STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL

PETITION OF DOOSAN FUEL CELL, AMERICA, INC. FOR A DECLARATORY RULING FOR THE LOCATION AND CONSTRUCTION OF A 9.66 MEGAWATT FUEL CELL GRID-SIDE DISTRIBUTED ENERGY RESOURCE AT 600 IRANISTAN AVE., BRIDGEPORT, CONNECTICUT	:	PETITION NO.

PETITION OF DOOSAN FUEL CELL AMERICA, INC. AS AN AGENT FOR A DECLARATORY RULING

Pursuant to Conn. Gen. Stat. §§ 4-176 and 16-50k(a) and Conn. Agencies Regs. § 16-50j-38 et seq., Doosan Fuel Cell America, Inc. ("Doosan"), as an agent for and behalf of its Customer, NuPower Bridgeport FC, LLC ("NuPower"), requests that the Connecticut Siting Council ("Council") approve by declaratory ruling the location and construction of a grid-side distributed resources project comprised of twenty one (21) new natural-gas fueled PureCell® Model 400 phosphoric acid fuel cells ("Fuel Cell") and associated equipment (the "Facility"), providing 9.66-megawatts ("MW") of power to the United Illuminating, Congress St. Substation, Bridgeport, CT. The Facility will be installed by Doosan and owned and operated by NuPower. The fuel cells will be maintained by Doosan.

Conn. Gen. Stat. § 16-50k(a) provides that:

> Notwithstanding the provisions of this chapter or title 16a, the council shall, in the exercise of its jurisdiction over the siting of generating facilities, approve by declaratory ruling . . . (B) the construction or location of any fuel cell, unless the council finds a substantial adverse environmental effect or of any customer-side distributed resources project or facility . . . with a capacity of not more than sixty-five megawatts, as long as such project meets air and water quality standards of the Department of Energy and Environmental Projection."

I. INTRODUCTION

The proposed Facility will be a grid-side distributed resource under 65 MW that complies with the air and water quality standards of the Department of Energy and Environmental Protection ("DEEP"). Doosan submits that no Certificate of Environmental Compatibility and Public Need is required because the proposed installation will not have a substantial adverse environmental effect.

II. DESCRIPTION AND PURPOSE OF THE PROJECT

The proposed facility will be a distributed generation resource with grid interconnection at the Congress St. Substation owned and operated by United Illuminating. The Facility at 600 Iranistan Ave. will consist of a 3 ½ story steel and concrete structure located directly adjacent to I-95 South bound on a vacant lot at the intersection of Iranistan Ave. and Railroad Ave (Attachment #1). The proposed installation consists of twenty one (21) 460KW Model 400 Fuel Cells manufactured by Doosan Fuel Cell America, Inc. in South Windsor, Connecticut (*See* Attachment #4 for Model 400 Data Sheets). The overall dimension of the individual Fuel Cells is eight feet four inches wide by twenty-seven feet four inches long by nine feet eleven inches tall. The Fuel Cells are totally enclosed and factory-assembled and tested prior to shipment.

The proposed Facility will feed power through two separate dedicated power cable runs to the United Illuminating, Congress St. Substation at medium voltage. Power produced by the facility will be sold to United Illuminating Co. in accordance with a PURA approved power-purchase agreement (PPA) between United Illuminating and NuPower Bridgeport FC, LLC

(Attachment #3). The completed facility will be capable of producing 9.66 MW of reliable power and up to 16.2 MMBtu/hr. of thermal energy to a district heating loop using a combination of high-grade and low-grade heat from the fuel cell. Natural gas supply for the facility will be provided by Southern Connecticut Gas.

When a utility grid outage occurs, the individual Fuel Cells will automatically disconnect from the facility electrical system using an internal breaker while continuing to operate providing all the internal loads needed to operate the Fuel Cells. Upon return of the utility supply, the fuel cells will monitor the grid for stability for five minutes and then will automatically reconnect and ramp up output.

The Fuel Cells are designed to have a minimum 20-year product life. This requires overhaul or replacement of major components after 10 years of operation. Components requiring overhaul include the cell stack assemblies and components in the fuel processing system.

III. SAFETY

The Fuel Cells are certified by CSA international to meet strict ANSI/CSA FC-1 2014 safety standards to protect against risks from electrical, mechanical, chemical, and combustion safety hazards. The Fuel Cells will be installed in strict accordance with NFPA 853. In accordance with Public Act 11-101, the fuel line pipe cleaning procedure uses inert nitrogen gas or atmospheric air. The following items are a few of the safety measures incorporated into the design. A draft emergency response plan is included in *Attachment* #5. Prior to operation of the facility, this plan will be reviewed with the City of Bridgeport Fire Marshall to determine any additional requirements they may have for an emergency response plan and safety training.

A. Fire Protection

The Fuel Cell design incorporates a combustible gas sensor and thermal fuses located throughout the Fuel Cell cabinet. The detection of a potential combustible gas mixture, a fire, or the failure of this detection circuit will result in a Fuel Cell shutdown, closing of the natural gas supply valves, and a subsequent inert gas (nitrogen) purge of the Fuel Cell stack and fuel processing system. This event will also result in an alarm callout notification to Doosan service personnel. The Fuel Cell is designed with an integral stop button on the outside of the enclosure to enable immediate shutdown in the event of an emergency. There is also a site-installed manual gas shut-off valve and electrical disconnect switch easily accessible to emergency personnel. First responders will have access to the site with the use of a Knox Security box positioned outside the gate directly adjacent to the natural gas shut off.

B. Gas Leak

The Fuel Cells are designed with a physical barrier that separates the equipment handling combustible gases (fuel compartment) from electrical or potential spark-creating equipment (motor compartment). The fuel compartment is maintained at a negative pressure relative to both ambient and the motor compartment to ensure that any gas leaks do not reach the electrical equipment in the motor compartment. The cabinet ventilation system ("CVS") is designed to dilute a potential gas leak in the fuel compartment to non-combustible levels.

C. Cell Stacks and Hydrogen

The Fuel Cells operate by converting hydrogen to DC electricity. Hydrogen is lighter than air and thus does not pool like other fuels and will readily dissipate with proper ventilation, making it less likely to ignite. Also, the Fuel Cell does not store hydrogen; instead, it produces hydrogen-rich gas at a rate equal to what it requires to produce power. The Fuel Cell stack is wrapped in a fire-retardant blanket. There are no materials inside the unit that would sustain a flame. There is no large volume of gas or any ignition that occurs within the cell stack.

D. Phosphoric Acid

Phosphoric acid is an integral part of the fuel cell system, acting as the electrolyte within the fuel cell stack. Phosphoric acid is a surprisingly common substance that is contained in common cola drinks. A leak of phosphoric acid is not possible because there is no reservoir of liquid: phosphoric acid is constrained within the porous structure of the fuel cell stack material by capillary action.

E. Fluid Leak

The only fluid source is water. All piping systems and pressurized water vessels are designed and fabricated to the appropriate ASME codes. Water produced through the electrochemical process is “pure” water and is reclaimed and reused by the process. Water mixed with propylene glycol and a rust inhibitor (to prevent rust and freezing in colder climates) is also used in the external cooling module.

IV. **HAZARDOUS MATERIALS**

As with other fuel cell technologies, hydrogen and oxygen combine in the presence of a catalyst, which causes an electrochemical reaction to produce an electric current. A phosphoric acid fuel cell uses an inorganic, concentrated phosphoric acid as the electrolyte, allowing the electrochemical reaction to take place. The Fuel Cell also employs on-board natural gas reforming as part of the balance of plant to provide hydrogen to the fuel cell. Within this Fuel Cell, there are only two components that contain hazardous material: the Cell Stack Assembly ("CSA") and the Integrated Low-Temperature Shift Converter ("ILS"). Neither of these components present risk when servicing the Fuel Cell. The material in both the CSA and the ILS is classified as hazardous material for the purposes of shipping. The CSA is classified as a "bulk bin," made from the repeating elements of the Fuel Cell stack. Some of these repeating elements are porous carbon graphite plates. The phosphoric acid used as the electrolyte is contained by capillary action within the pores of these plates. The ILS is a tank containing a self-heating solid catalyst composed of copper, zinc oxide, and alumina. Safety Data Sheets ("SDS") are available in the NuPower Thermal Bridgeport, Draft Emergency Response Plan (*See Attachment* #5).

A. Shipping of Hazardous Material

The Fuel Cell is classified as "hazardous in transportation" under the U.S. Department of Transportation ("DOT") 49CFR regulations, and likewise as dangerous goods under the International Maritime Dangerous Goods ("IMDG") regulations. The description of hazardous materials contained within each Fuel Cell are listed in subsections B and C below.

B. Integrated Low Shift Converter

The tank, a non-DOT specification container as described below, is a SELF HEATING SOLID INORGANIC N.O.S. (contains metallic copper on zinc oxide and alumina), CLASS 4.2, UN3190, PGII, 900 lb. net wt of hazardous material.

C. Cell Stack Assembly

The bulk bin, a non-DOT specification container as described below, is a SOLIDS CONTAINING CORROSIVE LIQUID N.O.S. (contains phosphoric acid), Class 8, UN3244, PGII, 1200 lb. net of hazardous material. The amount of phosphoric acid in the Fuel Cell complies with all applicable state and federal regulations. The exact amount of phosphoric acid is proprietary technical information and is less than the 5,000 lbs. reportable quantity under 40 CFR 117.3.

D. Integration into Fuel Cell Power Plant

The above items are individual components assembled side by side, with other non-hazardous components, to form one complete Fuel Cell. The containers holding the hazardous material are non-DOT specification containers. DOT regulations allow for the transportation of the hazardous material noted above in non-DOT specification portable tanks and closed bulk bins, as used for the shipment of the Fuel Cell. IMDG regulations require United Nations ("UN") specified containers or an exemption for international ocean transport.

E. Servicing of Product with Hazardous Material Present

The hazardous material contained within the CSA and the ILS presents no danger to installation and service personnel because direct exposure to the material is not possible. Under

normal operating conditions, each container, as defined above, will contain its hazardous material for the life of the component. When end of life requires replacement of either component, no special precautions need to be employed with respect to handling because hazardous material will not come in contact with service personnel.

F. Hazardous Waste

The Fuel Cell does not produce any hazardous waste.

V. **THE SITE**

The Facility is proposed to be located entirely on the Site. The proposed site location is a 0.51 acre parcel zoned Light Industrial under the zoning regulations of the City of Bridgeport (the "City") (Zoning Map *Attachment* #8). The Site is surrounded to the North by Railroad Ave. and the Metro North rail line, to the West by Iranistan Ave. and to the South by I-95 (*Attachment* #7). The nearest residential properties are approximately 136 feet North of the Site across Railroad Ave, Metro North Railway and Railroad Ave North.

The proposed installation consists of twenty one (21) 460KW Model 400 Fuel Cells manufactured by Doosan Fuel Cell America, Inc. in South Windsor, Connecticut (*See* Attachment #4 for Model 400 Data Sheet). The overall dimension of the individual Fuel Cells is eight feet four inches wide by twenty-seven feet four inches long by nine feet eleven inches tall. The Fuel Cells are totally enclosed and factory-assembled and tested prior to shipment.

The fuel cells and their associated cooling modules will be installed on a 3 ½ story steel and concrete structure (Attachment #6). The proposed installation will have four (4) 2500 kVA

and one (1) 1500 kVA, 13.8kV/480V transformers, low voltage and medium voltage switchgear, and associated metering equipment. A reverse osmosis (RO) system will provide treated water to the fuel cell power modules. A centralized purge system will be installed, including compressed gas storage tank and associated piping. The proposed facility will be surrounded by an 8' chain-link fence and access to the site will be restricted. The proposed Facility will be a maximum of 65 feet above ground level and does not fall under the FAA notification requirement of 14 CFR Part 77.9 (Attachment #9).

VI. **PROJECT BENEFITS**

Fuel cell technology represents an important step in advancing Connecticut's goal of diversifying its energy supply through the use of renewable energy, as expressed in Connecticut General Statutes Section 16-244 et seq. The Facility will serve as a cost-effective clean energy source as well as provide thermal energy. Further, this Fuel Cell installation will support the efforts of the State of Connecticut to be a leader in the utilization of fuel cell technology. The facility will bring benefits to the customers of the thermal loop, economic development opportunities to the City of Bridgeport, and environmental benefits to the entire state.

Because a fuel cell does not burn fuel, the system will significantly reduce air emissions associated with acid rain and smog. Emissions standards of Connecticut will further be discussed in the next section. The Facility is designed to operate in total water balance – no make-up water is normally required after start-up and no water discharges to the environment will occur under normal operating circumstances.

VII. ENVIRONMENTAL EFFECTS

1. Water, Heat and Air Emissions

The proposed installation will have no substantial adverse environmental effect. The installation and operation of the Fuel Cell installation will meet all air and water quality standards of DEEP.

Section 22a-174-42 of the Regulations of Connecticut State Agencies ("RCSA") governing air emissions from new distributed generators exempts fuel cells from air permitting requirements. Notwithstanding this exemption, the Fuel Cell meets the Connecticut emissions standards for a new distributed generator as shown in Table 1 below, and no permits, registrations or applications are required under rules based on the actual emissions of the Fuel Cell. Furthermore, the Fuel Cells utilized at the facility are certified by the California Air Resources Board to meet the Distributed Generation Certification Regulation 2007 Fossil Fuel Emissions Standards (*See Attachment* #10).

Table 1: CT Emissions Standards for a New Distributed Generator

Air Pollutant	CT Emissions Standard (lbs/MWh)	PureCell Model 400 Fuel Cell System at Rated Power (lbs/MWh)
Oxides of Nitrogen	0.15	.02
Carbon Monoxide	1	.01
Carbon Dioxide	1650	998

With respect to water discharges, the Fuel Cell is designed to operate without water discharge under normal operating conditions. To the extent that minimal water overflow may occasionally occur, such discharges will consist of de-ionized water and will be directed to the city's sewer system. This discharge will be incorporated into the overall site design, and will be

covered by the Site's water discharge permit, if necessary. The Fuel Cell operates in water balance below 86°F. The initial fill requires 350 gallons of water per Model 400 system. The amount of make-up water above 86°F increases linearly from 0gpm to 1gpm per Model 400 system at 110°F. A reverse osmosis system will be used by the facility to provide treated make-up water.

The Facility will also meet state criteria thresholds and projected emissions for all greenhouse gases defined in as Section 22a-174-1(49) as shown in Table 2. Section 22a-174-1(49) states the following: "Greenhouse gases" or "GHGs" means the aggregate of the following six components gases: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), sulfur hexa fluoride (SF6), any hydrofluorocarbon (HFC) or any perfluorocarbon (PFC)." There is no defined criteria threshold for these compounds, however Section 22a-174-1(21) provides a method for computing carbon dioxide equivalent emissions "CO2e." The proposed Facility will have no emissions of SF6, HFC, and PFC. Emissions of CH4 and N2O will be very low and will not contribute significantly to the GWP of the proposed facility.

Table 2: PureCell® Model Emissions Data

Emission Type	Projected Emissions	GWP in 40 CFR 98, Table A-1	Projected CO2e
CO2	41,916 ton/yr	1	41,916 ton/yr
CH4	<0.42 ton/yr	25	<10.5 ton/yr
N2O	<0.21 ton/yr	298	<63 ton/yr
SF6	N/A	22,800	N/A
HFC	N/A	12 to 14,900*	N/A
PFC	N/A	7,390 to 17,340	N/A

Current control technologies are not commercially available to reduce the greenhouse gas emissions from the Facility. The utilization of the waste heat in the Facility into the proposed district heat loop on site will offset CO2 emissions for customers of the heat loop. According to Doosan's analysis the proposed project will result in a net CO2 emissions reduction of 9,558 metric ton/yr of CO2 (*Attachment* #20).

2. Wildlife and Habitat

According to the relevant portion of the CT DEEP Bridgeport Natural Diverse Database Areas Map (*See attachments* #11), the proposed Site is not located within the City of Bridgeport Natural Diversity Data Base Areas.

3. Noise Analysis

The proposed site is located directly adjacent to I-95, a busy elevated highway with a high volume of truck traffic. Parcels in the immediate vicinity include light industrial, commercial, and residential. Background noise levels of the proposed site as measured by a professional acoustic engineer show intermittent night-time noise associated with truck traffic on I-95 (Acoustic Survey Report, *Attachment #12*).

Results of acoustical testing and modeling indicate a potential for the project to have acoustical impacts on properties in close vicinity if no mitigating actions are completed. The proposed project will be constructed to allow for installation of the noise-treatment solutions to mitigate the acoustical impacts. Noise treatment solutions will only be installed on the facility as determined by acoustical testing during commissioning activities. Following completion of noise treatment solution installation acoustical testing will be conducted to demonstrate compliance with City and state noise ordinances.

4. Visual Impact

The site is bordered on the south and east by I-95 SB, the north by Railroad Ave and the Metro-North Railroad, and the west by Iranistan Ave. A rendering of the proposed facility is included in Attachment #2. Some items such as pumps, heat exchangers, ducts, and piping are not included in the rendering. The proposed facility will be visible from adjoining surface streets, I-95, and the Metro-North Railroad. The proposed facility will fit with the light industrial nature of the area the project is situated.

5. Public Notice

Notice was provided via certified mail to all property owners, abutters and state and local officials pursuant to Conn. Agencies Regs.§16-50j-40(a). Doosan's copy of the notice letter is included in *Attachment #13*. A list of abutters is included in *Attachments* #14. Applicable Federal, State and Municipal officials of Bridgeport provided notice are listed in *Attachment* #15, Certified mail receipts are included in *Attachment* #16.

Project Decommissioning Plan

Following the 20-year operational life of the Facility, the decommissioning plan is as follows:

A) Isolate, lock out and disconnect all piping for cooling module at the power module. Remove gas piping to the unit. Disconnect nitrogen purge system at power module.

B) Disconnect all electrical conductors and conduit at the Fuel Cell to include electrical power, cooling module power, and nitrogen pressure switch. Shore power to be maintained to the unit to maintain temperature as needed.

C) Contractor will work in concert with Doosan's Service Department personnel during decommissioning and shutdown.

D) Return Site to original condition with the exception of the concrete pads and steel structure.

E) The decommissioned Fuel Cells will be stripped, the parts are separated and either recycled, reclaimed or transported to landfill.

7. Aquifer Protection Area, Coastal Boundaries, and Flood Zones

Based on an analysis of the Federal Emergency Management Agency's ("FEMA") National Flood Insurance Program ("NFIP") flood mapping data for Bridgeport (*See Attachment* #17), proposed project location is within the 100 yr. flood zone area, in an area with a base flood elevation of 12'. Fill will be added to the site as needed to bring the base elevation for all equipment 2' above the flood elevation.

The City of Bridgeport has no Aquifer Protection Areas. The proposed project is located within the city of Bridgeport's coast boundary zone (*See Attachment* #18). A coastal boundary zone permit application will be filed with the city during the municipal permitting process.

8. Cultural Resources.

The proposed Facility will be located in an already developed vicinity, consequently construction and operation of the Fuel Cell will have no unpleasant effect on any cultural (historical and archaeological) resources in the area.

9. Natural Gas Desulfurization Process

Sulfur is present in pipeline natural gas. It is primarily used as an odorant so leaks can be easily detected. Unfortunately, sulfur is also a poison to fuel cell systems and must be removed by the Fuel Cell. For further details of desulfurization please refer to the attached Desulfurization Memo (*See Attachment* #19).

VIII. CONSTRUCTION AND MAINTENANCE

Doosan plans to start construction work by January 2021. Construction will take approximately eight (8) months, followed by approximately twelve weeks of testing and startup. Regular working hours for the proposed project are Monday through Friday from 8:00 am to 5:00 pm. Doosan and its contractors will fully cooperate with the City Inspector and will follow all City of Bridgeport and Connecticut State construction policies and codes.

IX. LOCAL INPUT

The design and construction team Dan Fisher of ICDS, Walter Bonola Doosan fuel cell America and Nupower Principle Scott Guilmartin all met with City officials to discuss the project. Bruce Nelson Building Official, Lynn Haig Director of Planning and Max Perez Director of Business Development were in attendance. The conceptual drawings were shared and

discussed at the meeting. Doosan and ICDS presented an overview of the project including raising the grade above flood level, decorative fencing options and general appearance of the building.

X. CONCLUSION

As set forth above, Doosan requests that the Council issue a determination, in the form of a declaratory ruling, that the proposed installation above is not one that would have a substantial adverse effect, and, therefore, that a Certificate is not needed.

Respectfully submitted,

…….

Walter Bonola

Installation Manager

Doosan Fuel Cell America, Inc.

LIST OF ATTACHMENTS

Attachment 1: Photos of project location

Attachment 2: Rendering of proposed project

Attachment 3: PURA Decision

Attachment 4: PureCell Model 400 Data sheet

Attachment 5: Draft Emergency Response Plan

Attachment 6: Site Plan

Attachment 7: Survey of property

Attachment 8: Zoning Map

Attachment 9: 14CFR Part 77.9

Attachment 10: California Air Resources Board Emission Certification

Attachment 11: DEEP Diverse Database Areas Map

Attachment 12: Acoustical Report

Attachment 13: Notice Letter

Attachment 14: Abutters List and Map

Attachment 15: List of Federal, State, and Local Officials

Attachment 16: Copy of Cert. Mail receipts for letters to Abutters and Officials

Attachment 17: Flood Map

Attachment 18: Coastal Boundary Zone Map

Attachment 19: Doosan Fuel Cell Desulpherization Memo

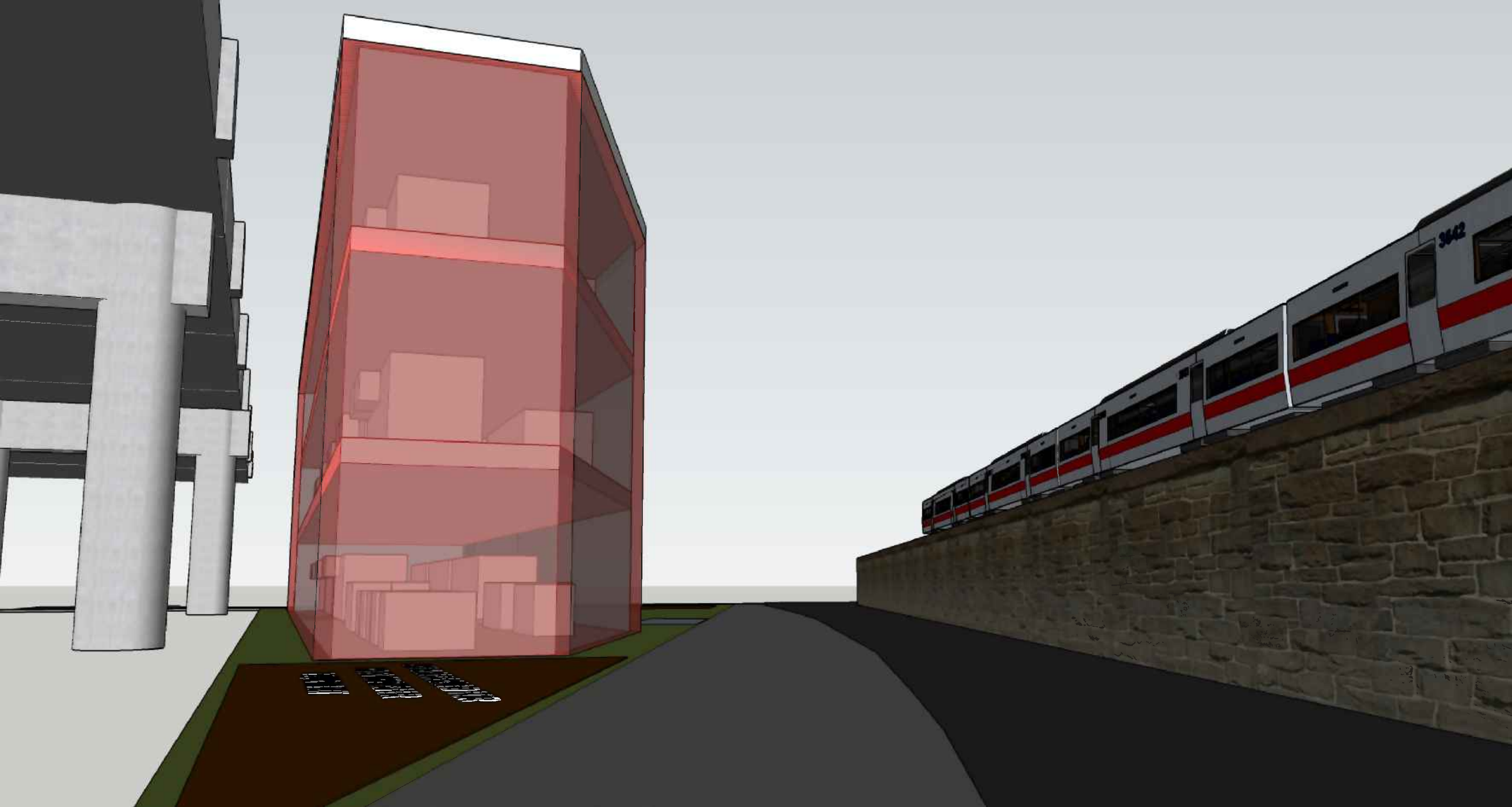
Attachment 20: Avoided Emissions

Attachment #1
Photos of Project Location


95
Connecticut Turnpike
Southwest Community
Health Center
95
95
Connecticut Tur

Attachment #2
Project Renderings

Note: Some items not included such as transformers, pumps, ducts and piping.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Attachment #3

STATE OF CONNECTICUT

PUBLIC UTILITIES REGULATORY AUTHORITY
TEN FRANKLIN SQUARE
NEW BRITAIN, CT 06051

DOCKET NO. 18-08-14 PURA REVIEW OF THE COMBINED HEAT AND POWER PROJECT SOLICITATION PURSUANT TO CONN. GEN. STAT. SECTION 16-258e

October 2, 2019

By the following Commissioners:

John W. Betkoski, III
Michael A. Caron

DECISION

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DECISION

I. INTRODUCTION

A. SUMMARY

In this Decision, the Public Utilities Regulatory Authority approves the request of The United Illuminating Company to enter into a Power Purchase Agreement with NuPower Bridgeport FC, LLC for a combined heat and power district energy project in Bridgeport, Connecticut pursuant to § 16-258e of the General Statutes of Connecticut, subject to certain conditions.

B. BACKGROUND OF THE PROCEEDING

The United Illuminating Company (UI or Company) issued a request for proposals (RFP) for energy and Connecticut Class I and/or Class III renewable energy certificates (RECs) from combined heat and power system (CHP) facilities in distressed municipalities in its service territory. See, December 21, 2018 Application of The United Illuminating Company for Review and Approval of Power Purchase Agreement (Application), pp. 1 and 2. NuPower of Bridgeport FC, LLC (NuPower) submitted a conforming bid (NuPower RFP Bid) for the NuPower Thermal Bridgeport fuel cell project (Project) in response to the solicitation. Id. p. 2. The NuPower RFP Bid was the only bid received by UI. Id. While UI did not initially accept the NuPower RFP Bid. UI reconsidered its decision and negotiated a PPA with NuPower. Id. However, instead of pursuing negotiations based on the pricing included in the NuPower Bid, UI proposed to NuPower that the parties negotiate a PPA with pricing based on a cost of service (COS) model. Id.

On December 21, 2018, UI submitted an application (Application) to the Public Utilities Regulatory Authority (PURA or the Authority) for (1) review and approval of an unexecuted power purchase agreement (PPA) between UI and NuPower. UI also seeks (2) authorization to recover all costs associated with the PPA, including all costs prudently incurred by UI to administer and enforce the PPA and an Authority determination of the appropriate return on equity for the COS model under the PPA. Finally, UI requests (3) acceptance by the Authority of the responsibility to review (a) the pro forma COS model, including the capital cost of the facility, (b) the true-up between the pro-forma and actual capital costs of the facility, approximately 90 days after the facility's commercial operation date, and (c) if necessary, review the annual actual revenue requirement if it exceeds the pro-forma revenue requirement for that year by greater than 5%.

C. CONDUCT OF THE PROCEEDING

A Notice of Proceeding was issued on December 28, 2018, and a Notice of Request for Written Comments was issued on March 8, 2019. Two Notices of Admitted Evidence were issued, one on March 7, 2019, and the other on May 16, 2019.

By Notice of Hearing dated March 7, 2019, the Authority scheduled and conducted a public hearing on this matter on March 27, 2019, at its offices, Ten Franklin Square,

New Britain, Connecticut.[1] A Late-Filed Exhibits (LFE) Hearing was held on May 21, 2019 at those same offices.

Pursuant to a Notice of Admitted Evidence dated March 7, 2019, the Authority admitted into evidence the Edison Electric Institute's Q3 2018 Regulatory and Financial Update: Rate Review Summary.

Pursuant to a Notice of Admitted Evidence dated May 16, 2019, the Authority admitted into evidence documents from Federal Energy Regulatory Commission (FERC) Docket ER18-1639-000 that included: (1) FERC Order Accepting Agreement, Subject to Condition, and Directing Briefs, 165 FERC ¶ 61,267, issued December 20, 2018 (FERC Order); and (2) Constellation Mystic Power, LLC, Revised Exhibit No. MYS-0011, Schedules Regarding ROE Analysis, Capital Structure, and Cost of Debt, filed September 17, 2018 (Mystic ROE Exhibit).

The Authority issued a Proposed Final Decision in this Docket on September 9, 2019. All participants were provided the opportunity to submit Written Exceptions and present Oral Arguments on the Proposed Final Decision.

D. PARTIES AND INTERVENORS OR PARTICIPANTS

The Authority recognized the following as Participants to this proceeding: NuPower of Bridgeport FC, LLC (NuPower), 103 North Park Avenue, Easton, CT 06612; Office of Consumer Counsel (OCC), Ten Franklin Square, New Britain, CT 06051; the Commissioner of the Department of Energy and Environmental Protection (BETP or DEEP), 79 Elm Street, Hartford, CT 06106; and The United Illuminating Company, 180 Marsh Hill Road, Orange, CT 06477.

II. POSITIONS OF PARTICIPANTS

A. THE UNITED ILLUMINATING COMPANY

UI stated that the Authority should approve the PPA if it concludes that it complies with the requirements of Conn. Gen. Stat. § 16-258e(b) and serves the long-term Interests of ratepayers. UI Brief, p. 4. UI argued that the PPA is the product of an arm's length negotiation between UI and NuPower, and provides the financial foundation for the financing of NuPower's fuel cell project and the associated thermal loop. Id. UI stated that the PPA is structured with COS pricing and approval of the PPA will require regulatory oversight and approval of costs to provide UI with the ability to pass contract costs through to its customers. Id. UI requested that the Authority's decision in this docket also include an ongoing process to review (a) the pro forma COS model; (b) the true-up between pro-forma and actual COS approximately 90 days after the facility's commercial operation date (COD); and (c) if necessary, review the annual actual COS if it exceeds the pro-forma COS for that year by greater than 5%. Id., p. 5.

UI also stated that the Authority should consider the level of ratepayer support that is dedicated to this project when setting an appropriate return on equity (ROE). Id. UI

[1] There is no statutory requirement for a hearing.

said that it has not performed an analysis to determine the appropriate ROE under COS ratemaking for a generation project of this scale owned by a single-asset entity like NuPower and the Company has no experience with fair and reasonable rates of returns for privately funded projects developed through a single purpose entity. Id.

UI asserted that it does not advocate the Authority adopt a specific ROE for this project, and the Company does not take a position on the appropriate ROE. Id., p. 8.

Finally, UI stated that the Authority should ensure UI's cost recovery and authorize UI to recover all contract-related costs from all customers and credit any contract-related benefits to all customers, through a fully-reconciling component of electric rates for all customers of UI for the full term of the PPA. Id, p. 9. Further, consistent with prior Authority decisions, the Company proposes to reconcile these costs and benefits through the nonbypassable federally mandated congestion cost (NBFMCC) charge. Id., p. 9.

B. NUPOWER

NuPower claimed that the Project is a critical piece of the overall thermal loop development in downtown Bridgeport. By passing Conn. Gen. Stat. § 16-258e(b), the Connecticut legislature recognized that a 10MW fuel cell developed within an urban center and connected to a district heating system will bring benefits to the customers of the thermal loop (the thermal loop is being designed to be capable of bringing hot water to local institutions, businesses, and residences located in Bridgeport), economic development opportunities to the City of Bridgeport, and environmental benefits to the entire state. NuPower Brief, p. 27.

NuPower stated that the legislature specifically required that the solicitation be limited to the most populous municipalities in the state and by doing so, the legislature recognized the special relationship between district heating systems and densely populated urban centers. Id. According to NuPower, the legislature also recognized the cost structure necessary to develop the Project in an urban center and the unique obstacles that exist when a project cannot be sited outside of the urban center and given the intent of Conn. Gen. Stat. § 16-258e(b), the benefits of the Project to the thermal loop, Bridgeport, the region, and the State of Connecticut, PURA should approve the Project so that these benefits can be realized. Id.

C. THE OFFICE OF CONSUMER COUNSEL

The OCC argued that the Project is too expensive to be in the long-term interest of ratepayers for purposes of Conn. Gen. Stat. § 16-258e. OCC Brief, p. 6. The OCC further claimed that the Project, if approved and if it achieves its goals, will receive multiple subsidies from gas customers and electric customers. Id., p. 12.

The OCC also argued that the ROE issue is unimportant because the Project is unacceptably expensive at any ROE within the range discussed in the record. Id., p.13. The OCC claims that the NuPower affiliate that is the thermal energy transportation company does not yet have firm customer commitments for thermal energy services. Id., p. 15.

The OCC concluded that, with net lifetime costs of over $60 million, the Project is too expensive to be in the long-term interest of ratepayers and the claimed benefits of the Project have either been poorly quantified or do not actually impact ratepayers. The OCC recognized the effort that has gone into the Project but, concluded that the project is simply not supportable under the "long-term interests of ratepayers" standard in Conn. Gen. Stat. § 16-258e. Id., p. 16.

D. THE DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION

The BETP argued that the PPA was prematurely filed since, at the time, NuPower did not provide any firm commitments and thus does not meet the statutory requirement for firm commitments. BETP Brief, p. 9. BETP further argued that since no firm customers are known, the Authority cannot evaluate the whether the location of the fuel cell maximizes the efficiency of the thermal energy. Id.

The BETP also argued that the even if the Authority did not reject the Project as prematurely filed, it should reject the Project as not meeting the statutory requirement of being in the long-term interest of ratepayers. Id. The BETP asserted that the "significantly below 1.0 benefit-to-cost [ratio] of the [P]roject, the lack of any appreciable benefits to the electric system, the increase in expected carbon dioxide emissions from the [P]roject, and the reliance on multiple ratepayer incentive programs, demonstrate that the [P]roject is decidedly not in the interest of ratepayers." Id. pp. 9–10 (footnote omitted).

III. AUTHORITY ANALYSIS

Conn. Gen. Stat. § 16-258e states, in part:

> (b) No later than fifteen days after an electric distribution company enters into a power purchase agreement pursuant to subsection (a) of this section, the electric distribution company shall submit such agreement to the Public Utilities Regulatory Authority for review and approval. The authority shall evaluate such agreement and may approve such agreement if the authority finds that the agreement (1) complies with the requirements of this section, and (2) serves the long-term interests of ratepayers. The authority shall not approve any agreement supported in any form of cross subsidization by entities affiliated with the electric distribution company. A combined heat and power system acquired and built pursuant to a power purchase agreement entered into pursuant to this section shall not exceed a total nameplate capacity rating of ten megawatts in the aggregate. The electric distribution company may not, under any circumstances, recover more than the full costs of the agreement approved by the authority. The net costs of any such agreement, including costs incurred by the electric distribution company under the agreement and reasonable costs incurred by the electric distribution company in connection with the agreement, shall be recovered on a timely basis through a reconciling component of electric rates as determined by the authority that is nonbypassable when switching electric suppliers. Any net revenues from the sale of products purchased in accordance with any agreement entered into pursuant to this section shall be credited to customers through the same reconciling component of

> electric rates that is utilized to recover the costs of such agreement. Certificates issued by the New England Power Pool Generation Information System for any Class I or Class III source procured by an electric distribution company pursuant to this section may be (A) sold into the New England Power Pool Generation Information System renewable energy credit market to be used by an electric supplier or electric distribution company to meet the requirements of section 16-245a, so long as the revenues from such sale are credited to electric distribution company customers as described in this subsection, or (B) retained by the electric distribution company to meet the requirements of section 16-245a. In considering whether to sell or retain such certificates, the company shall select the option that is in the best interest of such company's ratepayers, consistent with the procurement plan approved pursuant to sections 16-244c and 16-244m.

A. COST OF SERVICE PRICING

UI's stated objective in adopting COS model was to reduce the total expected cost to customers by reducing NuPower's development and construction cost risk (especially for electric and gas interconnection costs), and the risk of purely volumetric pricing, and thus allow NuPower to accept a lower return commensurate with the lower risk. Application, p. 2. While UI and NuPower have not agreed to a return on equity (ROE) for the proposed COS model, all other substantive issues have been resolved, and the PPA and COS model (other than ROE) submitted in this docket are the product of the negotiation between UI and NuPower. Id.

The COS model agreed to by UI and NuPower includes a pro forma COS that includes the projected cost to develop and construct the facility, to be trued up to the actual cost to develop and construct the facility, no later than 90 days after achievement of the COD. Id., p. 4. Thereafter, if for any year the actual COS for that year exceeds the pro forma COS for that same year by greater than 5%, the actual COS for that year will be submitted for the Authority's review. Id.

Additionally, while UI and NuPower expect that actual costs will be close to pro forma costs for the majority of the line items in the pro form cost of service model, the cost of the facility's electric interconnection is still highly uncertain. Id. UI understands that the pro forma cost of service model includes only a preliminary estimate of the cost to interconnect the facility to UI's distribution system because only preliminary work on the interconnection application has commenced. Id. Additional study is required according to the standard interconnection process to obtain a more robust estimate of the cost to interconnect the facility. Id., p. 5. UI and NuPower have agreed to exclude the cost of electric interconnection from the 5% annual threshold between actual and pro forma cost of service. Id.

The Authority finds that structuring the PPA with cost of service pricing helped to lower the estimated going forward costs of the project, relative to the original NuPower Bid. The PPA, as structured, provides assurance of cost recovery for NuPower's fuel cell project and the thermal loop. The heat generated from the CHP may be used to provide thermal energy to an urban downtown thermal loop and replace older inefficient boilers in

a distressed municipality, provided adequate customer commitments for this product are achieved.

For the reasons stated herein, the Authority finds that the NuPower Project complies with the requirements of Conn. Gen. Stat. § 16-258e(b) and serves the long-term interests of ratepayers, and approves the request of The United Illuminating Company to approve the PPA, subject to certain conditions discussed below.

1. Return on Equity

NuPower provided testimony in the Application, in which it proposed a post-tax weighted average cost of capital (WACC) of 10.38%. Application, Exhibit C-1, p. 16. The proposed WACC was based on a capital structure of 50:50 debt to equity. Id. NuPower proposed long-term debt rate of 5.75% and a ROE rate of 15%. Id. NuPower states that it proposed a fixed capital structure for the life of the project in order to reduce investor uncertainty, which is a key factor for attracting investment capital. Nevertheless, NuPower acknowledges that the financing will change and mature over time. Id.

NuPower indicates that the Interim Decision dated December 5, 2018, in Docket No. 18-05-04, PURA Implementation of June Special Session Public 17-3 (Millstone Interim Decision) provided a building-block approach for determining a reasonable ROE to keep the Millstone nuclear facilities operating. Therrien and Stone Supplemental PFT, pp. 2-5. According to NuPower, in the Interim Decision, the Authority accepted 13.4% as a reasonable ROE for a hypothetical merchant natural gas plant based on the New England Independent System Operator's (ISO-NE) Net Cost of New Entry Study (Net CONE Study), and that the ROE for a generic merchant gas plant should be adjusted upward to account for plant specific risks. Id. Specifically, NuPower states that the Authority determined that Millstone, under a merchant operation scenario, would deserve an ROE of at least 15%. Id. Thus, NuPower claims that the Millstone Interim Decision provided additional supports for its proposed 15% ROE for the fuel cell project. Id.

NuPower claims that the estimated ROE for its fuel cell project under a building-block approach is 21.90%. Therrien and Stone Supplemental PFT, pp. 5-12. The Company derived the 21.90% building-block ROE by adjusting the 13.4% ROE proposed in the ISO-NE Net CONE Study for a new entrant merchant gas-fired generator by four additional risk premia. Id. NuPower reduces this base ROE by 100 basis points for cost of service (COS) PPA pricing and increases it by 400 basis points for development risk; 150 basis points for technology risk; and 400 basis points for size risk. Id. NuPower claims that the estimated ROE of 21.9%, using a building-block estimation approach, supports the Company's position that its proposed ROE of 15% is reasonable. Id. Also, to support its proposed 15% ROE, NuPower cites the Department of Energy's 2016 study (2016 DOE Study) titled, "Fuel Cell Technologies Market Report 2016," which noted that Intelligent Energy raised £30 million ($39 million) through the issuance of 13.0% senior secured convertible loan notes 2019, which NuPower labelled as "a benchmark for ROE." NuPower Brief, p. 17. NuPower also refers to the discussion on the cost of capital for power generation in the publication *Economic Analysis and Policy* (EAP Study), which postulated that for a merchant power generator, the marginal equity cost leans towards 15-16%, but towards 11-12% for an investment-grade integrated merchant utility. Id., p. 18.

NuPower states that it is generally accepted that small companies have certain risk characteristics that are more prevalent than in larger companies. Therrien and Stone Supplemental PFT, p. 8. These include limited access to capital, management depth concerns, and liquidity concerns. Id. NuPower further states that for this reason, it is reasonable to include a "size premium," or basis point adder to one's estimate of ROE to account for small company size. Id., pp. 8 and 9.

NuPower indicates that the FERC Order and Mystic ROE Exhibit are irrelevant and immaterial and should not be given weight in this proceeding because there are related to a cost of service contract to prevent the retirement of 1,700 MW of capacity from the Mystic Units 8 and 9 during the June 2022 through May 2024 capacity commitment period. NuPower Brief. p. 24. According to NuPower, the FERC Order relates to the ROE to be granted to Mystic Units 8 and 9 generating plants that are threatening to retire. The closing of Mystic would not only affect 1,700 MW of existing generation, but the affiliated Everett liquefied natural gas (LNG) import facility. Id. NuPower also states that the FERC methodology for determining ROE can change because the FERC Order directed parties to file briefs based on the new proposed Coakley methodology for determining ROE in FERC cases, which the FERC order recognizes is a proposal and not a final policy, and that FERC has not made a decision on Mystic's ROE. Id., p. 25. Moreover, NuPower indicates that evidence in the FERC Order is incomplete, and based on a discounted cash flow (DCF) analysis of publicly traded companies that are comparable to Mystic's parent company Exelon, with revenues of $33 billion and with risks significantly different than that of a single asset 9.66 MW fuel cell project. NuPower implies that there is no showing of relevance or that the multi-billion dollar proxy companies in the Mystic proceeding associated with the FERC Order are similar to the NuPower project in the instant proceeding. Id. pp. 25 and 26.

The OCC states that the NuPower Project is too expensive at any ROE range. The total 20 year revenues at NuPower's proposed 15% ROE is about $178 million, and about $157 million at the low end of 9.60%. The OCC also stated that the low-end ROE only reduces the estimated lifetime cost of the facility from $63 million to $42 million. OCC Brief, pp. 13–14. According to the OCC, NuPower did not provide any traditional ROE analysis that supports the correctness of its proposed 15% ROE, which is "completely out of the range of any PURA ruling in memory either for a utility or a generating plant with a long-term contractual backstop." Id., p. 14. The OCC also cites testimony that the cap on ROE for a similar GenConn peaking COS contract is 10.75% and that UI was allowed only 25 basis points over its the approved distribution ROE, which is currently below 10%, for its own Bridgeport fuel cell project. The OCC further indicates that NuPower Project is a CHP unit with a long-term COS-based contract that mitigates much of the risk associated with its development and operation. OCC states NuPower does not deserve an ROE in excess of 11%. Id. Moreover, regarding the NuPower's claim that it is not comparable to other independent power producers (IPP) with large portfolios and balance sheets, or to regulated utilities, the OCC theorized that NuPower could receive approval for a contract with a locked-in 15% ROE, then "turn around and assign the contract or partner with a larger entity, eliminate the balance sheet risk, and achieve a windfall." According to the OCC, NuPower chose to pursue this project through LLCs of a small size and low capitalization instead of partnering with a larger entity; thus shifting and adding the risk of overpayment to UI's customers. Id., p. 15

UI indicated that the Parties had agreed to all terms of the PPA except for the 15% ROE proposed NuPower. Application, pp. 2 and 4. UI suggested that the NuPower's PPA is different from those selected in DEEP's RFPs because the related distributed generation project is combined with a thermal loop to capture the waste heat. Tr. 03-27-19, pp. 16-17. Also, UI wrestles with the level of ratepayers' support for the fuel-cell project, given the public policy support for fuel cell manufacturers in Connecticut. Id., UI Brief, p. 8. UI also indicates that while it has not performed any analysis on the appropriate ROE for a single-asset entity such as NuPower and cannot identify a directly analogous project, UI inferred that NuPower's project is comparable to other existing ratepayer supported peaking and fuel cell projects that similarly employed the COS models. Id., pp. 5 and 6. UI also recognizes a potential "flaw" in NuPower's reliance on the Authority's determination in Millstone Interim Decision regarding whether a 15% ROE may be appropriate for a merchant nuclear generator. Unlike the scenario set out in the Millstone Interim Decision, the NuPower CHP project would never be exposed to wholesale market risks, nor reliant on market revenues to meet its operating costs and returns on and of capital investments. Id. p. 7.

The Authority finds that the 15% ROE proposed by NuPower is excessive, not consistent with COS pricing mechanisms currently used, and fails to satisfy UI's stated primary objective for the COS pricing approach, which is to "reduce the total expected cost to customers" and "allow NuPower to accept a lower return commensurate with the lower risk." Application, p. 2. NuPower's building-block approach for determining a reasonable ROE in support of its ROE request is not contemplative of COS-based projects, but rather, riskier merchant generators.

NuPower's use of the calculated ROE for merchant entrants (13.4%) is not an appropriate ROE benchmark for calculating an allowed ROE for the Project. The fixed and variable costs of operating merchant units are recovered by the generation owner solely through effective and efficient operations and participation in the wholesale markets, and with no guarantee. The ISO-NE CONE and ORTP Analysis (CEA Study) describes the CONE and Net CONE values as the compensation a cost-effective new entrant would need to recover its capital and fixed costs under long-term equilibrium conditions. LFE No. 7, Attachment 1, p. 5. The offer review trigger price (ORTP) value is a benchmark price used to screen supply offers for competitiveness. Id. The Authority concludes that the inherent risks associated with the reference units used to develop the CONE, Net CONE and ORTP values are significantly higher than that a generator operating under a COS contract, which greatly reduces, if not eliminates, most of the risk the project may not recover its capital and fixed costs.

To illustrate the difference, the owner of Mystic Generation Station, a merchant generation facility, recently sought to retire units 8 and 9, which were retained by the ISO New England through a reliability-must-run COS contract, approved by the Federal Energy Regulatory Commission (FERC). The ROE proposed by Exelon, for the continued operation of Mystic units 8 and 9 under a cost of service scenario, is 10.26%. FERC Order, p. 8. For this proposed ROE level, various participants in the FERC Order proceeding still argued that the Mystic expert witness had adjusted the screening criteria for the proxy group in order to skew the result toward higher numbers. FERC Order, p. 10.

In the Millstone Interim Decision, the Authority used an assumed rate of return requirement of 13.4%, adjusted upward to account for some added risk associated with operating a merchant nuclear plant. The Authority noted in the Millstone Interim Decision that a merchant operation scenario is one in which a resource is selling its output into the regional wholesale market and through bilateral contracts and is reliant on revenues realized through those sales to meet its operating costs and return requirements. Id. In the Millstone Interim Decision, the Authority did not determine the justness or reasonableness of the 15% rate of return, nor did it establish a specific rate of return to which the Millstone Station is entitled. Id.

The Authority finds that the NuPower Project, as proposed, does not have the same risk profile as a merchant generator. A COS scenario, like that of the Mystic Units referenced above, better represents the risk profile the NuPower Project faces, relative to the merchant scenarios described above. In determining the appropriate cost of capital to allow NuPower under the cost of service pricing, Conn. Gen. Stat. § 16-19e (a) requires that:

> [t]he level and structure of rates be sufficient, but no more than sufficient, to allow public service companies to cover their operating costs including, but not limited to, appropriate staffing levels, and capital costs, to attract needed capital and to maintain their financial integrity, and yet provide appropriate protection to the relevant public interests, both existing and foreseeable . . .

The Authority considered similar cost of service-based pricing scenarios in determining an appropriate ROE.

UI currently has three fuel cell projects in its renewable connections program (RCP Projects). Tr. 05/21/19, p. 265. Two of UI's three RCP Projects are located in distressed municipalities, Bridgeport and New Haven. Id. The allowed ROE that UI receives for the RCP Projects is 9.35%, which consists of UI's current distribution ROE of 9.10% plus a 25 basis point adder, and is subject to adjustment as UI's allowed ROE is amended in a general rate case. Id., p. 265; RCP Reconsideration Decision, p. 6.

Additionally, the *Edison Electric Institute's Q3 2018 Regulatory and Financial Update: Rate Review Summary* (EEI 2018 Financial Update) shows that electric utilities filed 12 new rate reviews in third quarter of 2018; and the average requested ROE was 10.25% and the average awarded ROE was 9.53%. EEI 2018 Financial Update, p. 1.

The COS pricing mechanism provides for the return of, and return on, the prudent investment by NuPower for 20 years, similar to the business model for regulated utilities. The COS pricing mechanism proposed allows for the projected development and construction costs to be trued up to the actual costs. As a result, ratepayers share in the risk of project development. Further, the NuPower Project may true up its actual ongoing cost of service in any given year. The PPA parties have proposed that the Authority ensure that all costs associated with the operation of the NuPower CHP are recoverable through distribution rates charged by UI. The NuPower PPA comes with an assurance that the counterparty, a regulated utility, will make the periodic payments agreed to within the terms of the related contract.

In its Written Exceptions, NuPower indicated that, from a cost of equity perspective, the Project is not comparable to UI's RCP Projects. NuPower asserted that its Project is more risky to investors than the RCP projects because its construction and operation are subject to risks and penalties that could result in revenue loss or, in the extreme, termination of the contract. NuPower stated that, unlike UI, it does not have multiple revenue sources, or risk-mitigating ratemaking mechanisms such as decoupling mechanisms to reconcile costs and revenues; nor other rate adjustment mechanisms such as the nonbypassable federally mandated congestions charge. NuPower Written Exceptions, p. 3. Also, NuPower stated that UI's investment in the RCP Projects of approximately $50 million is very small when compared to its rate base of about $1 billion. Id., pp. 3 and 4

NuPower stated that the Authority allowed UI 50 basis points over its utility business only ROE for very limited construction and operational risks that pale in comparison to the level of risks to be endured by NuPower under the proposed PPA. Id. NuPower reasserted that it is a single asset entity with significant financing, project development, construction, capital, and operational risks, without UI's large balance sheet to absorb such risks. Additionally, NuPower claimed that a rating agency would combine the stand-alone nature of the Project with the construction and ongoing operation risks to further reduce its overall credit rating. Id. p. 5.

Furthermore, NuPower stated that in the proposed Second Interim Decision dated August 29, 2019, in Docket No. 18-05-04, PURA Implementation of June Special Session Public Act 17-3 (Millstone Second Interim Decision), the Authority approved a COS contract for half of Millstone's output that essentially insulates 50% of Millstone's output from merchant risk. NuPower Written Exceptions, p. 11. NuPower also stated that in the Millstone Second Interim Decision, the Authority allowed Millstone's owner an ROE of 14%, which is higher than the expected ROE for a Connecticut regulated utility, in spite of Millstone's advantages of depreciated capital costs and a lower cost structure. Id.

Given that NuPower does not have the same risk profile as a merchant generator, the Authority continues to find that the 15% ROE proposed by NuPower is excessive, and reduces the intended public benefits of the Project. Nevertheless, the Authority reconsiders its earlier ROE determination made in the September 9, 2019 Proposed Final Decision and agrees with NuPower that, while UI's RCP projects are COS-based as well, the Project faces significantly more financing, construction, and operational risks than the RCP projects. The Authority agrees with NuPower that level of risk for the proposed Project is notably different from that of regulated utility-sponsored project such that the allowed ROE should provide the developer the capability to attract needed capital to fund the project. The Authority will therefore allow NuPower a ROE of 12% for the proposed PPA under a COS-pricing model. This allowed ROE will provide additional compensation to the Project for the added risks noted above, while not exceeding benchmark ROE of 13.4% for a merchant generator.[2].

[2] The Authority notes that applying the premiums for development risk, technology risk and size risk proposed in NuPower's building-block approach, even to the regulated utility ROE, yields a ROE far in excess of 13.4%.

2. Pass-Through Entity Income Tax Rates

For current and deferred income taxes, NuPower applied the top Federal personal income rate of 37% and Connecticut pass-through entity (PET) rate of 6.99%. NuPower indicates that adjusting its proposed revenue requirement for corporate tax rates instead of the higher PET rates increases the fixed energy component of the PPA price. The lower corporate tax rates decreases the total deferred taxes, which serve as a deduction to rate base. Consequently, this results in a higher average rate base over the life of the project and increases the cost of service. Late Filed Exhibit No. 5, p. 1.

The Authority's review of both public and non-public exhibits supports NuPower's conclusion that using the statutory corporate income tax rates instead of the personal income tax rates would result in higher revenue requirements for CHP Project. The Authority's analysis shows that revenue would increase by approximately $10.7 million from increases to rate base as a result of reductions to the deferred taxes. The offsetting reductions to income taxes only totaled approximately $4.3 million. Hence, the Authority accepts NuPower's position to use personal income tax rates to calculate current and deferred income taxes.

3. Payroll Taxes

In its pro forma exhibits for calculating variable revenue requirements for the CHP Project, NuPower included the employees' portions of Medicare tax of $36,250, and Social Security tax of $15,922 in its calculation of the total other taxes. Response to Interrogatory EL-7 Attachment, p. 2. Also, the Company included the employer's portions of Medicare tax of $36,250, and Social Security tax of $15,922. Id. NuPower does not and will not have any employees. Tr. 3/27/19, pp. 142. NuPower LLC has only two members or principals. Id. The Company confirmed that the maximum Social Security wage of $256,800 and Medicare wage of $2.5 million are for two employees and that the $2.5 million Medicare wage represents estimated cash outflow. Id., p. 143.

Based on the Authority's inquiry, UI testified that it has never included employee portions of the payroll taxes in rate case applications. Late Filed Exhibit No. 3.

The Authority concludes that the cash outflow of $2.5 million upon which both the employee's and employer's portions of the proposed payroll taxes are calculated represents below the line distributions to the two members of NuPower LLC. Generally, self-employed person pays the entire 15.3% for Medicare and Social Security taxes, but half of these taxes are the employer's portions, which are allowed as above-the-line deductions. In other words, the two NuPower's members would deduct as a self-employment tax expense half of the 15.3% in their personal income tax returns. Therefore, the Authority concludes that NuPower should not include the non-deductive employee's portions of the Medicare and Social Security taxes as business expenses recoverable from UI's ratepayers.

4. Investment Tax Credits

In its pro forma exhibits, NuPower calculates and reduces income tax expenses by an annual total investment tax credits (ITC) of $650,700 over 20 years. Response to

Interrogatory EL-7 Attachment, pp. 8 and 9. NuPower also calculates a maximum Internal Revenue Service (IRS) ITC of $14.49 million based on total capacity of 9.66 MW and ITC credit of $1.5 million per MW. Id.

The Authority takes issue with NuPower's calculations of both the annual ITC amount and the IRS maximum ITC rate of $1.5 million per MW. The annual ITC deduction of $650,700 amounts to $13.014 million over 20 years and does not reflect 30% of the total reported gross plant of $69,132,244. Id., p. 7. Also, according to the United States Department of Energy, the tax credit cap for a qualified fuel cell energy property with a minimum capacity of 0.5 kW and an electricity-only generation efficiency of 30% or higher is $1,500 per 0.5 kW.[3] As a result, the Authority finds that the annual ITC calculated by NuPower does not align with a qualified fuel cell property costing $69,132,244, or with total capacity of 9.66 MW.

5. Test Period Revenue

The PPA indicates that the Seller may sell and deliver to the Buyer or other third parties any energy and RECs produced by or associated with the Facility during the Test Period, which is defined as the period prior to the COD. Exhibit A, pp. 19, 29, and 30. The PPA also specifies that energy, RECs and capacity generated by or associated with the Facility during the Test Period not purchased by Buyer under Section 4.1 shall not be deemed Products. Id. p. 13. In response to an inquiry to UI regarding whether revenues that NuPower would generate during the test period would be credited ratepayers, UI appears to indicate that they would not. Tr. 3/27/19, pp. 54-55. UI states that the cost of service agreement starts at COD, and that the Test Period is outside of the scope of the 20 years allowed under Conn Gen. Stat. § 16-258e. Thus, costs incurred for any product purchased from NuPower, during the Test Period, will be essentially passed-through to customers. Id.

The Authority acknowledges the fact the PPA term will start subsequent to the Test Period. However, the capital costs and significant O&M expenses for the CHP Project that are recoverable from UI's ratepayers would be incurred prior to the start of the PPA term. For a COS project, the Authority expects a clear stipulation that revenues earned during the Test Period by NuPower would either be used to mitigate the first year revenue requirement or reduce costs incurred prior to the start of the PPA term.

In its written exceptions, NuPower agreed that test period revenues for pre-COD costs should not be recovered again under the COS formula via the PPA. However, the Company claimed that it should retain revenues from costs incurred that are not recovered under the PPA and proposed a one-time 90-day post-COD compliance filing reconciling costs and revenues for test period. NuPower Written Exceptions, p. 19.

The Authority agrees that NuPower should be required to submit a post-COD compliance filing reconciling costs and revenues for test period. Any amount by which the revenues exceeded the test period costs should be credited to UI's customers in NuPower's first year fixed revenue requirements.

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[3] www.energy.gov/savings/business-energy-investment-tax-credit-itc

6. Ongoing Process to Review COS Model

UI is authorized to seek recovery of all costs associated with the PPA, including all costs prudently incurred by UI to administer and enforce the PPA. In approving the PPA, the Authority acknowledges its responsibility to review (a) the pro forma COS model, including the capital cost of the facility, (b) the true-up between pro-forma and actual capital cost of the facility approximately 90 days after the facility's COD, and (c) if necessary, review the annual actual revenue requirement if it exceeds the pro-forma revenue requirement for that year by greater than 5%.

The Authority will direct the PPA parties to submit a COS model for the actual capital cost of the Project for the 20-year term of the PPA, approximately 90 days after the facility's COD. Further, the Authority will direct UI to submit any adjustments to the COS model in the applicable rate adjustment mechanism (RAM) proceeding.

B. FIRM CUSTOMER COMMITMENTS FOR THE THERMAL ENERGY

Conn. Gen. Stat. § 16-258e(a) includes a requirement that "the thermal energy produced by such combined heat and power system shall be subject to firm customer commitments to subscribe to thermal energy services from such thermal energy transportation company, as demonstrated by such thermal energy transportation company, for the term of the power purchase agreement entered into pursuant to this section."

The PPA included terms which were meant to mirror the firm customer commitments requirement of the statute. Tr. 3/27/19, p. 77.

The following sections of the PPA specify the terms about thermal customer commitments:

- Section 3.1(a)(ii) requires that NuPower have a firm commitment from an off-taker for the thermal energy from the thermal loop for the term of the contract within 12 months of receiving approval from the Authority.

- Section 3.4(b) which, in relevant part, requires NuPower to construct the CHP system so that the facility "shall produce thermal energy that is subject to firm customer commitments to subscribe to thermal energy services from such thermal energy transportation company, as demonstrated by such thermal energy transportation company, for the term of [the PPA]."

- Section 7.2(n)(v) where NuPower affirms that the Facility, as defined in the PPA, "is subject to firm customer commitments to subscribe to thermal energy services for no less than the [term of the PPA]."

Application, Exhibit A (Public), pp. 16, 18, 36, and 38.

According to the provisions of the PPA noted above, UI and NuPower established a milestone of one thermal energy customer commitment within 12 months of PPA approval. The remaining provisions simply mirror the statutory language requiring firm customer commitments. UI provided little guidance on how it would administer these provisions of the PPA, other than to say that it might require at least two firm commitments and to the extent that it believed NuPower did not meet these threshold requirements, then it would bring the matter before the Authority. Tr. 3/27/19, pp. 80 and 81. UI stated that it would accept guidance from the Authority on how to further enforce this requirement. Id., p. 78.

NuPower first provided a letter of intent, and later a signed contract, for some portion of the expected thermal energy from the CHP system with Approved Storage and Waste Inc. NuPower Reply Brief, Attachment A. NuPower appears to deem this lone contract as satisfying the firm commitments statutory requirement. Tr. 3/27/18, p. 188. NuPower stated further that it had additional potential customers to which it was marketing. Tr. 3/27/19 pp. 104, 127 and 128. NuPower has had discussions with the University of Bridgeport to develop a contract for the thermal energy; the University of Bridgeport thermal demand is large enough to utilize all of the potential thermal energy provided by the CHP system. Id., p. 125. Indeed, the Authority received letters expressing interest in the thermal loop from potential customers including the University of Bridgeport and The Windward Apartments. University of Bridgeport Letter dated June 12, 2019; CT Community Renewal Associates Letter dated June 18, 2019.

The BETP argued that the PPA was prematurely filed since, at the time, NuPower did not provide any firm commitments and thus does not meet the statutory requirement for firm commitments. BETP Brief, p. 9. BETP further argued that since no firm customers are known, the Authority cannot evaluate the whether the location of the fuel cell maximizes the efficiency of the thermal energy. Id.

The statutory language specifies only that there must be firm commitments for the term of the PPA. Since the statutory language does not specify either the required number of firm customer commitments or the required amount of thermal energy for any and all commitments, the Authority will use its discretion to determine what requirements are reasonable given the evidence at hand.

The only PPA term that addresses firm customer commitments as a practical matter is the milestone in Section 3.1(a)(ii) that requires one “off-taker” within 12 months of Authority approval. Application, Exhibit A (Public), p. 16. It appears to the Authority that NuPower has satisfied that requirement of the PPA in the signed agreement with Approved Storage and Waste, Inc. NuPower Reply Brief, Attachment A.

The question remains what level of thermal energy offtake is sufficient to satisfy the statutory requirement for firm customer commitments and whether the one contract with Approved Storage and Waste Inc. does just this. Indeed, it is already clear NuPower and UI differ in their interpretation of the contract terms for meeting the firm customer commitments statutory requirement: UI stated that it might require more than one commitment to satisfy the statutory requirement, but NuPower believed that only one contract, even the one currently with Approved Storage and Waste Inc., satisfies the statute. Tr. 3/17/19, 80, 81, and 188; NuPower Reply Brief, p. 21.

The Authority finds that it is not in the long term interest of ratepayers to leave this question unanswered, especially since there is no common understanding between UI and NuPower. Therefore, the Authority will establish a clear standard by which to evaluate whether NuPower meets the requirements of the statute.

As the Authority noted above, the statute establishes only the requirement that there be firm customer commitments for the term of the PPA. While providing no further guidance about the quantity of thermal energy, the statute does indicate that its purpose is to evaluate district heating systems in furtherance of the Comprehensive Energy Strategy (CES). The Authority finds that the main benefit to ratepayers from this project is the advancement of the CES, which in this instance relates to meeting the state's greenhouse gas emission reductions targets specified in Conn. Gen. Stat. § 22a-200a. This matches the main benefits proposed by NuPower itself: to develop and evaluate a district heating system's capability to reduce both natural gas demand and greenhouse gas emissions. Application, Exhibit D (Public), pp. 4 and 5.

To evaluate district heating systems and their ability to reduce greenhouse gas emissions and natural gas demand requires actual thermal loop customers to offtake the thermal energy from the CHP system.

The Levitan analysis projected the direct carbon dioxide emissions of the facility over 20 years at 565,019 tons. Application, Exhibit B (Public), p. 3. The Levitan analysis compared an estimate of the avoided carbon dioxide emissions from the fuel cell displacing other New England generation sources based on projections over 20 years of the New England generation fleet and its expected emissions. Id. The expected avoided carbon dioxide emissions over 20 years was estimated at 544,940 tons. Id. Therefore, over the life of the PPA, and making assumptions that the generation fleet will reduce its carbon emissions profile over 20 years, Levitan projected that the fuel cell will result in a 20,079 ton increase in carbon dioxide. Id.; Response to Interrogatory EL-18. Converting from tons to metric tons (1 metric ton = 1.1 tons) gives projected fuel cell direct emissions of 513,654 metric tons (565,019 / 1.1), expected avoided emissions of 495,400 metric tons (544,940 / 1.1), and results in an increase in 18,254 metric tons of emissions. This estimate does not factor in potential carbon emissions reductions from the thermal loop.

NuPower submitted annual greenhouse gas emissions profiles for both the fuel cell and the thermal energy for the thermal loop. The emissions profile for the fuel cell alone was developed by Doosan and estimated two emissions profiles, one based on existing regional generation fleet as it existed in 2010, and one based on existing regional generation fleet as it existed in 2016. Supplemental Response to Interrogatory EL-18, Doosan Attachment and Ramboll Attachment. NuPower provided emissions profiles for the thermal loop with the assumption that all of the thermal energy from the fuel cell is being used. Id. The Table below displays annual emissions profiles as estimate by Levitan, Doosan and the Ramboll Group.

Annual Predicted Emissions Profiles for Fuel Cell and Thermal Loop

	Direct Emissions (m. tons)	Avoided Emissions (m. tons)	Net Emissions (m. tons)
Fuel Cell (Levitan)[4]	25,683	(24,770)	913
Fuel Cell (Doosan – regional fleet in 2010)	39,837	(53,967)	(14,130)
Fuel Cell (Doosan – regional fleet in 2016)	38,026	(47,584)	(9,558)
Thermal Loop at 100% capacity offtake[5]	n/a	(7,925)	(7,925)

Application, Exhibit B, p. 3; Supplemental Response to Interrogatory EL-18.

Neither UI nor NuPower could comment with any authority on Levitan's emissions calculations, but relied on Levitan's expertise. Tr. 3/27/19, p. 15; Response to Interrogatory EL-18.

The Authority accepts that the scenarios above present a reasonable range within which to expect net negative or net positive CO2 emission reductions from the project. On one end of the spectrum, ratepayers are faced with a scenario of funding a project that results in a net increase in CO2 emissions (according to the Levitan analysis) if 10% or less of the thermal energy is utilized in the thermal loop.

NuPower has argued that Levitan's assumptions regarding the change in renewable generation percentage of the fleet are questionable and that it is more reasonable to apply existing fleet profiles to evaluate the benefits of their program. NuPower Brief, pp. 12 and 13. The Authority finds the argument has some merit, but notes that using existing regional fleet instead of projected fleet characteristics, is just as questionable. This is obvious when comparing the avoided emission profiles of the 2010 and 2016 existing regional generation fleet noted in the Table above: the regional fleet has already shown a substantial change in emissions reductions.

The risk that UI ratepayers may fund an expensive project that increases emissions is exacerbated since there is only one small contract to date and that no district heating or thermal loop infrastructure exists. Tr. 3/27/19, pp. 122 and 127.

Therefore, the Authority finds that more thermal energy, whether a pilot program or not, must be subject to firm customer commitments before the Authority grants approval to help mitigate the risk of a UI ratepayer funded project increasing carbon emissions.

The Authority has considered the arguments made by NuPower in its Written Exceptions about the consequences of requiring the condition that firm customer commitments not less than 75% of the thermal energy be demonstrated by March 31, 2020. Proposed Final Decision, p. 16; NuPower Written Exceptions, p. 17. The Authority

[4] For ease of comparison Levitan's 20 year emissions profile was converted to an annual figure by dividing the figures by 20.

[5] Ramboll provided the emissions in annual avoided carbon dioxide at 8,717 tons. Supplemental Response to Interrogatory EL-18, Ramboll Attachment. Converting that number to metric tons gives 7,925 metric tons (8,717 / 1.1).

finds merit in NuPower's assertion that these requirements may limit the potential customer base for the thermal energy and may introduce other unintended disadvantages. Id. Nevertheless, the Authority finds that the current level of firm customer commitments in the form of the one contract with Approved Storage and Waste Inc. is not sufficient to meet the statutory requirement that the project is in the long-term interest of the ratepayers.

Accordingly, to ensure that the project is in the interest of ratepayers, and to ensure that thermal loop can be evaluated, the Authority conditionally approves this PPA upon UI submitting for Authority review and approval a revised PPA that requires NuPower to demonstrate firm customer commitments for not less than 50% of the total annual thermal energy output no later than two (2) years from COD; such requirement shall continue for the duration of the PPA. Failure to meet this requirement shall be considered an Event of Default by Seller under Section 9.2, which the Seller shall be given one hundred twenty (120) days to cure.

No later than two years from COD, the Authority will require NuPower to submit a compliance filing demonstrating compliance with this condition, including copies of contract(s) signed by thermal energy customer(s) and the thermal energy transportation company. The contracts must provide a similar level of detail for the thermal offtake as demonstrated in the Letter of Intent that NuPower signed with Approved Storage and Waste Inc., especially pertaining to the details for the thermal offtake. Letter of Intent dated December 12, 2018, filed January 17, 2019. The level of detail must be sufficient to demonstrate to the Authority the exact the minimum annual thermal energy offtake and the daily and hourly thermal energy offtake requirements.

The Authority will require additional information from NuPower in order to evaluate the thermal loop and its ability to further the CES in distressed communities and its long-term benefit to UI ratepayers. Accordingly, NuPower will be required to submit to the Authority annual filings no later than one year following the COD of the Facility. The information requested will show the number of contracts signed, the thermal offtake contracted for, and the actual thermal energy delivered.

C. ELECTRIC DISTRIBUTION SYSTEM INTERCONNECTION COSTS

NuPower proposed an $8 million electrical interconnection cost to interconnect the project to UI's distribution system. Response to Interrogatory EL-7, Attachment (Public), p. 3. All electrical interconnection costs will be passed through to electric customers through the COS model. Tr. 3/27/19, p. 65. This estimate was based on an initial projection from UI that included a cost range from minus 50% to plus 200%, or $4 to $24 million. Tr. 3/27/19, p. 35. According to UI, the upper bound on the costs are high because of all the uncertainty that could influence interconnection costs. The estimate was based on a review of circuit maps and did not include any detailed studies, field investigations, or a consideration of any adverse construction conditions such as the serviceability of existing facilities such as manholes, duct lines, and poles. Id., p. 33 and 36. System operating conditions such as voltage regulation at substations and thermal conditions in underground ducting, might also influence the interconnection costs. Id., p. 30. Other added costs might include city construction requirements that might require overtime

work, area congestion, and the amount of underground and overhead work. Id., p. 87. All of these factors contribute to the large uncertainty surrounding interconnection costs.

UI must first receive a completed application to interconnect and a signed and paid for study agreement before it conducts the Impact Study. Id., pp. 26 and 27. UI had received an initial application from the equipment manufacturer prior to June 2018. UI Response to Interrogatory EL-4. By June 2018, UI indicated to NuPower and the manufacturer that it needed clarification about the application and that it needed additional operating information about generator to properly model its impact to the distribution system. Id.; Tr. 3/27/19, pp. 25 and 26. UI had not received completed application materials as of March 2019, and so had not begun the Impact Study by that time. Id., p. 26. Once the Impact Study is completed, UI would then conduct a Facilities Study to develop a detailed budgetary estimate. Id., pp. 27 and 28. Estimates from Facilities Studies typically have an uncertainty range of plus and minus ten to twenty percent. Id., p. 35. Impact studies typically take 30 business days to conduct. Id., p. 27. Facilities Studies take at least 30 business days to complete, which will increase with the increase of complexity of the study. Id., pp. 29 and 36.

In its Written Exceptions, NuPower insists that the Authority has overstated the risk for exceeding the proposed interconnection costs and urges the Authority to grant approval of the interconnection estimate as a separate pass through expense that is fully recoverable as proposed in the Application. NuPower Written Exceptions, pp. 20 and 21. The Authority rejects this claim and refers to the Authority's findings above. The Authority continues to be concerned with these cost uncertainties. The PURA notes again that it is the ratepayers of UI that bear the interconnection cost overruns if the Authority were to grant approval of the interconnection estimate at this stage. The Authority finds this proposition unacceptable at this time and reminds NuPower that it inquired about the status of the distribution interconnection process and found that this process had been stalled due to NuPower not providing UI a complete interconnection application since the summer of 2018. Tr. 3/27/19, pp. 25 and 26. The Authority does not deem it reasonable that UI ratepayers should bear the risk of the interconnection cost overruns at this time.

The Authority finds that it is not in the interest of ratepayers to authorize interconnection costs that have such a large degree of uncertainty. Accordingly, the Authority defers making a final determination regarding cost recovery of interconnection costs until (1) a Facilities Study has been completed and submitted to the Authority, and (2) a revised estimate of interconnection costs is submitted for review and approval. The Authority directs UI to complete and submit to the Authority a Facilities Study by December 31, 2019. If a Facilities Study has not been completed by UI at that time, the Authority will require UI to file for an extension for submission for good cause shown. The Authority also directs NuPower to submit, no later than 30 days following UI's submission of the Facilities Study, an updated interconnection cost estimate and cost recovery proposal based on UI's Facilities Study. After receiving UI's and NuPower's compliance filings, the Authority will make a final determination regarding NuPower's cost responsibility and cost recovery for interconnection costs.

To keep apprised of the distribution interconnection process and to ensure it is undertaken in a timely manner, the Authority directs NuPower and UI to provide monthly

updates on the status of the interconnection process. At a minimum, the updates must include the following:

1. Current status: current study being undertaken or if the project is on hold. If the process is on hold, an explanation for the hold must be included.
2. Whether a completed application has been submitted and payment received by UI.
3. The length in business days it has taken to perform each study to date, including completed and active studies.
4. An explanation for any studies that have exceeded a thirty (30) business day window.
5. A list and description of any communications between UI and NuPower about the interconnection process for the preceding month.

D. GAS FACILITIES

The Southern Connecticut Gas Company (Southern) will build the natural gas distribution facilities necessary to serve the proposed fuel cell. Southern will provide service to the fuel cell facility under Rate Large General Service System Expansion (LGS-SE), for firm customers with an annual consumption equal to or greater than 30,000 ccf a year. Under Rate LGS-SE, customers can either elect to receive commodity service from Southern or a Third Party Supplier, as required under the tariff. Rate LGS-SE is a firm service tariff for all new commercial or industrial customers that qualify and began receiving service after January 1, 2014. Under that tariff, Southern commits to provide firm service 24 hours a day, 365 days a year at the contracted maximum Daily Quantity of gas and at the rates listed in the LGS-SE tariff.

Southern proposes to build 17,000 feet of 12" welded steel with a 199 psi maximum allowable operating pressure (MAOP) to provide the required capacity in the distribution system to support the daily and peak day demand of the fuel cell facility. Southern defines the proposed project as a system enhancement project that will provide additional capacity to the Housatonic Avenue regulator station, where the existing system has a MAOP of 60 psi. The existing distribution system served from that regulator station has enough capacity to serve an additional demand of 1,200 cfh. Any additional demand above 1,200 cfh, without a system enhancement project would lower pressures in the distribution system to unsustainable pressures. Southern's Response to Interrogatory EN-5.

Southern's proposed enhancement project would add approximately 147,000 cfh of additional capacity to the Bridgeport distribution system to serve customers' design peak day demands. The fuel cell will consume 84,000 cfh, which equals 2,089 MMBtus/d of capacity. The existing system has 1,200 cfh of unused capacity remaining to serve future customers' demands. Once the enhancement project is complete and the fuel cell facility is connected to the distribution system, 64,200 cfh (147,000 cfh – 84,000 cfh + 1,200 cfh) of capacity will be available to serve future customer growth in addition to the fuel cell. Southern's Response to Interrogatory EN-5.

Based on the map Southern provided, the proposed 199 psi distribution main will parallel the existing 600 psi distribution main from the Coram Lane gate station to the

existing regulator station on Housatonic Avenue. At that station, the gas pressure will be reduced from 199 psi to 60 psi and injected into the existing local distribution system to provide the required gas supply. Southern's Response to Interrogatory EN-05, Attachment 1.

The fuel cell will consume 2,089 MMBtus/day of primary firm design peak day capacity supplied through Southern's existing gas supply and capacity portfolio. Primary firm capacity is required to meet the operational requirements of the fuel cell and to ensure that its fuel source is uninterrupted, in accordance with the tariff. The gas will flow via the Tennessee Gas Pipeline Company (Tennessee) through the Coram Lane gate station in Milford. Southern indicated that it has more than enough primary firm design peak day capacity on Tennessee and through that gate station to supply the additional demand from the fuel cell. Southern's Response to Interrogatory EN-6.

Southern has not performed a detailed construction cost analysis, but estimates the construction costs to be $6.6 million. NuPower would be required to pay a $1.6 million contribution-in-aid-of-construction (CIAC). Response to Interrogatory EL-16. Under Southern's LGS-SE tariff, NuPower has the right to ask Southern to recalculate the Hurdle rate if the fuel Cell facility adds new equipment or new gas services are directly added to the portion of main supported by the customer's CIAC. However, Southern testified that since the construction of the new main project is a 199 psi reinforcement project to bring additional capacity to the Housatonic Ave regulator station, the company does not intend to connect any new customers to that 199 psi main. Southern's Response to Interrogatories EN-3 and EN-4.

The Authority reviewed Southern's responses in the instant proceeding and finds that the construction of the 199 psi MAOP main will add enough capacity in the system to allow the fuel cell to run uninterrupted under a firm service tariff. Further, the Authority agrees that Southern will have sufficient interstate pipeline capacity in its gas supply portfolio to provide primary design peak day capacity for the fuel cell. Finally, the Authority finds that the $1.6 million CIAC that Southern requires NuPower to pay is proper because it will reduce the capital costs in the Hurdle Rate Model so that there is a positive net value over the 25 year analysis period.

IV. FINDINGS OF FACT

1. NuPower proposed a post-tax WACC of 10.38%.

2. The Company proposed a capital structure that is 50:50 debt to equity.

3. The Company proposed long-term debt rate of 5.75% and ROE rate of 15%.

4. In the Millstone Interim Decision, the Authority accepted 13.4% as a reasonable ROE for a hypothetical merchant natural gas plant based on the ISO-NE's Net CONE Study.

5. NuPower claims that the Millstone Interim Decision provided additional support for its proposed 15% ROE for the fuel cell project. Id.

6. NuPower claims that the estimated ROE for its fuel cell project under building-block approach is 21.90%.

7. The ROE for GenConn peaking COS contract is 10.75.

8. The NuPower CHP project would never be exposed to wholesale market risks, nor reliant on market revenues to meet its operating costs and returns on and of capital investments.

9. The Millstone Interim Decision did not call for a ROE determined by building up a CAPM ROE for risks already reflected in the MRP.

10. A merchant operation is a situation in which a resource is selling its output into the wholesale market and is reliant on revenues realized through those sales to meet its operating costs and return requirements.

11. The Millstone nuclear facilities are existing resources contemplating submitting a de-list bid in FCA.

12. NuPower's "building-block" ROE method, is not an acceptable method for evaluating the cost of capital or making alternative investment decisions.

13. The ROE proposed for the Mystic units 8 and 9 is 10.26%.

14. EEI 2018 Financial Update shows that electric utilities filed 12 new rate reviews in the third quarter of 2018; and the average requested ROE was 10.25% and the average awarded ROE was 9.53%.

15. The three fuel cell projects in the RCP Reconsideration Decision are allowed UI's allowed distribution ROE plus 25 basis points.

16. For current and deferred income taxes, NuPower applied the top Federal personal income rate of 37% and Connecticut PET rate of 6.99%.

17. The lower corporate tax rates decreases the total deferred taxes, which serve as a deduction to rate base.

18. Using corporate tax rates would result in a higher average rate base over the life of the project and increase the cost of service.

19. NuPower included the employee's portions of Medicare tax of $36,250, and Social Security tax of $15,922 in its calculation of the total other taxes.

20. NuPower also included the employer's portions of Medicare tax of $36,250, and Social Security tax of $15,922.

21. NuPower does not and will not have any employees.

22. NuPower LLC has only two members or principals.

23. The Company confirmed that the maximum Social Security wage of $256,800 and Medicare wage of $2.5 million are for two employees and that the $2.5 million Medicare wage represents estimated cash outflow.

24. UI testifies that it has never included employee portions of the payroll taxes in rate case applications.

25. NuPower calculates and reduces income tax expenses by an annual total ITC of $650,700 over 20 years.

26. NuPower calculates maximum IRS ITC of $14.49 million based on total capacity of 9.66 MW and ITC credit of $1.5 million per MW.

27. The total ITC amount is 30% of the total reported gross plant addition.

28. The IRS maximum ITC rate is $1.5 million per MW.

29. The PPA indicates that the Seller may sell and deliver to the Buyer or other third parties any energy and RECs produced by or associated with the Facility during the Test Period.

30. The Test Period is defined as period prior to the COD.

31. Energy, RECs, and capacity generated by or associated with the Facility during the Test Period are not be deemed as Products under the PPA.

32. The capital costs and O&M expenses for the CHP Project are recoverable from UI's ratepayers.

33. The PPA included terms which were meant to mirror the firm customer commitments requirement of the statute.

34. Section 3.4(b) which, in relevant part, requires NuPower to construct the CHP system so that the facility "shall produce thermal energy that is subject to firm customer commitments to subscribe to thermal energy services from such thermal energy transportation company, as demonstrated by such thermal energy transportation company, for the term of [the PPA]."

35. Section 7.2(n) where NuPower affirms that the CHP system "is subject to firm customer commitments to subscribe to thermal energy services for no less than the [term of the PPA]."

36. UI and NuPower established a milestone of one thermal energy customer commitment within 12 months of PPA approval and a mirroring of statutory language that requires firm commitments.

37. UI has committed to bring customer commitment matters before the Authority.

38. UI has committed to seek and accept guidance from the Authority on how to enforce the firm customer commitment requirement.

39. NuPower filed a signed contract for some portion of the expected thermal energy from the CHP system with Approved Storage and Waste Inc.

40. NuPower proposed an $8 million electrical interconnection cost to interconnect the project to UI's distribution system.

41. The interconnection cost estimate was based on an initial projection from UI that included a cost range from minus 50% to plus 200%, or $4 to $24 million.

42. The interconnection estimate was based on a review of circuit maps and did not include any detailed studies, field investigations, or a consideration of any adverse construction conditions such as the serviceability of existing facilities like manholes, duct lines, and poles.

43. System operating conditions, such as voltage regulation at substations and thermal conditions in underground ducting, influence the interconnection costs.

44. Added interconnection costs might include city construction requirements that might require overtime work, area congestion, and the amount of underground and overhead work.

45. UI must first receive a completed application to interconnect before it conducts the Impact Study.

46. UI had not received completed application for interconnection to the distribution system as of March 2019.

47. UI conducts the Facilities Study after the Impact Study to develop a detailed budgetary estimate. Estimates from Facilities Studies typically have an uncertainty range of plus and minus ten to twenty percent.

48. Impact studies typically take 30 business days to complete and Facilities Studies take a minimum 30 business days to complete.

49. Southern proposes to build 17,000 feet of 12" welded steel with a 199 psi MAOP to provide the required capacity in the distribution system to support the daily and peak day demand of the fuel cell facility.

50. NuPower would be required to pay a $1.6 million CIAC.

51. Southern indicated that it has more than enough primary firm design peak day capacity on Tennessee and through the Coram Lane gate station to supply the additional demand from the fuel cell.

V. CONCLUSION AND ORDERS

A. CONCLUSION

After review, the Public Utilities Regulatory Authority conditionally approves the request of The United Illuminating Company to enter into a PPA with NuPower Bridgeport FC, LLC for a combined heat and power district energy project in Bridgeport, Connecticut.

B. ORDERS

For the following Orders, the Company shall submit one original of the required documentation to the Executive Secretary, 10 Franklin Square, New Britain, Connecticut 06051 and file an electronic version through the Authority's website at www.ct.gov/pura. Submissions filed in compliance with the Authority's Orders must be identified by all three of the following: Docket Number, Title and Order Number. Compliance with orders shall commence and continue as indicated in each specific Order or until the Company requests and the Authority approves that the Company's compliance is no longer required after a certain date.

1. No later than November 1, 2019, UI shall submit a revised PPA for the Authority's review and approval that incorporates the modifications to the thermal energy offtake provisions articulated in Section III.B, which are a condition of this Decision.

2. No later than December 31, 2019, UI shall submit a Facilities Study for Authority review and approval. UI shall not sign and execute the PPA until the Authority makes a determination regarding NuPower's electrical interconnection cost responsibility and recovery. If UI cannot complete the Facilities Study by December 31, 2019, it may request an extension for submission of the Facilities Study for good cause shown. No later than 30 days following UI's submission of the Facilities Study, NuPower shall submit to the Authority an updated interconnection cost estimate and cost recovery proposal based on UI's Facilities Study.

3. No Later than the first business day of each month, starting November 1, 2019 and ending with the final submission of NuPower's filing in Order No. 2 above, UI and NuPower shall individually submit monthly updates on the status of the interconnection process as detailed in Section III.C. Electric Distribution System Interconnection Costs.

4. No later than two years following the COD of the facility, NuPower shall submit to the Authority firm customer commitment(s) for not less than 50% of the total annual thermal energy capacity.

5. No later than 90 days following the COD of the facility, NuPower shall file with the Authority an exhibit reconciling costs and revenues for the test period. The filing shall indicate if the revenues exceeded the test period costs and if so, NuPower shall credit such excess amount to customers in its first year fixed revenue requirements.

6. No later than 90 days following the COD of the facility annual filings thereafter, NuPower shall submit to the Authority worksheet(s) detailing the Project's COS model for the actual capital cost of the facility for the 20-year term of the PPA. The filing shall also include worksheet(s) showing the truing-up of the projected capital and operating costs to actuals.

7. In its annual RAM filings following the COD of the facility and each annual filings thereafter, UI shall include worksheet(s) showing the calculation of the actual annual revenue requirement (ARR) for the NuPower facility and attest that the ARR did not exceed the pro-forma revenue requirement for that year by more than 5% based on NuPower's COS annual filing required by Order No. 4.

8. No later than one year following the COD of the Facility and continuing annually for the full term of the PPA, NuPower shall file with the Authority the following information regarding the firm customer commitments for the thermal energy:

    a. A list of total number of contracts with customers signed to date;
    b. Total annual and daily thermal energy contracted with each customer;
    c. Total annual thermal energy delivered for each year of the contract;
    d. Average daily and hourly thermal energy delivered for the preceding twelve month period; and
    e. An explanation for any thermal delivery shortfall from the preceding twelve month period.

DOCKET NO. 18-08-14 PURA REVIEW OF THE COMBINED HEAT AND POWER PROJECT SOLICITATION PURSUANT TO CONN. GEN. STAT. SECTION 16-258e

This Decision is adopted by the following Commissioners:

John W. Betkoski, III

Michael A. Caron

CERTIFICATE OF SERVICE

The foregoing is a true and correct copy of the Decision issued by the Public Utilities Regulatory Authority, State of Connecticut, and was forwarded by Certified Mail to all parties of record in this proceeding on the date indicated.

October 2, 2019

Jeffrey R. Gaudiosi, Esq.
Executive Secretary
Public Utilities Regulatory Authority

Date

Attachment #4

PureCell® Model 400

PURECELL SYSTEM BENEFITS

Energy Security

Proven PAFC fuel cell technology that is setting durability records

Energy Productivity

Increased efficiency and continuous on-site generation reduces energy costs

Energy Responsibility

Ultra-low emissions equals sustainability

PURECELL SYSTEM COMPETITIVE ADVANTAGES

Long Life

Industry leading 10-year cell stack life assures high availability and low service cost

Modular & Scalable

Solutions for multi-megawatt applications to meet growing energy demand

Experience

Most knowledgeable and experienced team in the industry

High Efficiency

Up to 90% total CHP Efficiency

Grid-Independence

Proven performance delivering power when the utility grid fails

Load Following

Capable of dispatching power to match building needs

Small Footprint

Highest power density among clean generation technologies

Flexible Siting

Indoor, outdoor, rooftop, multi-unit

RATED POWER OUTPUT: 460KW, 480VAC, 50/60HZ

Characteristic	Units	Operating Mode	
		Power 460kW	Eco 440kW
Electric Power Output[1]	kW/kVA	460/532	440/518
Electrical Efficiency	%, LHV	43%	45%
Peak Overall Efficiency	%, LHV	90%	90%
Gas Consumption[1]	MMBtu/h, HHV (kW)	4.09 (1,200)	3.77 (1,104)
Gas Consumption[1,2]	SCFH (Nm^3/h)	3,995 (107)	3,674 (98.4)
High Grade Heat Output @ up to 250°F[1]	MMBtu/h (kW)	0.72 (212)	0.55 (162)
Low Grade Heat Output @ up to 140°F[1]	MMBtu/h (kW)	1.03 (301)	1.00 (292)

FUEL

Supply ..... Natural Gas
Inlet Pressure ..... 10 to 14 in. water (2.5 - 3.5 mbar)

EMISSIONS[3,4]

NOx ..... 0.02 lbs/MWh (0.009 kg/MWh)
CO ..... 0.01 lbs/MWh (0.005 kg/MWh)
VOC ..... 0.01 lbs/MWh (0.005 kg/MWh)
SO_2 ..... Negligible
Particulate Matter ..... Negligible
CO_2[1] (electric only) ..... 998 lbs/MWh (454 kg/MWh)
(with High-Grade heat recovery) ..... 815 lbs/MWh[5] (371 kg/MWh)
(with full heat recovery) ..... 485 lbs/MWh[5] (220 kg/MWh)

OTHER

Ambient Operating Temp ..... -20°F to 104°F (-29°C to 40°C)
Relative Humidity ..... 0 to 100%
Sound Level ..... <65 dBA @ 33 ft. (10m)
Water Consumption ..... None (up to 86°F (30°C) Ambient Temp.)
Water Discharge ..... None (Normal Operating Conditions)

CODES AND STANDARDS

ANSI/CSA FC1-2014: Stationary Fuel Cell Power Systems
UL1741 SA: Inverters for Use With Distributed Energy Resources

NOTES

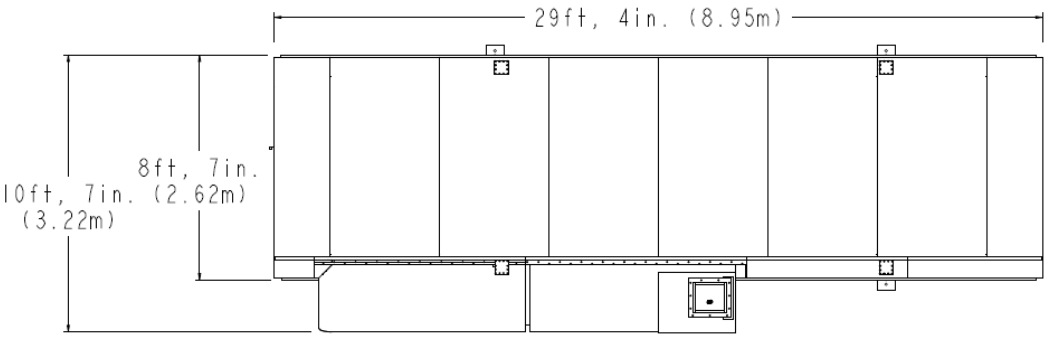
1. Average performance during 1st year of operation.
2. Based on natural gas higher heating value of 1025 Btu/SCF (40.4 MJ/Nm3)
3. Emissions based on 440 kW operation.
4. Fuel cells are exempt from air permitting in many U.S. states.
5. Includes CO_2 emissions savings due to reduced on-site boiler gas consumption

Doosan Fuel Cell America, Inc.
Corporate Headquarters
195 Governor's Highway
South Windsor, CT 06074
860.727.2253
www.doosanfuelcellamerica.com
email: fuelcells@doosan.com

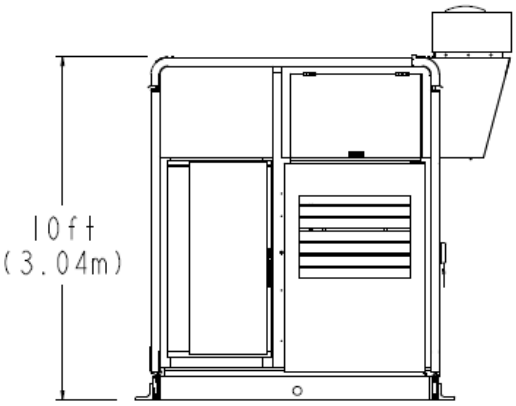
PureCell® Model 400

SYSTEM DIMENSIONS

Power Module

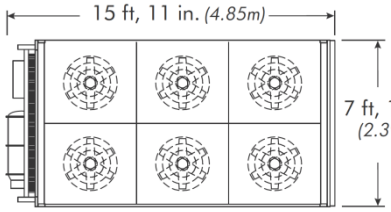


Top View

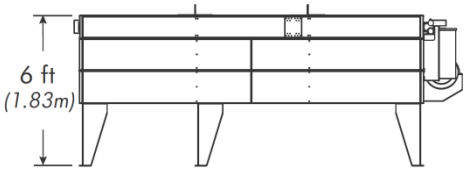


Side View

Cooling Module



Top View



Side View

PHYSICAL SPECIFICATIONS

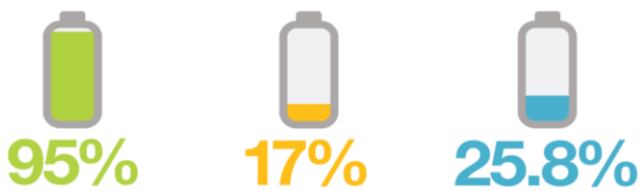
	Power Module	Cooling Module
Length	29′ 4″ (8.95m)	15′ 11″ (4.85m)
Width	8′ 7″ (2.62m)	7′ 10″ (2.39m)
Height	10′ (3.02m)	6′ 0″ (1.83m)
Weight	57,000 lb (27,216 kg)	3,190lb (1,447 kg)

PURECELL ADVANTAGE

OFFSET 3x MORE CO_2

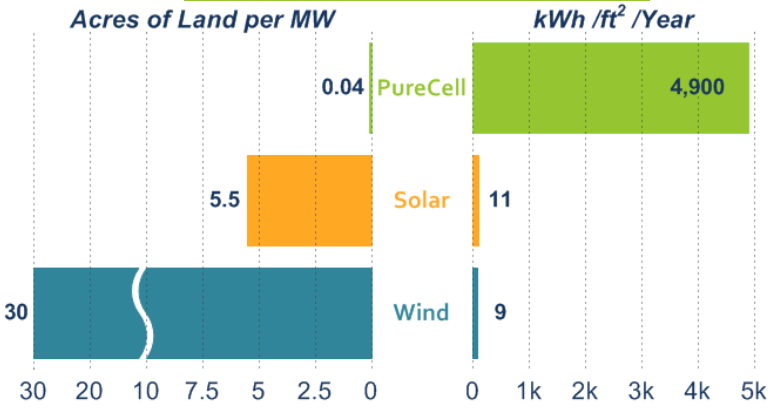
PureCell® System vs. Solar vs. Wind

CAPACITY FACTOR



CO_2 OFFSET

USE LESS LAND



Doosan Fuel Cell America, Inc.
Corporate Headquarters
195 Governor's Highway
South Windsor, CT 06074
860.727.2253
www.doosanfuelcellamerica.com
email: fuelcells@doosan.com

Attachment #5 Draft Emergency Response Plan

Doosan Fuel Cell America, Inc.

Fuel Cell Emergency Response Guide

NuPower Bridgeport FC, LLC

600 Iranistan Ave

Bridgeport, CT 06605

DISCLAIMER

Doosan Fuel Cell America reserves the right to change or modify, without notice, the design or equipment specifications of the PureCell® system Model 400 without obligation with respect to equipment either previously sold or to be sold. This guide is provided by Doosan Fuel Cell America, and no liability will accrue to Doosan Fuel Cell America based on the information or specifications included herein. No warranties or representations are made by this guide and no warranties or representations shall apply to the equipment except as stated in Doosan Fuel Cell America's standard terms and conditions of sale applicable at the time of purchase, a copy of which will be provided upon request. The Model 400 is designed to provide safe and reliable service when operated within design specifications, according to all applicable instructions, and with the appropriate operating materials. When operating this equipment, use good judgment and follow safety precautions to avoid damage to equipment and property or injury to personnel. Be sure to understand and follow the procedures and safety precautions contained in all applicable instructions, operating materials, and those listed in this guide. All information in this document is as of February 10, 2020.

Policy

The following plan has been developed to minimize the severity of damage to human health, the environment, and property in the event of an unexpected failure.

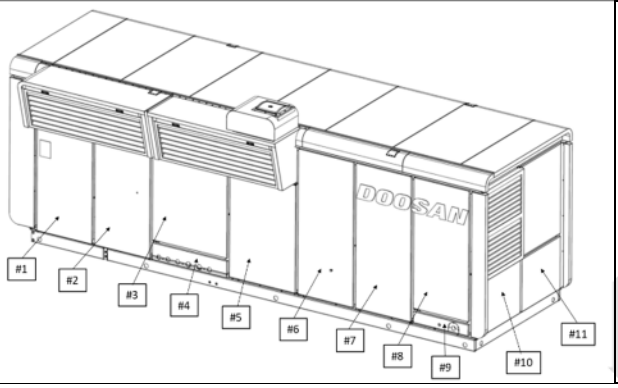
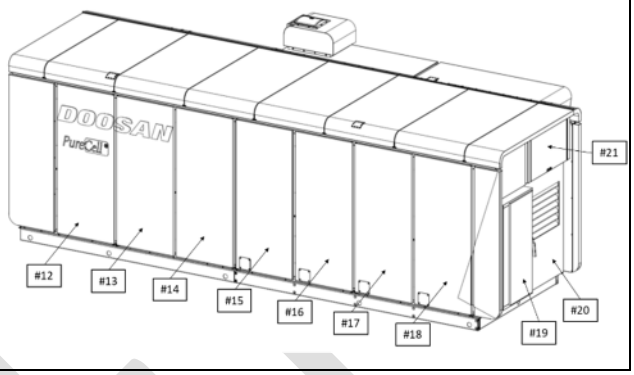
Scope

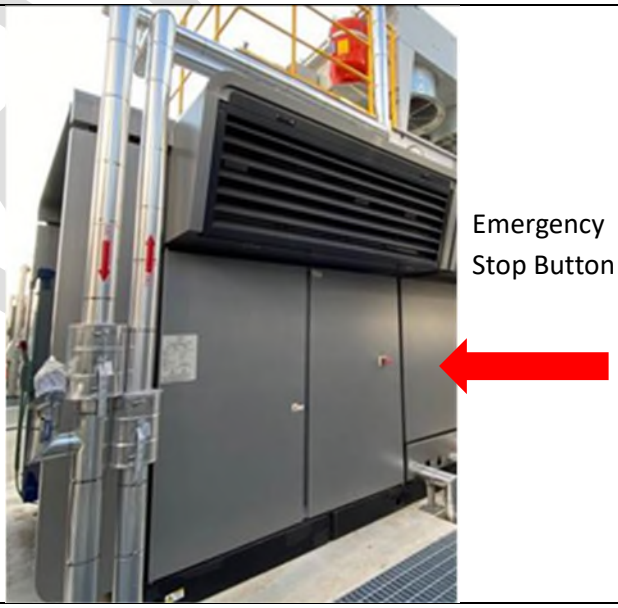
This Emergency Response Guide shall be integrated into the site Emergency Response Plan. Information contained in this document is customized to meet local requirements and shall be shared with local responders as necessary. This guide in no way assumes or transfers liability or ownership. Doosan Fuel Cell America should be contacted if clarification is needed.

Emergency Contacts and Numbers

Local Emergency Number	**911**
Doosan Fuel Cell America Control Center	**(860) 727-2847**
Fire Department – Non-emergency number	City of Bridgeport Fire Department (203) 337-2070
Hospital – Non-emergency number	Bridgeport Hospital 267 Grant St. Bridgeport, CT 06610
Electric Utility Name: United Illuminating	**800-722-5584**
Gas Utility Name: Southern Ct. Gas	**888-268-2887** ***Gas Leaks Only: 800-513-8898**
Local Oil & Chemical Spill Response Division	**800-645-8265**
Connecticut Oil & Chemical Spill Response Division	**860-424-3338**
EPA - Environmental Protection Agency Region 1	**(800) 424-8802** Environmental Emergency
OSHA - Occupational Safety and Health Admin. Emergency Number	**(800) 321-6742** National Emergency Number
Poison Control Center	**(800) 222-1222** National Emergency Number

Fuel Cell Hazard Overview

Front	Back
	

Rear View	Front View
	

Rear View Panel	Primary Hazard	Front View Panel	Primary Hazard
1 (Computer Terminal)	Electrical = 120 VAC	**12 (Reformer)**	Electrical = 480 VAC Chemical = Air sensitive catalyst / combustibles Thermal = 600°F Reformer Pressure = 150 psi steam
2 (Swing Door)	Electrical = 480 VAC	**13 (Reformer)**	Electrical = 480 VAC Chemical = Air sensitive catalyst / combustibles Thermal = 600°F Reformer Pressure = 150 psi steam
3 (Mechanical Entry)	Electrical = 480 VAC Chemical = Propylene Glycol Thermal = 350°F Steam Pressure = 150 psi Steam	**14 (Reformer)**	Electrical = 480 VAC Chemical = Air sensitive catalyst / combustibles Thermal = 600°F Reformer Pressure = 150 psi steam
4 (Mechanical Entry)	Chemical = Propylene Glycol Thermal = 350°F Steam Pressure = 150 psi Steam	**15 (DC Cell Stack)**	Electrical = 300 VDC Chemical = Solid phosphoric acid / combustibles
5 (TMS)	Electrical = 480 VAC Chemical = Propylene Glycol / Deionized Water / Resin Thermal = 350oF Steam Pressure = 150 psi Steam	**16 (DC Cell Stack)**	Electrical = 300 VDC Chemical = Solid phosphoric acid / combustibles
6 (ILS)	Electrical = 480 VAC Chemical = Air sensitive catalyst / combustibles Thermal = 600°F Reformer Pressure = 150 psi steam	**17 (DC Cell Stack)**	Electrical = 300 VDC Chemical = Solid phosphoric acid / combustibles
7 (Fuel Processing Area)	Electrical = 480 VAC Chemical = Air sensitive catalyst / combustibles Thermal = 600°F Reformer Pressure = 150 psi steam	**18 (DC Cell Stack)**	Electrical = 300 VDC Chemical = Solid phosphoric acid / combustibles
8 (Fuel Processing Area)	Electrical = 480 VAC Chemical = Air sensitive catalyst / combustibles Thermal = 600°F Reformer Pressure = 150 psi steam	**19 (Grid Connect Disconnect)**	Electrical = 480 VAC
9 (Gas/Nitrogen Inlet)	Chemical = combustibles	**20 (ESM)**	Electrical = 1400 VDC / 480 VAC
10 (Reformer)	Electrical = 480 VAC Chemical = Air sensitive catalyst / combustibles Thermal = 600°F Reformer Pressure = 150 psi steam	**21 (Blower 110)**	Electrical = 300 VDC Mechanical = Blower
11 (Reformer)	Electrical = 480 VAC Chemical = Air sensitive catalyst / combustibles Thermal = 600°F Reformer Pressure = 150 psi steam	**ALL Roof Panels**	Multiple Hazards DO NOT WALK ON ROOF!

Conditional Assessment

Normal Condition	Potential Abnormal Condition	Response
Fuel Cell White steam exiting power plant at exhaust chimney, above panel #6 (It can be a large amount of white steam depending on ambient conditions)	Dark colored smoke exiting chimney or any other part of enclosure	1. Establish safe perimeter 2. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**
	Observable fire or heavy smoke at any point on fuel cell	1. Press Fuel Cell 'Stop Button' – Only if safely accessible! 2. Dial 911 or Local Emergency Response Number 3. Establish safe perimeter 4. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**
Fuel Cell Moderate humming, clicking and fan sounds	Grinding or loud intermittent noises	1. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**
	Observable fire or heavy smoke at any point on fuel cell	1. Press Fuel Cell 'Stop Button' – Only if safely accessible! 2. Dial 911 or Local Emergency Response Number 3. Establish safe perimeter 4. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**
Cooling Module Fan humming	Smoke or fire coming from module	1. Press Fuel Cell 'Stop Button' – Only if safely accessible! 2. Dial 911 or Local Emergency Response Number 3. Establish safe perimeter 4. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**

	Grinding or loud noise coming from fans	1. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**
Cooling Module No leaking from cooling loop piping or coils	Small leak dripping from joint, valve or connection	1. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**
	Medium to large leak	1. Follow local spill response protocol or contact Clean Harbors Emergency Cleanup Response **(800) 645-8265** 2. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**
Mechanical Hi/Lo Grade Piping Small amounts of condensate dripping from piping	Small leak dripping from joint, valve or connection	1. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**
	Medium to large leak	1. Follow local spill response protocol or contact Clean Harbors Emergency Cleanup Response **(800) 645-8265** 2. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**
Disconnects/Other Equipment No leaks or smoke	Smoke or fire coming from equipment	1. Dial 911 or Local Emergency Response Number 2. Establish safe perimeter 3. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**
Compressed Gas Manifold (N2/H2) No leaks, May hear intermittent gas flow during purges	Leaks – may be able to hear hissing sound.	1. **If Indoors – Evacuate Immediately!** Dial 911 or Local Emergency Response Number 2. Establish safe perimeter 3. Contact Doosan Fuel Cell America Control Center **(860) 727-2847**

Fuel Cell Related Safety Data Sheets (SDS)

1	Propylene Glycol – DowFrost®
2	Phosphoric Acid – Solid
3	Reformer/ILS Catalysts
4	Anion/Cation Resin
5	Nitrogen / Hydrogen Compressed Gas Mixture (non-flammable)

Inspections

Inspection Type	Equipment Requirements	Frequency Required
General Maintenance	Laptop, Service Vehicle	Monthly
General Housekeeping	N/A	Monthly
Waste and Chemical Storage*	N/A	Weekly
Internal Combustible Gas Monitor	AT-160 Calibration Kit	Annual
Fire Prevention	N/A	Monthly

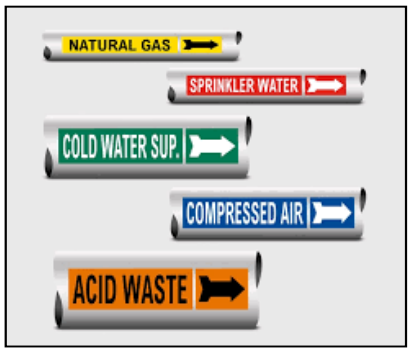
*When applicable

Fuel Cell operation is monitored and controlled remotely 24 hours a day 7 days a week by the Doosan Fuel Cell America Control Center. Upset or abnormal occurrences outside of normal operating parameters are immediately identified and service technicians are dispatched within 24 hours to respond when required.

Emergency Procedures

Alarms	There are no audible or visual alarms on Fuel Cell. Alarm conditions are relayed immediately to the Doosan Fuel Cell America Control Center. The Doosan Fuel Cell America Control Center will then contact the appropriate site personnel on the site's emergency contact list.
Emergency Shut Down Onsite	Actuate Fuel Cell Stop Button
Emergency Area Egress - Gas Odor	Evacuate 330 Feet in all directions
Emergency Area Egress - Fire	Evacuate 330 Feet in all directions – CV000 automatic natural gas supply shut off
Emergency Egress - General	Fuel cell is unmanned remotely monitored and controlled. No Doosan Fuel Cell America employees attending unit unless service or maintenance is required.

Signage and labeling



Perimeter fencing will have signage clearly identifying that “No smoking, no ignition sources” on every side of the fence. Signage will be similar to the sign below:

General:

Safety Hazard Analysis

The PureCell® Model 400 fuel cell system has been designed to meet strict ANSI/CSA safety standards to protect against risks from electrical, mechanical, chemical, and combustion safety hazards. The following items are a few of the safety measures incorporated into the design.

Fire Detection and Protection:

The power plant design incorporates a combustible gas sensor as well as thermal fuses located throughout the power module cabinet to detect fire. The detection of a potential flammable gas mixture, a fire, or the failure of this detection circuit will result in a power plant shutdown and a subsequent inert gas (nitrogen) purge of the fuel cell stack and fuel processing system. This event will also result in an alarm callout notification to Doosan Fuel Cell America service personnel. The power plant is designed with an integral emergency-stop button on the outside of the enclosure to enable immediate shutdown in the event of an emergency. There is also a gas shut-off valve and electrical disconnect switch easily accessible to emergency personnel. There are no restrictions for type of fire suppression equipment.

Gas Leak:

Augmenting the internal combustible gas sensor, the power plant also monitors the flow rate of natural gas. If the gas flow rate exceeds the equivalent power production of the power plant then a shutdown will result. The largest possible accumulation from a leak prior to shutdown is below combustible limits. Fuel valves inside the power plant are “fail safe” and will return to their normally closed position upon loss of power. The power plant is designed to have a physical barrier that separates the equipment handling combustible gases (fuel compartment) from electrical or potential spark-creating equipment (motor compartment). The fuel compartment is kept at a negative pressure to contain and remove any potential gas leaks, whereas the motor compartment is pressurized by a fan source to prevent combustible gases from entering.

Hydrogen:

Hydrogen is lighter than air and thus does not pool like other fuels and will readily dissipate with proper ventilation making it less likely to ignite. Although hydrogen has low self-ignition characteristics, the fuel in the power plant is not pure hydrogen. Also, the power plant is not producing or storing hydrogen, it consumes hydrogen-rich gas equal to what it requires to produce power. The fuel cell stack is wrapped in a fire retardant blanket. There are no materials inside the unit that would sustain a flame. There is no large volume of gas or any ignition that occurs within the cell stack.

Phosphoric Acid:

Phosphoric acid is integral part of the fuel cell system, acting as the electrolyte within the fuel cell stack. Phosphoric acid is a surprisingly common substance that is contained in common cola drinks. A leak of phosphoric acid is not possible because phosphoric acid is not in liquid form once applied in the equipment. There is no reservoir of liquid. Phosphoric acid is contained in the porous structure of the fuel cell stack material by capillary action, similar to how ink is absorbed into a blotter.

Fluid Leak:

The only fluid source is water. All pressurized water vessels are designed to ASME boiler codes and inspected annually. All piping, welds, etc. meet pressurized piping standards. Water produced through the electrochemical process is “pure” water and is reclaimed and reused by the process. The other source of water is water used in the external cooling module, which is mixed with a polypropylene glycol and a rust inhibitor to prevent rust and freezing in colder climates.

Hazardous Waste:

The fuel cell does not produce any hazardous waste. Standard Material Safety Data Sheets (MSDS) are available upon request.

APPENDIX 1 – SAFETY DATA SHEETS

SAFETY DATA SHEET

1. Identification

Product identifier: PHOSPHORIC ACID

Other means of identification

Synonyms: Ortho-Phosphoric Acid, White Phosphoric Acid

Product No.: 0240, 6908, 2798, 2797, 5854, 2796, 5804, 2788, 0259, 5372, 0274, 0269, 0268, 0265, 0264, 0262, 0260, 0255, 0251

Recommended use and restriction on use

Recommended use: Not available.

Restrictions on use: Not known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer

Company Name:	Avantor Performance Materials, Inc.
Address:	3477 Corporate Parkway, Suite 200 Center Valley, PA 18034
Telephone:	Customer Service: 855-282-6867
Fax:	
Contact Person:	Environmental Health & Safety
e-mail:	info@avantormaterials.com

Emergency telephone number:

24 Hour Emergency: 908-859-2151

Chemtrec: 800-424-9300

2. Hazard(s) identification

Hazard classification

Physical hazards

Corrosive to metals	Category 1

Health hazards

Acute toxicity (Oral)	Category 4
Skin corrosion/irritation	Category 1
Serious eye damage/eye irritation	Category 1
Specific target organ toxicity - single exposure	Category 3

Unknown toxicity

Acute toxicity, oral	0 %
Acute toxicity, dermal	0 %
Acute toxicity, inhalation, vapor	100 %
Acute toxicity, inhalation, dust or mist	100 %

Unknown toxicity

Acute hazards to the aquatic environment	84 %
Chronic hazards to the aquatic environment	84 %

Label elements

Hazard symbol:

Signal word: Danger

Hazard statement: May be corrosive to metals.
Harmful if swallowed.
Causes severe skin burns and eye damage.
May cause respiratory irritation.

Precautionary statement

Prevention: Keep only in original container. Do not breathe dust/fume/mist/vapors. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection. Wash thoroughly after handling.

Response: Absorb spillage to prevent material damage. IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Remove/take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or doctor/physician.

Storage: Store locked up. Store in a well-ventilated place. Keep container tightly closed. Store in corrosive resistant container with a resistant inner liner.

Disposal: Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.

Other hazards which do not result in GHS classification: None.

3. Composition/information on ingredients

Mixtures

Chemical identity	Common name and synonyms	CAS number	Content in percent (%)*
PHOSPHORIC ACID		7664-38-2	80 - 90%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

General information: Get medical advice/attention if you feel unwell. Show this safety data sheet to the doctor in attendance.

Ingestion:	Do NOT induce vomiting. Call a physician or poison control center immediately. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.
Inhalation:	Move to fresh air. Call a physician or poison control center immediately. Apply artificial respiration if victim is not breathing If breathing is difficult, give oxygen.
Skin contact:	Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician or poison control center immediately. Wash contaminated clothing before reuse. Destroy or thoroughly clean contaminated shoes.
Eye contact:	Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove contact lenses. Call a physician or poison control center immediately. In case of irritation from airborne exposure, move to fresh air. Get medical attention immediately.

Most important symptoms/effects, acute and delayed

Symptoms:	Causes severe skin and eye burns. Causes digestive tract burns.

Indication of immediate medical attention and special treatment needed

Treatment:	Treat symptomatically. Symptoms may be delayed.

5. Fire-fighting measures

General fire hazards:	No data available.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media:	The product is non-combustible. Use fire-extinguishing media appropriate for surrounding materials.
Unsuitable extinguishing media:	None known.
Specific hazards arising from the chemical:	Not combustible, but if involved in a fire decomposes to produce toxic gases.

Special protective equipment and precautions for firefighters

Special fire fighting procedures:	Move containers from fire area if you can do so without risk. Use water spray to keep fire-exposed containers cool.
Special protective equipment for fire-fighters:	Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA. Product is highly acidic. Wear protective gear if spilled during fire fighting.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures:	See Section 8 of the MSDS for Personal Protective Equipment. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Keep unauthorized personnel away. Keep upwind. Ventilate closed spaces before entering them.

Methods and material for containment and cleaning up:	Neutralize with lime or soda ash. Absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Clean surface thoroughly to remove residual contamination. Dike far ahead of larger spill for later recovery and disposal.
Notification Procedures:	Inform authorities if large amounts are involved.
Environmental precautions:	Do not contaminate water sources or sewer. Prevent further leakage or spillage if safe to do so.

7. Handling and storage

Precautions for safe handling:	Do not get in eyes, on skin, on clothing. Do not taste or swallow. Wash thoroughly after handling. Do not eat, drink or smoke when using the product. Use caution when adding this material to water. Add material slowly when mixing with water. Do not add water to the material; instead, add the material to the water.
Conditions for safe storage, including any incompatibilities:	Do not store in metal containers. Keep container tightly closed. Store in a well-ventilated place.

8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Chemical identity	Type	Exposure Limit values	Source
PHOSPHORIC ACID	TWA	1 mg/m3	US. ACGIH Threshold Limit Values (2011)
	STEL	3 mg/m3	US. ACGIH Threshold Limit Values (2011)
	REL	1 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	STEL	3 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	PEL	1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	TWA	1 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
	STEL	3 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
	TWA	1 mg/m3	US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A (06 2008)
	STEL	3 mg/m3	US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A (06 2008)
	ST ESL	10 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (12 2010)
	AN ESL	1 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (12 2010)
	TWA PEL	1 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (08 2010)
	STEL	3 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (08 2010)

Appropriate engineering controls No data available.

Individual protection measures, such as personal protective equipment

General information:	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. An eye wash and safety shower must be available in the immediate work area.
Eye/face protection:	Wear safety glasses with side shields (or goggles) and a face shield.
Skin protection	
Hand protection:	Chemical resistant gloves
Other:	Wear suitable protective clothing and gloves.
Respiratory protection:	In case of inadequate ventilation use suitable respirator. Respirator type: Chemical respirator with acid gas cartridge.
Hygiene measures:	Provide eyewash station and safety shower. Observe good industrial hygiene practices. Wash hands before breaks and immediately after handling the product. Wash contaminated clothing before reuse. Avoid contact with eyes. Avoid contact with skin.

9. Physical and chemical properties

Appearance	
Physical state:	Liquid
Form:	Liquid
Color:	Colorless
Odor:	Odorless
Odor threshold:	No data available.
pH:	1.5 0.1 N Aqueous solution
Melting point/freezing point:	21.1 °C
Initial boiling point and boiling range:	158 °C
Flash Point:	Not applicable
Evaporation rate:	No data available.
Flammability (solid, gas):	No data available.
Upper/lower limit on flammability or explosive limits	
Flammability limit - upper (%):	No data available.
Flammability limit - lower (%):	No data available.
Explosive limit - upper (%):	No data available.
Explosive limit - lower (%):	No data available.
Vapor pressure:	0.3 kPa
Vapor density:	No data available.
Relative density:	1.69 (20 °C)
Solubility(ies)	
Solubility in water:	Miscible with water.
Solubility (other):	No data available.
Partition coefficient (n-octanol/water):	No data available.
Auto-ignition temperature:	No data available.
Decomposition temperature:	No data available.
Viscosity:	No data available.

10. Stability and reactivity

Reactivity:	No dangerous reaction known under conditions of normal use.
Chemical stability:	Material is stable under normal conditions.
Possibility of hazardous reactions:	Hazardous polymerization does not occur.
Conditions to avoid:	Avoid contact with oxidizing agents. Avoid contact with strong reducing agents. Contact with alkalis.
Incompatible materials:	Strong reducing agents. Alkalies. Strong oxidizing agents. Metals.
Hazardous decomposition products:	oxides of phosphorus

11. Toxicological information

Information on likely routes of exposure

Ingestion:	Harmful if swallowed.
Inhalation:	Severely irritating to respiratory system.
Skin contact:	Causes severe skin burns.
Eye contact:	Causes serious eye damage.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral
Product: ATEmix (Rat): 1,700 mg/kg

Dermal
Product: ATEmix (): 3,044.44 mg/kg

Inhalation
Product: No data available.

Repeated dose toxicity
Product: No data available.

Skin corrosion/irritation
Product: Causes severe skin burns.

Serious eye damage/eye irritation
Product: Causes serious eye damage.

Respiratory or skin sensitization
Product: Not a skin sensitizer.

Carcinogenicity
Product: This substance has no evidence of carcinogenic properties.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:
No carcinogenic components identified

US. National Toxicology Program (NTP) Report on Carcinogens:
No carcinogenic components identified

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):
No carcinogenic components identified

Germ cell mutagenicity

In vitro
Product: No mutagenic components identified

In vivo
Product: No mutagenic components identified

Reproductive toxicity
Product: No components toxic to reproduction

Specific target organ toxicity - single exposure
Product: None known.

Specific target organ toxicity - repeated exposure
Product: None known.

Aspiration hazard
Product: Not classified

Other effects: Not known.

12. Ecological information

Ecotoxicity:

Acute hazards to the aquatic environment:

Fish
Product: No data available.

Aquatic invertebrates
Product: No data available.

Chronic hazards to the aquatic environment:

Fish
Product: No data available.

Aquatic invertebrates
Product: No data available.

Toxicity to Aquatic Plants
Product: No data available.

Persistence and degradability

Biodegradation
Product: Expected to be readily biodegradable.

BOD/COD ratio
Product: No data available.

Bioaccumulative potential
Bioconcentration factor (BCF)
Product: No data available on bioaccumulation.

Partition coefficient n-octanol / water (log Kow)
Product: No data available.

Mobility in soil: The product is water soluble and may spread in water systems.

Other adverse effects: The product may affect the acidity (pH-factor) in water with risk of harmful effects to aquatic organisms.

13. Disposal considerations

Disposal instructions: Discharge, treatment, or disposal may be subject to national, state, or local laws.

Contaminated packaging: Since emptied containers retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN number:	UN 1805
UN proper shipping name:	Phosphoric acid solution
Transport hazard class(es)	
Class(es):	8
Label(s):	8
Packing group:	III
Marine Pollutant:	No

IMDG

UN number:	UN 1805
UN proper shipping name:	PHOSPHORIC ACID SOLUTION
Transport hazard class(es)	
Class(es):	8
Label(s):	8
EmS No.:	F-A, S-B
Packing group:	III
Marine Pollutant:	No

IATA

UN number:	UN 1805
Proper Shipping Name:	Phosphoric acid, solution
Transport hazard class(es):	
Class(es):	8
Label(s):	8
Marine Pollutant:	No
Packing group:	III

15. Regulatory information

US federal regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):

PHOSPHORIC ACID Reportable quantity: 5000 lbs.

Superfund amendments and reauthorization act of 1986 (SARA)

Hazard categories

[X] Acute (Immediate) [X] Chronic (Delayed) [ ] Fire [ ] Reactive [ ] Pressure Generating

SARA 302 Extremely hazardous substance
None present or none present in regulated quantities.

SARA 304 Emergency release notification

Chemical identity	RQ
PHOSPHORIC ACID	5000 lbs.

SARA 311/312 Hazardous chemical

Chemical identity	Threshold Planning Quantity
PHOSPHORIC ACID	500 lbs

SARA 313 (TRI reporting)
None present or none present in regulated quantities.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)
PHOSPHORIC ACID Reportable quantity: 5000 lbs.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):
None present or none present in regulated quantities.

US state regulations

US. California Proposition 65
No ingredient regulated by CA Prop 65 present.

US. New Jersey Worker and Community Right-to-Know Act
PHOSPHORIC ACID Listed

US. Massachusetts RTK - Substance List
PHOSPHORIC ACID Listed

US. Pennsylvania RTK - Hazardous Substances
PHOSPHORIC ACID Listed

US. Rhode Island RTK
PHOSPHORIC ACID Listed

Inventory Status:

Australia AICS:	On or in compliance with the inventory
Canada DSL Inventory List:	On or in compliance with the inventory
EINECS, ELINCS or NLP:	On or in compliance with the inventory
Japan (ENCS) List:	On or in compliance with the inventory
China Inv. Existing Chemical Substances:	Not in compliance with the inventory.
Korea Existing Chemicals Inv. (KECI):	On or in compliance with the inventory
Canada NDSL Inventory:	Not in compliance with the inventory.
Philippines PICCS:	On or in compliance with the inventory
US TSCA Inventory:	On or in compliance with the inventory
New Zealand Inventory of Chemicals:	On or in compliance with the inventory
Japan ISHL Listing:	Not in compliance with the inventory.
Japan Pharmacopoeia Listing:	Not in compliance with the inventory.

16.Other information, including date of preparation or last revision

NFPA Hazard ID

Flammability
Health
Reactivity
Special hazard.

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

Issue date:	04-07-2014
Revision date:	No data available.
Version #:	1.0
Further information:	No data available.
Disclaimer:	THE INFORMATION PRESENTED IN THIS MATERIAL SAFETY DATA SHEET (MSDS/SDS) WAS PREPARED BY TECHNICAL PERSONNEL BASED ON DATA THAT THEY BELIEVE IN THEIR GOOD FAITH JUDGMENT IS ACCURATE. HOWEVER, THE INFORMATION PROVIDED HEREIN IS PROVIDED "AS IS," AND AVANTOR PERFORMANCE MATERIALS MAKES AND GIVES NO REPRESENTATIONS OR WARRANTIES WHATSOEVER, AND EXPRESSLY DISCLAIMS ALL WARRANTIES REGARDING SUCH INFORMATION AND THE PRODUCT TO WHICH IT RELATES, WHETHER EXPRESS, IMPLIED, OR STATUTORY, INCLUDING WITHOUT LIMITATION, WARRANTIES OF ACCURACY, COMPLETENESS, MERCHANTABILITY, NON-INFRINGEMENT, PERFORMANCE, SAFETY, SUITABILITY, STABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, AND ANY WARRANTIES ARISING FROM COURSE OF DEALING, COURSE OF PERFORMANCE, OR USAGE OF TRADE. THIS MSDS/SDS IS INTENDED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF THE MATERIAL BY A PROPERLY TRAINED PERSON USING THIS PRODUCT, AND IS NOT INTENDED TO BE COMPREHENSIVE AS TO THE MANNER AND CONDITIONS OF USE, HANDLING, STORAGE, OR DISPOSAL OF THE PRODUCT. INDIVIDUALS RECEIVING THIS MSDS/SDS MUST ALWAYS EXERCISE THEIR OWN INDEPENDENT JUDGMENT IN DETERMINING THE APPROPRIATENESS OF SUCH ISSUES. ACCORDINGLY, AVANTOR PERFORMANCE MATERIALS ASSUMES NO LIABILITY WHATSOEVER FOR THE USE OF OR RELIANCE UPON THIS INFORMATION. NO SUGGESTIONS FOR USE ARE INTENDED AS, AND NOTHING HEREIN SHALL BE CONSTRUED AS, A RECOMMENDATION TO INFRINGE ANY EXISTING PATENTS OR TO VIOLATE ANY FEDERAL, STATE, LOCAL, OR FOREIGN LAWS. AVANTOR PERFORMANCE MATERIALS REMINDS YOU THAT IT IS YOUR LEGAL DUTY TO MAKE ALL INFORMATION IN THIS MSDS/SDS AVAILABLE TO YOUR EMPLOYEES.

NN53

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: Shift Max 230, Reduced Heterogeneous Catalyst, FC72372

SECTION 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Doosan Fuel Cell America, Inc.
195 Governors Hwy.
South Windsor, CT 06074
USA

TELEPHONE: 24 HOUR EMERGENCY: 1-800-424-9300 (CHEMTREC)
PRODUCT INFORMATION: 860-727-2200

MSDS NO: NN53 INITIAL RELEASE DATE: 4/23/2009 REVISION DATE:

GENERIC DESCRIPTION: Reduced catalyst
PHYSICAL FORM: Cylindrical tablets
COLOR: Dark brown
ODOR: None
NFPA 704 CODES: HEALTH: 1 FLAMMABILITY: 4 REACTIVITY: 2

NOTE: NFPA = NATIONAL FIRE PROTECTION ASSOCIATION

SECTION 2. COMPOSITION / INFORMATION ON INGREDIENTS

CAS NUMBER	%WT/VOL.	COMPONENTS	EXPOSURE LIMITS OSHA	EXPOSURE LIMITS ACGIH
The following is the composition of the packed tablets:				
1344-28-1	9-12	Aluminum oxide	15 mg/m3 5 mg/m3 (respirable)	1 mg/m^3 (respirable)
7440-50-8	55-62	Copper	1 mg/m3	1 mg/m^3 (dust)
1314-13-2	28-33	Zinc oxide	15 mg/m3 5 mg/m3 (respirable)	2 mg/m^3 (respirable)

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: Shift Max 230, Reduced Heterogeneous Catalyst, FC72372

SECTION 3. EFFECTS OF OVEREXPOSURE

ACUTE EFFECTS:

EYE:	May cause irritation
SKIN:	Frequent or prolonged contact may irritate the skin and cause a skin rash (dermatitis).
INHALATION:	Prolonged or repeated inhalation may cause lung damage. Prolonged or excessive inhalation may cause respiratory tract irritation.
ORAL:	Moderately toxic and may be harmful if swallowed; may damage the liver, pancreas, kidney or nervous systems.

REPEATED EXPOSURE EFFECTS:

EYE:	Signs and symptoms of overexposure may include scratch or abrasion, damage to cornea (necrosis).
SKIN:	Overexposure may cause skin rash, dermatitis and or itching.
INHALATION:	Overexposure may cause coughing, wheezing, shortness of breath, difficult breathing, chest pain.
ORAL:	Ingestion may cause upset stomach and intestinal distress.

SECTION 3. EFFECTS OF OVEREXPOSURE

NOTE TO PHYSICIANS: N/D

THIS MATERIAL CONTAINS THE FOLLOWING COMPONENTS WITH THE SPECIAL HAZARDS LISTED BELOW.

CARCINOGENS	N/A
TERATOGENS	N/A
MUTAGENS	N/A
REPRODUCTIVE TOXINS	N/A
SENSITIZERS	N/A
COMMENTS:	None
NTP CLASSIFICATION:	N/A
IARC CLASSIFICATION:	N/A
OSHA CLASSIFICATION:	N/A

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: Shift Max 230, Reduced Heterogeneous Catalyst, FC72372

SECTION 4. FIRST AID MEASURES

EYE:	**Immediately flush eyes with plenty of water for at least 30 minutes. Get immediate medical attention.**
SKIN:	**Wash with plenty of soap and water. Get medical attention if irritation develops or persists.**
INHALATION:	**Remove to fresh air. If breathing is difficult seek immediate medical attention.**
ORAL:	**If swallowed, do NOT induce vomiting. Give victim large quantities of water. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person.**
COMMENTS:	**Exposure to fumes of the metal oxides may cause metal fume fever including irritation of eyes and respiratory tract and flu-like symptoms.**

SECTION 5. FIRE FIGHTING MEASURES

FLASH POINT (METHOD):	N/A
AUTOIGNITION TEMPERATURE:	N/A
FLAMMABILITY LIMITS IN AIR:	N/A
EXTINGUISHING MEDIA:	Protect exposures; cool with water fog. For small fires use Class D extinguishing media.
UNSUITABLE EXTINGUISHING MEDIA:	N/D
FIRE FIGHTING PROCEDURES:	Wear full protective clothing and SCBA's.
UNUSUAL FIRE HAZARDS:	Packed material will spontaneously oxidize in air, producing significant heat. Keep away from combustible materials.
HAZARDOUS DECOMPOSITION PRODUCTS:	Toxic metal fumes may be emitted if thermally decomposed.

SECTION 6. ACCIDENTAL RELEASE MEASURES

CONTAINMENT / CLEAN UP:

Small spill	With shovel or scoop, place material onto clean, dry non-flammable surface to allow catalyst to oxidize. Place oxidized catalyst into container and cover loosely. Remove containers from spill area. Protect against inhalation of dusts or fumes, Wear eye protection.
Large spill	Wet methods of cleanup are preferred. Keep airborne particulates to a minimum. Protect against inhalation of dusts or fumes, Wear eye protection. Place in appropriate containers for disposal.

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: Shift Max 230, Reduced Heterogeneous Catalyst, FC72372

SECTION 7. HANDLING AND STORAGE

HANDLING: No special precautions for intact containers.

STORAGE: Store in dry area. Prevent exposure to air by maintaining under an inert gas atmosphere such as nitrogen. Use additional precautions to prevent asphyxiant hazards due to inert gas usage.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS

LOCAL EXHAUST: If user operations generate dust or fume, use ventilation to keep exposure to airborne contaminates below the exposure limits.

GENERAL VENTILATION: N/A

PERSONAL PROTECTIVE EQUIPMENT FOR ROUTINE HANDLING

EYES: Wear safety glasses with side shields or goggles.

SKIN: Wear protective clothing, including long sleeves and gloves to prevent skin contact.

SUITABLE GLOVES: Impermeable, such as latex, Nitrile, etc.

INHALATION: Wear NIOSH approved respirator with particulate filter.

PERSONAL PROTECTIVE EQUIPMENT FOR SPILLS

EYES: Chemical goggles

SKIN: Chemical resistant gloves

INHALATION / SUITABLE RESPIRATOR: (Min) Use NIOSH-approved respirator with particulate filter

PRECAUTIONARY MEASURES: N/D

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: Shift Max 230, Reduced Heterogeneous Catalyst, FC72372

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

TYPICAL PHYSICAL PROPERTIES ARE GIVEN BELOW.

APPEARANCE: Cylindrical tablets
COLOR: Dark brown
ODOR: None
ODOR THRESHOLD: N/A
pH: N/A
BOILING POINT C (F): N/A
MELTING POINT C (F): N/A
SOLUBILITY IN WATER: Insoluble
VISCOSITY AT_____: N/A
VISCOSITY AT_____:
RELATIVE DENSITY TO: 65-85 lb./CF (bulk)

POUR POINT C (F): N/A
FREEZING POINT C (F): N/A
VOLATILE ORGANIC COMPOUND:
SPECIFIC GRAVITY: (H_2O = 1) >8
VAPOR PRESSURE - mmHg: N/A
VAPOR DENSITY @ TEMP:_____: N/A
EVAPORATION RATE RELATIVE TO_____: N/A
EXPLOSIVE PROPERTIES: Will not explode
OXIDIZING PROPERTIES: Not an oxidizer

SECTION 10. STABILITY AND REACTIVITY

STABILITY (THERMAL, LIGHT, ETC.): Generally considered stable when contained under an inert atmosphere.

CONDITIONS TO AVOID: Exposure to air.

INCOMPATIBILITY (MATERIALS TO AVOID): Combustible materials.

HAZARDOUS DECOMPOSITION PRODUCTS: Thermal decomposition may produce metal oxide fumes.

HAZARDOUS POLYMERIZATION: Not expected to occur.

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: Shift Max 230, Reduced Heterogeneous Catalyst, FC72372

SECTION 11. TOXICOLOGICAL DATA

Exposure to metal oxide fume may produce "metal fume fever" which is characterized by flu-like symptoms including fever, chills and general aches.

SECTION 12. ECOLOGICAL INFORMATION

No data available.

SECTION 13. DISPOSAL CONSIDERATIONS

Local regulations may vary; all waste must be disposed/recycled/reclaimed in accordance with federal, state and local environmental control regulations.

SECTION 14. TRANSPORT INFORMATION

PROPER SHIPPING NAME: Self-heating solid, inorganic, N.O.S.

HAZARD TECHNICAL NAME: Reduced copper catalysts.

HAZARD CLASS: 4.2

UN NUMBER: 3190

PACKING GROUP: II

SECTION 15. REGULATORY INFORMATION

TSCA STATUS: Component materials are in the TSCA inventory.

EPA SARA TITLE III CHEMICAL LISTINGS:

SECTION 302 HAZARDOUS SUBSTANCES: No

SECTION 355 EXTREMELY HAZARDOUS SUBSTANCES: No

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: Shift Max 230, Reduced Heterogeneous Catalyst, FC72372

SECTION 15. REGULATORY INFORMATION, CONTINUED

SECTION 312 HAZARD CLASS:

ACUTE:	Yes
CHRONIC:	Yes
FIRE:	Yes
PRESSURE:	No
REACTIVE:	No

SECTION 372 TOXIC CHEMICALS: Copper.

SECTION 16. OTHER INFORMATION

COMMENTS: N/D = Not Determined
N/A = Not Applicable

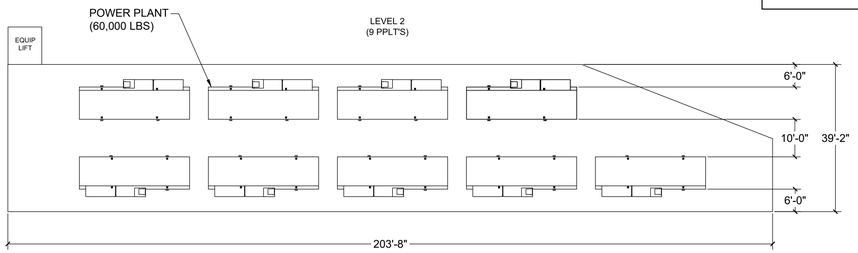
As a unit, the materials do not pose a hazard. However, should the container be compromised and the packed catalyst become available, measures must be taken to prevent exposure to air.

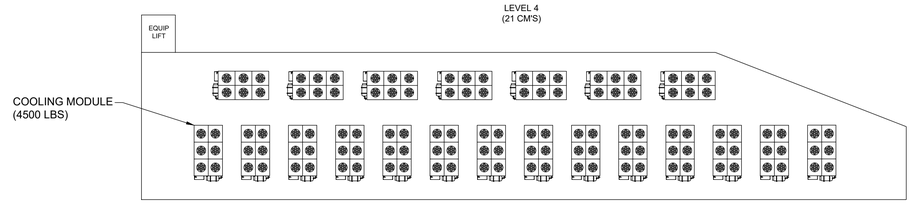
PREPARED BY: D. Black, J. Preston
Revision By:

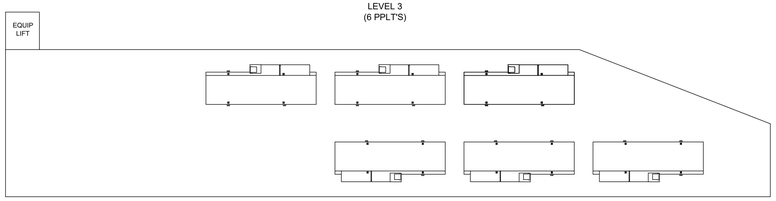
DATE: 4/23/2009

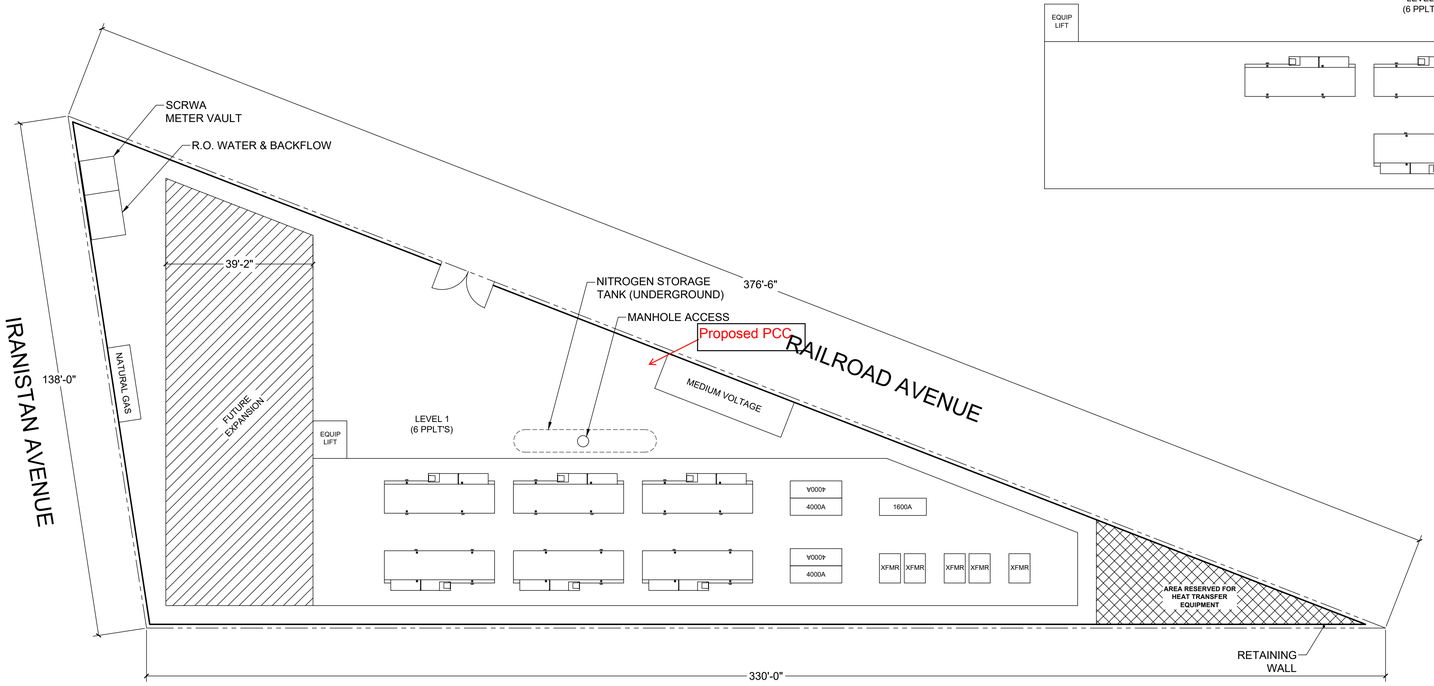
INFORMATION GIVEN HEREIN IS OFFERED IN GOOD FAITH AS ACCURATE, BUT WITHOUT GUARANTEE. CONDITIONS OF USE AND SUITABILITY OF THE PRODUCT FOR PARTICULAR USES ARE BEYOND OUR CONTROL; ALL RISKS OF USE OF THE PRODUCT ARE THEREFORE ASSUMED BY THE USER AND WE EXPRESSLY DISCLAIM ALL WARRANTIES OF EVERY KIND AND NATURE, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE IN RESPECT TO THE USE OR SUITABILITY OF THE PRODUCT. NOTHING IS INTENDED AS A RECOMMENDATION FOR USES WHICH INFRINGE VALID PATENTS OR AS EXTENDING LICENSE UNDER VALID PATENTS. APPROPRIATE WARNINGS AND SAFE HANDLING PROCEDURES SHOULD BE PROVIDED TO HANDLERS AND USERS.

Attachment #6 - Site Layout

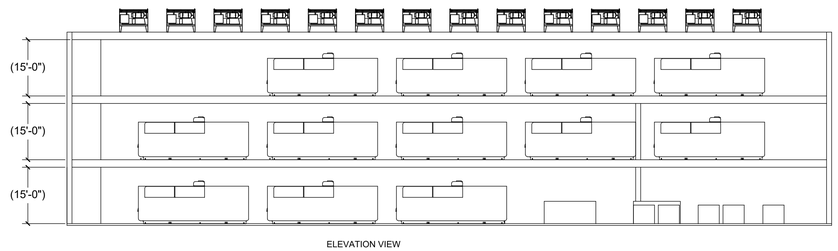








INTERSTATE 95 (CT TURNPIKE)



ELEVATION VIEW

THESE DRAWINGS ARE PROVIDED BY DOOSAN FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE WITHOUT NOTICE.

CONTACT DOOSAN FOR THE LATEST REVISIONS BEFORE USING THESE DRAWINGS FOR DESIGN PURPOSES.

SITE–SPECIFIC CONSTRUCTION DRAWINGS MUST BE PREPARED BY THE ENGINEER OF RECORD. DOOSAN IS NOT RESPONSIBLE FOR THE ACCURACY OF CONSTRUCTION DRAWINGS, INCLUDING, BUT NOT LIMITED TO, THE DESIGN OF THE SYSTEMS THAT INTERFACE WITH DOOSAN'S EQUIPMENT.

NOT FOR CONSTRUCTION

REPRESENTATION OF MATERIAL ON THIS DRAWING DOES NOT INDICATE A RESPONSIBILITY OF DOOSAN TO SUPPLY THE EQUIPMENT. DOOSAN SCOPE OF SUPPLY IS DEFINED IN CUSTOMER CONTRACT DOCUMENTS.

MARK	DATE	DESCRIPTION
A	11–8–18	INITIAL RELEASE
ISSUE:		

ORIGINAL RELEASE:	
DRAWING NO:	FCL107418
DRAWING SCALE:	NONE
DRAWING REVISION:	A
CAGE CODE:	
DRAWN BY:	K. WOTTON
CHECKED BY:	W. BONOLA

SHEET TITLE

SITE LAYOUT, NuPower, BRIDGEPORT

1

SHEET 1 OF 1

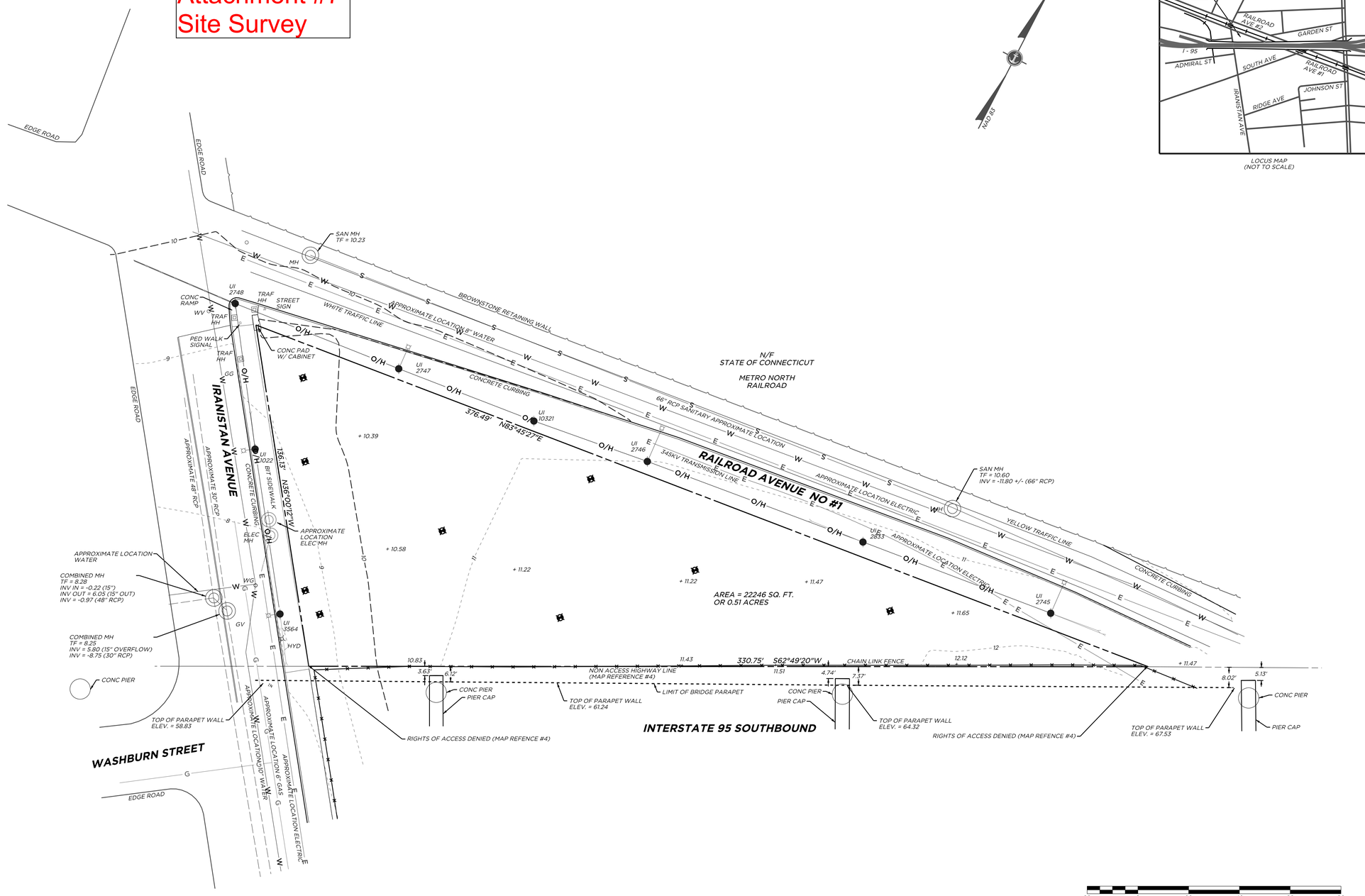
Attachment #7
Site Survey

MAP REFERENCES:

1. *RIGHT OF WAY MAP TOWN OF BRIDGEPORT CONNECTICUT TURNPIKE FROM THE FAIRFIELD-BRIDGEPORT TOWN LINE EASTERLY TO THE BRIDGEPORT-STRATFORD TOWN LINE SCALE: 1" = 80'. DATED: AUGUST 19, 1974 LAST REVISED 11/88. BY: CONNECTICUT DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS. MAP NO. 15-03 SHEET 3 OF 9.*
2. *RIGHT OF WAY MAP TOWN OF BRIDGEPORT CONNECTICUT TURNPIKE FROM THE FAIRFIELD-BRIDGEPORT TOWN LINE EASTERLY TO THE BRIDGEPORT-STRATFORD TOWN LINE SCALE: 1" = 80'. DATED: AUGUST 19, 1974 BY: CONNECTICUT DEPARTMENT OF TRANSPORTATION BUREAU OF HIGHWAYS. MAP NO. 15-03 SHEET 4 OF 9.*
3. *MAP SHOWING LAND OWNED BY ROBERTA LICHTENSTEIN, TRUSTEE RAILROAD & IRANISTAN AVENUES BRIDGEPORT, CONNECTICUT. SCALE : 1" = 20'. DATED: JAN. 1987 LAST REVISED AUG 1987. BY: NASCIMBENI & JAHNE SURVEYORS, P.C. MAP NO. M86-198.*
4. *COMPILATION PLAN TOWN OF BRIDGEPORT MAP SHOWING LAND RELEASED TO RAYMOND RIZIO, TRUSTEE INTERSTATE 95- CONNECTICUT TURNPIKE AT IRANISTAN AND RAILROAD AVENUE. SCALE: 1: 500 METERS. DATED: OCT. 2004. BY: THE STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION.*
5. *INTERSTATE 95 @ BRIDGE 00105A MNRR, SOUTH AVE & PARK AVE IN THE TOWN OF BRIDGEPORT PROJECT NO. 170-3250. SCALE: 1" = 40'. DATED: SEPT 2014. BY: STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION.*

NOTES:

1. *FIELD SURVEY WAS PERFORMED BY ANCHOR ENGINEERING SERVICES INC. NOVEMBER 2018.*
2. *HORIZONTAL DATUM BASED UPON MAP REFERENCE #1.*
3. *ELEVATIONS ARE BASED UPON NAVD 1988 OBTAINED VIA RTK GPS THROUGH SUPERIOR INSTRUMENT RTK NETWORK.*
4. *PARCEL IS IN ZONE AE (EL= 12)-SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD FLOOD INSURANCE RATE MAP FAIRFIELD COUNTY, CONNECTICUT PANEL 437 OF 626 MAP NUMBER 09001C0437G JULY 8, 2013.*
5. *SEWER MANHOLE INVERTS INACCESSIBLE DURING FIELD SURVEY. INFORMATION BASED UPON MAP REFERENCE #5.*
6. *UTILITY NOTE: UNDERGROUND UTILITY, STRUCTURE AND FACILITY LOCATIONS DEPICTED AND NOTED HEREON HAVE BEEN COMPILED, IN PART, FROM RECORD MAPPING SUPPLIED BY THE RESPECTIVE UTILITY COMPANIES OR GOVERNMENTAL AGENCIES, FROM PAROL TESTIMONY AND FROM OTHER SOURCES. THESE LOCATIONS MUST BE CONSIDERED AS APPROXIMATE IN NATURE. ADDITIONALLY, OTHER SUCH FEATURES MAY EXISTON THE SITE. THE EXISTENCE OF WHICH ARE UNKNOWN TO ANCHOR ENGINEERING SERVICES, INC. THE SIZE, LOCATION AND EXISTENCE OF ALL SUCH FEATURES MUST BE FIELD DETERMINED AND VERIFIED BY THE APPROPRIATE AUTHORITIES PRIOR TO CONSTRUCTION. DIG SAFE 1-888-344-7233.*



LOCUS MAP
(NOT TO SCALE)

LEGEND

PROPERTY LINE	
CHAIN LINK FENCE	
WATER LINE	W
GAS LINE	G
ELECTRIC LINE	E
COMBINED SEWER	
SANITARY SEWER	S
OVERHEAD WIRES	O/H
UTILITY POLE	
UTILITY POLE WITH LIGHT	
MAJOR CONTOUR	10
MINOR CONTOUR	8
HANDHOLE	HH
WATER VALVE	WV OR WG
GAS GATE	GG OR GV
PEDESTRIAN SIGNAL	PED
GUY WIRE	
SPOT GRADE	+ 11.21
BORING	

20 0 20 40 60 80
SCALE: 1"=20'

REVISED 4/23/20: ADDED BRIDGE PARAPET AND BORING LOCATIONS

THIS SURVEY AND MAP HAS BEEN PREPARED IN ACCORDANCE WITH SECTIONS 20-300b-1 THRU 20-300b-20 OF THE REGULATIONS OF CONNECTICUT STATE AGENCIES-"MINIMUM STANDARDS FOR SURVEYS AND MAPS IN THE STATE OF CONNECTICUT" AS ENDORSED BY THE CONNECTICUT ASSOCIATION OF LAND SURVEYORS INC. IT IS AN EXISTING CONDITIONS PLAN, BOUNDARY DETERMINATION CATEGORY DEPENDANT RESURVEY, CONFORMING TO HORIZONTAL ACCURACY CLASS A-2 AND TOPOGRAPHIC ACCURACY CLASS T-2.

TO THE BEST OF MY KNOWLEDGE AND BELIEF THIS MAP IS SUBSTANTIALLY CORRECT AS NOTED HEREON.

WILLIAM E. WERTZ, CT. L.S. #70067

ANY ORIGINAL OR DUPLICATE OF THIS MAP IS NOT VALID UNLESS IT BEARS THE EMBOSSED SEAL OF THE SURVEYOR WHOSE REGISTRATION APPEARS ABOVE NO OTHER CERTIFICATION OR WARRANTY IS EXPRESSED OR IMPLIED.

I:\ANR\SURVEY\PLOT_SURVEY_Railroad_Ave_Bridgeport.dgn

ANCHOR ENGINEERING SERVICES, INC.
41 Sequin Drive
Glastonbury, CT 06033
Phone: (860) 633-8770
Fax: (860) 633-5971
www.anchorengr.com
Civil Engineering • Environmental Consulting • Land Surveying • Construction Management

PROJ. ENGINEER	ASF
PROJ. MANAGER	WEW
OFFICE REVIEW	WEW
REVISIONS	
4/23/20	

SCALE: 1" = 20'

EXISTING CONDITIONS PLAN

BOUNDARY SURVEY
PREPARED FOR
NuPOWER LLC
RAILROAD & IRANISTAN AVENUES — BRIDGEPORT, CT

PROJECT	DATE	SHEET NO.	OF
1418-01	12/10/18	1	1

Attachment 7
City Zoning Map

Town of Trumbull

Town of Fairfield

Town of Stratford

Zoning Districts

- R-A, Residential - A Single Family Zone
- R-AA, Residential - AA Single Family Zone
- R-B, Residential - B Two Family Zone
- R-BB, Residential - BB Two and Three Family Zone
- R-C, Residential - C Multi-Family Zone
- R-CC, Residential CC - Residential High Density Zone
- NCVD, Neighborhood Center Village District
- MU-LI, Mixed Use - Light Industrial Zone
- MU-EM, Mixed Use - Educational/Medical Zone
- MU-W, Mixed Use - Waterfront Zone
- OR, Office/Retail Zone
- OR-G, Office/Retail General
- OR-R, Office/Retail Regional Zone
- PDD, Planned Development District
- DVD-CORE, Downtown Core Village District
- DVD-TOD, Downtown Transit-Oriented Development Village District
- DVD-CIVIC, Downtown Civic Village District
- DVD-BLVD, Downtown Boulevard Village District
- DVD-WF, Downtown Waterfront Village District
- I-H, Industrial Heavy Zone
- I-L, Industrial Light Zone
- Z-P, Zoological Park Zone
- CVOD, Commercial Village Overlay District

Proposed project location and area of detail

Lake Forest
Charcoal Pond
Bunnell's Pond
Success Lake
Stillman Pond
Pequonnock River
Yellow Mill Channel
Johnsons Creek
Cedar Creek
Burr Creek
Ash Creek
Bridgeport Harbor
Black Rock Harbor
Long Island Sound

City of Bridgeport: Zoning Map

THE OFFICIAL ZONING MAP OF BRIDGEPORT, CONNECTICUT, PREPARED FROM OFFICIAL ZONING RECORDS OF THE PLANNING AND ZONING COMMISSION, ADOPTED NOVEMBER 30TH, 2009, EFFECTIVE JANUARY 1ST, 2010

CHAIRMAN
PLANNING AND ZONING COMMISSION

Amended: June 25th, 2018

Prepared for:
City of Bridgeport
Planning & Zoning Commission

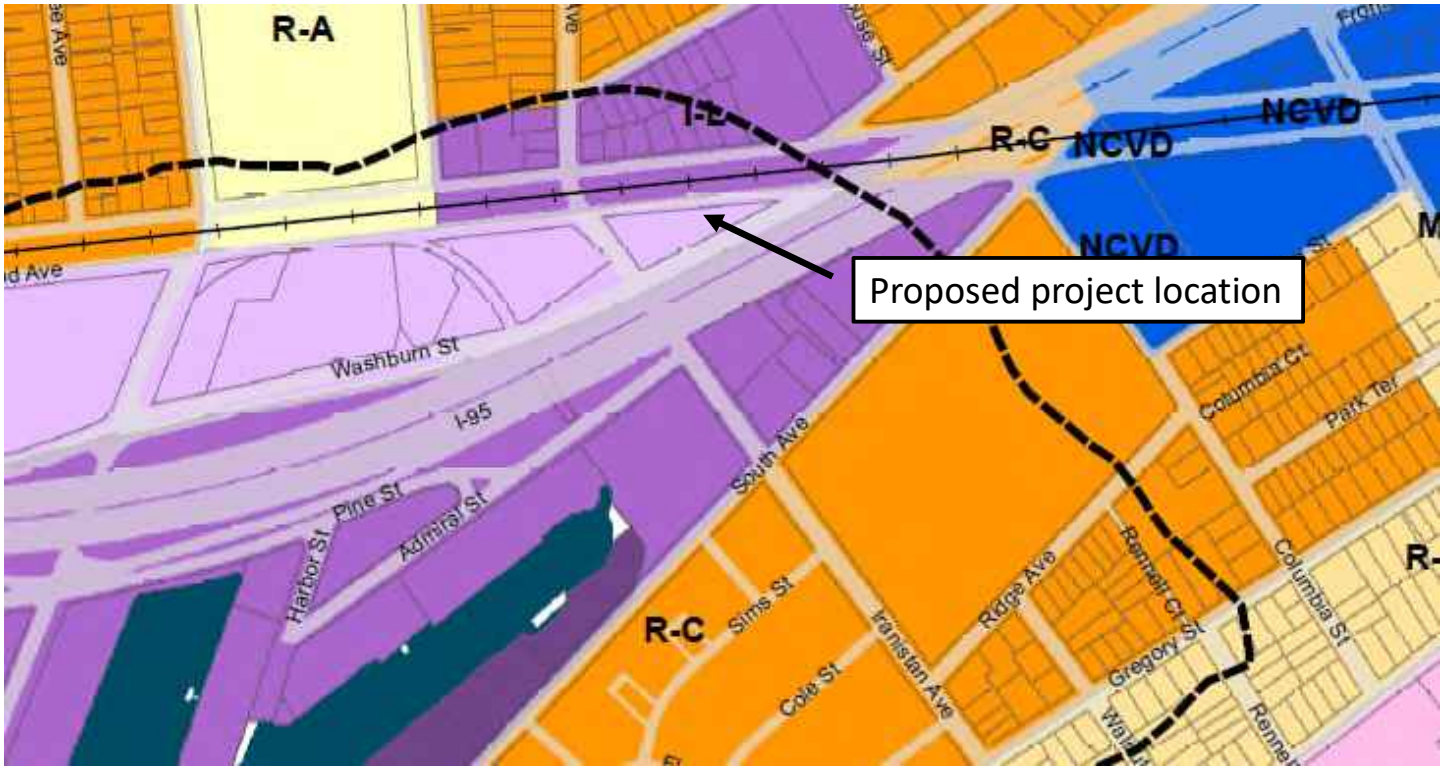
Prepared by:
City of Bridgeport
Office of Planning & Economic Development

999 Broad St.
2nd Floor
Bridgeport, CT 06604
(203) 576-7221
www.bridgeportct.gov

- Coastal Boundary
- Railroad
- Local Historic Districts
- Parcels
- Waterbodies

0 1,500 3,000 Feet

N W E S


R-A
I-L
R-C
NCVD
NCVD
NCVD
Proposed project location
Washburn St
I-95
Pine St
Admiral St
Harbor St
South Ave
R-C
Sims St
Cole St
Ramsdell Ave
Ridge Ave
Columbia Ct
Park Ter
Columbia St
Gregory St
Rennell Ct

exceeds 2,000 ft. in height above ground level (AGL), the FAA presumes it to be a hazard to air navigation that results in an inefficient use of airspace. You must include details explaining both why the proposal would not constitute a hazard to air navigation and why it would not cause an inefficient use of airspace.

(e) The 45-day advance notice requirement is waived if immediate construction or alteration is required because of an emergency involving essential public services, public health, or public safety. You may provide notice to the FAA by any available, expeditious means. You must file a completed FAA Form 7460–1 within 5 days of the initial notice to the FAA. Outside normal business hours, the nearest flight service station will accept emergency notices.

§ 77.9 Construction or alteration requiring notice.

If requested by the FAA, or if you propose any of the following types of construction or alteration, you must file notice with the FAA of:

(a) Any construction or alteration that is more than 200 ft. AGL at its site.

(b) Any construction or alteration that exceeds an imaginary surface extending outward and upward at any of the following slopes:

(1) 100 to 1 for a horizontal distance of 20,000 ft. from the nearest point of the nearest runway of each airport described in paragraph (d) of this section with its longest runway more than 3,200 ft. in actual length, excluding heliports.

(2) 50 to 1 for a horizontal distance of 10,000 ft. from the nearest point of the nearest runway of each airport described in paragraph (d) of this section with its longest runway no more than 3,200 ft. in actual length, excluding heliports.

(3) 25 to 1 for a horizontal distance of 5,000 ft. from the nearest point of the nearest landing and takeoff area of each heliport described in paragraph (d) of this section.

(c) Any highway, railroad, or other traverse way for mobile objects, of a height which, if adjusted upward 17 feet for an Interstate Highway that is part of the National System of Military and Interstate Highways where overcrossings are designed for a minimum of 17 feet vertical distance, 15 feet for any other public roadway, 10 feet or the height of the highest mobile object that would normally traverse the road, whichever is greater, for a private road, 23 feet for a railroad, and for a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it, would exceed a standard of paragraph (a) or (b) of this section.

(d) Any construction or alteration on any of the following airports and heliports:

(1) A public use airport listed in the Airport/Facility Directory, Alaska Supplement, or Pacific Chart Supplement of the U.S. Government Flight Information Publications;

(2) A military airport under construction, or an airport under construction that will be available for public use;

(3) An airport operated by a Federal agency or the DOD.

(4) An airport or heliport with at least one FAA-approved instrument approach procedure.

(e) You do not need to file notice for construction or alteration of:

(1) Any object that will be shielded by existing structures of a permanent and substantial nature or by natural terrain or topographic features of equal or greater height, and will be located in the congested area of a city, town, or settlement where the shielded structure will not adversely affect safety in air navigation;

(2) Any air navigation facility, airport visual approach or landing aid, aircraft arresting device, or meteorological device meeting FAA-approved siting criteria or an appropriate military service siting criteria on military airports, the location and height of which are fixed by its functional purpose;

(3) Any construction or alteration for which notice is required by any other FAA regulation.

(4) Any antenna structure of 20 feet or less in height, except one that would increase the height of another antenna structure.

Attachment #10 - CARB Certification

State of California
AIR RESOURCES BOARD
Executive Order DG-047
Distributed Generation Certification of
Doosan Fuel Cell America, Inc.
460 kW PureCell Model 400

WHEREAS, the Air Resources Board (ARB) was given the authority under California Health and Safety Code section 41514.9 to establish a statewide Distributed Generation (DG) Certification Program to certify electrical generation technologies that are exempt from the permit requirements of air pollution control or air quality management districts;

WHEREAS, this DG Certification does not constitute an air pollution permit or eliminate the responsibility of the end user to comply with all federal, state, and local laws, rules and regulations;

WHEREAS, on October 26, 2017, Doosan Fuel Cell America, Inc. applied for a DG Certification of its 460 kW PureCell Model 400 fuel cell power plant and whose application was deemed complete on February 7, 2018;

WHEREAS, Doosan Fuel Cell America, Inc. has demonstrated, according to test methods specified in title 17, California Code of Regulations (CCR), section 94207, that its natural-gas-fueled 460 kW PureCell Model 400 fuel cell power plant has complied with the following emission standards:

1. Emissions of oxides of nitrogen no greater than 0.07 pounds per megawatt-hour; and

2. Emissions of carbon monoxide no greater than 0.10 pounds per megawatt-hour; and

3. Emissions of volatile organic compounds no greater than 0.02 pounds per megawatt-hour.

WHEREAS, Doosan Fuel Cell America, Inc. has demonstrated that its 460 kW PureCell Model 400 fuel cell power plant complies with the emission durability requirements in title 17, CCR, section 94203 (d);

WHEREAS, I find that the Applicant, Doosan Fuel Cell America, Inc., has met the requirements specified in article 3, title 17, CCR, and has satisfactorily demonstrated that the 460 kW PureCell Model 400 fuel cell power plant meets the DG Certification Regulation 2007 Fossil Fuel Emission Standards;

NOW THEREFORE, IT IS HEREBY ORDERED, that a DG Certification, Executive Order DG-047 is granted.

This DG Certification:

1) is subject to all conditions and requirements of the ARB's DG Certification Program, article 3, title 17, CCR, including the provisions relating to inspection, denial, suspension, and revocation; and

2) shall be void if any manufacturer's modification results in an increase in emissions or changes the efficiency or operating conditions of a model, such that the model no longer meets the DG Certification Regulation 2007 Fossil Fuel Emission Standards; and

3) shall expire on the 5th day of April, 2023.

Executed at Sacramento, California, this 6th day of April 2018.

/S/

Floyd V. Vergara, Esq., P.E.
Chief, Industrial Strategies Division

Natural Diversity Data Base Areas

BRIDGEPORT, CT

December 2019

Attachment 11

DEEP NDDB Map

State and Federal Listed Species

Critical Habitat

Town Boundary

NOTE: This map shows general locations of State and Federal Listed Species and Critical Habitats. Information on listed species is collected and compiled by the Natural Diversity Data Base (NDDB) from a variety of data sources . Exact locations of species have been buffered to produce the generalized locations.

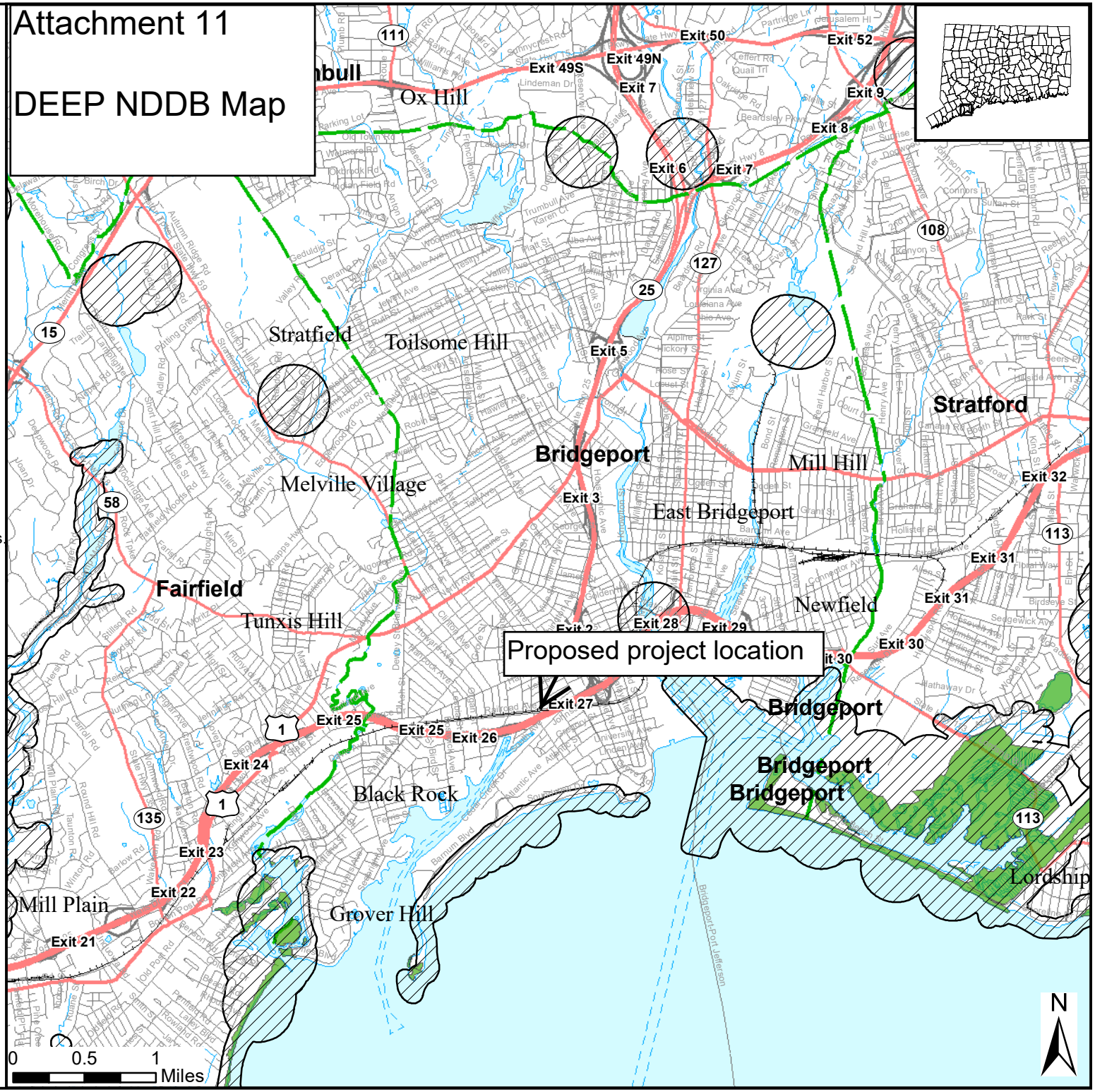
This map is intended for use as a preliminary screening tool for conducting a Natural Diversity Data Base Review Request. To use the map, locate the project boundaries and any additional affected areas. If the project is within a hatched area there may be a potential conflict with a listed species. For more information, complete a Request for Natural Diversity Data Base State Listed Species Review form (DEP-APP-007), and submit it to the NDDB along with the required maps and information. More detailed instructions are provided with the request form on our website.

www.ct.gov/deep/nddbrequest

Use the CTECO Interactive Map Viewers at www.cteco.uconn.edu to more precisely search for and locate a site and to view aerial imagery with NDDB Areas.

QUESTIONS: Department of Energy and Environmental Protection (DEEP)
79 Elm St, Hartford, CT 06106
email: deep.nddbrequest@ct.gov
Phone: (860) 424-3011

Connecticut Department of Energy & Environmental Protection
Bureau of Natural Resources
Wildlife Division



Attachment #12

Prepared For: Doosan Fuel Cell America Inc.

Point of Contact: Walter Bonola

Prepared by: Acoustical Technologies Inc.
50 Myrock Avenue
Waterford, CT 06385-3008

Subject: Bridgeport New Power
Twenty-One Fuel Cells
Airborne Noise Assessment
At 600 Iranistan Avenue

Author: Carl Cascio

Date: May 8, 2020

Revision: 1

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Country of Origin is the United States of America

Summary

This document makes an acoustic assessment that should help in meeting any acoustic noise concerns during the operation of twenty-one Doosan 460 KW fuel cells at the 600 Iranistan Avenue site in Bridgeport, CT. An acoustic assessment plan was developed and executed to acquire airborne acoustic information to explain and mitigate the potential airborne noise issues associated with operation of the Doosan fuel cells. It is important to show that the airborne noise generated by the fuel cells will not significantly impact the facility's neighbors. On site acoustic testing after installation of the fuel cells is recommended to confirm that the acoustic environment at the nearby properties due to the fuel cells is acceptable.

The airborne noise levels expected to be generated by the twenty-one Doosan fuel cells operating at the Bridgeport site were simulated by exciting a set of six co-located speakers at the fuel cell Cooling and Power Module positions. (The Cooling Module is the dominant noise source.) The six speakers produced an overall airborne noise level that was 6 to 12 dB higher than the levels measured for a similar Doosan fuel cell installed at New Britain High School in New Britain, CT. One-third octave band analysis showed the speakers to be near the New Britain fuel cell airborne noise levels at frequencies up to 250 Hertz where the airborne noise levels were low and to exceed the fuel cell signature by 5 to 20 dB at higher frequencies where the fuel cell signature was higher in noise level. Airborne noise with the speakers operating was measured at distances from 5 to 160 meters from the proposed fuel cell locations at the Bridgeport site. The speakers produced overall A-weighted sound pressure of approximately 86 to 87 dBA at 5 meters and 77 to 84 dBA at 10 meters (ref 20 microPascals) from the proposed fuel cell locations at ground level. Airborne noise from the speakers at nearby properties was measured at levels from 53 to 73 dBA. The highest property line measurement was 73 dBA at 571 Iranistan Avenue. Industrial Zone measurements on Railroad and South Avenues were lower because of the longer distance to the speakers. Beyond 80 meters the speakers could not be heard. Analysis of the speaker data indicated propagation losses from 8 to 25 dB from the fuel cell location to the nearby property lines. The acoustic source level at 10 meters from the operation of a Doosan fuel cell at New Britain High School was then used as a basis for making the Doosan fuel cell airborne noise estimates at all the locations. Airborne noise estimates from one fuel cell were than scaled up to 21 fuel cells using the "noisetools" application to account for the height of the installed Cooling and Power Modules. A power summation of the twenty-one individual Cooling and Power Module estimates was then used to produce an overall sound level at each of six property lines.

Operation of the twenty-one Doosan fuel cells without noise mitigation may produce noise levels above both the Industrial and Residential Zone noise limits at some of the closest nearby properties. Background noise levels at properties near Interstate I95 often exceed the 51 dBA night time noise limit. The closest Residential Zone properties may be above the night time residential noise limit of 51 dBA with predicted airborne noise levels of 58 to 62 dBA with the twenty-one fuel cells on. These predicted levels may not exceed the background noise by 5 dB. The nearest industrial property at 571 Iranistan Avenue could see a noise level of 70 to 71 dBA. Airborne noise levels along South and Railroad Avenues should be below 69 dBA. The highest expected residential airborne noise level may be 62 dBA at the residence at 720 Black Rock Avenue. Other nearby residences on Black Rock Avenue should see similar noise levels. Airborne noise from the twenty-one fuel cells might have to be mitigated to preclude the combined Cooling and Power Module noise from exceeding both the 70 dBA industrial limit and the night time residential limit of 51 dBA. This mitigation should be designed to provide sufficient sound attenuation to show that the airborne noise generated by the fuel cells will not significantly impact the facility's very closest neighbors. The major goal to reduce the airborne noise to levels below 51 dBA or below 5 dB above background at the nearby residences on Black Rock, Garden and South Avenues is recommended. This will also reduce the airborne noise along Railroad Avenue where the few residences in the Industrial Zone will also benefit.

The Connecticut's Noise Code (Reference 1) also calls for review of acoustic issues associated with impulse noise, prominent discrete tones, infrasonic and ultrasonic noise. Operation of the twenty-one fuel cells is expected to meet all of these requirements at all of the nearby properties.

Introduction

Acoustical Technologies Inc. was tasked as part of a Doosan site permitting process with an assessment of potential acoustic issues associated with fuel cell airborne noise reaching the properties adjacent to 600 Iranistan Avenue in Bridgeport, CT. Responding to a request from Walter Bonola, a site visit was made on April 23, 2020. During the visit, a survey of the airborne noise levels produced by a set of speakers simulating the airborne noise produced by a Doosan Fuel Cell was made in order to identify potential airborne noise issues. Airborne noise measurements were taken to quantify the propagation of the simulated fuel cell airborne noise to the adjacent properties. Background airborne noise levels were also made with the speakers off. This document provides an acoustic assessment to assist in meeting acoustic noise concerns during the permitting process for the siting of twenty-one Doosan fuel cells at 600 Iranistan Avenue in Bridgeport, CT.

Development of the Acoustic Assessment Plan

The purpose of this effort is to acquire acoustic information useful in explaining the potential airborne noise issues associated with the operation of twenty-one Doosan 460-kiloWatt fuel cells at 600 Iranistan Avenue in Bridgeport, CT. The site at 600 Iranistan Avenue is located in a Mixed Use – Light Industrial Zone near Interstate 95 and is surrounded by a Mixed Use – Light Industrial Zone to the west and Industrial Light Zones to the north and south, as well as Residential Multi-Family Zones to the north, north east and south east. (The Bridgeport zoning map near the site is given below.) It is important to determine whether the airborne noise generated by the twenty-one Doosan fuel cells will impact these neighbors.

The acoustic impact is assessed in the following way. The 460-KW fuel cells are yet to be installed so there is no way to measure fuel cell operating airborne noise levels at the new site. The fuel cell airborne noise has been measured at other sites and both overall and one-third octave band airborne noise data of Doosan 400- and 460-KW fuel cells are available (References 2 and 3). The only difference between the 400-KW and 460-KW fuel cells is the electrical output of the cell stacks. The rest of the hardware including fans and fan noise remain the same between the models. Using this data, a set of six speakers have been programmed through a set of octave and one-third octave band filters to generate a noise spectrum similar to that of the new fuel cells. (It is assumed that the Cooling and Power Module noise in the two measured units are similar to the new units.) This spectrum will then be played through an audio amplifier to create the electrical voltage necessary to drive the six speakers. In order to overcome the potentially high background noise at the site the speaker output will be increased to levels that vary from 6 to 12 dB higher than the overall airborne noise level measured on one 460-KW fuel cell at a distance of 10 meters.

With the six speakers on, this approach then follows the traditional “What is the airborne noise level at the neighbor’s property line?”. The six speakers were run and airborne measurements made near the proposed fuel cell locations and at the nearest neighbor’s property lines. This measured site data can also be used to estimate noise levels at other neighbor’s property lines. Using the measurements for one fuel cell, the performance of twenty-one fuel cells will then be scaled up to account for all the fuel cells operating at the same time. The City of Bridgeport has

a Noise Ordinance (Ref. 4) with similar noise requirements to the State of Connecticut's Noise Ordinance and both have been consulted to assess the impact of the measured and estimated acoustic levels. Because of the closeness of the fuel cell site to the nearby properties noise mitigation may be recommended if the airborne noise estimated for the twenty-one fuel cells comes near or exceeds the airborne noise requirements at the neighbors' property lines.

Acoustic Measurement Program

The acoustic data necessary to assess the impact of the twenty-one fuel cells are described below: Airborne sound pressure measurements and audio tape recordings were conducted at the 600 Iranistan Avenue site on April 23, 2020 during the daylight hours (11 am – 2 pm). This testing established both background airborne noise levels and simulated airborne noise levels with the speakers operating. The overall A-weighted airborne noise measurements were made with an ExTech model 407780A Digital Sound Level Meter (s/n 140401544) that was calibrated prior to and just after the test with a Quest model QC-10 Calibrator (s/n Q19080194). Measurements were taken with A-weighting (frequency filtering that corresponds to human hearing) and with the sound level meter in a Slow response mode. For reference, a noise level increase of 1 dB is equal to an airborne sound pressure increase of 12.2 per cent. The audio tape recordings were made with a Sony Digital Audio Tape Recorder (model TCD-D7 s/n 142000) with microphones on channels 1 and 2. The two PCB microphones (model 130F20 s/n 53933 and 130F20 s/n 53994) were powered by two Wilcoxon P702B power supply/amplifiers (s/n 1992 and 1995 respectively). The PCB microphones were also calibrated prior to and after the test with the Quest model QC-10 Calibrator (s/n Q19080194). All of the measurements were made with the microphones and sound level meter at a height above ground between five and six feet. A Hewlett Packard model HP3561A Dynamic Signal Analyzer, s/n 2338A00659, was used to perform A-weighted spectral analysis on the tape-recorded data. The tape-recorded data were also used to verify the ExTech sound level meter overall dBA readings.

At the 600 Iranistan Avenue site "speaker on" and background airborne noise measurements were taken near the two speaker locations and at the following nine nearby property lines:

Location	**Business**	**Distance**	**Zone Type**
A - 600 Iranistan Avenue	Building North End	5 &10 meters	MU Industrial Light
B - 600 Iranistan Avenue	Building South End	5 &10 meters	MU Industrial Light
P1 – 792 Railroad Avenue	Residence	80/68 meters	Industrial Light
P2 – 780 Railroad Avenue	Residence	65/63 meters	Industrial Light
P3 – 756 Railroad Avenue	Business	50/68 meters	Industrial Light
P4 – 744 Railroad Avenue	Greenskeeper Lawn	58/52 meters	Industrial Light
P5 – 571 Iranistan Avenue	Business	60/25 meters	MU Industrial Light
P6 – 478 Iranistan Avenue	Nunes Auto	80/75 meters	Industrial Light
P7 – 840 South Avenue	Nunes Auto Repairing	75/85 meters	Industrial Light
P8 – 800 South Avenue	Veolia Water	93/120 meters	Industrial Light
P9 – Garden & Railroad Ave	Parking Lot	160/195 meters	Residential M-Family

See the Google satellite map in Figure 1 for the approximate measurement locations. Position A was located at the center of the east end of the building while Position B was at the center of the

west end. Measurements at 5 and 10 meters from these proposed operating Cooling and Power Module sites were simultaneously taken with the ExTech sound level meter and two microphones recording on the digital tape recorder. Figures 2 and 3 provide photographs of the site locations for Positions A and B as well as the sensors at 5 and 10 meters. At speaker locations A and B, a one to two-minute record of the acoustic noise was stored for the speakers in the "on" condition at the start and end of the airborne noise measurements. There was a decrease of about 4 dB in sound output from the speakers for Position B. One minute of background airborne noise data were also recorded after the speaker "on" measurements.

Figure 1. Bridgeport - 600 Iranistan Avenue Site Map from Google Maps

Airborne noise measurements taken outside are corrupted by rain and wind so a day was selected when the winds were expected to be 10 miles per hour or less. Table 1 provides the weather data at New Haven Airport (closest data to 600 Iranistan Avenue) for the acoustic measurements on April 23, 2020. Measurements were taken over the period from 11:00 am until 2:00 pm. The table below shows the temperature and wind speeds in hourly intervals. Wind conditions were very good for most of the day with only one period as high as 10 mph (12:53 pm). Acoustic

measurements were further enhanced by the shielding provided by the railroad wall to the west. The wind did not affect the operating and background airborne noise measurements. There was no rain during the testing on April 23. The traffic noise from Interstate 95 next to the 600 Iranistan Avenue site generated most of the background noise for all of the measurement locations. Motor traffic along Iranistan, South and Railroad Avenues was light and few of the measurements had to be delayed until no traffic was present. Background noise levels at all but one of the measurement positions were acceptable with levels from 53 to 56 dBA. The locations nearest to the I95 highway had the highest levels (60 – 63 dBA). The noise level at Garden and Railroad (P9) was 61 dBA, 10 dB above the residential night time noise requirement. This background noise level would made it difficult to hear the speakers at any level below 55 dBA.

Figure 2. Position A – Building North End at the Bridgeport 600 Iranistan Avenue Site

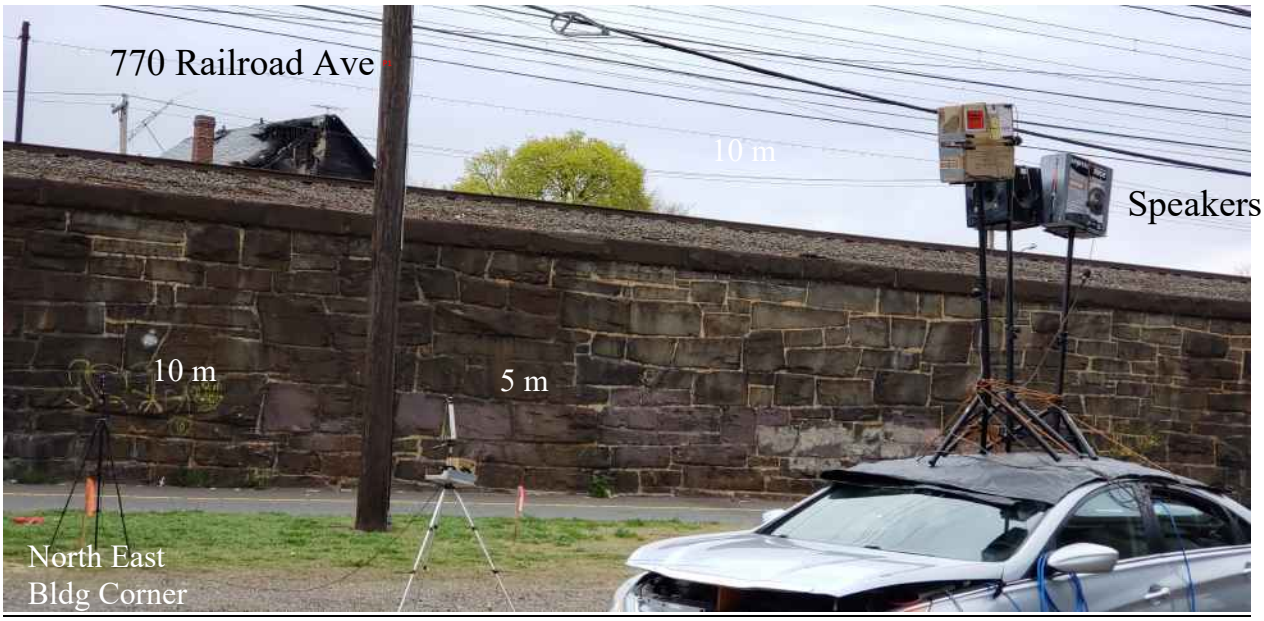
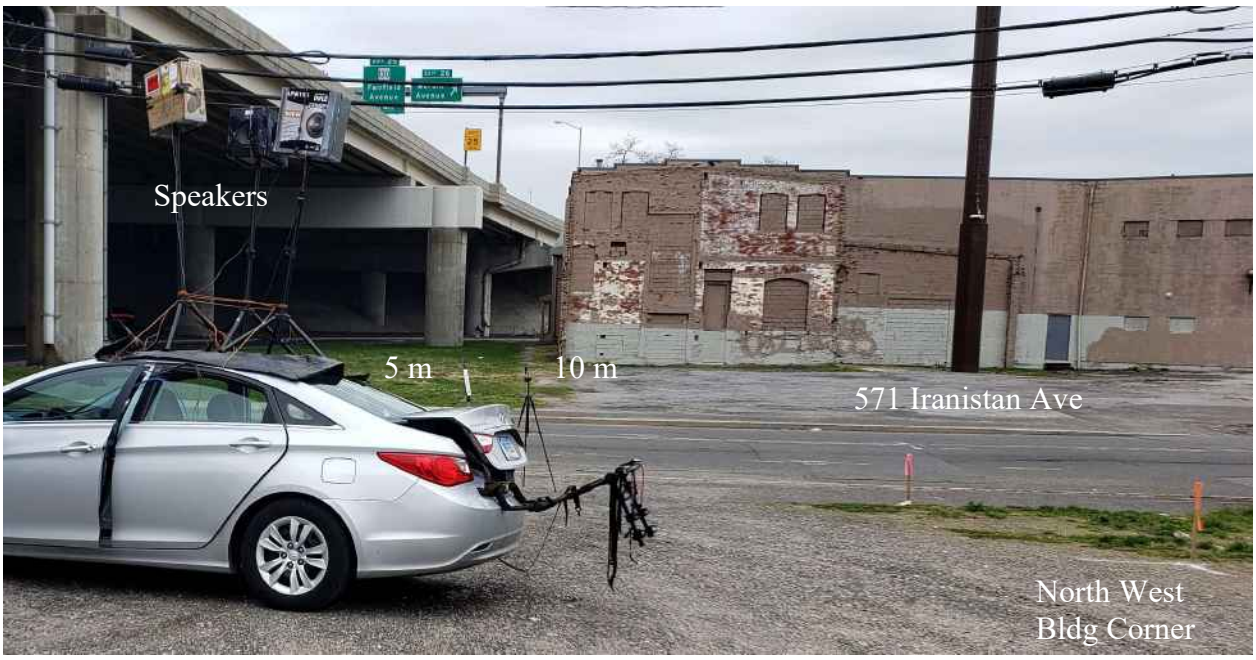


Table 1. Approximate Bridgeport (East Haven) Weather Data on April 23, 2020
https://www.wunderground.com/history/daily/KHVN/date/2020-4-23

Time (EST)	Temp. (°F)	Humidity (%)	Dew Point (°F)	Barometer (in HG)	Wind Speed (mph)	Wind Direction	Condition
7:53 AM	41 F	49 %	23 F	30.06 in	6 mph	WSW	PartlyCloudy
8:53 AM	41 F	45 %	21 F	30.07 in	5 mph	WNW	Cloudy
9:53 AM	42 F	43 %	21 F	30.09 in	5 mph	SSW	Cloudy
10:53 AM	43 F	43 %	22 F	30.08 in	5 mph	WSW	Cloudy
11:53 AM	44 F	45 %	24 F	30.07 in	8 mph	SSW	Cloudy
12:53 PM	44 F	45 %	24 F	30.06 in	10 mph	SW	Cloudy
1:53 PM	44 F	51 %	27 F	30.05 in	6 mph	WSW	Cloudy
2:53 PM	45 F	46 %	25 F	30.03 in	9 mph	WSW	Cloudy
3:53 PM	45 F	52 %	28 F	30.02 in	9 mph	SSW	Cloudy
4:53 PM	45 F	52 %	28 F	30.00 in	3 mph	S	Cloudy

Figure 3. Position B - Building South End at the Bridgeport 600 Iranistan Avenue Site



Note: The speakers were raised to a height of about 10 feet above ground to provide a better path for sound to reach over the railroad tracks to the north (as shown in Figure 2).

Data Analysis

This section analyzes the airborne noise levels measured at the Bridgeport site and then estimates the source level and transmission loss to nearby property lines expected during actual fuel cell operation. Both background noise levels at the Bridgeport 600 Iranistan Avenue site and the measured speaker operating noise levels are reported in Table 2. The background data are used to correct the measured operating airborne noise levels providing estimates of only the speaker noise contribution at each location. Table 3 then reports estimated equipment operating noise levels for a single fuel cell. A following section will then develop noise estimates for all twenty-one fuel cells. Comparing the twenty-one-fuel cell estimated levels with the state and city noise limits will identify which nearby locations may or may not meet the airborne noise requirements. Position P10 is at 753 South Avenue at the bottom of Figure 1. Position P11 is at 270 Black Rock Avenue and is shown at the top of Figure 1. These and P9 are the closest residences in the nearby Residential Zones and will be analyzed to determine their expected airborne noise levels.

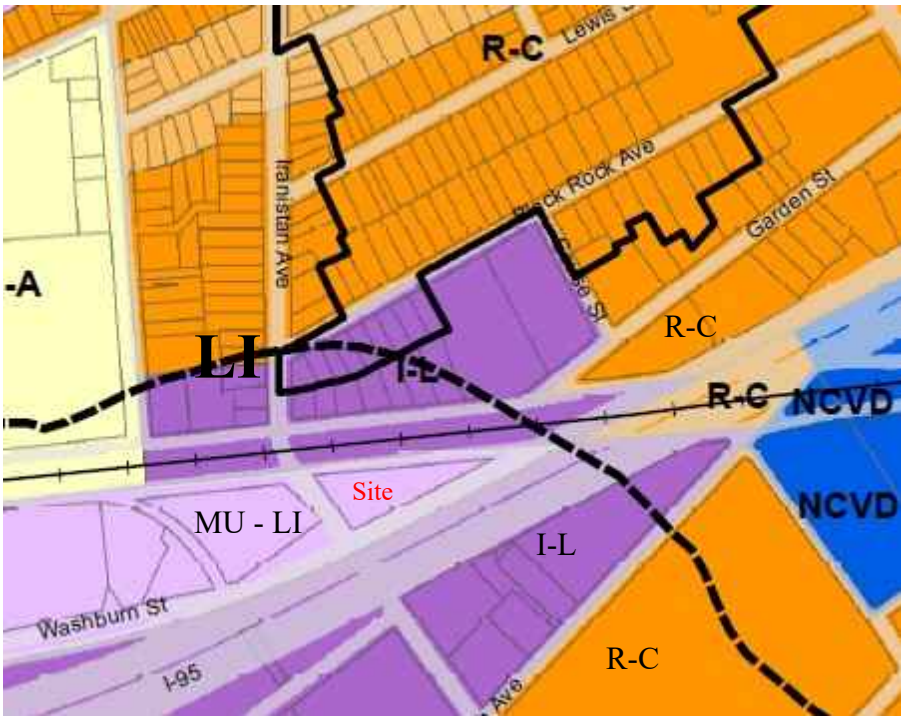
The complete set of overall A-weighted airborne noise levels measured at the Iranistan Avenue site are provided in Table 2 for the conditions with the speakers on and off. The range from the speakers to the microphone locations shown in Table 3 were calculated with Google Maps. Each value is the range to the center of the Position A and B speaker locations. The closest location is P5, which is about 25 meters south west from Position B to the business across the street at 571 Iranistan Avenue. The second closest location is P3, which is about 50 meters to the north from Position A and is a business that is on the other side of the railroad tracks. The next closest measurement locations where the speakers could actually be heard were at distances from 52 to

80 meters from the speakers. Beyond 80 meters the speakers could not be heard. The closest residential zone property is 110 meters to the north at 270 Block Rock Avenue. The residential properties along Garden and South Avenues are at least 165 meters away. Airborne noise at the residential zone locations to the north, north east and south east could not be heard when the speakers were operating due to the high background noise level from Interstate 95.

Table 2. Measured Overall Sound Pressure Levels in dBA reference 20 microPascals

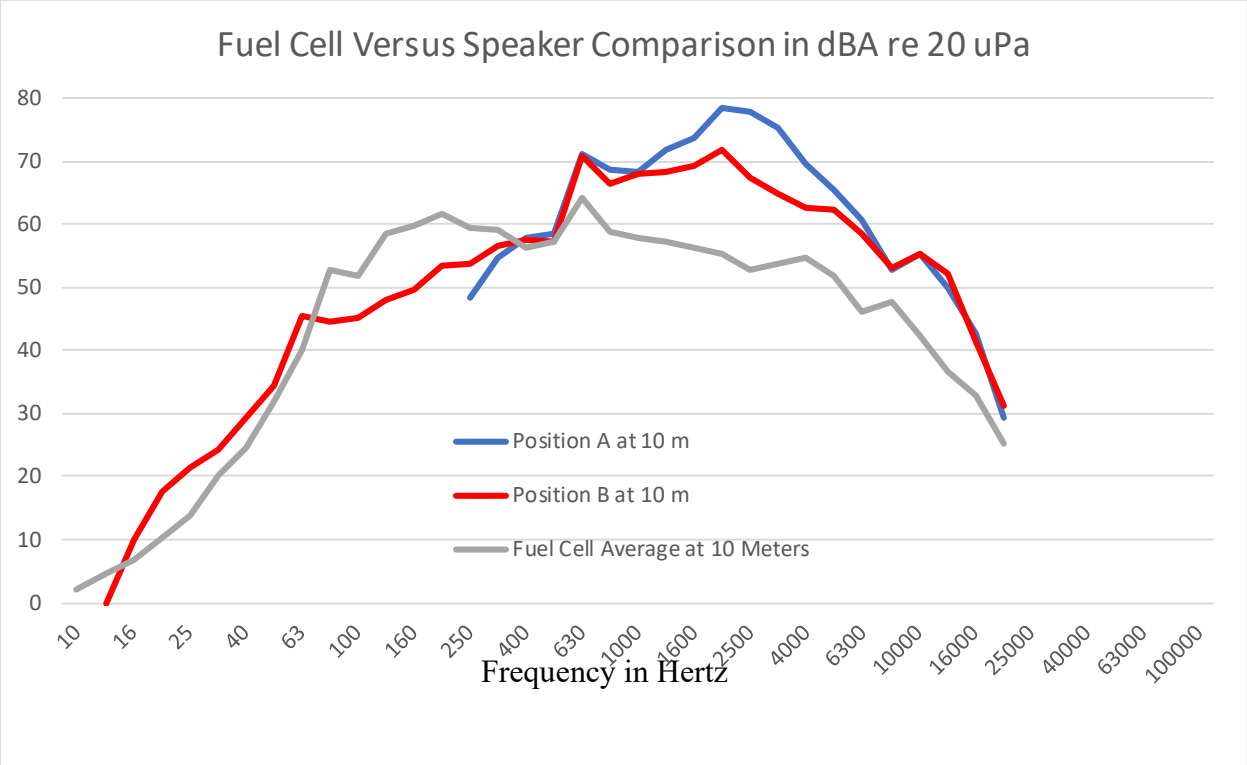
Location	Speakers A	Background	Bkgd Corrected	Speakers B	Background	Bkgd Corrected
Speaker 5 m	87.1	65.3	87.1	85.9	62.3	85.9
Speaker 10 m	83.7	65.4	83.6	77.5	64.6	77.3
P1 – 792 Railroad Ave	57.0	58	<50	63.6	58	62.2
P2 – 780 Railroad Ave	58.5	57	53.2	61.2	57	59.1
P3 – 756 Railroad Ave	60.3	56	58.3	58.7	56	55.4
P4 – 744 Railroad Ave	60.3	59	54.4	58.2	59	<50
P5 – 571 Iranistan Ave	64.5	63	59.2	73.1	63	72.7
P6 – 478 Iranistan Ave	63.7	58	62.4	63.9	58	62.6
P7 – 840 South Ave	63.3	59.5	61.0		59.5	-
P8 – 800 South Ave	63.6	60.6	60.6		60.6	-
P9 – Garden&Railroad	60.4	61	<55	61.7	61	53.5

Figure 4. Bridgeport Zoning Map Showing the Doosan Fuel Cell Site



A comparison of the airborne noise produced at 10 meters by the Doosan fuel cell at the New Britain High School site with the airborne noise produced by the speakers at the Bridgeport site is shown in Figure 5. The speakers are near the fuel cell airborne noise for frequencies below 250 Hertz and greatly exceed the fuel cell airborne noise at the middle frequencies where the fuel cell airborne noise levels are the highest. The overall airborne noise levels are 12.1 and 5.8 dB higher for the speakers at Site A and Site B locations, respectively, as compared to what was expected from the Doosan 460 KW fuel cell that was measured at New Britain High School in New Britain, CT. The differences in level were subtracted from the Bridgeport measured levels to estimate the expected fuel cell's acoustic signature at each location for a 10-foot-high source. These noise calculations are displayed in Table 3 below. The New Britain fuel cell airborne noise levels at 10 meters for one fuel cell were used with the Bridgeport speaker data to estimate the expected single fuel cell airborne noise for nearby neighbors at the Bridgeport 600 Iranistan Avenue property lines. Next, we will scale the expected airborne noise for twenty-one fuel cells.

Figure 5. At 10 Meters, 6 Speakers Generate Airborne Noise Above That of a Single Fuel Cell



The estimated airborne noise levels to be produced by a single Doosan fuel cell are shown in Table 3. For each of the nine locations the Bridgeport measurements are corrected to account for the higher speaker levels. The fuel cell noise correction at the Site A Cooling Module location is estimated to be 12.1 dB because the speaker levels are that much higher than the New Britain fuel cell level. The speakers at the Site B Power Module were estimated to be 5.8 dB higher. (These estimates are based on the overall dBA readings for the two sets of measurements. If individual one-third octave band values were calculated and then averaged over the frequencies of interest, the result would be numbers about 1 higher. The lower, more conservative overall noise level values were used in this report to scale the speaker data.)

The measurements at the 600 Iranistan Avenue site were taken at various distances from the speakers and then background corrected. Close to the speakers at 571 Iranistan Avenue the maximum airborne noise values are expected to be as high as 67 dBA for one fuel cell, which is slightly below the industrial noise limit. A pure power summation of 21 fuel cells would bring this number up to 80 dBA. This is not expected because most of the 21 fuel cells are much further away than 25 meters. Only three are at the west end of the building while the others can be as far as 60 meters away. However, the three closest fuel cells, if at ground level, would add about 4.7 dB to the noise level and produce about 72 dBA at the 571 Iranistan Avenue neighbor. The other significant difference from the Bridgeport measurements and the actual installation is that the Cooling Modules that generate most of the airborne noise will be located on the fourth floor of the building, some 51 feet above the ground level. This is 41 feet higher than where the speakers were and this difference in height needs to be addressed. All the other industrial properties are expected to have levels from a single fuel cell below 57 dBA for a single fuel cell. A pure power summation of 21 fuel cells would bring this number up to about 70 dBA, the industrial limit. This is not expected to happen because most of the units would be at greater distances and higher up on the building. The two highest levels at locations P3 and P6 will be analyzed to confirm that twenty-one fuel cells will not exceed the industrial noise limit. Nearby property in the Residential Zones to the north, north east and south east will also be analyzed.

Table 3. Expected Overall Sound Pressure Levels, dBA ref. 20 microPascals for **One Fuel Cell**

Location	Range in Meters A / B	Speakers at A	Correction	Position A Estimated SPL in dBA	Speakers at B	Correction	Position B Estimated SPL in dBA
P1 – 792 Railroad Ave	80/68	<50	-12.1	<38	62.2	-5.8	56.4
P2 – 780 Railroad Ave	65/63	53.2	-12.1	41.1	59.1	-5.8	53.3
P3 – 756 Railroad Ave	50/68	58.3	-12.1	46.2	55.4	-5.8	49.6
P4 – 744 Railroad Ave	58/52	54.4	-12.1	42.3	<50	-5.8	44.2
P5 – 571 Iranistan Ave	60/25	59.2	-12.1	47.1	72.7	-5.8	66.9
P6 – 478 Iranistan Ave	80/75	62.4	-12.1	50.3	62.6	-5.8	56.8
P7 – 840 South Ave	75/85	61.0	-12.1	48.9	-	-5.8	-
P8 – 800 South Ave	93/120	60.6	-12.1	48.5	-	-5.8	-
P9 – Garden & Railroad	160/195	<55	-12.1	42.9	53.5	-5.8	47.7

Red indicates locations above the industrial noise limit of 70 dBA – there are no levels that high

The propagation of sound from the Cooling Modules on the fourth floor of a building is analyzed in the following way. The Cooling Module configuration has 21 modules in three rows of seven each. The first calculation concerns the propagation to the property at 571 Iranistan Avenue. The first three cooling modules are approximately 25 meters horizontal from the property line. The next three cooling modules are about 29.2 meters away, followed by three at 33.4 meters, followed by three at 37.6 meters, followed by three at 41.8 meters, followed by three at 46 meters, and followed by the last three at 50.2 meters. Sound estimates will be calculated at each of these distances and 4.8 dB added to the results for the three units at each distance. The estimates will be made for receiver heights of 5, 15 and 25 feet to account for multiple floors in the business at 571 Iranistan Avenue. The individual calculations will be power summed to account for all 21 fuel cell cooling modules. A similar process will be used for the Power Modules on the second and third floors of the building. The acoustic propagation tool at http://noisetools.net/noisecalculator2 will be used to provide the calculations for the individual modules. The input acoustic power for a single fuel cell is taken from Table 7 of Reference 2.

A typical Cooling Module calculation is shown in Figure 6 below. The cooling module is 51 feet (15.5 m) above ground while the 4th floor is at 45 feet (13.7 m). The middle of the building is about 17.8 meters from the west end of the building. The receiver is 78 feet (23.9 m) from the west end of the building at a height of 5 feet. The estimated SPL is 43 dBA from one cooling module. The other distances have Cooling Module airborne noise levels that vary from a high of 59.2 dBA at the west end to a low of 40 dBA at the east end. These levels are power summed.

Figure 6. 571 Iranistan Avenue Noise Estimate - Cooling Module in the Middle of the Building

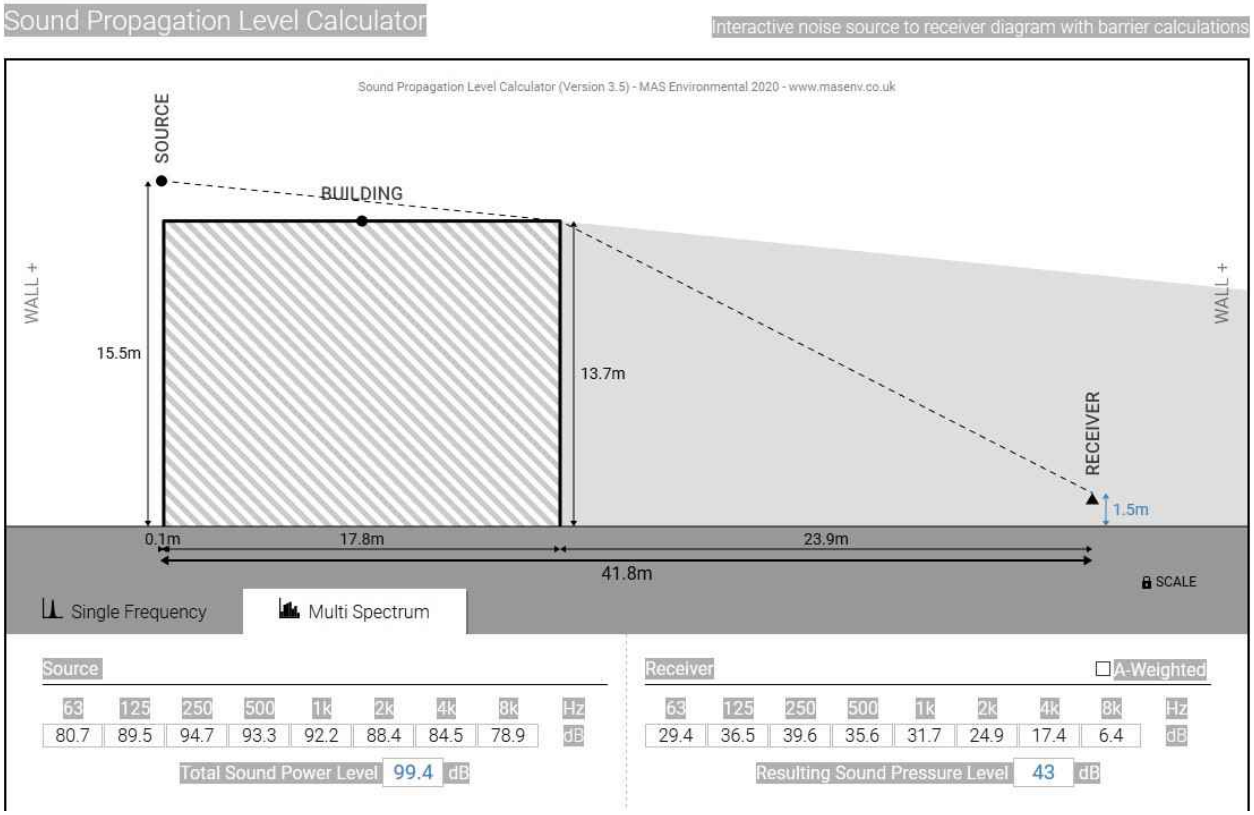


Table 4. Expected Overall Sound Pressure Levels, in dBA ref. 20 microPascals

Location	Height in feet	21 Total Estimate	21 Cooling Modules	21 Power Modules	Max Value	Max 5 Foot Measurement
P5 – 571 Iranistan Ave	5	69.9	67.2	66.6		
P5 – 571 Iranistan Ave	15	70.7	68.1	67.1	**71.4**	Noise Tool Est 69.9
P5 – 571 Iranistan Ave	25	**71.4**	69.2	67.5		Currently only 2 story
P6 – 478 Iranistan Ave	5	65.1	63.6	59.9		
P6 – 478 Iranistan Ave	15	65.4	63.8	60.2	**65.8**	Noise Tool Est 65.1
P6 – 478 Iranistan Ave	25	65.8	64.3	60.3		Required 70 dBA
P3 – 756 Railroad Ave	5	67.9	66.6	62.2		
P3 – 756 Railroad Ave	15	68.5	67.1	63.0	**68.9**	Noise Tool Est 67.9
P3 – 756 Railroad Ave	25	68.9	67.5	63.4		
P9 – Garden & Railroad	5	**57.6**	**56.3**	**51.8**		
P9 – Garden & Railroad	15	**57.9**	**56.6**	**52.0**	**58.1**	Noise Tool Est **57.6**
P9 – Garden & Railroad	25	**58.1**	**56.8**	**52.1**		Required 51 dBA
P10 - 753 South Avenue	5	**57.8**	**56.5**	**51.7**		(night time)
P10 - 753 South Avenue	15	**58.1**	**56.9**	**51.9**	**58.1**	Noise Tool Est **55.8**
2 Story Only on South Ave						
P11 – 270 Black Rock	5	**61.0**	**59.7**	**55.3**		
P11 – 270 Black Rock	15	**61.3**	**60.0**	**55.5**	**61.6**	Noise Tool Est **59.0**
P11 – 270 Black Rock	25	**61.6**	**60.4**	**55.6**		

The calculations for sources at different heights are based on the acoustic propagation tool at http://noisetools.net/noisecalculator2. To calibrate this tool, it was used to check the measurements that were made with the speakers at a height of 10 feet. Measured data from four of the property lines was compared to the "noisetools" result for the same speaker – receiver

distances. The average difference between the measurements and the "noisetools" results was 0.2 dB. Because some differences were plus and some minus the standard deviation was 2 dB. For example, the measured level at 571 Iranistan Avenue was 72.7 dBA while the calculation was 69.7 dBA. To adjust for this variability 2 dB was added to the estimate for 21 fuel cells.

The calculation results for expected airborne noise are shown in Table 4 above. The highest airborne noise levels are expected to be at 571 Iranistan Avenue in the Industrial Zone. The expected level is just above the noise requirement and varies from 0.1 dB below to 1.4 dB above the allowed level depending on the receiver height (or floor). The maximum airborne noise at 478 Iranistan Avenue and 756 Railroad Avenue are at least 4 dB and 1 dB below the requirement, respectively. Other Industrial Zone properties should be further below the requirement. The three estimates for residential properties are expected to be from 6.6 dB to 10.6 dB over the residential zone night time noise limit of 51 dBA.

Figures 7, 8 and 9 show typical cooling and power module calculations for the properties at 478 Iranistan and 756 Railroad Avenue as well as the property at the corner of Garden and Railroad. Figure 7 shows the Cooling Module calculation for the units at the north end of the building. Figure 8 shows the Power Module calculation for the units at the south end of the building. Figure 9 shows the Power Module calculation for the units at the west end of the building. For each address the individual calculations are combined to produce a total noise level for the 21 Cooling Modules on the 4th floor as shown above. Similar calculations are made for the 21 Power Modules on the 2nd and 3rd floors. The third column has the total airborne noise. The two floors of Power Module noise estimates are combined in the results shown in the fifth column.

Figure 7. 478 Iranistan Avenue Estimate - Cooling Module at the Opposite End of the Building

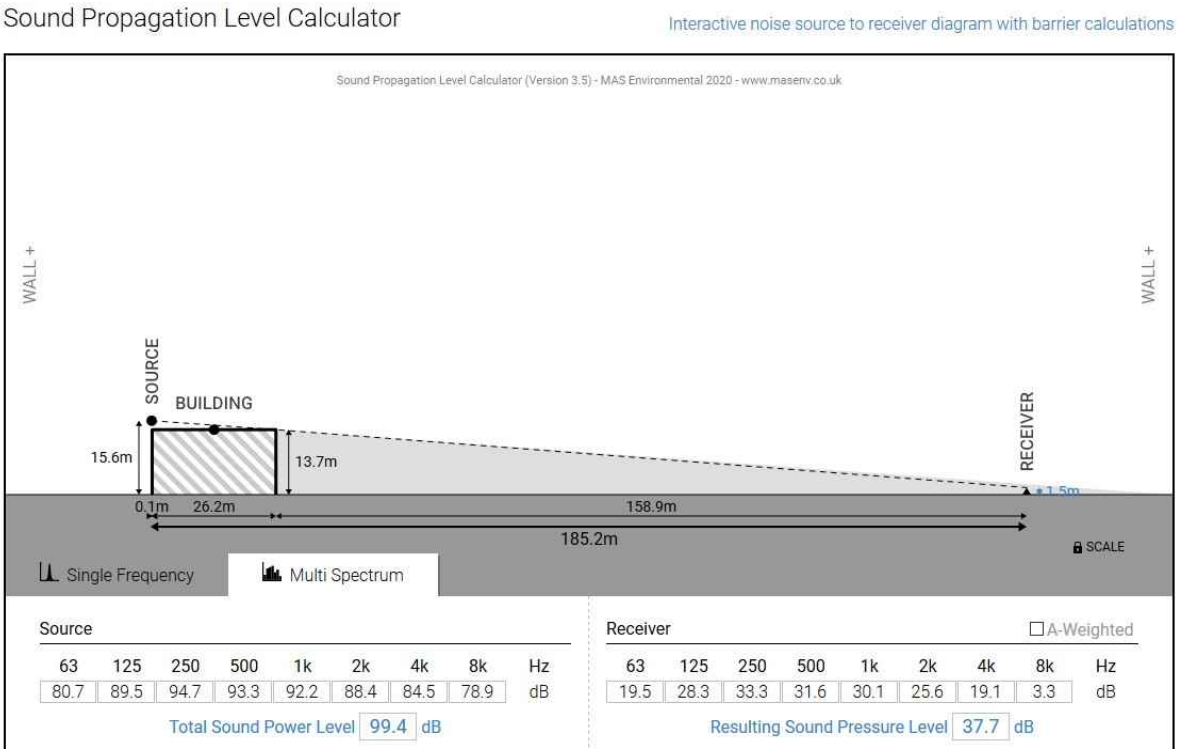


Figure 8. 756 Railroad Avenue Noise Estimate - Power Module at Opposite End of the Building

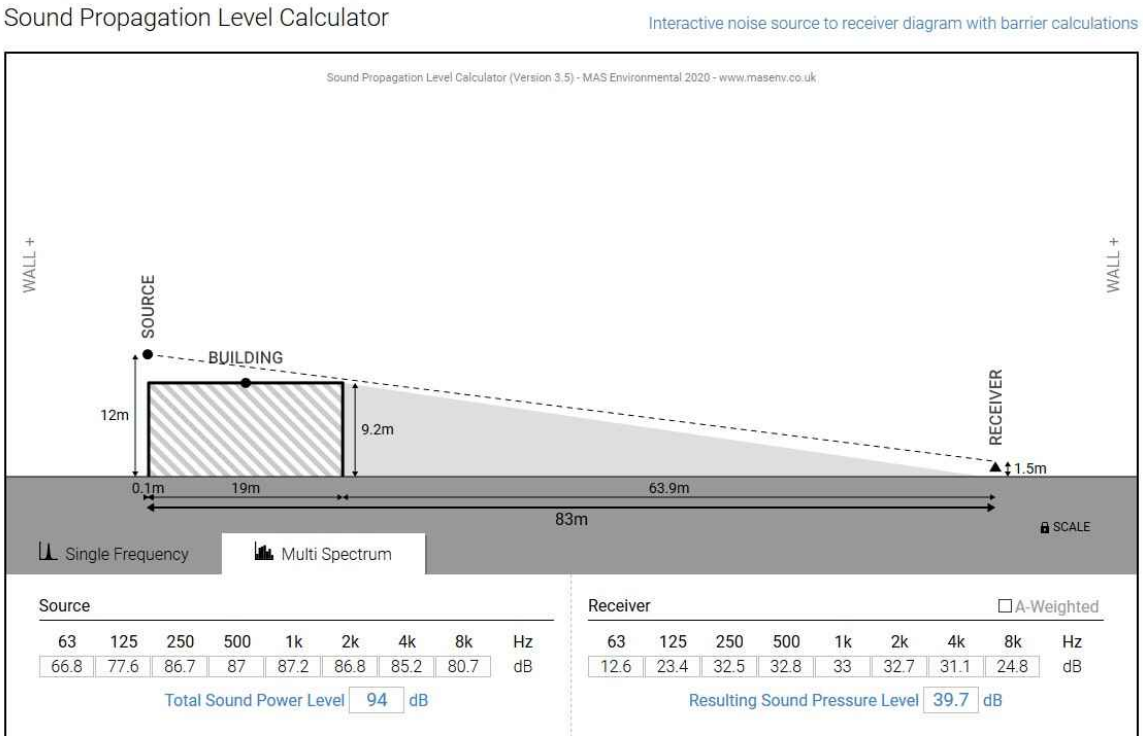
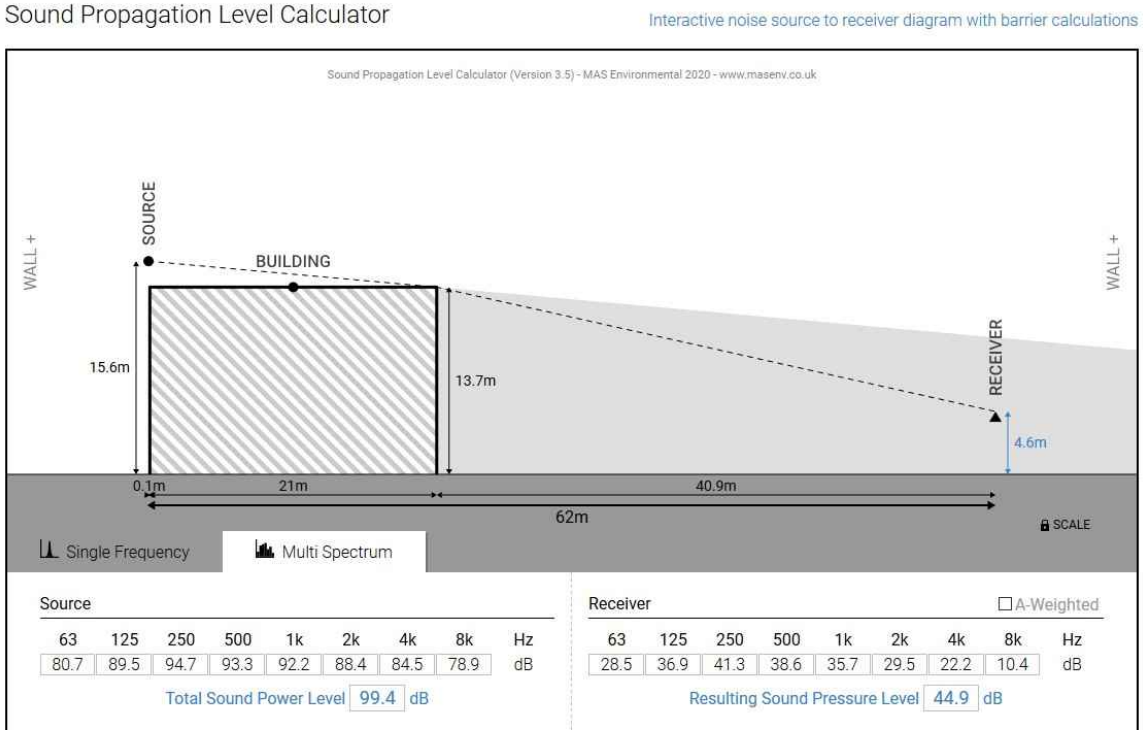


Figure 9. Garden & Railroad Ave Estimate – Cooling Module at Opposite End of the Building

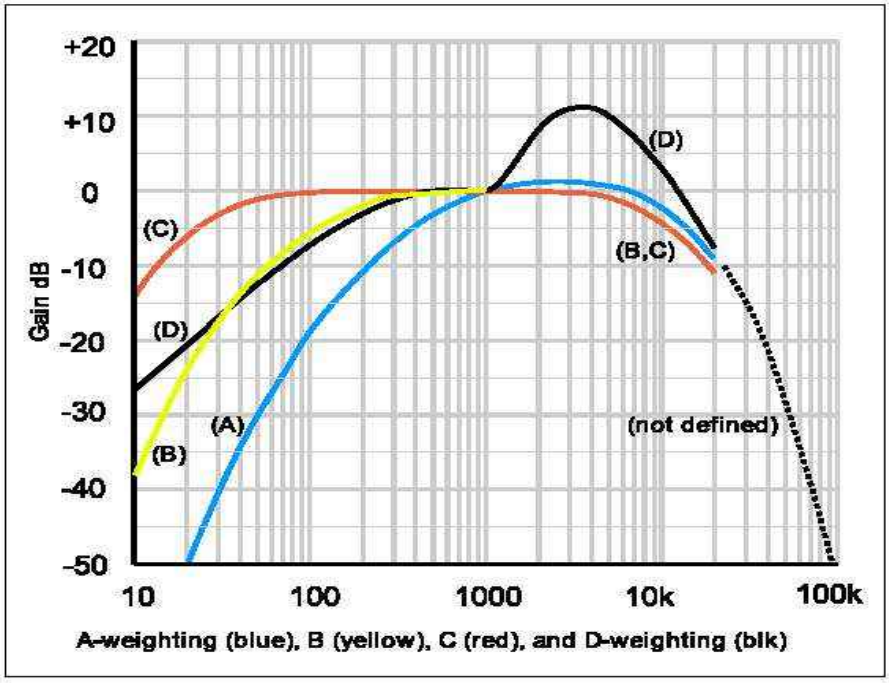


Allowable Noise Levels

The Connecticut regulation for the control of noise provides in *CT section 22a-69*-3 (Ref. 1) the requirements for noise emission in Connecticut. *CT section 22a-69*-3.1 states that no person shall cause or allow the emission of excessive noise beyond the boundaries of his/her Noise Zone so as to violate any provisions of these Regulations. The Bridgeport Noise Ordinance has the same noise levels as the CT Noise Ordinance but redefines daytime and night time as "Day-time hours means the hours between seven a.m. and six p.m. Monday through Friday, and the hours between nine a.m. through six p.m. on Saturday and Sunday" (Reference 4). These ordinances will be used to evaluate the noise generated by the twenty-one Doosan 460 KW fuel cells. Following sections discuss each type of noise using the results obtained from the New Britain and Mount Sinai fuel cell measurements as well as the Bridgeport speaker measurements.

The southern part of the Bridgeport zoning map near Iranistan Avenue is given in Figure 4. As stated above, this site at 600 Iranistan Avenue is located in a Mixed Use Industrial Light Zone near Interstate 95 and is surrounded by Mixed Use Industrial Light Zone to the west, Residential Zones to the north, north east and south east as well as Industrial Light Zones to the north and south. The closest residential property is 110 meters away on Black Rock Avenue to the north on the other side of the Amtrak tracks in a R-C Residential Multi-Family Zone. Other residences to the north east and south east are at least 160 meters away. Sound from the ATI speakers cannot be heard or measured at any of these locations. The acoustic estimates from position P9 show that the speaker noise was below 55 dBA at a distance of 160 meters.

Figure 10. Acoustic Airborne Noise Weighting Curves



Impulse Noise

The Connecticut noise code states in *CT section 22a-69*-3.2 (part a) *Impulse Noise* that no person shall cause or allow the emission of impulse noise in excess of 80 dB peak sound pressure level during the night time to any class A Noise Zone. Night time is defined as 10 pm to 7 am. *CT section 22a-69-3.2 (part b) Impulse Noise* states that no person shall cause or allow the emission of impulse noise in excess of 100 dB peak sound pressure level at any time to any Noise Zone. Bridgeport has the same 80 dB and 100 dB noise limits but defines night time as 6 pm to 7 am.

Impulse noise in excess of 80 dB was not observed on the tape-recorded data during any of the measurements of the Doosan 460 KW fuel cell made at the New Britain High School on 30 July, 2018. This fuel cell design is similar to the unit that will be installed in Bridgeport. Given the steady state nature of the fuel cell's noise signature there should be no acoustic issues with the Bridgeport and State of Connecticut's impulse noise requirements.

A few words are in order to discuss the difference between A-weighted and un-weighted impulse noise. A-weighting emphasizes the middle and higher frequencies while reducing the influence of the low frequencies. Figure 10 plots the A-weighting curve versus frequency in blue. Below a frequency of 1 kiloHertz the acoustic level is attenuated by increasing amounts. The reduction is about 10 dB at 200 Hertz, 20 dB at 90 Hertz and 30 dB at 50 Hertz. It also reduces the level at very high frequency being down in level by 10 dB at 20 kiloHertz.

Prominent Discrete Tones

The Connecticut regulation for the control of noise states in *CT section 22a-69-3.3 Prominent discrete tones:* Continuous noise measured beyond the boundary of the Noise Zone of the noise emitter in any other Noise Zone which possesses one or more audible discrete tones shall be considered excessive noise when a level of 5 dBA below the levels specified in section 3 of these Regulations is exceeded. Bridgeport's noise regulations do not mention discrete tones. The CT Regulations establish different noise limits for different land use zones. Residential (homes and condominiums) and hotel uses are in Class A. Schools, parks, recreational activities and government services are in Class B. Forestry and related services are in Class C. By my reading of the regulations the 600 Iranistan Avenue fuel cells are a Class C emitter in an Industrial Zone. The noise zone standards in *CT section 22a-69-3.5* state that a Class C emitter cannot exceed the following overall sound pressure levels:

To Class C 70 dBA To Class B 66 dBA To Class A 61 dBA (day) 51 dBA (night)

The discrete tones limits are 5 dBA lower so that no tone may be higher than the following:

To Class C 65 dBA To Class B 61 dBA To Class A 56 dBA (day) 46 dBA (night)

To address the discrete tone issue, we use measured data from the testing of a similar Doosan fuel cell (Reference 3). This data does not have A-weighting. The photo in Figure 11 plots the airborne noise measured 10 meters from the Mount Sinai Cooling Module (Reference 3) for frequencies from 0 to 1000 Hertz. This curve shows the two largest discrete tones produced by

the Doosan Fuel Cell Cooling Module. The first tone is at 86 Hertz at a level of 65 dB reference 20 microPascals. The second tone is at 630 Hertz at a level of 56 dB reference 20 microPascals. (88.6 dB added to the dBV values in the figure.) The A-weighting corrections are -21.5 dB at 86 Hertz and -1.9 dB at 630 Hertz. Incorporating these corrections gives A-weighted levels of 44 dBA at 86 Hertz and 54 dBA at 630 Hertz (for one fuel cell) both at a distance 10 meters from the Cooling Module. The minimum transmission loss to the property to the south west is 8 dB and 21 Cooling Modules adds 7.2 dB so the maximum possible discrete tone would be 53 dBA at 571 Iranistan Avenue. This level is below the 65 dBA requirement in an Industrial Zone. The minimum transmission loss to the closest Residential Zone property to the north is at least 25 dB and 21 Cooling Modules add 11 dB so the maximum possible discrete tone would be 40 dBA at 270 Black Rock Avenue. This level is below the 46 dBA requirement in a Residential Zone. Operating the twenty-one Doosan fuel cells should produce airborne noise levels well below the CT discrete tone requirement at all the property lines. There should be no acoustic issue with the CT discrete tone noise requirements.

Infrasonic and Ultrasonic Noise

The Connecticut regulation for the control of noise states in *CT section 22a-69-3.4 Infrasonic and Ultrasonic* that no person shall emit beyond his/her property infrasonic or ultrasonic sound in excess of 100 dB at any time. 100 dB with respect to the reference of 20 microPascals is a sound pressure of 2 Pascals or 0.00029 psi. Infrasonic sounds are sound pressure fluctuations below a frequency of 20 Hertz. Ultrasonic sounds are sound pressure fluctuations at frequencies above 20,000 Hertz. Bridgeport's noise regulations do not mention infrasonics and ultrasonics.

Narrow bandwidth sound pressure spectrums in dB reference 20 microPascals at the 10-meter Cooling Module location given in Reference 3 can be used to compare with these Infrasonic and Ultrasonic noise requirements. Mount Sinai Hospital airborne noise data were processed in the 0 to 100 Hertz and 0 to 100,000 Hertz frequency ranges. The bandwidth of each data point is 0.375 Hertz for the 100 Hertz range and 375 Hertz for the 100,000 Hertz frequency range. The infrasonic noise for frequencies up to 20 Hertz is shown in Figure 12. The maximum level at 10 meters is 57 dB reference 20 microPascals for one fuel cell. The entire 20 Hertz band can be power summed and equals 66 dB reference 20 microPascals, well below the requirement at 10 meters. The closest property is at 25 meters so the maximum possible infrasonic noise would be 65.2 dBA at the south western property line. All the other industrial locations will be below 63 dBA. The resident property at 270 Black Rock Avenue will see levels of 43 dB.

The ultrasonic noise for frequencies up to 100 KiloHertz is given in Figure 13. The maximum level at 10 meters is 20 dB reference 20 microPascals for one fuel cell. The entire 80 KiloHertz band from 20 to 100 kiloHertz has been power summed and equals a noise level value of 31 dB ref. 20 microPascals. Both of the infrasonic and ultrasonic noise levels will fall well below the 100 dB limit at a distance 10 meters from the Cooling Module. The ultrasonic airborne noise at the closest property will be 30 dB. All the other industrial locations will be below 28 dBA. The noise levels at the closest Residential Zone will be much lower (17 dBA) and there should be no issue with either infrasonic or ultrasonic noise at any of the neighboring properties. Fortunately, the measured noise levels are low at 20 kiloHertz and decrease with higher frequencies and thus, no ultrasonic acoustic issues are expected above 25 kiloHertz.

Figure 11. Discrete Tones Produced by Fuel Cell Cooling Module (0 dBV = 88.6 dB re20µPa)

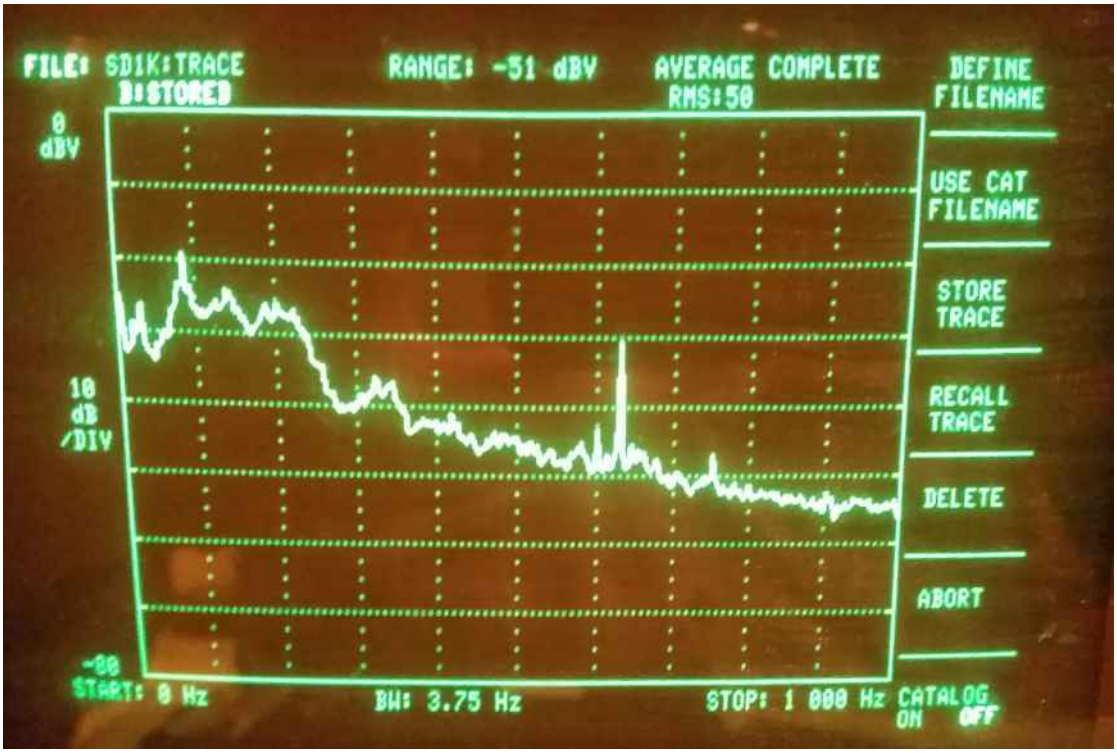


Figure 12. Infrasonic Noise from the Fuel Cell Cooling Module (0 dBV = 88.6 dB re 20µPa)

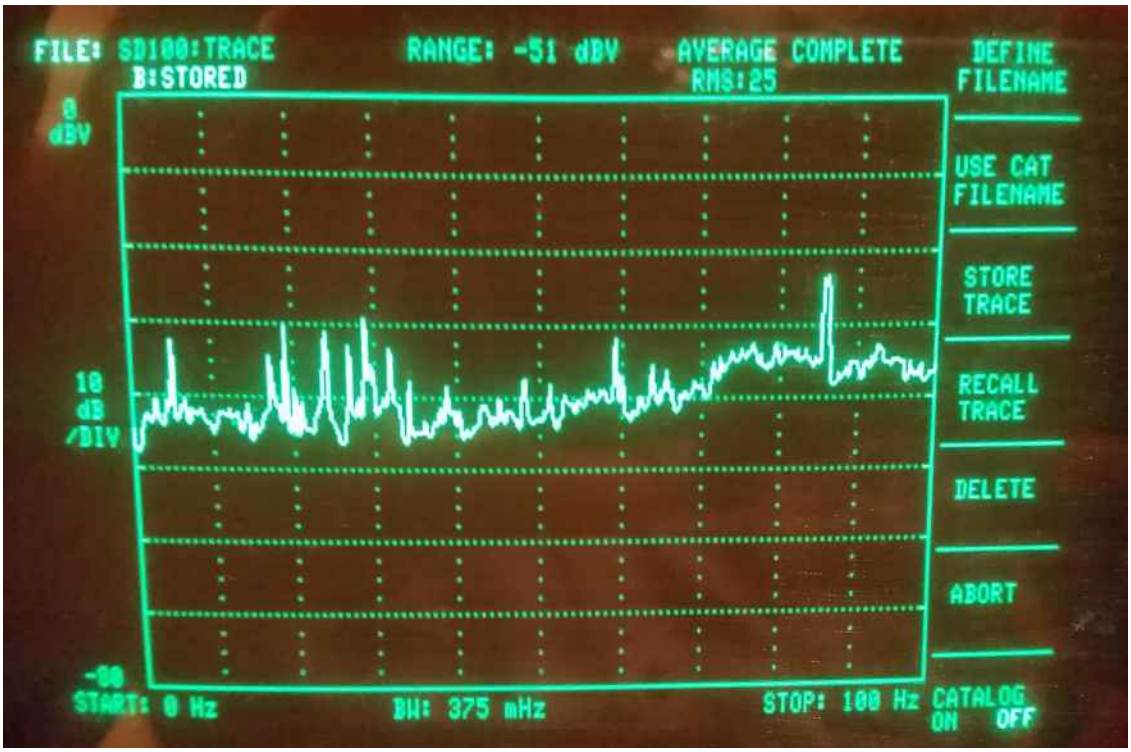
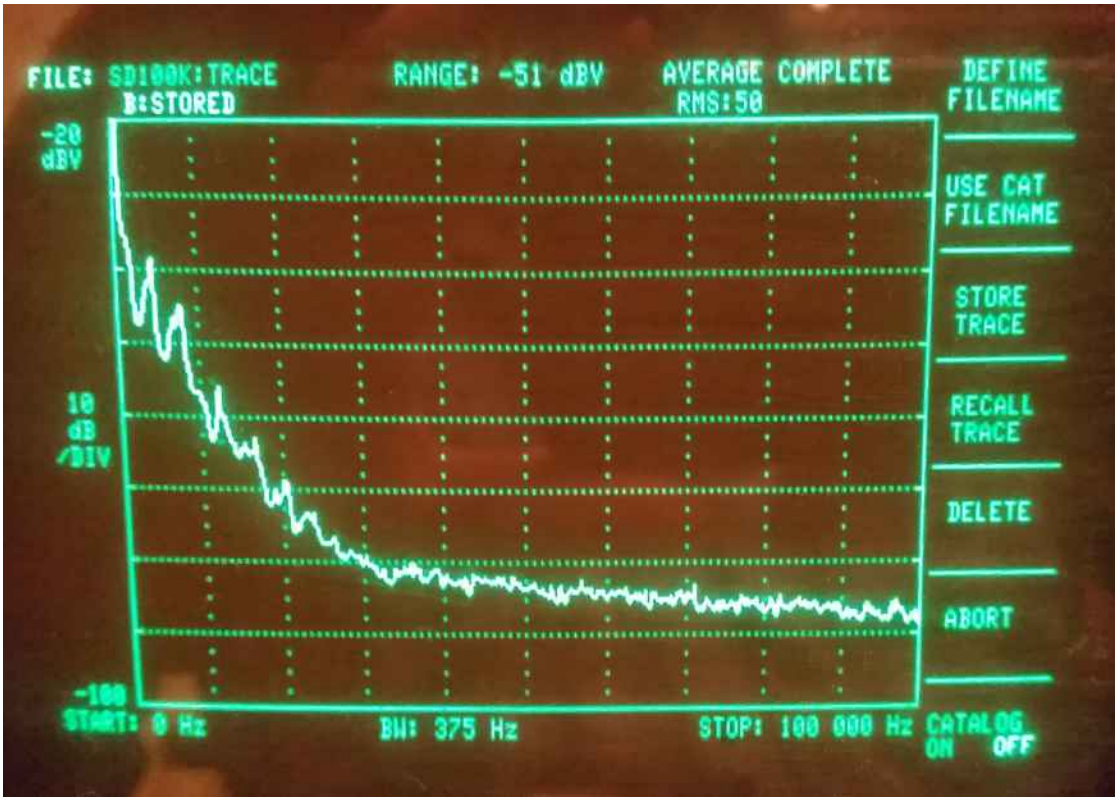


Figure 13. Ultrasonic Noise from the Fuel Cell Cooling Module (0 dBV = 88.6 dB re 20μPa)



Overall Sound Pressure Levels

The Connecticut regulations for the control of noise state that
(a) No person in a Class C Noise Zone shall emit noise exceeding the levels below:

To Class C 70 dBA To Class B 66 dBA To Class A 61 dBA (day) 51 dBA (night)

The Bridgeport 600 Iranistan Avenue site is in an Industrial Zone that is surrounded by other Industrial Zones and Residential Zones to the north, north east and south east. The nearby neighbors are classified as industrial with noise limits of 70 dBA. The nearby Residential Zones have a noise limit of 51 dBA at night and 61 dBA during the day. These limits may be increased by up to 5 dB above the background if the background noise levels are higher than the limits in the ordinance. The city of Bridgeport has the same noise limits as the State of Connecticut.

Acoustical Technologies Inc. measured the airborne noise from six speakers used to simulate the noise generated by a Doosan 640 KW fuel cell. The acoustic source level at 10 meters from the operation of a Doosan fuel cell at New Britain High School was then used as a basis for making Doosan fuel cell airborne noise estimates at all the measured locations. Airborne noise estimates from one fuel cell were than scaled up to 21 fuel cells using the "noisetools" application to account for the height of the installed Cooling and Power Modules. A power summation of the twenty-one individual Cooling and Power Module estimates was then calculated to produce an overall sound level at each of six property lines as shown in Table 4.

Table 3 provides the single fuel cell estimates from the data taken on April 23, 2020. Table 4 provides the airborne noise estimates for twenty-one fuel cells operating simultaneously. The second column in Table 4 gives the approximate receiver height for each measurement location, with locations identified by a P number in Figure 1. Estimates for the first, second and third floors of nearby buildings were made. Column 3 gives the total estimated noise levels expected from twenty-one fuel cells. Column 4 gives the Cooling Module contribution. Column 5 gives the Power Module contribution. Column 6 gives the maximum noise level expected at each property. Column 7 gives the expected value at the first floor from the "noisetools" analysis. Values shown in red may be above the night time residential noise requirement of 51 dBA and the industrial noise requirement of 70 dBA.

Reviewing Table 4, it is clear that the expected airborne noise levels may be high near the closest residences and within 25 meters of the fuel cells at 571 Iranistan Avenue. A summary of the maximum expected levels (at the 3rd floor) are given in Table 5 below. The 1st floor values are approximately 0.5 to 1 dB lower. The P11 residence at 720 Black Rock Avenue is expected to see airborne noise levels of 62 dBA with all the fuel cells operating. Other homes along Black Rock Avenue should see similar airborne noise levels. This level may be 1 dB above the day time requirement and 11 dB above the night time requirement. The residences along Garden and South Avenues should see airborne noise levels of 58 dBA and lower. The nearby residential properties to the north, north east and south east may be above the night time noise requirement and require noise mitigation. The expected maximum airborne noise value at 571 Iranistan Avenue is marginally above the industrial noise requirement as shown in Table 5 below. A less substantial noise treatment for the 4th floor of the south end of the building would be useful in improving the noise performance at 571 Iranistan Avenue. (Treating the residential noise emanating on the north, east and south sides of the 4th floor may redirect sound energy towards the west side and 571 Iranistan). All of the other industrial property line estimates on Railroad and South Avenues should meet the 70 dBA Industrial Zone noise limits.

Operation of the Doosan fuel cells may have significant acoustic impact at all of the closest Residential Zone properties to the north, north east and south east sides of the 600 Iranistan Avenue site. The industrial property next to the 600 Iranistan Avenue site at 571 Iranistan Avenue may exceed the 70 dBA requirement. Railroad and South Avenue industrial properties should see airborne noise levels from the 21 fuel cells no higher than 69 dBA which is just below the industrial noise limit of 70 dBA. All of the other nearby industrial properties should not be affected by the operation of the fuel cells. Background airborne noise levels of 53 to 63 dBA from the traffic on Interstate 95 were measured during a normal working day. These background noise levels will drop during the overnight hours as the traffic levels decrease. (The L90 background level has to exceed 46 dBA before background noise can affect the night time noise limit. This may or may not happen.) As a result, the fuel cell noise may or may not become the dominant noise source for the nearby residences. Noise mitigation may be recommended to bring the fuel cell noise levels down to airborne noise values less than 51 dBA or less than the background plus 5 dB in the Residential Zones and below 70 dBA for the business at 571 Iranistan Avenue. On site acoustic testing after installation of the fuel cells is recommended to confirm that the acoustic environment at the nearby properties is acceptable.

Table 5. Expected Airborne Noise Levels from Operating 21 Doosan Fuel Cells (ref. 20 µPA)

P3	P5	P6	**Limit**		**Location**
69 dBA	71 dBA	66 dBA	70 dBA	←	Industrial
P9	P10	P11		←	Residential
58 dBA	58 dBA	62 dBA	51 dBA		

Conclusions

The purpose of this effort is to evaluate the acoustical environment at the proposed 600 Iranistan Avenue fuel cell site in Bridgeport, CT. This has been accomplished and the results show that the operation of twenty-one Doosan 460 KW fuel cells may not meet all of the State of Connecticut and Bridgeport airborne noise requirements at all the nearby properties. Residential properties to the north, north east and south east could be affected by the airborne noise from the twenty-one fuel cells. An industrial property to the south west could also be minimally affected by the airborne noise from the twenty-one fuel cells. This industrial property may see airborne noise levels just above the 70 dBA limit in an Industrial Zone. The residential properties may see airborne noise levels above the 51 dBA limit in a Residential Zone. Airborne noise from the twenty-one fuel cells may have to be mitigated to preclude the combined fuel cells from exceeding the 70 dBA industrial and 51 dBA residential limits. The night time limit may be adjusted to be 5 dB above the high background noise levels caused by Interstate I95. The noise mitigation should be designed to provide sufficient sound attenuation to show that the airborne noise generated by the fuel cells will not significantly impact the facility's closest neighbors.

References

1) CT DE&EP *Noise Control Regulation RCSA Section 22a-69*-1 to 22a-69-7.4 http://www.ct.gov/dep/lib/dep/regulations/22a/22a-69-1through7.pdf

2) New Britain High School Fuel Cell Acoustic Assessment, Acoustical Technologies Inc., August 8, 2018

3) Mount Sinai Rehabilitation Hospital Airborne Noise Assessment, Carl A. Cascio, Acoustical Technologies Inc., January 26, 2017

4) Bridgeport Noise Ordinance https://library.municode.com/ct/bridgeport/codes/code_of_ordinances?nodeId=TIT8HESA_CH8.80NOCORE

Attachment #13

April 24, 2020

RE: Petition For a Declaratory Ruling That No Certificate of Environmental Compatibility and Public Need is Required ("Petition") for the Installation of Twenty One , 460 KW Fuel Cells at 600 Iranistan Ave. Bridgeport, CT 06605.

Dear Recipient,

Pursuant to Section 16-50j-40 of the Connecticut Siting Council's (the "Council") Rules of Practice, we are notifying you that Doosan Fuel Cell America, Inc. intends to file a petition for declaratory ruling with the Connecticut Siting Council ("Council") on or about May 1, 2020. The petition will request the Council's approval of the installation of twenty one (21) 460kW fuel cell and ancillary equipment in support of a Utility-side, distributed generation project at 600 Iranistan Ave. Bridgeport, CT 06605. The fuel cells will be powered by natural gas and generated electricity will be distributed to the Grid.

The proposed placement of the fuel cells are directly adjacent to I-95 contained in a 2 ½ story structure.

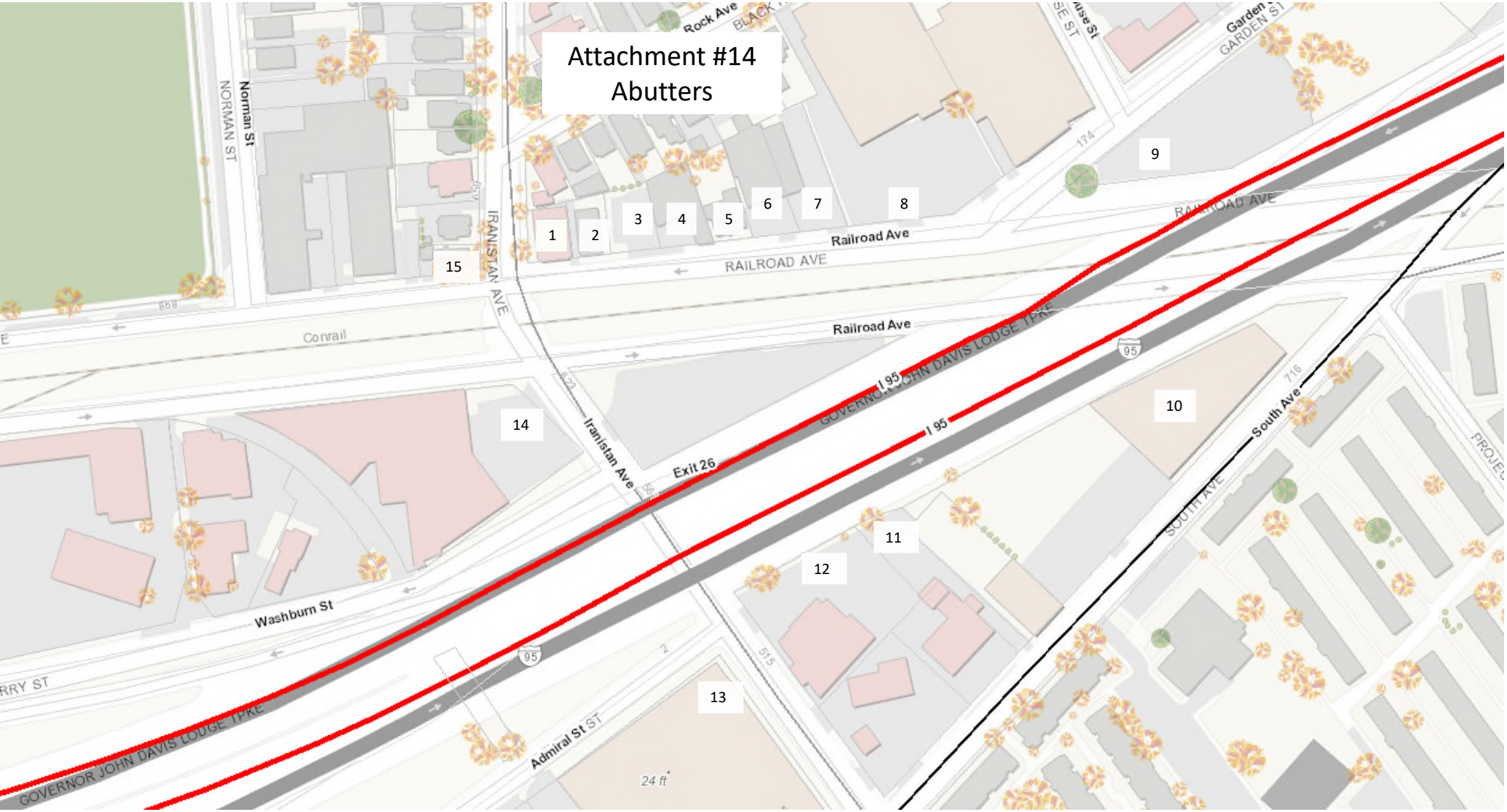
If you have any questions regarding the proposed work, please contact any of the following:

Doosan Fuel Cell America, Inc.

Walter Bonola
101 Riverside Dr.
East Hartford, CT 06074
860.727.2010
walter.bonola@doosan.com

Connecticut Siting Council

10 Franklin Square
New Britain, CT 06051
Tel: 860.827.2935


Attachment #14
Abutters
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Railroad Ave
RAILROAD AVE
Conrail
Iranistan Ave
Exit 26
I 95
GOVERNOR JOHN DAVIS LODGE TPKE
Washburn St
Admiral St
South Ave
Norman St
Rock Ave
Garden ST
24 ft

Nupower Thermal - Abutters Mailing List

No	Property ID	Site Address	Owner Name	Mailing Address	Mailing City	Mailing State	Mailing Zip
1	9055	790 Railroad Ave	DOS JAY LLC	1540 Iranistan Ave	Bridgeport	CT	06604
2	9056	778 Railroad Ave	Uszkiewicz, Adam	780 Railroad Ave #782	Bridgeport	CT	06604
3	9057	770 Railroad Ave	Trefz Management Co Inc	PO Box 310	Bridgeport	CT	06601
4	9058	756 Railroad Ave	Trefz Management Co Inc	PO Box 310	Bridgeport	CT	06601
5	9059	746 Railroad Ave	Lombardi, Kenneth G	8 Huntington St Suite 141	Shelton	CT	06484
6	9060	740 Railroad Ave	RR Ave LLC	26 Manor Dr	Monroe	CT	06468
7	9061	722 Railroad Ave	RR Ave LLC	26 Manor Dr	Monroe	CT	06468
8	9062	225 Black Rock Ave	Calzone Brothers Partnershp	225 Black Rock Ave	Bridgeport	CT	06605
9	9072	141 Garden St	New Beginnings Family	184 Garden St	Bridgeport	CT	06605
10	2580	816 South Ave	816 South Ave, LLC	816 South Ave	Bridgeport	CT	06605
11	2584	824 South Ave	Nunes Maria Theresa & Maria	840 South Ave	Bridgeport	CT	06604
12	2583	500 Iranistan Ave	Nunes Jose M & Maria F Nunes	500 Iranistan Ave	Bridgeport	CT	06605
13	2850	455 Iranistan Ave	Iranistan Ave Venture LLC	154 Admiral St	Bridgeport	CT	06601
14	2821	32 Washburn St	54 Washburn Street LLC	54 Washburn St	Bridgeport	CT	06605
15	8960	619 Iranistan Ave	Cabrera-Astudillo Kleber O	621 Iranistan Ave	Bridgeport	CT	06605

Attachment #15 Officials Notification List

Joseph Ganim

Office of the Mayor

999 Broad St.

Bridgeport, CT. 06604

Rep. Dennis Bradley

853 Fairfield Ave.

Bridgeport, CT 06604

Dennis Buckley

Planning and Zoning Commission

45 Lyon Terrace Rm 210

Bridgeport, CT 06604

Sen. Christopher Murphy

One Constitution Plaza, 7th floor

Hartford, CT 06103

Bruce A. Nelson Building Official

45 Lyon Terrace

Bridgeport, CT 06604

Richard Blumenthal

90 State House Square

Hartford, CT 06103

Rep. Marilyn Moore

House District 22

666 Cleaveland Ave.

Bridgeport, CT 06605

DEEP

Kaite Dykes, Commissioner

79 Elm St.

Hartford, CT 06106

Rep. Antonio Felipe

House District 130

666 Iranistan Ave

Bridgeport, CT 06605

State Council on Environmental Quality

79 Elm St.

Hartford, CT 06106

Raul Pino, M.D, MPH

State Dept of Public Health

410 Capitol Avenue

Hartford, CT 06134

Greater Bridgeport MCOG

1000 Lafayette Blvd.

Bridgeport, CT 06604

Melody A. Currey, Acting Commissioner

State Dept. of Agriculture

165 Capitol Ave

Hartford, CT 06106

William Tong, Attorney General

55 Elm St.

Hartford, CT 06106

John Urquidi, PE, Town Engineer

45 Lyon Terrace Rm 216

Bridgeport, CT 06604

Public Utilities Regulatory Authority

John W. Betkoski III – Vice Chairman

Ten Franklin Square

New Britain, CT 06051

Office of Policy and Management

Melissa McCaw, Secretary

450 Capitol Ave.

Hartford, CT 06106

Dept. of Emergency Services and Public Protection

James C. Rovella, Commissioner

1111 Country Club Rd.

Middletown, CT 06457

State Dept. of Economic and Community Development

David Lehman, Commissioner

505 Hudson St.

Hartford, CT 06106

Dept. Of Administrative Services

Josh Geballe, Commissioner

450 Columbus Blvd.

Hartford, CT 06103

Bridgeport Director of Planning

Thomas F. Gill

999 Broad St.

Bridgeport, CT 06605

Department of Transportation

Joseph Giulietti, Commissioner

2800 Berlin Tpke.

Newington, CT 06111

Department of Consumer Protection

Michelle H. Seagull, Commissioner

450 Columbus Blvd.

Hartford, CT 06103

Department of Labor

Kurt Westby, Commissioner

200 Foley Brook Blvd.

Wethersfield, CT 06109

Attachment #16
Mail Receipts

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USPS 06066-9998

7019 1640 0001 1178 8350

Sent To: Josh Geballe DAS Commissioner
Street and Apt. No., or PO Box No.: 450 Columbus Blvd.
City, State, ZIP+4®: Hartford CT 06103

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VERNON/ROCKVILLE CT
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7019 1640 0001 1178 8343

Sent To: Sen. Richard Blumenthal
Street and Apt. No., or PO Box No.: 90 State House Square
City, State, ZIP+4®: Hartford CT 06103

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7019 1640 0001 1178 8326

Sent To: Marcia Leclerc
Street and Apt. No., or PO Box No.: 241 Main St. #4
City, State, ZIP+4®: Hartford, CT 06106

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7019 1640 0001 1178 8350

Sent To: William Tong
Street and Apt. No., or PO Box No.: 55 Elm street
City, State, ZIP+4®: Hartford CT 06106

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7019 1640 0001 1178 8333

Sent To: Raul Pino M.D., MPH
Street and Apt. No., or PO Box No.: 410 Capitol Ave
City, State, ZIP+4®: Hartford, CT 06134

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Sent To: State Council on Environ Quality
Street and Apt. No., or PO Box No.: 79 Elm St.
City, State, ZIP+4®: Hartford, CT 06106

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Sent To: Joseph Giulietti DOT
Street and Apt. No., or PO Box No.: 2800 Berlin Turnpike
City, State, ZIP+4®: Newington CT 06111

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Sent To: John W. Betkoski III
Street and Apt. No., or PO Box No.: 10 Franklin Square
City, State, ZIP+4®: New Britain CT 06051

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- ☐ Adult Signature Restricted Delivery $

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Sent To: Michelle H. Seagull
Street and Apt. No., or PO Box No.: 450 Columbus Blvd.
City, State, ZIP+4®: Hartford, CT 06103

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Sent To: 876 South Ave, LLC
Street and Apt. No., or PO Box No.: 876 South Ave.
City, State, ZIP+4®: Bridgeport, CT 06605

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Sent To: Mayor Joseph Ganim
Street and Apt. No., or PO Box No.: 999 Broad St.
City, State, ZIP+4®: Bridgeport, CT 06604

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Sent To: Theresa & Maria Nunes
Street and Apt. No., or PO Box No.: 874 South Ave
City, State, ZIP+4®: Bridgeport, CT 06605

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Sent To
Melody A Curry
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165 Capitol Ave.
City, State, ZIP+4®
Hartford, CT 06106

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45 Lyon Terrace Rm 210
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Bridgeport, CT 06604

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240 Railroad Ave.
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Bridgeport, CT 06605

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James C. Bovelle Commissioner
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111 Country Club Rd.
City, State, ZIP+4®
Middletown, CT 06457

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Bridgeport, CT 06605

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Sent To
Jose M. & Maria F. Munes
Street and Apt. No., or PO Box No.
500 Iranistan Ave.
City, State, ZIP+4®
Bridgeport, CT 06605

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Iranistan Venture, LLC
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455 Iranistan Ave.
City, State, ZIP+4®
Bridgeport, CT 06605

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Street and Apt. No., or PO Box No.
756 Railroad Ave, #766
City, State, ZIP+4®
Bridgeport, CT 06605

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Sent To
34 Wash Dorn St., LLC.
Street and Apt. No., or PO Box No.
32 Wash Dorn St.
City, State, ZIP+4®
Bridgeport, CT 06605

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Sent To

Commissioner Kaite Dykes

Street and Apt. No., or PO Box No.

79 Elm St.

City, State, ZIP+4®

Hartford, CT 06106

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

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Sent To

Rep. Denis Bailey

Street and Apt. No., or PO Box No.

833 Fairfield Ave

City, State, ZIP+4®

Bridgeport, CT 06604

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

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- ☐ Adult Signature Restricted Delivery $

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Sent To

Stephen Stadtstrom

Street and Apt. No., or PO Box No.

120 Sailors Lane

City, State, ZIP+4®

Bridgeport, CT 06605

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

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- ☐ Adult Signature Restricted Delivery $

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Sent To

Sen. Christopher Murphy

Street and Apt. No., or PO Box No.

One Constitution Plaza

City, State, ZIP+4®

Hartford, CT 06103

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

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- ☐ Certified Mail Restricted Delivery $
- ☐ Adult Signature Required $
- ☐ Adult Signature Restricted Delivery $

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Sent To

Kenneth G. Lombardi

Street and Apt. No., or PO Box No.

946 Railroad Ave #250

City, State, ZIP+4®

Bridgeport, CT 06605

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- ☐ Certified Mail Restricted Delivery $
- ☐ Adult Signature Required $
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Sent To

Pedro Samuel

Street and Apt. No., or PO Box No.

946 Railroad Ave #792

City, State, ZIP+4®

Bridgeport, CT 06605

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City, State, ZIP+4®
Bridgeport, CT 06605

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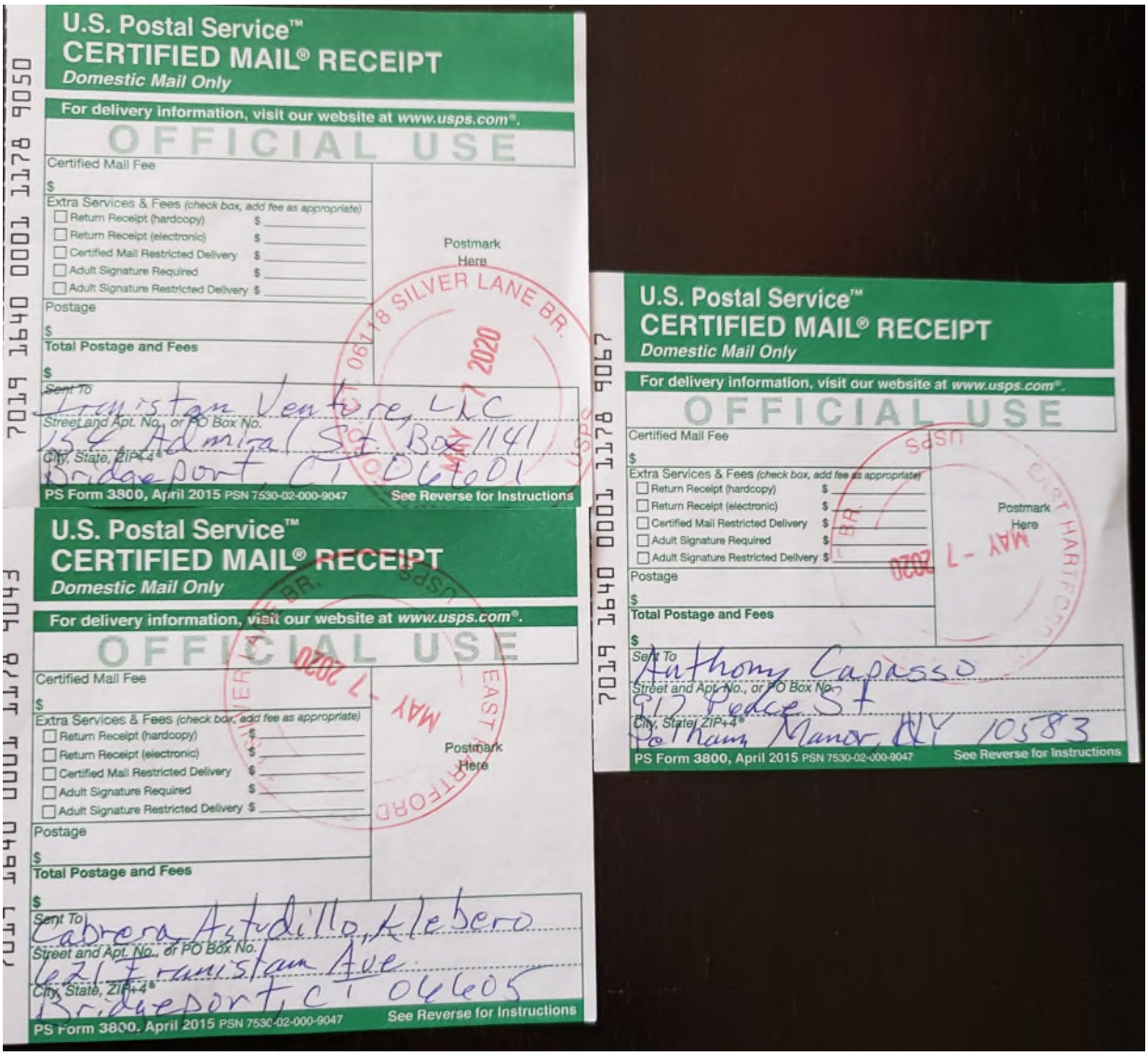

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City, State, ZIP+4®
Bridgeport CT 06605

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Attachment #17

COASTAL BOUNDARY
BRIDGEPORT, CONNECTICUT

LEGEND

Coastal Boundary

EXPLANATION

The coastal boundary map shows the extent of lands and coastal waters as defined by Connecticut General Statute within Connecticut's coastal area. The coastal boundary is a continuous line delineated on the landward side by the interior contour elevation of the one hundred year frequency coastal flood zone, as defined and determined by the National Flood Insurance Act, or a one thousand foot linear setback measured from the mean high water mark in coastal waters, or a one thousand foot linear setback measured from the inland boundary of tidal wetlands, whichever is farthest inland; and shall be delineated on the seaward side by the seaward extent of the jurisdiction of the state.

Any regulated activity conducted within the coastal boundary by a municipal agency (i.e., plans of development, zoning regulations, municipal coastal programs and coastal site plan review (i.e., site plans submitted to zoning commission, subdivision or resubdivision plans submitted to planning commission, application for special permit or exception to the zoning or planning commissions or zoning board of appeals, variance submitted to zoning board of appeals and a referral of a municipal project)) must be conducted in a manner consistent with the requirements of the Connecticut Coastal Management Act (CMA). As the Coastal Boundary is a hybrid of the Coastal Area, all state and federal agency activities must be consistent with the requirements of the CMA. The coastal boundary is a hybrid of the original 1:24,000 version maps prepared by DEP and the revised boundary mapping undertaken by twenty-two coastal towns. This layer therefore does not replace the legal maps and may not be used for legal determinations.

The following twenty-two towns have adopted municipal coastal boundaries: Chester, Clinton, Darien, Deep River, East Haven, Essex, Fairfield, Greenwich, Groton, Guilford, Hamden, Ledyard, Madison, Milford, New Haven, New London, North Haven, Norwalk, Old Lyme, Old Saybrook, Stamford and Waterford. The coastal boundary maps for these towns may be at different scales than the original DEP draft maps and may contain minor adjustments to the boundary.

DATA SOURCES

COASTAL BOUNDARY DATA - The original boundary maps were created in 1979 on stable mylar overlay using the 1:24,000-scale US Geological Survey topographic quadrangle maps (mylar film format). The source for tidal wetland maps were the legal 1:24,000 maps (mylar format) adopted by the Commissioner of DEP and transformed to 1:24,000 mylar-scale maps by the Office of Policy and Management (OPM) using an accurate pantograph. OPM similarly converted FEMA's flood insurance maps (various scales) to a 1:24,000 mylar overlay. The inland extent of coastal waters was plotted on 1:24,000 USGS topographic maps following the procedures and sources described in The Boundary Between Saltwater and Freshwater in Connecticut, December 1978 prepared by the State of Connecticut, Department of Environmental Protection, Coastal Area Management Program.

BASE MAP DATA - Based on data originally from 1:24,000-scale USGS 7.5 minute topographic quadrangle maps published between 1969 and 1992. It includes political boundaries, railroads, airports, hydrography, geographic names and geographic places. Streets and street names are from Tele Atlas® copyrighted data. Base map information is neither current nor complete.

RELATED INFORMATION

This map is intended to be printed at its original dimensions in order to maintain the 1:24,000 scale (1 inch = 2000 feet).

MAPS AND DIGITAL DATA - Go to the CT ECO website for this map and a variety of others. Go to the DEEP website for the digital spatial data shown on this map.

MAP LOCATION

State Plane Coordinate System of 1983. Zone 3526
Lambert Conformal Conic Projection
North American Datum of 1983

1 0.5 0 1 Miles
1000 0 1000 2000 3000 4000 5000 6000 7000 Feet
1 0.5 0 1 Kilometers

SCALE 1:24,000 (1 inch = 2000 feet) when map is printed at original size

STATE OF CONNECTICUT
DEPARTMENT OF
ENERGY & ENVIRONMENTAL PROTECTION
79 Elm Street
Hartford, CT 06106-5127

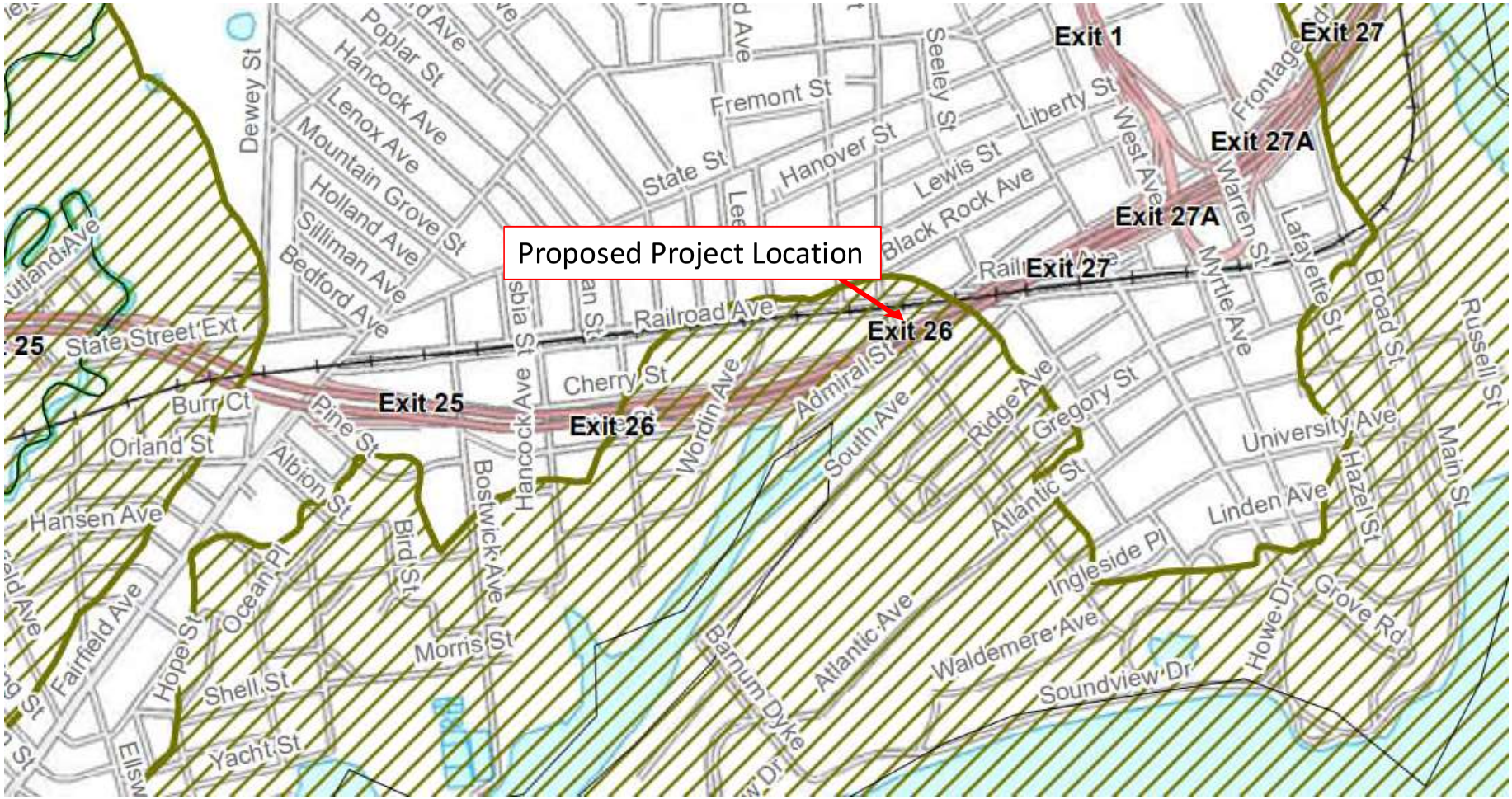
Map created by DEEP
January 2013

Map is not colorfast
Protect from light and moisture

Attachment #18
Coastal Boundary Zone Map

Proposed project location

EASTON
WESTON
TRUMBULL
SHELTON
ORANGE
MILFORD
STRATFORD
BRIDGEPORT
FAIRFIELD
WESTPORT


Proposed Project Location
Exit 1
Exit 27
Exit 27A
Exit 27A
Exit 27
Exit 26
Exit 25
Exit 26
Railroad Ave
State Street Ext
Fremont St
State St
Hanover St
Liberty St
Lewis St
Black Rock Ave
Seeley St
West Ave
Warren St
Myrtle Ave
Lafayette St
Broad St
Russell St
Main St
Dewey St
Poplar St
Hancock Ave
Lenox Ave
Mountain Grove St
Holland Ave
Silliman Ave
Bedford Ave
Cherry St
Wordin Ave
Admiral St
South Ave
Ridge Ave
Gregory St
University Ave
Linden Ave
Hazel St
Atlantic St
Ingleside Pl
Howe Dr
Grove Rd
Waldemere Ave
Soundview Dr
Atlantic Ave
Barnum Dyke
Burr Ct
Orland St
Pine St
Albion St
Bird St
Bostwick Ave
Hancock Ave
Morris St
Hope St
Ocean Pl
Shell St
Yacht St
Fairfield Ave
Hansen Ave

Attachment 19: Desulfurization Memo

PureCell Model 400 Fuel Processing System (FPS)

The FPS converts pipeline-quality natural gas into hydrogen reformate – a hydrogen-rich gas that is delivered to the anode side of the fuel cell stacks. This module includes a condenser to recover water generated in the fuel cell reaction by condensing water vapor from the process exhaust. This eliminates the need for makeup water under most operating conditions. The recovered water is used in the steam reformation process. The main components of the FPS include the following:

Hydro-Desulfurizer

The desulfurizer system removes sulfur used as an odorant in natural gas, which is a poison to the catalysts used in the fuel cell systems. Sulfur is converted to zinc-sulfide, a non-hazardous waste, within the desulfurizer and remains there until an overhaul is required, nominally after 10 years. This system will also remove small amounts of oxygen in the gas.

Steam Reformer

Steam (H_2O) generated in the cell stack cooling loop of the TMS is combined in the reformer with methane (CH_4) in the natural gas to generate a gas composed of hydrogen (H_2), carbon monoxide (CO), and carbon dioxide (CO_2).

$2CH_4 + 3H_2O = 7H_2 + CO + CO_2$ *Equation 1*

Integrated Low-Temperature Shift Converter

The integrated low-temperature shift converter (ILS) generates additional hydrogen through a water-gas reaction in which CO and water is converted to hydrogen and CO_2. The reduced CO content minimizes its adverse effect on fuel cell stack performance.

CO + H2O = H2 + CO2 *Equation 2*

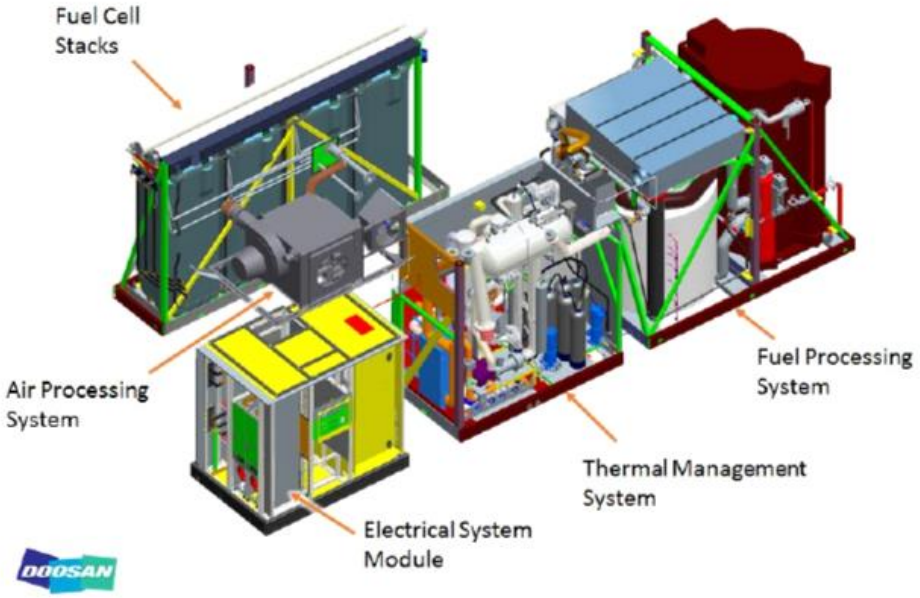


Figure 1. PureCell Model 400 Subsystems

Desulfurization Memorandum
PureCell® Model 400 Stationary Fuel Cell System

Date: 2017-01-05

Sulfur Background

Sulfur is present in pipeline natural gas. It is primarily used as an odorant so leaks can be detected. Unfortunately, sulfur is also a poison to fuel cell systems and exposure to sulfur will drastically reduce the life and efficiency of the fuel cell.

Types of sulfur found in natural gas vary from region to region. Some common examples are:

- Hydrogen Sulfide (H_2S)
- Tetrahydrothiophene (THT)
- Mercaptain – (MCP) - Broad family of sulfur molecules characterized by a sulfur atom attached to a hydrocarbon molecule or chain

The majority of it the odorants are organic with the exception of hydrogen sulfide. Standard pipeline natural gas contains up to 6 parts per million by volume (ppmv) sulfur on average with spikes as high as 30 ppmv possible. In order to successfully maintain operation of the fuel cell for a period of 10 years, the sulfur levels must be reduced to less than 0.02 ppmv, or a 99.7% removal rate. An additional benefit of this is that it removes sulfur dioxide from the emissions of the fuel cell power plant.

Sulfur Removal Techniques

Sulfur removal can be broken down into two main techniques, physical capture and reactive capture.

Physical capture involves using porous media such as activated carbon or molecular sieves to capture and concentrate the odorant before it enters the fuel cell. Doosan elected not to pursue this path due to several factors, including:

- The process concentrates the odorant and turned it into hazardous waste
- The concentrated odorant is highly toxic and requires specially trained personnel to handle the waste
- Would result in more service being required at customer sites to maintain the system

Reactive capture is the method used by Doosan to remove sulfur. It involves chemically reacting the odorant over a catalyst bed in order to separate the sulfur molecule. Once the sulfur molecule is separated from the odorant, the remaining odorant is destroyed in another catalyst bed. The sulfur molecule is then captured and converted to a compound called Zinc Sulfide.

$$*S + H_2 \leftrightarrow H_2S + * \qquad \textit{Equation 4}$$

$$H_2S + ZnO_{(s)} \leftrightarrow ZnS_{(s)} + H_2O \qquad \textit{Equation 5}$$

Note: * represents the non-sulfur odorant components

Doosan's system has been sized such that it will run for the 10 year service life of the unit and not need to be changed out. When the unit is removed from service, the decommissioning or refurbishment of the unit will be carried out by trained personnel and a company specializing in removal of the waste Zinc Sulfide will recover the spent material. Zinc sulfide has some commercial value, so that company will either process it and sell it or split it into Zinc and Sulfur and sell them separately.

Respectfully,
Jesse Hayes, Director, Product Management, Doosan Fuel Cell
195 Governors Highway
South Windsor, CT 06074
Jesse.hayes@doosan.com
(860) 560-3309

Attachment #20

Avoided Emissions

This method is consistent with the guidance of the U.S. EPA CHP Partnership

Customer:	NuPower
Location:	Bridgeport with heat loop

Date: 3/11/2019

System:	PureCell® Model 400
QNTY:	21
Electrical Utilization:	100%
High Grade Heat Utilization:	100%
Low Grade Heat Utilization:	0%
Cooling Utilization:	0%
Heating Fuel:	Natural Gas
eGrid Sub-region (see map):	NEWE
T&D Losses:	4.49%

Annual Emissions Balance Sheet	***Energy Balance***		***Emissions Balance***		
	Electricity (kWh)	**Fuel (MMBTU)**	**CO2**	**NOx**	**SOx**
			(metric tons - MT)		
Facility Avoided Emissions	(84,000,054)	(224,419)	(47,584)	(20.40)	(4.31)
On-Site Power Emissions	0	715,631	38,026	0.73	0.00
BALANCE	***(84,000,054)***	***491,212***	***(9,558)***	***(19.66)***	***(4.31)***

Emissions Summary	***Emissions Reduction***		
	Metric Tons	**Equivalence**	**%**
CO_2	9,558	2205 acres of trees	20%
NO_X	19.66	1128 cars	96%
SO_2	4.31		100%
Water	35,775,623 gal	54.4 olympic pools	100%

Utility emissions factors based on U.S. EPA eGRID year 2016 for fossil fuel generation in sub-region.

U.S. EPA CHP Partnership Methodology can be found here: http://www.epa.gov/chp/documents/fuel_and_co2_savings.pdf