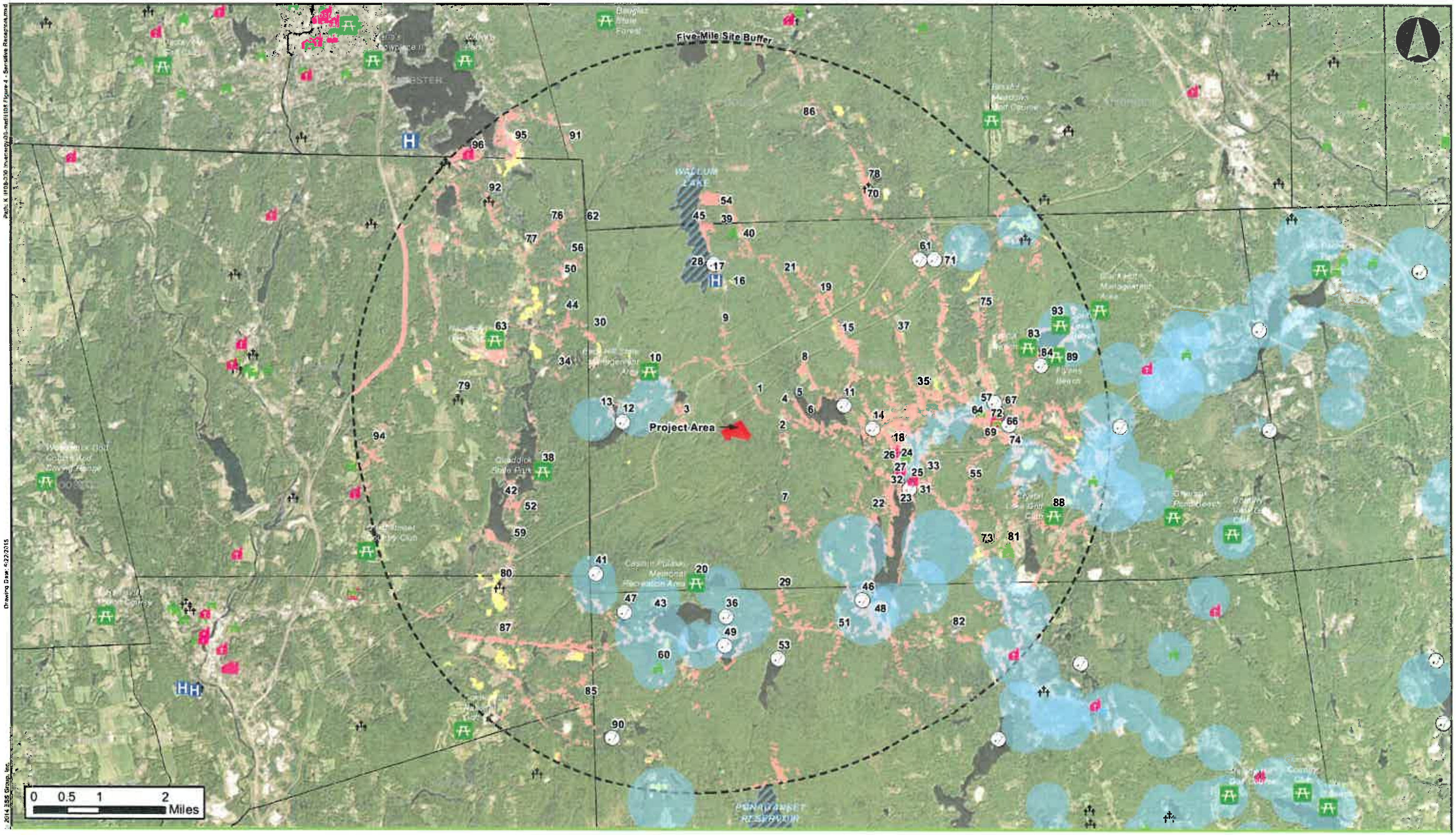
Source: 1) USGS, Topo Map, 2013
2) ESS, Site Location, 2014

Topographic Map

Legend

Project Area

Figure 3



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

Legend

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

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 MQ lb/yr
Ammonia	0.0037	lb/MMBtu	9.2	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	23.46	90.00%	2.92E-04	2.3	3
Acetaldehyde	4.0E-05	lb/MMBtu	0.27	2,183.38	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	3.2E-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	7.2E-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 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	1,164.64	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	202.00	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	11.31	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	0.8
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	50.03	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	2.98	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	35,235.69	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	2.5E-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	18,186.16	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 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	8.4E-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	1.94E+03	NA
Fluoranthene	2.9E-09	lb/MMBtu	4.1E-07	1.89E-03	NA
Fluorene	2.8E-06	lb/MMBtu	3.9E-04	1.80E+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	2.31E+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 emissions 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	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
ENERGY FACILITY SITING BOARD

IN RE: Application of
Invenergy Thermal Development LLC's
Proposal for Clear River Energy Center

Docket No.: SB – 2015-06

INVENERGY'S RESPONSES TO CONSERVATION LAW FOUNDATION'S FIRST DATA REQUESTS

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

---

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

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 River" and "Without Clear River").

- Please see the accompanying worksheet calculations.

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

(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).

(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

INVENERGY'S RESPONSES TO CONSERVATION LAW FOUNDATION'S FIRST DATA REQUESTS

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: January 28, 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]					
Year	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"*
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)

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
ENERGY FACILITY SITING BOARD

IN RE: Application of
Invenergy Thermal Development LLC's
Proposal for Clear River Energy Center

Docket No.: SB – 2015-06

INVENERGY'S RESPONSES TO CONSERVATION LAW FOUNDATION'S FIRST DATA REQUESTS

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:[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.

(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: January 28, 2016

INVENERGY THERMAL ENERGY
By its Attorneys,

____

Alan M. Shoer, Esq. (#3248)
Richard R. Beretta, Jr. Esq. (#4313)
Nicole Verdi (#9370)
ADLER POLLOCK & SHEEHAN, P.C.
One Citizens Plaza, 8th Floor
Providence, RI 02903-1345
Tel: 401-274-7200
Fax: 401-751-0604
Dated: January 28, 2016

CERTIFICATE OF SERVICE

I hereby certify that on January 28th, 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.

____