STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL

PETITION OF VFS, LLC. FOR A DECLARATORY RULING FOR THE LOCATION AND CONSTRUCTION OF A 2.76 MEGAWATT FUEL CELL CUSTOMER-SIDE DISTRIBUTED ENERGY RESOURCE WITH COMPANION 1.99-MEGAWATT BATTERY ENERGY STORAGE SYSTEM AT QUINNIPIAC UNIVERSITY, MOUNT CARMEL CAMPUS 275 MOUNT CARMEL AVE., HAMDEN, CT 06518

PETITION NO.

PETITION OF VFS, LLC 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., VFS, LLC. ("VFS"), as an agent for and on behalf of its Customer Quinnipiac University ("Quinnipiac"), requests that the Connecticut Siting Council ("Council") approve by declaratory ruling the location and construction of a Customer-side distributed resources project comprised of six (6) new natural-gas fueled PureCell® Model 400 phosphoric acid fuel cells ("Fuel Cell") and AESI TeraStor 7200 Battery Energy Storage System and associated equipment (the "Facility"), providing 2.76-Megawatts ("MW") (net) of power to the University facility located at 2756 Mount Carmel Ave., Hamden, CT *(See Attachment* 1 GA 1.1 I). The Facility will be installed, owned, operated, and maintained by VFS, LLC.

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 Protection."

I. INTRODUCTION

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

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II. DESCRIPTION AND PURPOSE OF THE PROJECT

The Facility will be a customer-side installed distributed generation resource with interconnection at the Quinnipiac Mount Carmel Campus Facility providing electricity to the

host facility. The proposed installation consists of six (6) concrete pad mounted 460KW Model 400+ Fuel Cells manufactured by HyAxiom, Inc. in South Windsor, Connecticut, a TeraStor 7200 Battery Energy Storage System ("BESS") Manufactured in Hudson Mass. (*See* Attachment #2 for 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 and the BESS measures 27' x 12'-5" x 8'-2". The Fuel Cells and BESS are totally enclosed and factory-assembled and tested prior to shipment. The associated electrical equipment will be ground mounted directly adjacent to the fuel cells. The overall dimensions for the fenced area containing the facility is 61'-6" x 141'-5".

As a power installation the proposed facility will deliver 2.76 MW of clean power. The BESS is rated at 1.99 mw and will be utilized for Peak Shaving. The completed facility will also supply 7.2 MMBtu of thermal energy year round to the newly constructed central plant and will be capable of a maximum total efficiency of approximately 94%.

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. The BESS is fully monitored and requires maintenance on an "as needed" basis.

III. **SAFETY**

The Fuel Cell is 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 Cell will be installed in accordance with NFPA 853. The BESS is

manufactured to be UL 9540 and NFPA 855 2026 compliant. In accordance with Public Act 11-101, the fuel line pipe cleaning procedure will use inert nitrogen gas or atmospheric air. The following items are a few of the safety measures incorporated into the design. VFS, LLC. through HyAxiom routinely offers on-site training to First Responders on all projects. Once the final design is complete a formal site-specific Emergency Response Plan will be created and implemented. Please also refer to the sample Emergency Response Plan in *Attachment* #3.

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 HyAxiom 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. The BESS Is monitored in real time for over temperature and smoke.

B. Gas Leak

The Fuel Cell is 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 in order 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 Cell operates 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**

The Fuel Cells are capable of delivering 460 kW of electric power each. 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 Sample Emergency Response Plan (*See Attachment* #3).

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 lb. 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 and BESS do not produce any hazardous waste emissions.

V. **THE SITE**

The Facility is proposed to be located entirely on the 141 acre Site immediately East of the Quinnipiac Arts and Sciences Center and just North of the Facilities offices and maintenance garage at 275 Mount Carmel Ave., Hamden. The site is zoned R2 by the town (attachment #4). The surrounding parcels bordering the East of the host property are zoned R2, To the North R1, and to the West R2R4. Attachment #5 shows an aerial map of the location of Facility on the Site. The nearest residential properties are over 690'to the South Southeast of the proposed

Facility. There is a forested area directly to the South of the Facility. Four white pine trees are required to be removed for the installation of the Facility. The nearest airport, is Tweed New Haven Airport some 9 miles from the Facility site. The proposed Facility will be a maximum of 10 feet above ground level and does not fall under the FAA notification requirement of 14 CFR Part 77.9 (Attachment #6).

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 while also reducing the demand for grid electricity from this location. This Fuel Cell installation will support the efforts of the State of Connecticut to be a leader in the utilization of fuel cell and battery technology. Further the deployment of the BESS benefits the University through Peak Shaving significantly reducing Utility charges.

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 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 Cell is certified by the California Air Resources Board to meet the Distributed Generation Certification Regulation 2007 Fossil Fuel Emissions Standards (*See Attachment* #7).

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	.01
Carbon Monoxide	1	.02
Carbon Dioxide	1650	1,049

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 a site dry well. This discharge will be incorporated into the overall site design. The Fuel Cell operates in water balance below 86°F. The initial fill requires 350 gallons of water each Fuel Cell. The amount of make-up water above 86°F increases linearly from 0gpm to 1gpm at 110°F.

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	2025 ton/yr	1	2025 ton/yr
CH4	<0.02 ton/yr	25	<0.5 ton/yr
N2O	<0.01 ton/yr	298	<3 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.

3. Wildlife and Habitat

According to the relevant portion of the CT DEEP Hamden Natural Diverse Database Areas Map (*See attachments* #8), the proposed Site is not located within the Natural Diversity Data Base Areas.

Noise Analysis

Based on the engineering study results conducted by a professional acoustical engineer of the proposed Site dated February 17, 2025, the noise level of the Facility will not exceed local and state noise level ordinance levels at neighboring properties However some noise control measures will be included in the final design drawings to curtail noise at some University buildings. Once in full operation further testing will be conducted to prove compliance with the ordinances. Please review the attached Acoustic Survey Report in *Attachments* #9.

5. Visual Impact

The Facility will not cause any significant visual effects. The proposed site is on a very large campus situated adjacent to the Facilities Maintenance garage and offices.

6. Public Notice

Notice was provided via USPS mail to all property owners, abutters and Federal, State and Local officials pursuant to Conn. Agencies Regs.§16-50j-40(a). VFS, LLC's copy of the

notice letter, Abutters list and Abutters' Map are included in *Attachments* 10, 11 and 12. Prior to filing this Petition, VFS, LLC sent notices to all applicable Federal, State and Municipal officials of Hamden as listed in *Attachment* 13. Proof of mailing for all notices is shown in Attachment #14. VFS and Quinnipiac University met with officials from the Town on April 24 to introduce and explain the project.

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 HyAxiom's Service Department personnel during decommissioning and shutdown.

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

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

F) The BESS will be disconnected electrically and returned to the manufacturer for recycling.

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 Hamden (*See Attachment* #15), the proposed Facility is not located within a 100/500 year flood zone and is being placed at approximate elevation 98'. The fuel cells and associated electrical equipment will be installed at or above elevation 98'. The Site is in already fully developed area of the campus with an existing facilities maintenance building adjacent to the Site. The Facility will be located in an Aquifer Protection Area as is the majority of the campus. Having referenced GIS mapping wetlands are within some 60' of the proposed Facility. VFS will work with the Town of Hamden to obtain the necessary permits, reviews and approvals. No negative impact to watercourses and wetlands is anticipated throughout the construction or operation of the Facility.

8. Cultural Resources.

The proposed Facility will be located in an already developed commercial property, Existing temporary buildings housing Laboratory space which were erected in a paved parking lot will be removed to make way for the Facility. 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* #16).

VIII. CONSTRUCTION AND MAINTENANCE

VFS, LLC. plans to start construction work by July 2025. Construction will take approximately twenty four weeks, followed by approximately four weeks of testing and startup. Regular working hours for the proposed project are Monday through Friday from 8:00 am to 5:00 pm. VFS and its contractors will fully cooperate with the Town Inspector and will follow all Town of Hamden and Connecticut State construction policies and codes.

IX. LOCAL INPUT AND STATE FUNDING

VFS, LLC. has shared plans for the project with the local officials and plans to present the plans for the installation of the Facility. This project has been awarded a contract to sell Low Emission Renewable Energy Credits (LREC) to United Illuminating through the CT Low and Zero Emission Renewable Energy Credit Program. VFS, LLC. will complete all necessary permitting before installing the Facility.

X. CONCLUSION

XI. As set forth above, VFS, LLC. 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,

Steve Pearson

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Clarkstown, MI 48346

spearson@vfsmi.com…….

LIST OF ATTACHMENTS

Attachment 1: GA 1, Site Plan

Attachment 2: Doosan PureCell® Model 400 Datasheet, AESI TeraStor 7200 Datasheet

Attachment 3: Emergency Response Plan

Attachment 4: Zoning Map

Attachment 5: Aerial Map

Attachment 6: 14CFR Part 77.9

Attachment 7: CARB Letter

Attachment 8: NDDB Map

Attachment 9: Acoustic Site Survey Report

Attachment 10: Abutters Notification Letter

Attachment 11: Abutters List

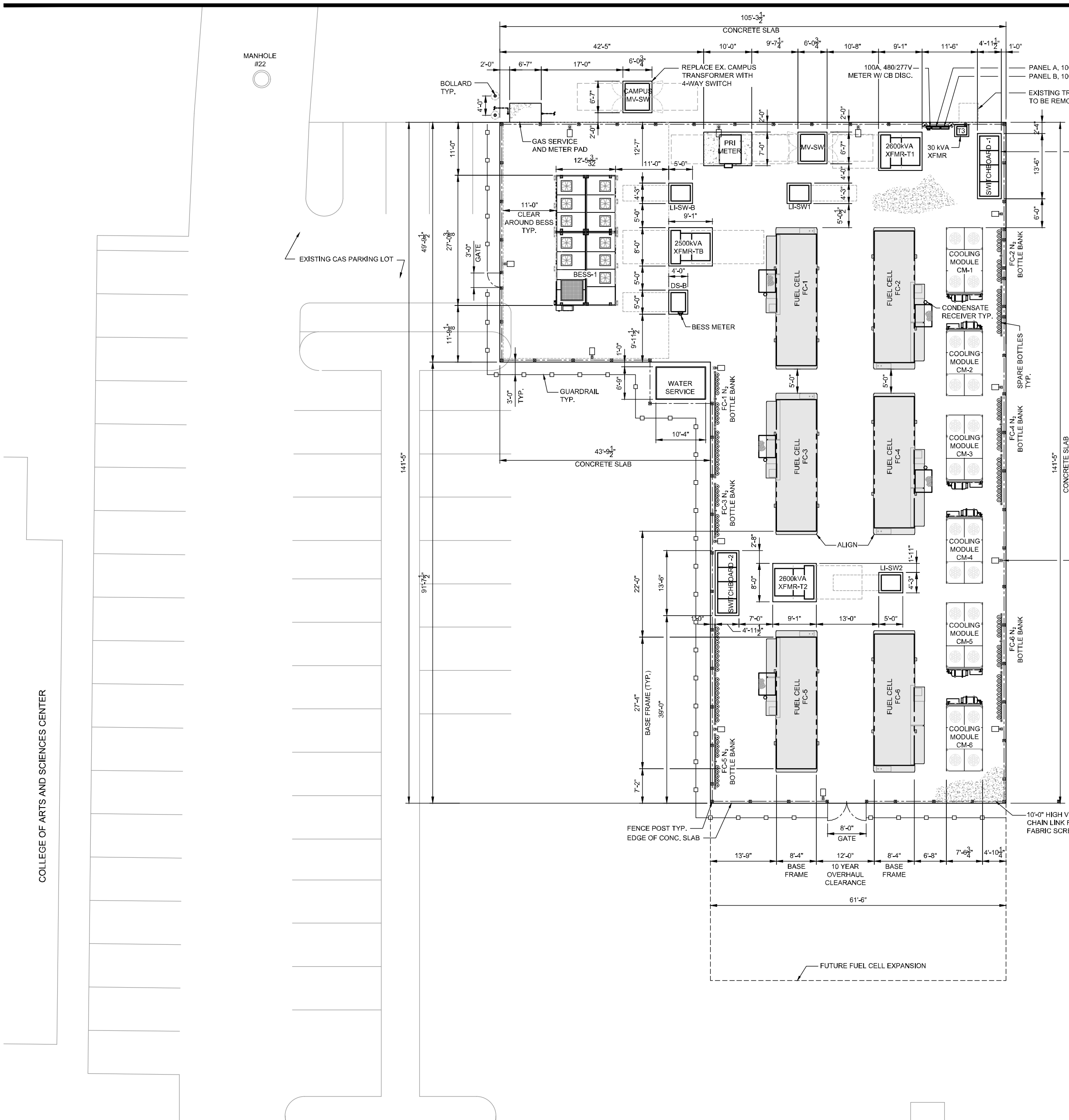
Attachment 12: Abutters Map

Attachment 13: Federal, State and Local Officials Notice List

Attachment 14: Proof of Mailing

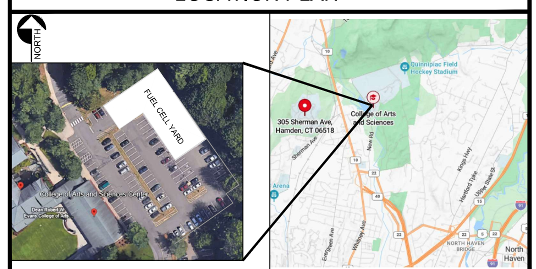
Attachment 15: Flood Map

Attachment 16: Desulfurization Memo



1 GENERAL ARRANGEMENT PLAN
Scale: 3/32" = 1'-0"

LOCATION PLAN



QUINNIPIAC UNIVERSITY
MT. CARMEL
555 NEW ROAD, HAMDEN, CT
FUEL CELL AND BESS INSTALLATION
GENERAL ARRANGEMENT

Rev.	Date	Description
A	01/30/25	ISS. FOR CONNECTICUT SITTING COUNCIL

ICDS
Innovative Construction & Design Solutions, LLC
10 White Wood Lane
N. Branford, CT 06471
Phone: (203) 453-8596
Email: info@icdsllc.com

Project No.:	Drawn By: KFH
Date: 01/30/25	Design By: KFH
Scale: AS NOTED	Check By: DSF

Drawing No.:
GA1.2-I

HyAxiom™
A Doosan Company

PureCell® Model 400

PURECELL SYSTEM BENEFITS

Energy Security

Proven PAFC fuel cell technology

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 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, 60HZ

Characteristic	Units	Operating Mode	
		Power 460kW	Eco 440kW
Electric Power Output[1]	kW/kVA	460/532	440/517
Electrical Efficiency[1]	%, LHV	43.5%	44.4%
Peak Overall Efficiency	%, LHV	90%	90%
Gas Consumption[1]	MMBtu/h, HHV (kW)	4.00 (1,172)	3.75 (1,098)
Gas Consumption[1,2]	SCFH (Nm^3/h)	3,902 (104)	3,657 (98)
High Grade Heat Output @ up to 250°F[1,7]	MMBtu/h (kW)	1.30 (382)	1.16 (341)
Low Grade Heat Output @ up to 140°F[1,6]	MMBtu/h (kW)	1.68 (492)	1.54 (452)

FUEL

Supply ..... Natural Gas
Inlet Pressure ..... 10 to 14 in. water (25 - 35 mbar)

EMISSIONS[3,4]

NO_x ..... 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_x ..... Negligible
Particulate Matter ..... Negligible
CO_2[1] (electric only) ..... 1,006 lbs/MWh (456 kg/MWh)
(with High-Grade heat recovery) ..... 567 lbs/MWh[5] (257 kg/MWh)
(with full heat recovery) ..... 496 lbs/MWh[5] (225 kg/MWh)

OTHER

Ambient Operating Temp ..... -20°F to 104°F (-29°C to 40°C)
Relative Humidity ..... 0 to 95% (non-condensing)
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 460 kW and 440 kW operation, respectively.
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.
6. With optional equipment.
7. Consult with HyAxiom for heat output at varying conditions

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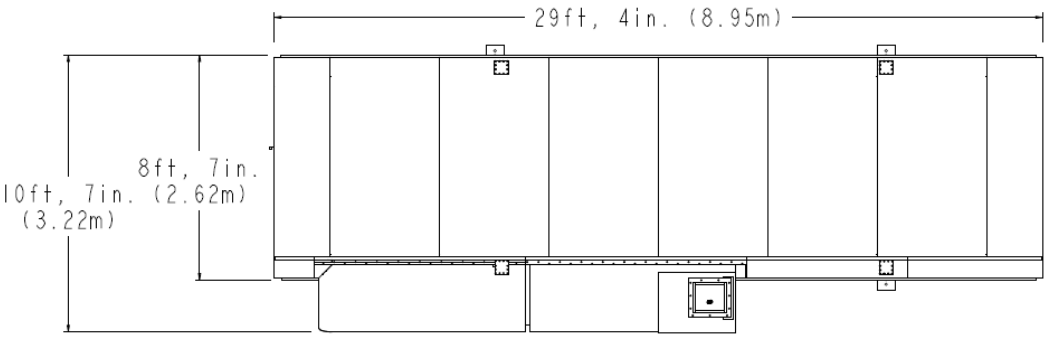
HyAxiom™
A Doosan Company

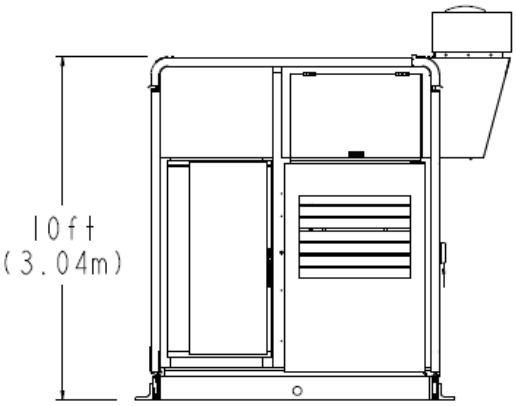
PureCell® Model 400

SYSTEM DIMENSIONS

Power Module

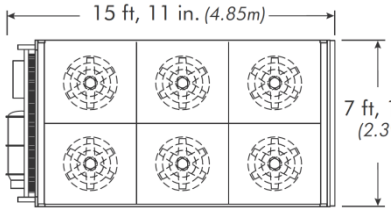


Top View

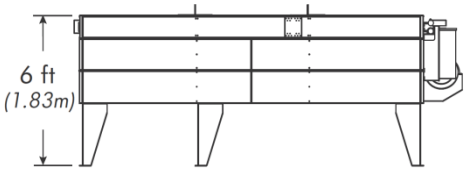


Side View

Cooling Module



Top View



Side View

PHYSICAL SPECIFICATIONS

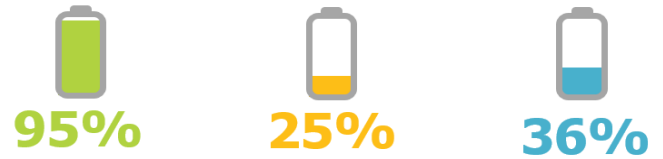
	Power Module	Cooling Module
Length	29′ 4″ (8.95m)	15′ 11″ (4.85m)
Width	8′ 7″ (2.62m)	7′ 10″ (2.39m)
Height	10′ (3.02m)	6′ 0″ (1.83m)
Weight	57,000 lb (27,216 kg)	3,190lb (1,447 kg)

PURECELL ADVANTAGE

OFFSET 3x MORE CO_2

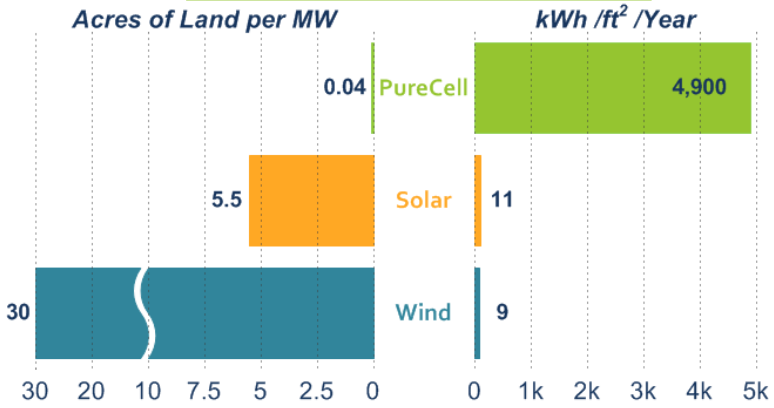
PureCell® System vs. Solar vs. Wind

CAPACITY FACTOR



CO_2 OFFSET

USE LESS LAND



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Corporate Headquarters
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East Hartford, CT 06108
(860) 727-2253
www.hyaxiom.com
email: sales@hyaxiom.com

American Energy Storage Innovations, Inc.

Presents

TeraStor™

Ultra-high density large-scale energy storage

- Easy to purchase
- Easy to install
- Easy to operate
- Easy to maintain

7.2 MWh AC CP/4

7.0 MWh AC CP/2

learn more

300 MWh per Acre

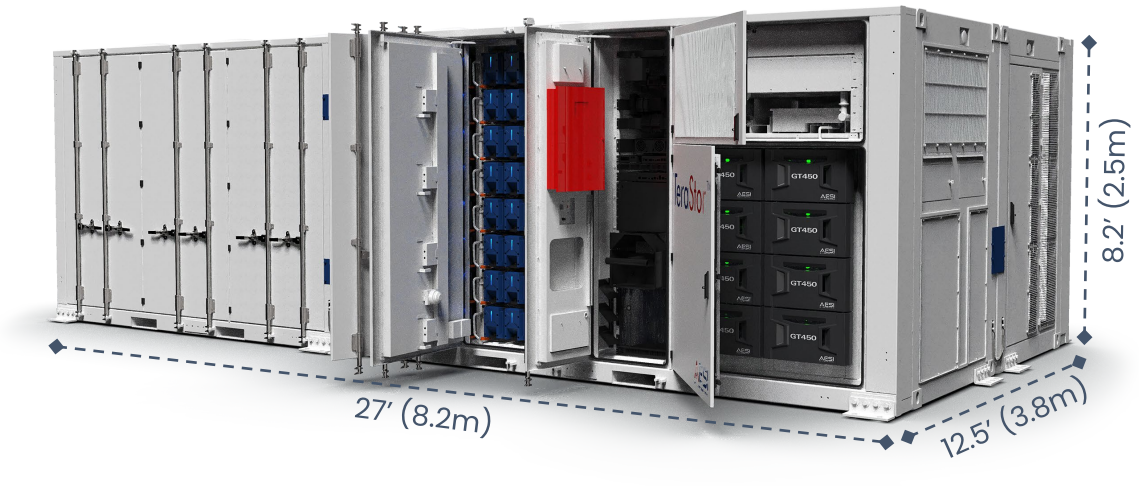
* 600 MWh per acre if double stacked

AESI AMERICAN ENERGY STORAGE INNOVATIONS

TeraStor™ 7200 Series

All-in-one, energy-dense TeraStor is factory-integrated and tested, arriving on-site and ready for commissioning in less than six hours. With an industry-low number of install connections, the self-powered, self-cooled, and self-managed unit significantly reduces on-site installation and O&M costs.

Under the hood, TeraStor's unique architecture significantly reduces the number of parts and potential points of failure compared to any other solution on the market.



AESI AMERICAN ENERGY STORAGE INNOVATIONS

2 Cabot Rd, Hudson, MA 01749, USA
www.aesi-ess.com

AESI
AMERICAN ENERGY STORAGE INNOVATIONS

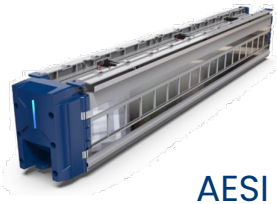
TeraStor™

Specifications

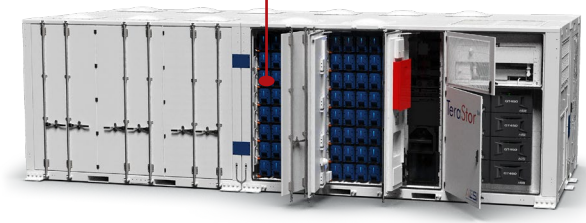
TS 7200

ALL-IN-ONE factory-installed supercells, PCS, circuitry, cooling & control

7200 Series



AESI supercell



* Delivered Energy @POI depends on efficiency rating of equipment installed between TeraStor AC output and the POI.

POWER / ENERGY	
Cells	280 Ah x 18P
Watt-hours per supercell	16,364 Wh
DC Voltage	2.5-3.6V

MECHANICAL	
Dimensions (H x W x L) mm	266 x 225 x 1422
Certification & Testing	UL1973, UN38.3, UL9540A
Density	190 Wh/L

MANAGEMENT	
Battery Management	Redundant voltage/temp. sensing/ balancing
External Interface	Wireless uplink
Thermal	Liquid cooled

AC Energy *	
CP/4	7.2 MWh
CP/2	7.0 MWh
AC Output Power	0.45-3.6 MVA
AC Output Voltage	740 VAC 3ph
Aux Power	Self-powered

Dimensions (H x W x L) F	8.2' x 12.5' x 27'
Certification & Testing	UL9540, UL9540A
IP Rating	IP66
Heating & Cooling	Integrated, factory-installed

Energy Management System	StorView integrated, VSP technology
Applications, Operating Modes	Many available in StorView standard configuration
External Interface	Fiber-optic ethernet
Warranty	5 yr incl. prev. maint. (up to 20 yr avail.)

AESI
AMERICAN ENERGY STORAGE INNOVATIONS

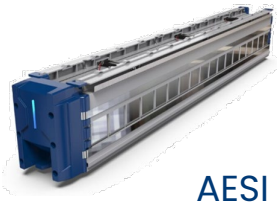
TeraStor™

Specifications

TS 6800 E & TS 7000 E

TeraStor with CAB 1000 external PCS

7200 Series



AESI supercell

* Delivered Energy @POI depends on efficiency rating of equipment installed between TeraStor AC output and the POI.

POWER / ENERGY	
Cells	280 Ah x 18P
Watt-hours per supercell	16,364 Wh
DC Voltage	2.5-3.4V

MECHANICAL	
Dimensions (H x W x L) mm	266 x 225 x 1422
Certification & Testing	UL1973, UN38.3, UL9540A
Density	188 Wh/L

MANAGEMENT	
Battery Management	Redundant voltage/temp. sensing/ balancing
External Interface	Wireless uplink
Thermal	Liquid cooled

AC Energy *	
CP/4	7.0 MWh
CP/2	6.8 MWh
AC Output Power	1.50-3.4 MVA
AC Output Voltage	690 VAC 3ph
Aux Power	Self-powered

Dimensions (H x W x L) F	8.2' x 12.5' x 27'
Certification & Testing	UL9540, UL9540A
IP Rating	IP66
Heating & Cooling	Integrated, factory-installed

Energy Management System	StorView integrated, VSP technology
Applications, Operating Modes	Many available in StorView standard configuration
External Interface	Fiber-optic ethernet
Warranty	5 yr incl. prev. maint. (up to 20 yr avail.)

AESI
AMERICAN ENERGY STORAGE INNOVATIONS

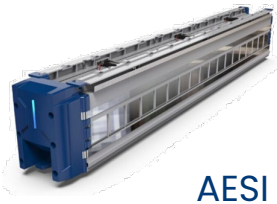
TeraStor™

Specifications

TS 6800 & TS 7000

DC-only option for customers, no PCS

7200 Series



AESI supercell

POWER / ENERGY		MECHANICAL		MANAGEMENT	
Cells	280 Ah x 18P	**Dimensions (H x W x L) mm**	266 x 225 x 1422	**Battery Management**	Redundant voltage/temp. sensing/ balancing
Watt-hours per supercell	16,364 Wh	**Certification & Testing**	UL1973, UN38.3, UL9540A	**External Interface**	Wireless uplink
DC Voltage	2.5-3.4V	**Density**	188 Wh/L	**Thermal**	Liquid cooled
DC Energy *		**Dimensions (H x W x L) F**	8.2' x 12.5' x 27'	**Energy Management System**	StorView integrated, VSP technology
CP/4	7.1 MWh				
CP/2	6.9 MWh				
DC Power		**Certification & Testing**	UL9540, UL9540A	**Applications, Operating Modes**	Many available in StorView standard configuration
CP/4	1.825 MW				
CP/2	3.65 MW				
DC Output Voltage	1,500V	**IP Rating**	IP66	**External Interface**	Fiber-optic ethernet
Aux Power	690 VAC 3ph up to 15kW	**Heating & Cooling**	Integrated, factory-installed	**Warranty**	5 yr incl. prev. maint. (up to 20 yr avail.)

* Delivered Energy @POI depends on efficiency rating of equipment installed between TeraStor AC output and the POI.

* Requires external auxiliary power source.

American Energy Storage Innovations, Inc.

Presents

TeraStor™

Ultra-high density large-scale energy storage

- Easy to purchase
- Easy to install
- Easy to operate
- Easy to maintain

7.9 MWh AC CP/4

learn more

7.7 MWh AC CP/2

330 MWh per Acre

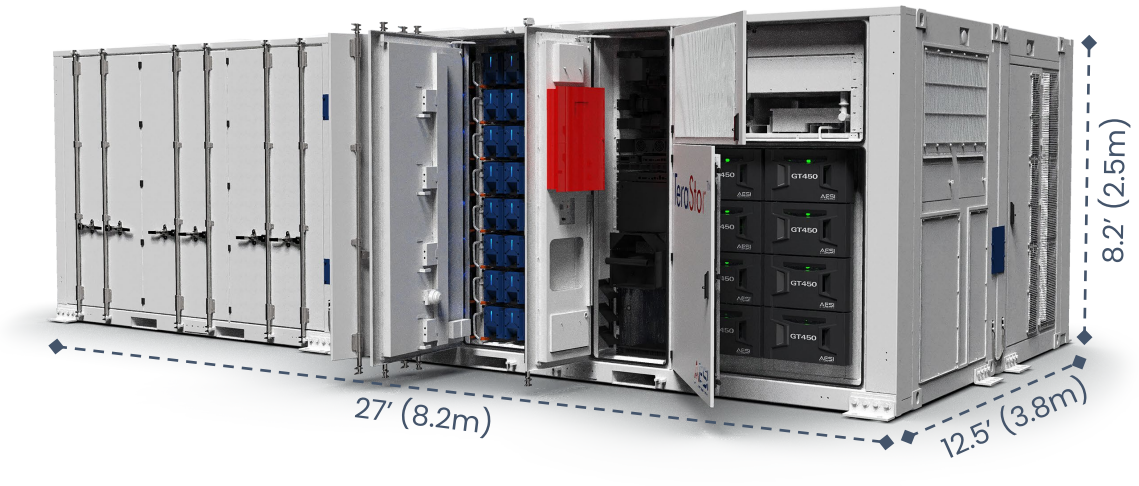
* 660 MWh per acre if double stacked

AESI AMERICAN ENERGY STORAGE INNOVATIONS

TeraStor™ 8000 Series

All-in-one, energy-dense TeraStor is factory-integrated and tested, arriving on-site and ready for commissioning in less than six hours. With an industry-low number of install connections, the self-powered, self-cooled, and self-managed unit significantly reduces on-site installation and O&M costs.

Under the hood, TeraStor's unique architecture significantly reduces the number of parts and potential points of failure compared to any other solution on the market.



AESI AMERICAN ENERGY STORAGE INNOVATIONS

2 Cabot Rd, Hudson, MA 01749, USA
www.aesi-ess.com

AESI
AMERICAN ENERGY STORAGE INNOVATIONS

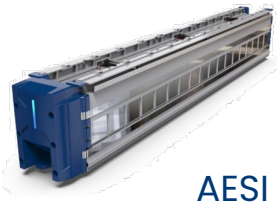
TeraStor™

Specifications

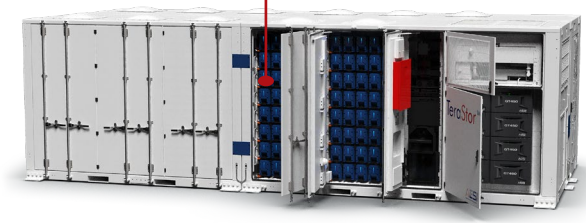
TS 8000

ALL-IN-ONE factory-installed supercells, PCS, circuitry, cooling & control

8000 Series



AESI supercell



* Delivered Energy @POI depends on efficiency rating of equipment installed between TeraStor AC output and the POI.

POWER / ENERGY	
Cells	314 Ah x 18P
Watt-hours per supercell	17,950 Wh
DC Voltage	2.5-3.6V
AC Energy *	
CP/4	7.9 MWh
CP/2	7.7 MWh
AC Output Power	0.45-3.6 MVA
AC Output Voltage	740 Vac 3 ph.
Aux Power	Self-powered

MECHANICAL	
Dimensions (H x W x L) mm	266 x 225 x 1422
Certification & Testing	UL1973, UN38.3, UL9540A
Density	213 Wh/L
Dimensions (H x W x L) F	8.2' x 12.5' x 27'
Certification & Testing	UL9540, UL9540A
IP Rating	IP66
Heating & Cooling	Integrated, factory-installed

MANAGEMENT	
Battery Management	Redundant voltage/temp. sensing/ balancing
External Interface	Wireless uplink
Thermal	Liquid cooled
Energy Management System	StorView integrated, VSP technology
Applications, Operating Modes	Many available in StorView standard configuration
External Interface	Fiber-optic ethernet
Warranty	5 yr incl. prev. maint. (up to 20 yr avail.)

AESI
AMERICAN ENERGY STORAGE INNOVATIONS

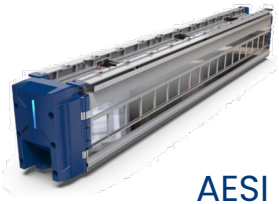
TeraStor™

Specifications

TS 8000 DC

DC-only option for customers, no PCS

8000 Series



AESI supercell

POWER / ENERGY	
Cells	314 Ah x 18P
Watt-hours per supercell	17,950 Wh
DC Voltage	2.5-3.4V

MECHANICAL	
Dimensions (H x W x L) mm	266 x 225 x 1422
Certification & Testing	UL1973, UN38.3, UL9540A
Density	211 Wh/L

MANAGEMENT	
Battery Management	Redundant voltage/temp. sensing/ balancing
External Interface	Wireless uplink
Thermal	Liquid cooled

DC Energy *	
CP/4	7.9 MWh
CP/2	7.7 MWh
DC Power	
CP/4	1.83 MW
CP/2	3.65 MW
DC Output Voltage	1,500V
Aux Power	690 VAC 3ph up to 15kW

Dimensions (H x W x L) F	8.2' x 12.5' x 27'
Certification & Testing	UL9540, UL9540A
IP Rating	IP66
Heating & Cooling	Integrated, factory-installed

Energy Management System	StorView integrated, VSP technology
Applications, Operating Modes	Many available in StorView standard configuration
External Interface	Fiber-optic ethernet
Warranty	5 yr incl. prev. maint. (up to 20 yr avail.)

* Delivered Energy @POI depends on efficiency rating of equipment installed between TeraStor AC output and the POI.
* Requires external auxiliary power source.

VFS, LLC.

Emergency Response Guide

Quinnipiac University Mount Carmel

275 Mount Carmel Avenue

Hamden, CT 06518

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DISCLAIMER

HyAxiom 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 HYAxiom, and no liability will accrue to HYAxiom 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 HyAxiom'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.

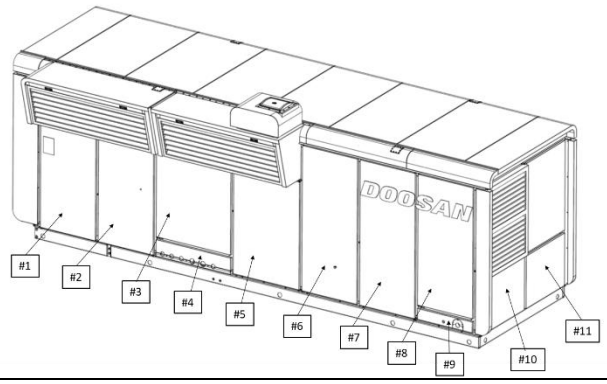
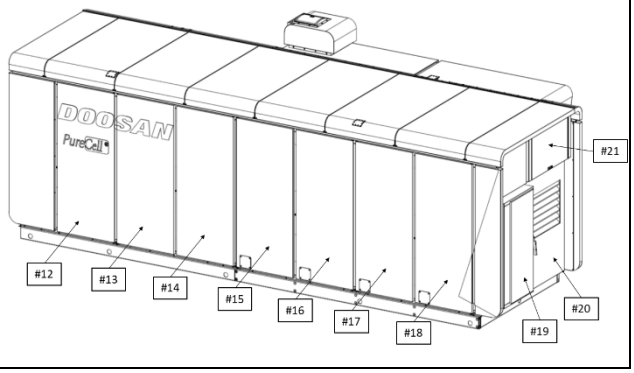
Scope

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. HyAxiom should be contacted if clarification is needed.

Emergency Contacts and Numbers

Local Emergency Number	**911**
HyAxiom Control Center	**(860) 727-2847**
Fire Department – Non-emergency number	Hamden Fire Dept. **(203) 407-5880**
Hospital – Non-emergency number	**Yale New Haven Hospital** **20 York Street** **New Haven, CT 06510** 203-688-4242
Electric Utility Name: United Illuminating	**(800) 722-5584**
Gas Utility Name: Southern CT. Gas Company	(866) 268-2887
Local Oil & Chemical Spill Response Division	**800-645-8265**
CT. DEEP Oil & Chemical Spill Response Division	**860-424-3338**
EPA Region 1 Emergency Response	**(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
 480 V Grid Disconnect	 Emergency Stop Button

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 HyAxiom 3. **(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 HyAxiom Control Center **(860) 727-2847**
Fuel Cell Moderate humming, clicking and fan sounds	Grinding or loud intermittent noises	1. Contact HYAxiom 2. 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 HYAxiom 5. 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 HyAxiom **(860) 727-2847**

		(860) 727-2847
	Grinding or loud noise coming from fans	1. Contact HYAxiom 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 HYAxiom 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** Contact HyAxiom 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 HyAxiom 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 HyAxiom 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 HyAxiom 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 HyAxiom 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

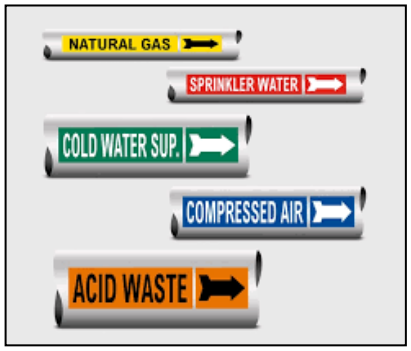
*When applicable

Fuel Cell operation is monitored and controlled remotely 24 hours a day 7 days a week by the HyAxiom 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 HYAxiom Control Center. The HyAxiom 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 HyAxiom 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 HyAxiom 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

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: 860-727-2300

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/m³ (respirable)
7440-50-8	55-62	Copper	1 mg/m3	1 mg/m³ (dust)
1314-13-2	28-33	Zinc oxide	15 mg/m3 5 mg/m3 (respirable)	2 mg/m³ (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.

Aerial Map


Proposed Fuel Cell Facility
New Rd
New Rd
CAS
Quinnipiac College of Arts & Sciences, CAS360
Dean Robert W. Evans College of Arts
College of Arts and Sciences Center
Mail Services Center
Image © 2025 Airbus

Attachment #6

Title 14 —Aeronautics and Space
Chapter I —Federal Aviation Administration, Department of Transportation
Subchapter E —Airspace
Part 77 —Safe, Efficient Use, and Preservation of the Navigable Airspace
Subpart B —Notice Requirements

Authority: 49 U.S.C. 106 (g), 40103, 40113–40114, 44502, 44701, 44718, 46101–46102, 46104.
Source: Docket No. FAA–2006–25002, 75 FR 42303, July 21, 2010, unless otherwise noted.

§ 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 7

State of California
Air Resources Board
Executive Order DG-047 (March 2023)
Distributed Generation Certification of
HyAxiom, Inc.
460 kW PureCell Model 400

Whereas, the California Air Resources Board (CARB) 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, CARB adopted the DG Certification Regulation in California Code of Regulations (CCR), title 17, article 3, sections 94200 to 94214;

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. was issued DG Certificate DG-047 on April 6, 2018, for its 460 kW PureCell Model 400 fuel cell power plant;

Whereas, on November 3, 2022, HyAxiom, Inc. requested an extension of the certification of the 460 kW PureCell Model 400 fuel cell power plant and whose application was deemed complete on January 26, 2023;

Whereas, within the request for extension of the certification, HyAxiom, Inc. indicated that the company name had changed from Doosan Fuel Cell America, Inc. to HyAxiom, Inc.;

Whereas, within the request for extension of the certification, it was noted the updated design incorporates modifications to the fuel processing system and cell stack assemblies, resulting in a more efficient power plant, while the other major system processes and strategies are unchanged and no other material changes to model form, fit, or function where noted;

Whereas, HyAxiom, Inc. has demonstrated that the 460 kW PureCell Model 400 fuel cell power plant complies with the minimum efficiency requirement in section 94203 (b);

Whereas, HyAxiom, Inc. has demonstrated, according to test methods specified in CCR, title 17, article 3, section 94207, that its natural-gas-fueled 460 kW

PureCell Model 400 fuel cell power plant complies 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, HyAxiom, Inc. has demonstrated that its 460 kW PureCell Model 400 fuel cell power plant complies with the emissions durability requirements in CCR, title 17, article 3, section 94203 (d); and

Whereas, I find that the applicant, HyAxiom, Inc., has met the requirements specified in CCR, title 17, article 3, and has satisfactorily demonstrated that the 460 kW PureCell Model 400 fuel cell power plant meets the DG Certification Regulation's 2007 Fossil Fuel Emission Standards in CCR, title 17, section 94203 (b);

Now therefore, it is hereby ordered, that the DG Certification, Executive Order DG-047, originally executed at Sacramento, California on April 6, 2018, is hereby extended.

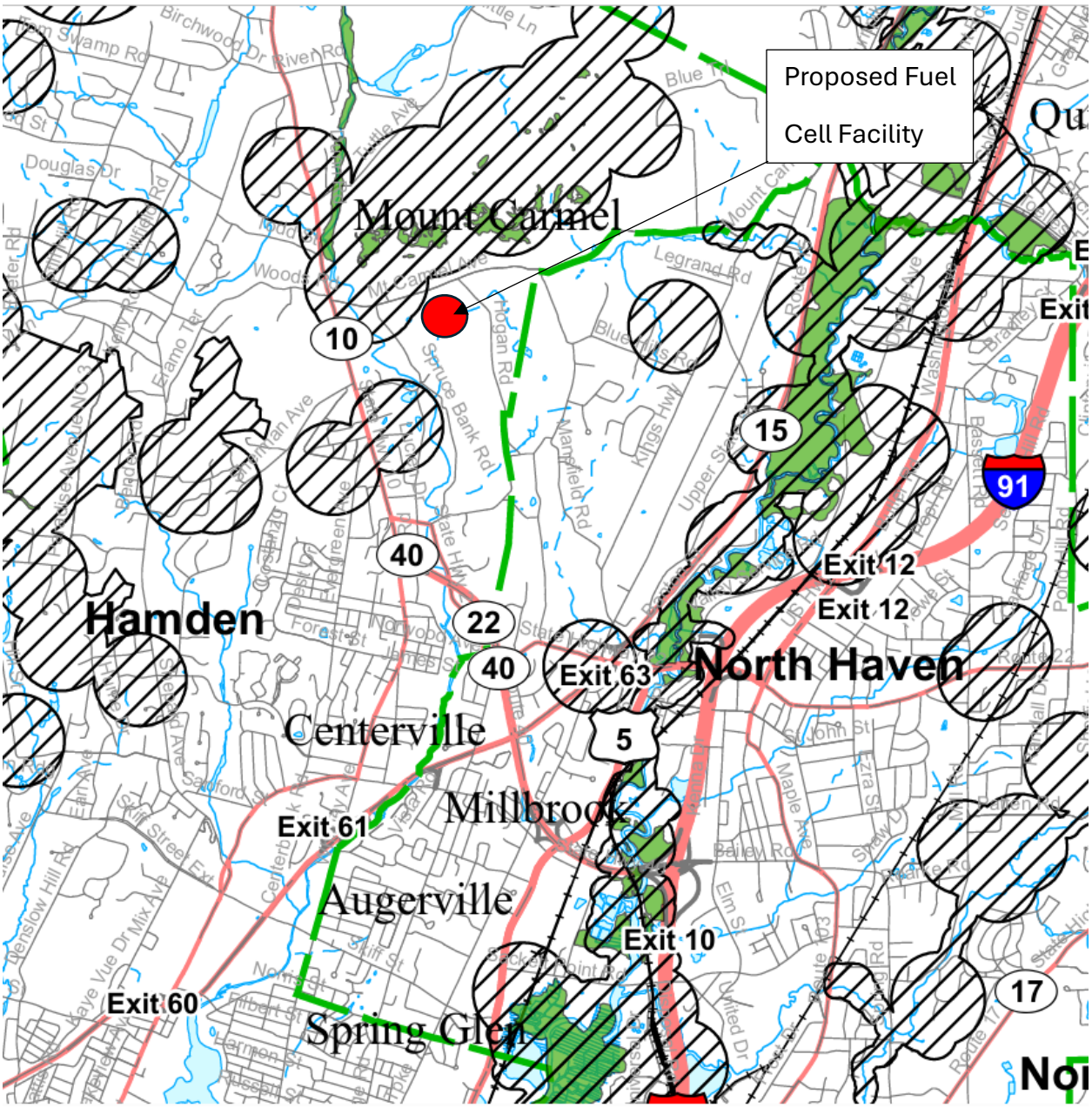
This DG Certification:

1) Is subject to all conditions and requirements of CARB's DG Certification Program, CCR, title 17, article 3, including the provisions relating to inspection, denial, suspension, and revocation.
2) Shall be void if any manufacturer modification results in the model no longer meeting the minimum efficiency requirements in section 94203 (b).
3) 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 2007 DG Certification emission standards.
4) Shall expire on the 5th day of April 2028.

Executed at Sacramento, California, this 21st day of March 2023.

Matthew Botill
Chief, Industrial Strategies Division

NDDB Map


Proposed Fuel
Cell Facility
Mount Carmel
Hamden
Centerville
Millbrook
Augerville
Spring Glen
North Haven
Exit 63
Exit 12
Exit 12
Exit 61
Exit 60
Exit 10
10
40
22
40
5
15
91
17

Prepared For: VFS, LLC

Point of Contact: Walter Bonola

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50 Myrock Avenue
Waterford, CT 06385-3008

Subject: Six 460 KW Fuel Cells
Airborne Noise Assessment
Quinnipiac University
275 Mt Carmel Avenue
Hamden, CT 06518

Author: Carl Cascio

Date: February 17, 2025

Revision: 0

Table of Contents

Summary

This document makes a positive acoustic assessment that should assist in meeting any acoustic noise concerns during the operation of six 460 KW fuel cells on the Quinnipiac University site at 275 Mt Carmel Avenue in Hamden, CT. An acoustic assessment plan was developed and executed to acquire airborne acoustic information that explains and mitigates potential airborne noise issues during operation of the six 460 KW fuel cells. It is important to show that the airborne noise generated by the fuel cells will not significantly impact the facility's neighbors.

The airborne noise levels expected to be generated by the fuel cells operating at the 275 Mt Carmel Avenue site were simulated by exciting a Soundboks speaker at two of the Cooling and Power Module positions. (The Cooling Module is the dominant noise source.) The Soundboks speaker produced an overall airborne noise level that was 22 dB higher than the levels measured for a single fuel cell installed at Montville, CT. One-third octave band analysis showed the speakers' level to be near the Montville fuel cell airborne noise levels at low frequencies where the airborne noise levels were low and to exceed the fuel cell signature by about 22 dB at higher frequencies where the fuel cell signature was higher in noise level.

Airborne noise levels with the speaker operating were measured at distances from 5 to 200 meters from the proposed fuel cell locations. The speaker produced overall A-weighted sound pressure levels of 94 dBA at 5 meters and 88 dBA at 10 meters (reference 20 microPascals) at the proposed fuel cell locations. The airborne noise levels from the speaker received at nearby buildings were measured at noise levels of 52 to 76 dBA. Residential measurement locations outside the school were too far away to be able to measure the airborne noise with the speaker on. No impact is expected outside the school. Analysis of the speaker data indicated propagation losses of at least 12 to 37 dB from the fuel cells' location to the nearby buildings. Based on the operation of six fuel cells at Montville, each cooling module was modeled at a 10-meter source level of 65 dBA while each power module was modeled at a 10-meter source level of 61 dBA.[1]

The measurements at 275 Mt Carmel Avenue were taken at various distances from the speaker and then corrected to estimate the expected noise from six fuel cells. The predicted airborne noise levels at six buildings were as much as 17 dB above the lowest residential night time noise limit of 45 dBA. Locations other than the six are expected to be below 40 dBA depending on how close the locations are to the six fuel cells. Operation of the six fuel cells will have no significant acoustic impact at all of the University buildings adjacent to the fuel cell site if 18 dB of noise mitigation to the west and 7 dB of noise mitigation to the north is included.

Connecticut's Noise Code[2] also calls for review of acoustic issues associated with impulse noise, prominent discrete tones, infrasonic and ultrasonic noise. Fuel cell operation is expected to meet all of these requirements at all of the nearby buildings with the recommended noise mitigation.

More margin in the radiated noise can be obtained by locating the cooling modules to the east and south of the power modules. The power modules radiate about 4 dB less noise than the cooling modules and even less if the fans in the power module are placed on the east side and south sides according to Figure 6. This arrangement will further reduce the airborne noise radiated to the six locations with the highest noise levels.

Acoustical Technologies Inc.

Introduction

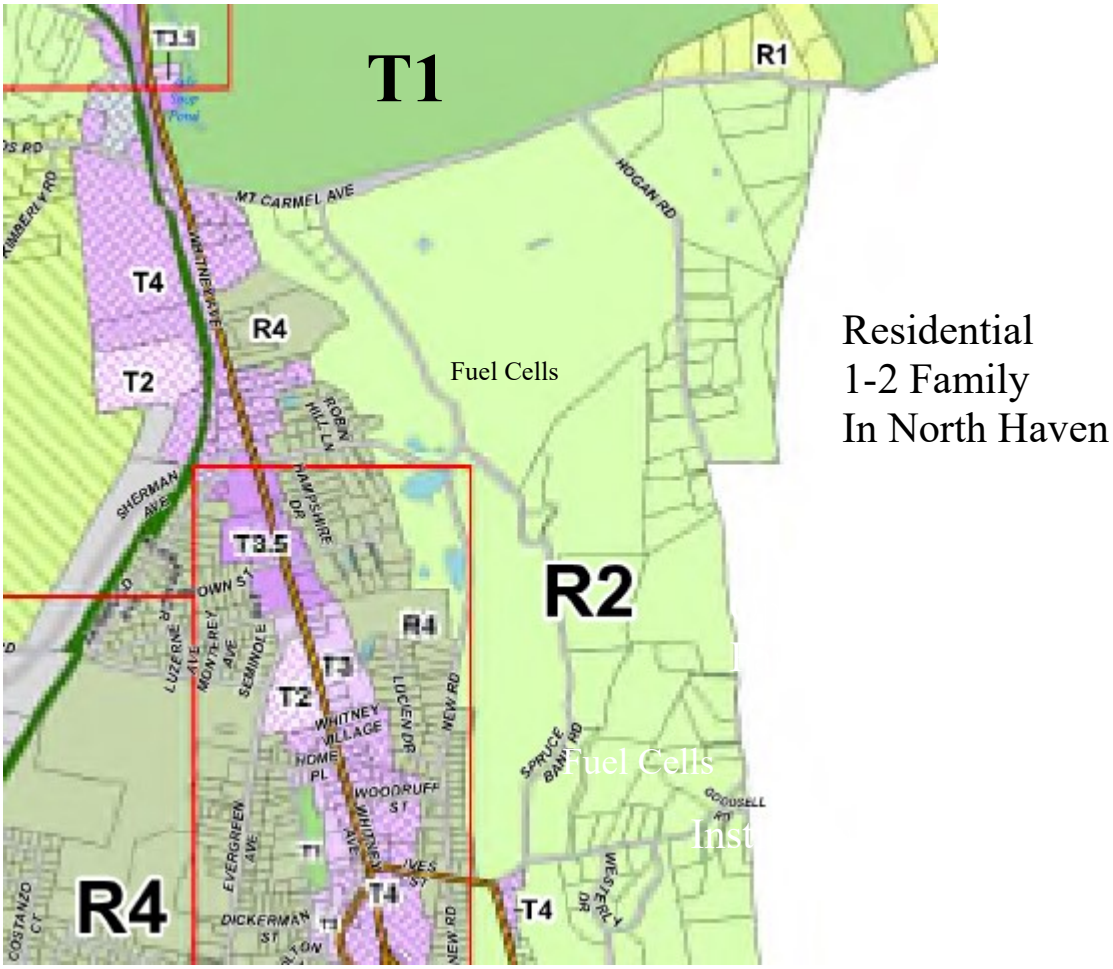
Acoustical Technologies Inc. was tasked as part of a site permitting process with an assessment of potential acoustic issues associated with fuel cell airborne noise reaching the properties adjacent to the Hamden campus of Quinnipiac University at 275 Mt Carmel Avenue. Responding to a request from Walter Bonola, a site visit was made on February 12, 2025. During the visit, a survey of the airborne noise levels produced by a Soundboks speaker simulating the airborne noise produced by six fuel cells 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 speaker off. This document provides an acoustic assessment to assist in meeting acoustic noise concerns during the permitting process for the siting of six fuel cells at the 275 Mt Carmel Avenue site at Quinnipiac's Hamden campus.

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 six 460 KW fuel cells at the Quinnipiac University site on Mt Carmel Avenue. The proposed site is located in a Residential Zone. This R-2 Residential Zone is surrounded by a T1 Rural Zone to the north, R4 Residential Zones to the west, and R3 Residential and T4 Rural Zones to the south. To the east is a 1-2 Family Residential Zone in North Haven. It is important to determine whether the airborne noise generated by the six fuel cells will impact the closest neighbors to the west, north and south.

The acoustic impact is assessed in the following way. The 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's airborne noise has been measured at other sites and both overall and one-third octave band airborne noise data of a typical 460 KW fuel cell are available (Reference 1). Using this data, a Soundboks speaker has been programmed through a set of filters to generate a noise spectrum similar to that of the 460 KW fuel cell. (It is assumed that the Cooling and Power Module noise in the existing measured 460 KW fuel cell 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 Soundboks speaker. In order to overcome the potentially high background noise at the 275 Mt Carmel Avenue site the speaker output will be increased to a level more than 22 dB higher than the overall dBA noise level measured on a 460 KW fuel cell at a distance of 10 meters. With the speaker on, this approach then follows the traditional "What is the airborne noise level at the neighbor's property line?". The speaker will be run and airborne measurements made near the proposed fuel cell locations and at several of the nearest neighbor's properties. This measured site data can also be used to estimate noise levels at other neighbor's property lines. The State of Connecticut's Noise Ordinance[2] and the Town of Hamden's Noise Ordinance[3] will then be consulted to assess the impact of the measured and estimated acoustic levels. Because of the closeness of the proposed fuel cell site to the nearest properties noise mitigation may be recommended if the airborne noise estimated for the six fuel cells comes near or exceeds the noise requirements at the neighbors' property lines. In this case neighboring properties are too far away to be affected by the fuel cell noise and instead, buildings on the Quinnipiac campus will be investigated to see if they are affected by the fuel cell noise.

Figure 1. Eastern Part of Hamden Zoning Map with the Area near the Six Fuel Cells



Acoustic Measurement Program

The acoustic data necessary to assess the impact of six 460 KW fuel cells are described below: Airborne sound pressure measurements were conducted at the 275 Mt Carmel Avenue site on February 12, 2025 during the afternoon hours (2 pm to 4 pm). This testing established both background airborne noise levels and simulated airborne noise levels with the speaker operating. The overall A-weighted airborne noise measurements were made with an ExTech model 407780A Digital Sound Level Meter (s/n 140401544) that had been 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. 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 53994 and 130F20 s/n 53994) were powered by two Wilcoxon P702B power supply/amplifiers (s/n 1992 and 2063 respectively). The PCB microphones were also calibrated prior to and after the test with the Quest model QC-10 Calibrator (s/n Q19080194). A Hewlett Packard model HP3561A Dynamic Signal Analyzer, s/n 2338A00659, was used to perform the A-weighted spectral analysis on the tape-recorded data.

For reference, a noise level increase of 1 dB is equal to an airborne sound pressure increase of 12.2 per cent. All measurements were made with the microphone at a height above ground between five and six feet. The sound pressure data reported herein are all given in decibels (dB) reference 20 microPascals.

One minute of background noise data was also analyzed at 5 and 10 meters with the first speaker position and at the nine nearby buildings. Vehicle traffic on the school roads was moderate and measurements were halted when vehicles were present. The background noise at the school did not interfere with the speaker data at all of the nine nearby buildings.

See the Google satellite map in Figure 3 for the approximate measurement locations (P1 – P9). The first speaker was at the proposed west side of the Cooling and Power Module units. Figures 4 and 5 provide photographs of two measurement location for the first speaker position. Sound pressure data were taken with the ExTech sound level meter. At all these locations, a one-minute record of the acoustic noise was analyzed for the speaker in the "on" and "off" condition.

Location	**Type**	**Distance**	**Zone**	**Type**
1 – Cooling Module West	Speaker	5 meters	R2	Residential
2 – Power Module West	Speaker	10 meters	R2	Residential
3 – Cooling Module East	Speaker	5 meters	R2	Residential
4 – Power Module East	Speaker	10 meters	R2	Residential
P1 – Arts & Sciences	School	44 meters	R2	Residential
P2– College of Arts	School	45 meters	R2	Residential
P3 – Mail Services Center	School	120 meters	R2	Residential
P4 – Building A	School	64 meters	R2	Residential
P5 – Building B – south end	School	70 meters	R2	Residential
P6 – Building B - middle	School	84 meters	R2	Residential
P7 – Student Center	School	200 meters	R2	Residential
P8 – Grove Residence Hall	School	96 meters	R2	Residential
P9 – The Commons	School	108 meters	R2	Residential

The grounds at Quinnipiac University are shown in Figure 2. The large size of the University property and the location of the fuel cells at the west edge of the property means the fuel cell noise will not be an issue to any of the neighbors. The boundary to the east is Hogan Road about 500 meters away while the boundary to the north is Mt Carmel Avenue about 590 meters away. To the west is the Mill River about 170 meters away. Residences to the west are at least 370 meters away from the fuel cells. The Quinnipiac campus buildings extend about 235 meters to the south limiting the acoustic concerns to the buildings on the Quinnipiac campus. The closest residences are 370 meters to the south west and 385 meters to the south east.

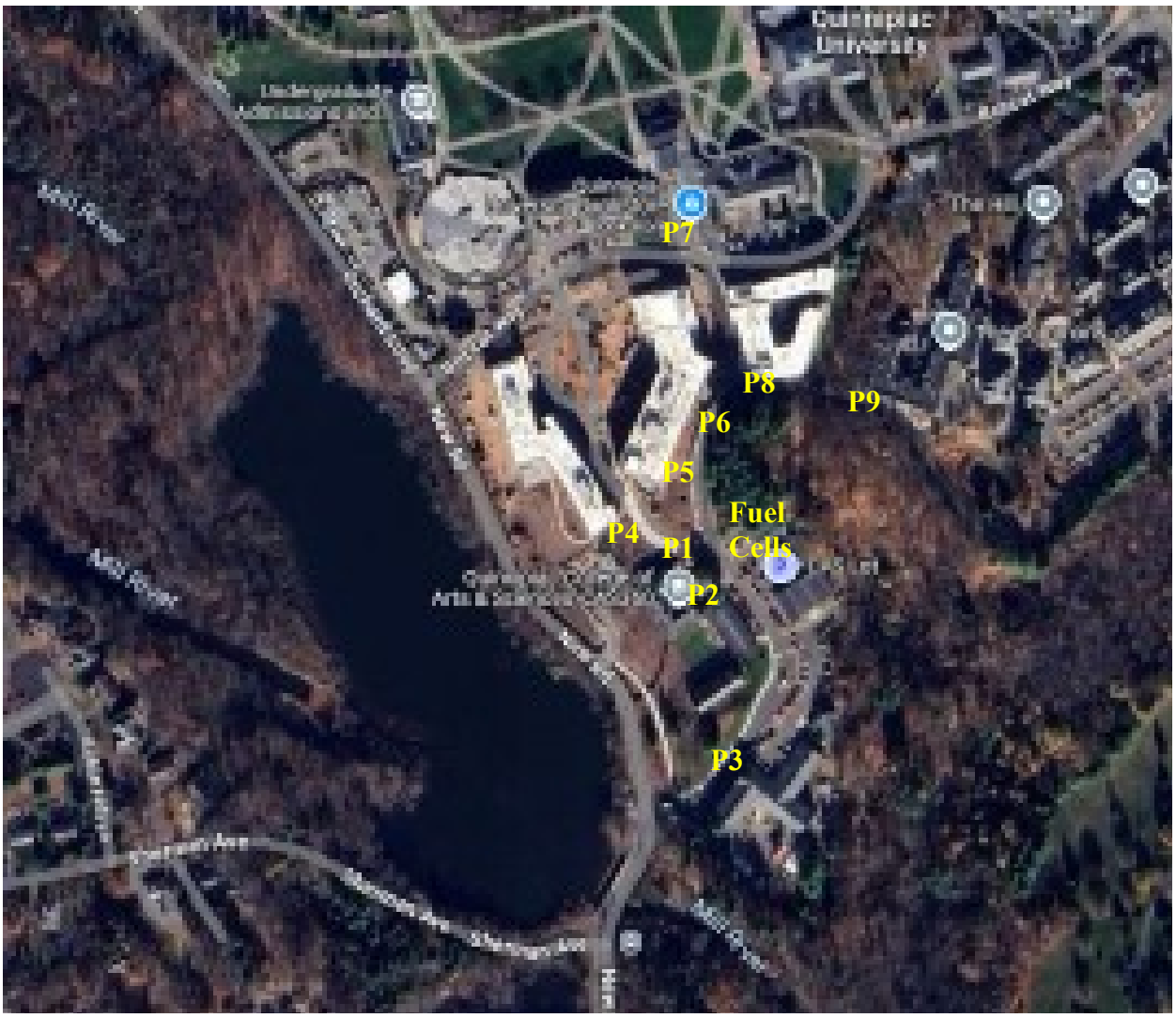
Airborne noise measurements taken outside are corrupted by rain and wind so a day was selected when the winds were expected to be 10 miles per hour or less. Table 1 provides the weather data near 275 Mt Carmel Avenue for the acoustic measurements on February 12, 2025. Acoustic measurements were taken over the period from 2 pm until 4 pm. Table 1 shows the temperature and wind speeds in hourly intervals. Wind conditions were very good during all the testing.

Also, there was no rain during the testing. Vehicle traffic along campus roads was moderate. Some of the measurements had to be delayed until all visible traffic was absent.

Because of construction and the distant traffic noise on campus roads, background noise levels at two of the building positions (P3 and P7) were high with levels from 54 to 59 dBA. These two positions were 120 and 200 meters away from the fuel cells and outside the 75-meter distance expected to be influenced by the fuel cells. The speaker was just faintly audible at these two locations. At all the other measurement locations the background noise levels were low (40 to 46 dBA) and it was possible to clearly hear the airborne noise from the speaker over the background noise. Airborne noise loss versus range to the buildings was determined at all nine locations on the campus.

Figure 2. Location of the Fuel Cell Pad (Red) At Quinnipiac's Mt Carmel Campus

Figure 3. Google Map Showing Measurement Positions P1 through P9



The highest airborne noise levels were obtained at the Art & Sciences Building (P1) and the College of Arts (P2) for the west speaker location. Transfer functions were calculated and then applied to the 460 KW data from Montville[1] in order to estimate the received levels for the new 460 KW fuel cells at 275 Mt Carmel Avenue. Six fuel cells could make as much as 7.8 dB more noise than one fuel cell if they were all in one place. Since they are spread out, a conservative level could be calculated by assuming they are all at the closest distance. Reasonable estimates for this and the other locations were calculated by looking at the transfer functions for distances to the buildings for each of the locations. Each cooling module is modeled as a 10-meter source level of 65 dBA while each power module is modeled at a 10-meter source level of 61 dBA.[3]

A conservative estimate of the airborne source level from all the fuel cells (Ls) can be obtained by power summing the contributions of six power modules and six cooling modules. This becomes

$$Ls = 10*\log (6*10^{(65/10)} +6*10^{(61/10)}) = 74.3 \text{ dBA}$$

Figure 4. West Speaker at the Arts & Sciences Parking Lot Looking West at the Microphones

Each building requires a combination of cooling module and power module noise. The west direction will produce the highest airborne noise levels since these buildings are closest (about 44 meters). The airborne noise at the Arts and Sciences Building is calculated by combining six power modules and six cooling modules. Calculations are made for the nine buildings using the

275 Mt Carmel Avenue measured transfer functions and the Montville measured fuel cell noise. The predicted levels are equal to (74.3 dBA – transfer function).

Figure 5. Measurement Location at College of Arts Looking West Away from the Speaker

Table 1. Weather Data near 275 Mt Carmel Avenue on February 12, 2025
https://www.wunderground.com/history/daily/us/ct/east-haven/KHVN/date/2025-2-12

Time (EST)	Temp. (°F)	Humidity (%)	Dew Point (°F)	Barometer (in HG)	Wind Speed (mph)	Wind Direction	Condition
10:53 AM	34 °F	67 %	24 °F	30.30 in	10 mph	NNE	Cloudy
11:53 AM	35 °F	61 %	23 °F	30.29 in	7 mph	NE	Cloudy
12:53 PM	37 °F	54 %	22 °F	30.26 in	7 mph	NNE	Mostly Cloudy
1:53 PM	37 °F	54 %	22 °F	30.27 in	6 mph	N	Cloudy
2:53 PM	38 °F	53 %	22 °F	30.26 in	8 mph	NNE	Cloudy
3:53 PM	37 °F	57 %	23 °F	30.27 in	7 mph	NNE	Cloudy
4:53 PM	38 °F	55 %	23 °F	30.27 in	3 mph	ENE	Cloudy
5:53 PM	38 °F	62 %	26 °F	30.29 in	10 mph	ENE	Cloudy
6:53 PM	37 °F	70 %	28 °F	30.30 in	10 mph	E	Cloudy

Data Analysis

This section analyzes the airborne noise levels measured at the 275 Mt Carmel Avenue site and then estimates the received level and transmission loss to nearby buildings expected during actual fuel cell operation. These estimated levels will be compared to the noise limits in the Connecticut and Hamden noise ordinances. Speaker operating noise levels at the 275 Mt Carmel Avenue site are reported in Table 2. Background noise levels at the 275 Mt Carmel Avenue site are reported in Table 3. The background data are used to correct the speaker levels providing estimates in Table 4 of only the speaker noise contribution at each location. Table 4 also reports the transfer functions and the operating noise levels estimated during operation of the six new 460 KW fuel cells. These operating noise levels should be kept below 45 dBA, the night time airborne noise limit in both the CT and Hamden noise ordinances. (Day time is 55 dBA.)

Figure 2 does not illustrate how the six-fuel cell cooling and power modules will be arranged at the Quinnipiac site. The power modules could block some of the airborne noise coming from the cooling modules and heading to the west or north. It is recommended that the power modules be placed to the west and north of the cooling modules with the fan side of the power module facing east and south, respectively. See Figure 6 below for one approach at implementing this design. Blocking this higher cooling module noise heading to the west and north would be helpful in increasing the noise mitigation for the closest buildings. (The cooling module is about 4 dB higher in level than the power module.) Thereby, some additional noise mitigation of 2 to 3 dB could be obtained by arranging the six units so that the power modules block the cooling module sound headed in the westerly and northerly directions toward the Arts and Sciences Building, College of Arts Building, the new South Quad, the Grove Residence and the Commons.

Table 2. Measured Overall Sound Pressure Levels in dBA ref. 20 microPascals with **Speaker On**

Location	Range in Meters	Direction	Leq	Max	Min	L90
Speaker On – Cooling W	5	West	94.3	95.1	93.8	**94.1**
Speaker On – Cooling W	10	West	88.5	89.1	88.0	**88.3**
Speaker On – Cooling E	5	East				
Speaker On – Cooling E	10	East				
Power West Speaker						
P1 – Arts & Sciences	44	West	75.3	76	74	**75.1**
P2– College of Arts	45	South West	76.3	77.5	75.8	**76.0**
P3 – Mail Services Center	120	South	60.2	62.8	58.2	**59.8**
P4 – Building A	64	North West	60.0	61.9	58.7	**59.9**
P5 – Building B -South End	70	West	58.5	63.1	57.9	**58.1**
P6 – Building B – Mid	84	North	60.4	66.2	58.2	**58.8**
P7 – Student Center	200	North	55.3	58.0	54.4	**54.6**
P8 – Grove Residence Hall	96	North	54.8	60.2	52.9	**53.1**
P9 – The Commons	108	North East	53.9	54.6	53.4	**53.6**
Power East Speaker						
P6 – Building B – Middle	85	North	60.0	70.4	59.3	**59.6**
P7 – Student Center	210	North	56.7	68.1	55.5	**56.0**
P8 – Grove Residence Hall	87	North	60.6	65.0	60.1	**60.3**
P9 – The Commons	96	North East	65.6	66.4	64.9	**65.1**

Leq: Equivalent continuous sound level over the measurement period. – **this is normally the level to be identified as the value to be compared with the steady state overall noise requirement. Because of the intermittent traffic noise, the L90 value is used instead.**

SPL MAX: Maximum one-second sound level observed during the measurement period.
SPL MIN: Minimum one-second sound level observed during the measurement period.
L90: - 90% percentile sound level – L90 is the level that is exceeded 90% of the time.
The CT State Noise Ordinance[2] identifies the L90 acoustic calculation as useful in determining background airborne noise. **This value will be used to estimate both the speaker and the background noise level.** This is a more conservative approach since using L90 eliminates the highest 90% of the measured noise, noise that could be coming from sources other than the provided by the speaker. The speaker noise is generated from a random noise application that does not vary with time.

The overall airborne noise levels are 22 dB higher for the speaker as compared to what was measured from the 460 KW cooling module at Montville, CT. This 22 dB difference in level

was subtracted from the 275 Mt Carmel Avenue measured levels to estimate the expected fuel cell acoustic signature for one fuel cell. Column 4 of Table 4 provides the background corrected data for the speaker. The transfer function to each property line is shown in column 5 and the estimated level for six fuel cells in shown in column 6. The 10-meter Montville airborne noise levels were used with the 275 Mt Carmel Avenue transmission loss data to estimate the expected six fuel cell airborne noise at the nine nearby buildings.

Table 3.Measured Overall Sound Pressure Levels in dBA ref. 20 microPascals with **Speaker Off**

Location	Range in Meters	Direction	Leq	Max	Min	L90
Speaker On – Cooling W	5	West	47.4	57.2	44.2	**45.0**
Speaker On – Cooling W	10	West	47.2	63.4	42.4	**42.7**
Speaker On – Cooling E	5	East				
Speaker On – Cooling E	10	East				
Power West Speaker						
P1 – Arts & Sciences	44	West	49.0	56.7	43.3	**43.7**
P2– College of Arts	45	South West	45.1	52.6	41.9	**42.3**
P3 – Mail Services Center	120	South	60.1	61.8	53.9	**58.7**
P4 – Building A	64	North West	47.3	51.1	44.3	**45.6**
P5 – Building B -South End	70	West	43.4	51.7	40.4	**40.5**
P6 – Building B – Mid	84	North	46.3	75.3	42.6	**43.8**
P7 – Student Center	200	North	54.5	72.7	53.7	**54.0**
P8 – Grove Residence Hall	96	North	43.0	59.1	40.9	**41.8**
63.4P39.5940 – The Commons	108	North East	42.3	63.4	39.5	**40.3**
Power East Speaker						
P6 – Building B – Middle	85	North	52.2	60.0	43.8	**44.7**
P7 – Student Center	210	North	54.6	57.5	53.7	**53.9**
P8 – Grove Residence Hall	87	North	48.6	52.4	46.2	**46.5**
P9 – The Commons	96	North East	46.9	53.3	41.1	**42.1**

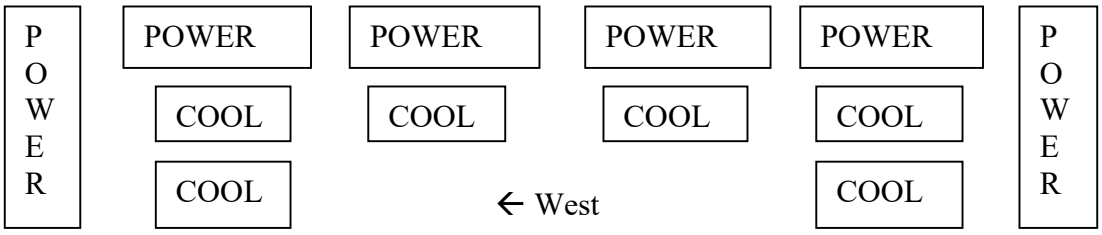
The highest expected level at the College of Arts is 17 dB above the 45 dBA requirement. The west speaker location's transfer function (12 dB) causes the building to reach an airborne noise level of 62 dBA at P2, 17 dB above the requirement. The Arts and Sciences Building (P1) is also high exceeding the 45 dBA limit by 16 dB. Three other locations to the north at the South Quad, Grove Residence Hall and the Commons can be as much as 6 dB above the night time requirement of 45 dBA.

Table 4 Background Corrected L90 Sound Pressure Levels in dBA ref. 20 microPascals

Location	Range in Meters	Direction	L90 Estimate	Transfer Function	Property Line	Over Spec
Power West Speaker			In dBA	In dB	dBA	dBA
P1 – Arts & Sciences	44	West	75.1	13.2	61.1	**16.1**
P2– College of Arts	45	South West	76	12.3	62	**17**
P3 – Mail Services	120	South	57.3	31	43.3	**-1.7**
P4 – Building A	64	North West	59.7	28.6	45.7	**0.7**
P5 – Building B - SE	70	West	58	30.3	44	**-1**
P6 – Building B – M	84	North	58.7	29.6	44.7	**-0.3**
P7 – Student Center	200	North	51.7	36.6	37.7	**-7.3**
P8 – Grove Residence	96	North	52.8	35.5	38.8	**-6.2**
P9 – The Commons	108	North East	53.4	34.9	39.4	**-5.6**
Power East Speaker						
P6 – Building B – M	85	North	59.5	28.8	45.5	**0.5**
P7 – Student Center	210	North	53.9	34.4	39.9	**-5.1**
P8 – Grove Residence	87	North	60.1	28.2	46.1	**1.1**
P9 – The Commons	96	North East	65.1	23.2	51.1	**6.1**

The measurements at 275 Mt Carmel Avenue were taken at various distances from the speaker and then corrected to estimate the expected noise from six fuel cells. The predicted airborne noise levels are as much as 17 dB above the lowest residential night time noise limit for locations P1, P2, P4, P6, P8 and P9. Locations other than these on the Quinnipiac campus are expected to be below 40 dBA depending on how close the locations are to the six fuel cells.

Figure 6. A Possible Fuel Cell Configuration to Limit Acoustic Noise Radiation



Allowable Noise Levels

Connecticut's regulation for the control of noise provides in *CT section 22a-69*-3[1] the requirements for noise emission in Connecticut. *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 CT ordinance will be used to evaluate the noise generated by the six 460 KW fuel cells. (The Hamden noise ordinance has the same noise limits.) Following sections discuss each type of noise using the results obtained from the February 12, 2025 speaker measurements in 275 Mt Carmel Avenue and the 460 KW fuel cell test in Montville, CT reported on July 13, 2020.

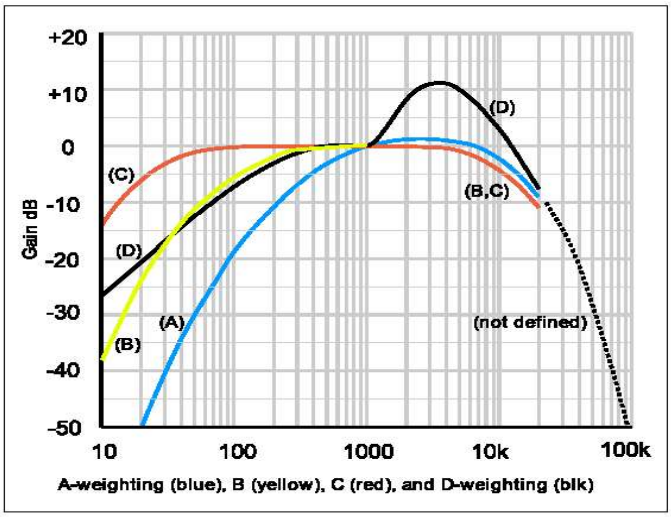
As stated above, the 275 Mt Carmel Avenue site is located in a Residential Zone on Mt Carmel Avenue and this R-2 Residential Zone is surrounded by a T1 Rural Zone to the north, R4 Residential Zones to the west, and R3 Residential and T4 Rural Zones to the south. To the east is a 1-2 Family Residential Zone in Hamden. Based on the analysis resulting in Table 4 the airborne noise from the six new fuel cells should be below the 45 dBA noise limit at distances greater than 75 meters. While six of the closest university buildings may exceed the 45 dBA limit all other nearby residential properties at far greater distances are expected to be well below the day time and night time Residential Zone noise limits for an emitter in a Residential Zone.

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. The Hamden noise ordinance sets the same limits for Impulse Noise as Connecticut does.

Impulse noise in excess of 80 dBA was not observed during any of the ten property line measurements of the Doosan 460 KW fuel cell made at the Montville site on 7 July, 2020[1]. The maximum level measured was 79.7 dBA at location P2 using the ExTech sound level meter. This and the other levels above 70 dBA were caused by vehicle traffic and not by the fuel cell. Unweighted impulse noise levels were determined using a Hewlett Packard HP3561A spectrum analyzer. (The maximum level ten meters from the fuel cell was 77 dBA.) The closest building showed 12 dB of transmission loss so the highest expected level would be below 73 dB. Given the steady state nature of the fuel cell's noise signature there should be no acoustic issues with the State of Connecticut's or the Town of Hamden's impulse noise requirements.

Figure 7. Acoustic Airborne Noise Weighting Curves



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 7 above 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. The fuel cell measurements show the unweighted overall levels to be about 9 dB higher than the A-weighted noise levels. Adding 9 dB to the Montville measured levels brings the peak impulse up to about 82 dB reference 20 microPascals. The impulse noise levels at the Arts & Science should be no higher than 82 dB reference 20 microPascals, just above the 80 dB night time limit.

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. The CT Regulations establish different noise limits for different land use zones. Residential (homes and condominiums) and hotel uses are in Class A. Schools, business, 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 275 Mt Carmel Avenue source is a Class A emitter in a Residential Zone. The noise zone standards in *CT section 22a-69-3.5* state that a Class A emitter cannot exceed the following overall sound pressure levels:

To Class C 62 dBA To Class B 55 dBA To Class A 55 dBA (day) 45 dBA (night)

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

To Class C 57 dBA To Class B 50 dBA To Class A 50 dBA (day) 40 dBA (night)

The Hamden noise ordinance does not discuss discrete tones so the CT Noise Ordinance will be used. To address the discrete tone issue, we use measured spectral data from the Reference 1 Montville testing. The data is the maximum level received in 1/30 octave bands for frequencies from 0.32 to 100,000 Hz. Figure 8 plots the airborne noise measured 10 meters from the Cooling and Power Modules in 1-30th octave bands. This figure shows some discrete tones in the middle frequencies produced by the Fuel Cell Cooling and Power Modules. The nine largest tones are given in Table 5. The highest is 55.1 dB reference 20 microPascals at 302 Hz. The second highest tone is at 213.8 Hz at a level of 54.3 dB reference 20 microPascals. All the remaining tones are below 53 dBA. The A-weighted discrete tone corrections are given in the 4th row of Table 5. Incorporating the transmission loss to the buildings gives the A-weighted levels in the last four rows of Table 5 after the 7.8 dB correction for six units is added. All the frequencies at the nearest buildings except P1 and P2 have levels that are below the 40 dBA requirement in a Residential Zone. The two closest buildings may exceed the 40 dB level by as much as 11 dB. All the other nearby buildings should meet all the discrete tone requirements. There should be no acoustic issue with the CT discrete tone noise requirements at any of the nearby buildings if noise mitigation of 12 dB to the westerly direction is included.

Figure 8. Montville Tones 460 KW Fuel Cell Cooling & Power Modules in 1-30th octave bands

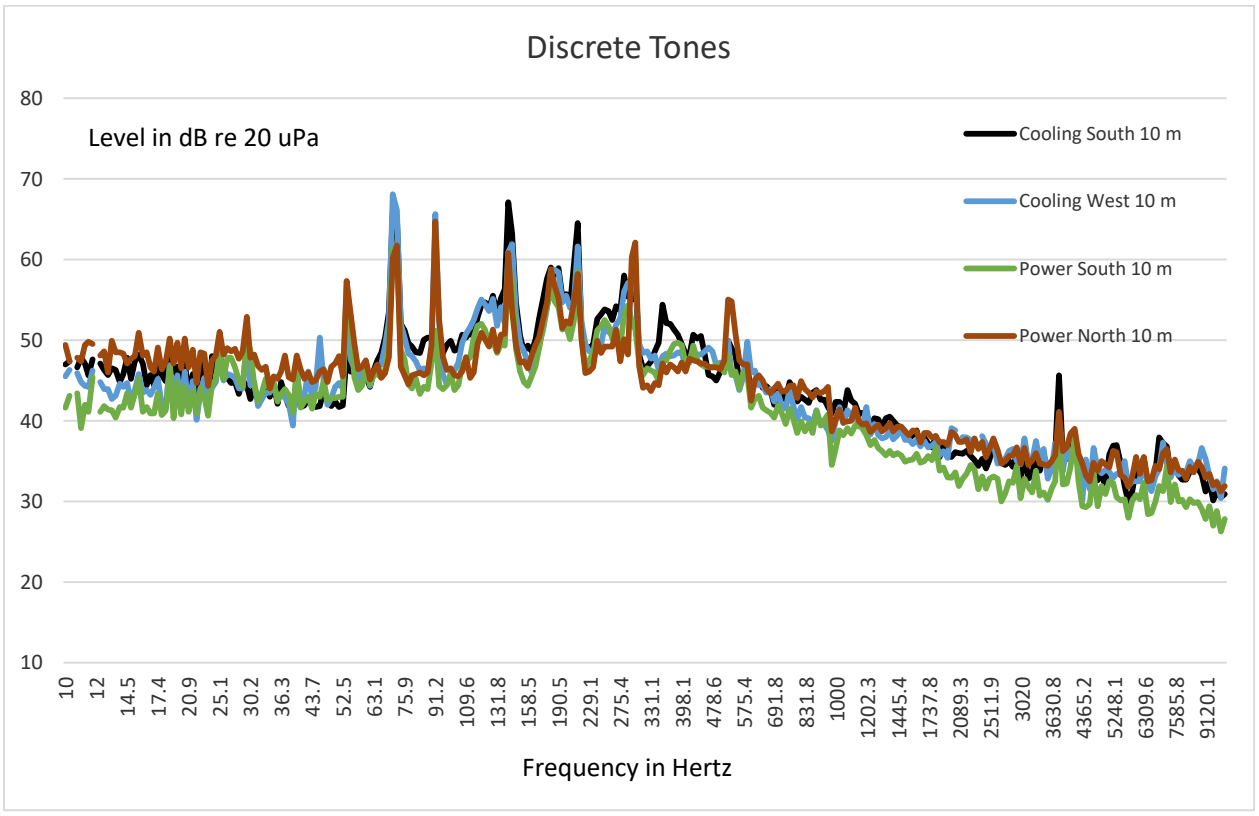


Table 5. Peak Fuel Cell Discrete Sound Pressure Level Estimates in dB ref. 20 microPascals

Location	Range Meters	53.7 Hz	70.8 Hz	91.2 Hz	141.3 Hz	213.8 Hz	302 Hz	3801 Hz	4169 Hz
Allowed Level		**40**	**40**	**40**	**40**	**40**	**40**	**40**	**40**
Montville	10	57.3	68.1	65.6	67.1	64.5	62.1	45.6	39
A Weighting		-29.0	-24.3	-20.5	-14.7	-10.2	-7.0	1.0	0.9
Mt Carmel Ave 1 unit	10	28.3	43.8	45.1	52.4	54.3	55.1	46.6	39.9
6 Fuel Cells	10	36.1	51.6	52.9	60.2	62.1	62.9	54.4	47.7
P1 - Arts & Sciences	44	22.9	38.4	39.7	**47**	**48.9**	**49.7**	**41.2**	34.5
P2 - College of Art	45	23.8	39.3	**40.6**	**47.9**	**49.8**	**50.6**	**42.1**	35.4
P9 - Commons	96	12.9	28.4	29.7	37	38.9	39.7	31.2	24.5
P8 - Grove	87	7.9	23.4	24.7	32	33.9	34.7	26.2	19.5
P6 – Mid Bldg	85	7.3	22.8	24.1	31.4	33.3	34.1	25.6	18.9

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. The Hamden Noise Ordinance does not limit infrasonic and ultrasonic noise so the State of CT Noise Ordinance will be used.

Narrow bandwidth sound pressure spectrums in dB reference 20 microPascals made at the Montville 10-meter Cooling Module location can be used to compare with the infrasonic and ultrasonic noise requirements. The Montville airborne noise data were processed in the 0 to 200 Hertz and 0 to 100,000 Hertz frequency ranges. The bandwidth of each data point is 0.75 Hertz for the 200 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 9 for the 460 KW unit at Montville[3]. The maximum level at 10 meters is 48 dB reference 20 microPascals. The entire 20 Hertz band can be power summed and never exceeds 70 dB reference 20 microPascals at 10 meters in Montville. After subtracting 12.3 dB for the maximum transfer function correction at Point P2 and adding the gain of 7.8 dB for six fuel cells, the 65.5 dB level is well below the Infrasonic requirement of 100 dB for the 275 Mt Carmel Avenue site. The noise levels at all the other nearby buildings will be lower. There should be no issue with the infrasonic noise requirement at any of the neighboring residential properties.

The ultrasonic noise for frequencies up to 100 KiloHertz is given in Figure 10. The Montville data uses a microphone with flat high frequency performance and provides a good estimate for the 460 KW fuel cell. The entire 80 KiloHertz band from 20 to 100 kiloHertz has been power summed and never exceeds a noise level of 62 dB reference 20 microPascals 10 meters from the fuel cell at Montville. After subtracting 12.3 dB for the maximum transfer function correction at Point P2, and adding the gain of 7.8 dB for six units, the ultrasonic level of about 57.5 dB is well below the requirement of 100 dB for the 275 Mt Carmel Avenue site. The noise levels at all the other nearby buildings will be lower and there should be no issue with ultrasonic noise at any of the neighboring properties.

Overall Sound Pressure Levels

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

To Class C 62 dBA To Class B 55 dBA To Class A 55 dBA (day) 45 dBA (night)

The Mt Carmel Avenue properties are in a Residential Zone that has surrounding Residential Zones. The nearby neighbors have airborne noise limits of 55dBA during the day and 45 dBA at night.

Figure 9. Infrasonic Noise from Montville Fuel Cell Cooling Modules in 1-30th octave bands

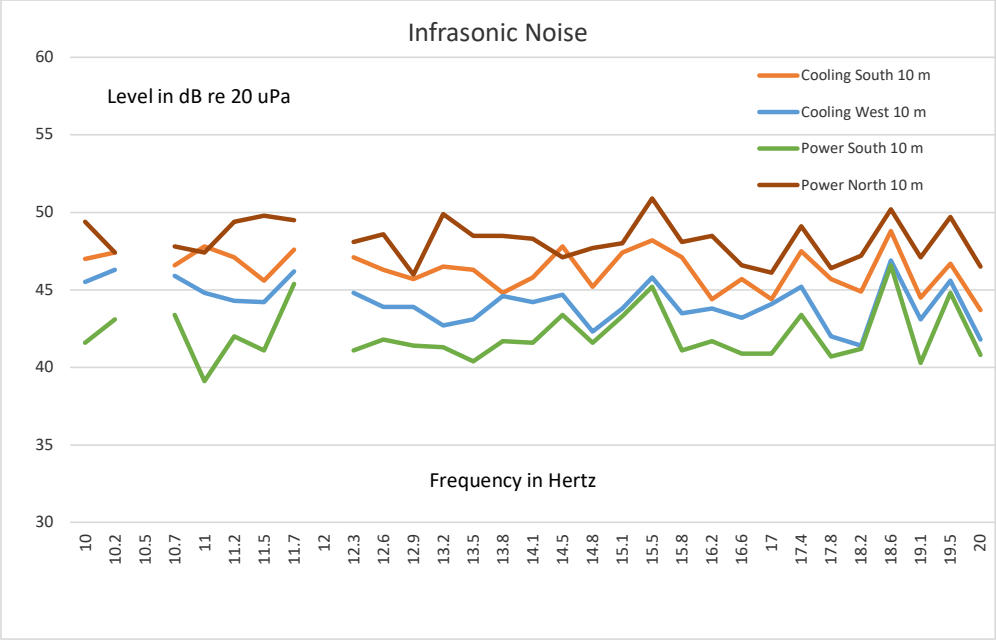
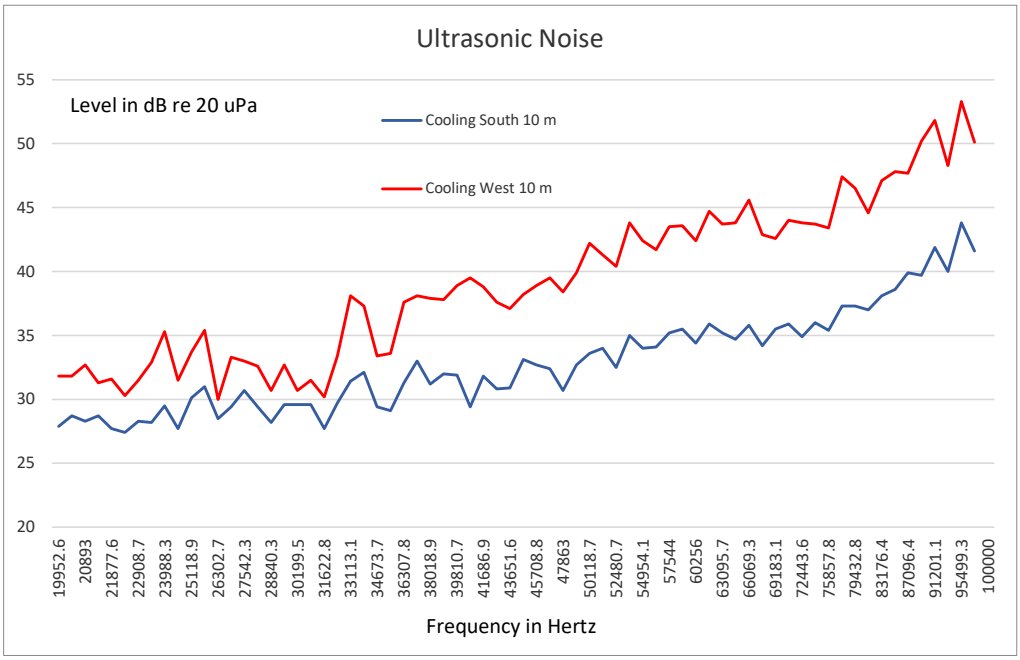


Figure 10. Ultrasonic Noise from Montville Fuel Cell Cooling Modules in 1-30th octave bands



The estimated overall A-weighted sound pressure levels for six fuel cells in dBA reference 20 microPascals are given in column 6 of Table 4 using the background corrected measurements made on February 12, 2025. The second column gives the approximate distance from the fuel cells to the measurement location, with locations identified by a P number in Tables 2 to 5. Column 3 gives the direction from the fuel cell to the building. The airborne noise values given in column 4 are the estimated background corrected received level for one speaker. The transfer functions in column 5 provide the loss in sound level from the fuel cells to the buildings. The values in column 6 provide the predicted airborne noise levels at the buildings with six fuel cells operating. The values for three locations are all below the residential zone noise limit for both day time and night time operation. The remaining six locations exceed the 45 dBA limit by up to 17 dB. These locations need a noise barrier that reduces the airborne noise by 18 dB to the west and 7 dB to the north. For the properties beyond the university boundaries, the increasing loss with distance means all airborne noise should be much lower than the 45 dBA reference 20 microPascals limit.

Operation of the six fuel cells will have no significant acoustic impact at all the nearby buildings and properties adjacent to the fuel cell site on Mt Carmel Avenue if the recommended noise mitigation is included in the fuel cell design.

With the recommended mitigation the buildings closest to the fuel cells should see overall airborne noise levels from the fuel cells below the 45 dBA airborne noise requirement. Some of these buildings may be able to hear the fuel cells when the background noise is below 40 dBA (when no or little Mt Carmel traffic is present). Residential properties on other roads in the Residential Zones outside the school are not expected to hear the six fuel cells. All of the nearby residential and rural properties should not be affected by the operation of the six fuel cells.

Conclusions

The purpose of this effort is to evaluate the acoustical environment at the 275 Mt Carmel Avenue site during operation of the six 460 KW fuel cells at Quinnipiac University. This effort has been accomplished and the results show that the operation of the six 460 KW fuel cells will meet all of the State of Connecticut and Town of Hamden airborne noise requirements at all the nearby properties outside the University. Some noise mitigation is needed to meet the 45 dBA requirement at the six closest buildings on the campus. Other residences and businesses in all directions are expected to meet all the noise requirements because they are far enough away from the new fuel cells and have airborne noise levels below 40 dBA. Locations outside the school at distances greater than 250 meters should not hear the operating 460 KW fuel cells during conditions of low background noise.

More margin in the radiated noise reduction can be obtained by locating the cooling modules as suggested in Figure 6. The power modules radiate about 4 dB less noise than the cooling modules and even less if the fans in the power module are placed on the east side and south sides. This arrangement and other similar arrangements will further reduce the airborne noise radiated to the buildings located to the west and north of the fuel cells.

References

1) Town of Montville Water Pollution Control Authority Airborne Noise Test
At 83 Pink Row, Acoustical Technologies Inc., July 13, 2020

2) 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

3) Hamden Noise Ordinance, hamdennoiseordinancepdf, https://portal.ct.gov/-
/media/deep/air/noise/ordinances/hamdennoiseordinancepdf.pdf

May 2, 2025

RE: Petition For a Declaratory Ruling That No Certificate of Environmental Compatibility and Public Need is Required ("Petition") for the Installation of a Six customer side, 460 KW Fuel Cells and Battery Energy Storage System installation at 275 Mount Carmel Ave., Hamden, CT. Quinnipiac University Mount Carmel Campus.

Dear Recipient,

Pursuant to Section 16-50j-40 of the Connecticut Siting Council's (the "Council") Rules of Practice, we are notifying you that VFS, LLC. intends to file a petition for declaratory ruling with the Connecticut Siting Council ("Council") on or about May 5, 2025. The petition will request the Council's approval of the installation of six (6) 460 KW fuel cells and ancillary equipment and a Battery Energy Storage System ("BESS") in support of a customer-side, distributed generation project at 275 Mount Carmel Ave., Hamden, CT. The fuel cells will be powered by natural gas and generated electricity will be sent directly to the host facility.

The proposed placement site is located to the North of the Facilities offices and Maintenance garage area. The proposed new construction will be approximately 140' long x 41' wide and 10' high.

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

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VFS, LLC

Walter Bonola
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HAMDEN CT 06518

3032-001-00-0000
BYERS BONNIE
300 HOGAN RD
HAMDEN CT 06518

3032-002-00-0000
LINDENFELSER PETER
110 WHITEHORN DR
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AGLAN MAHMMOUND
301 HOGAN RD
HAMDEN CT 06518

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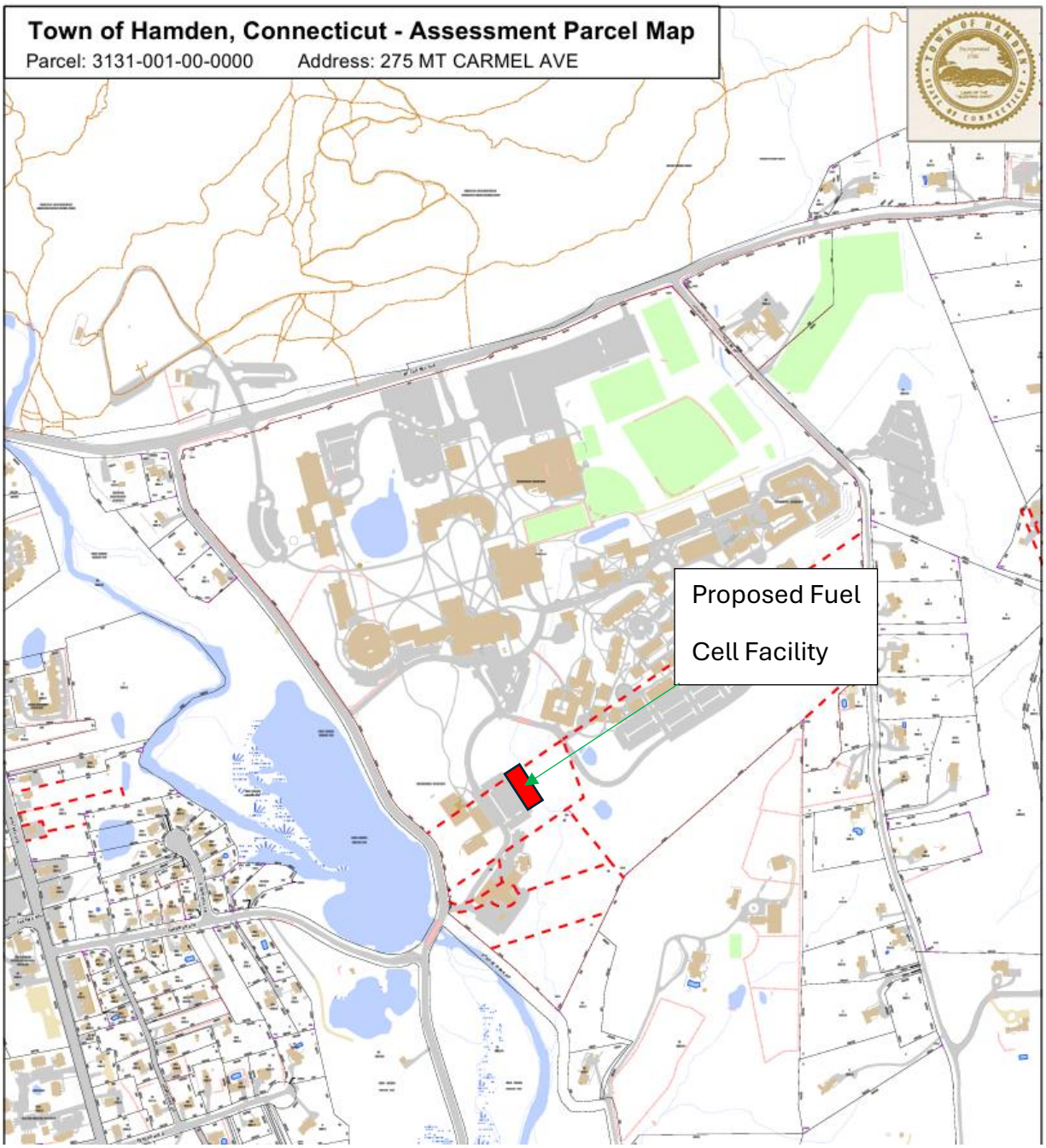

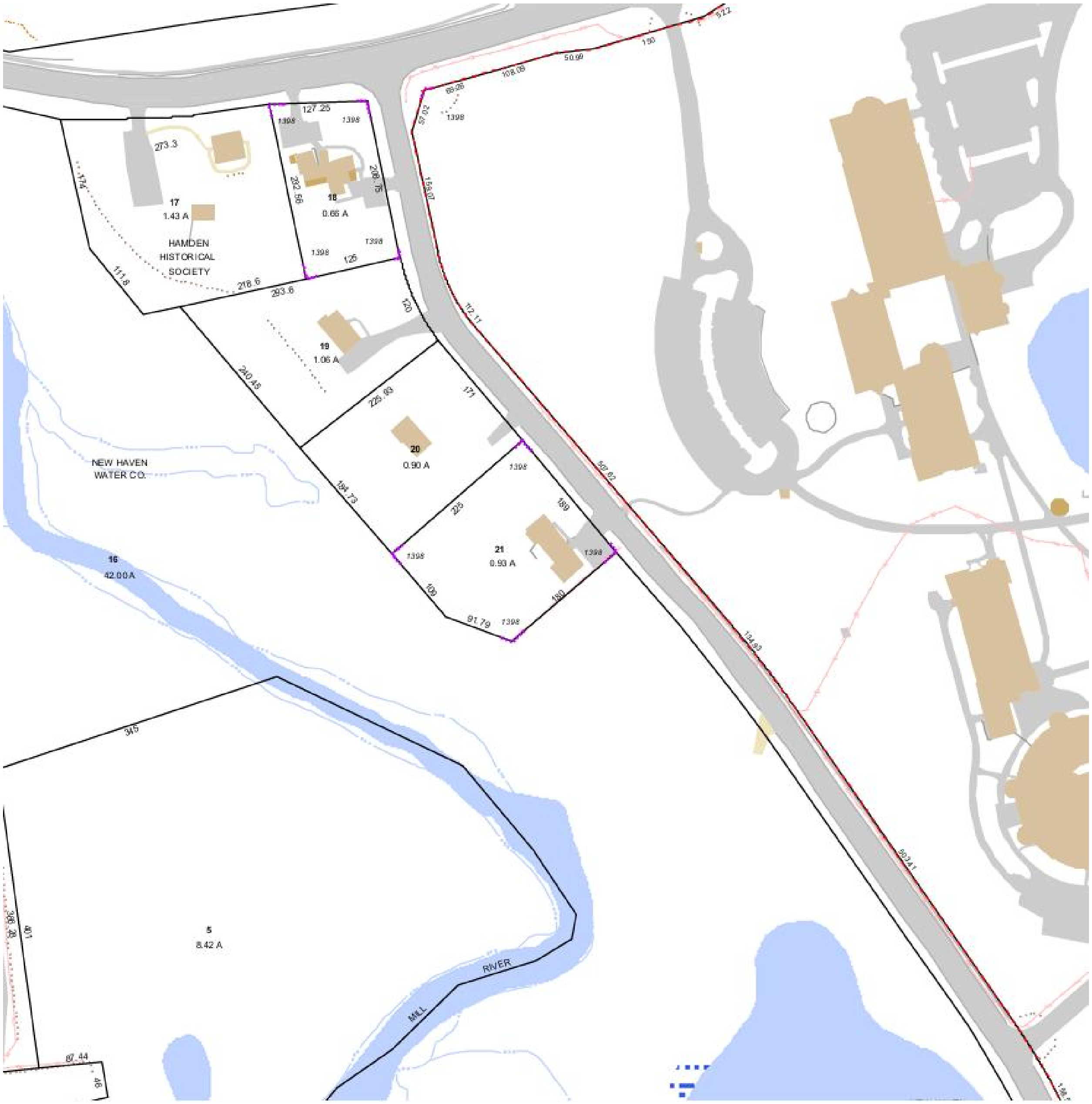

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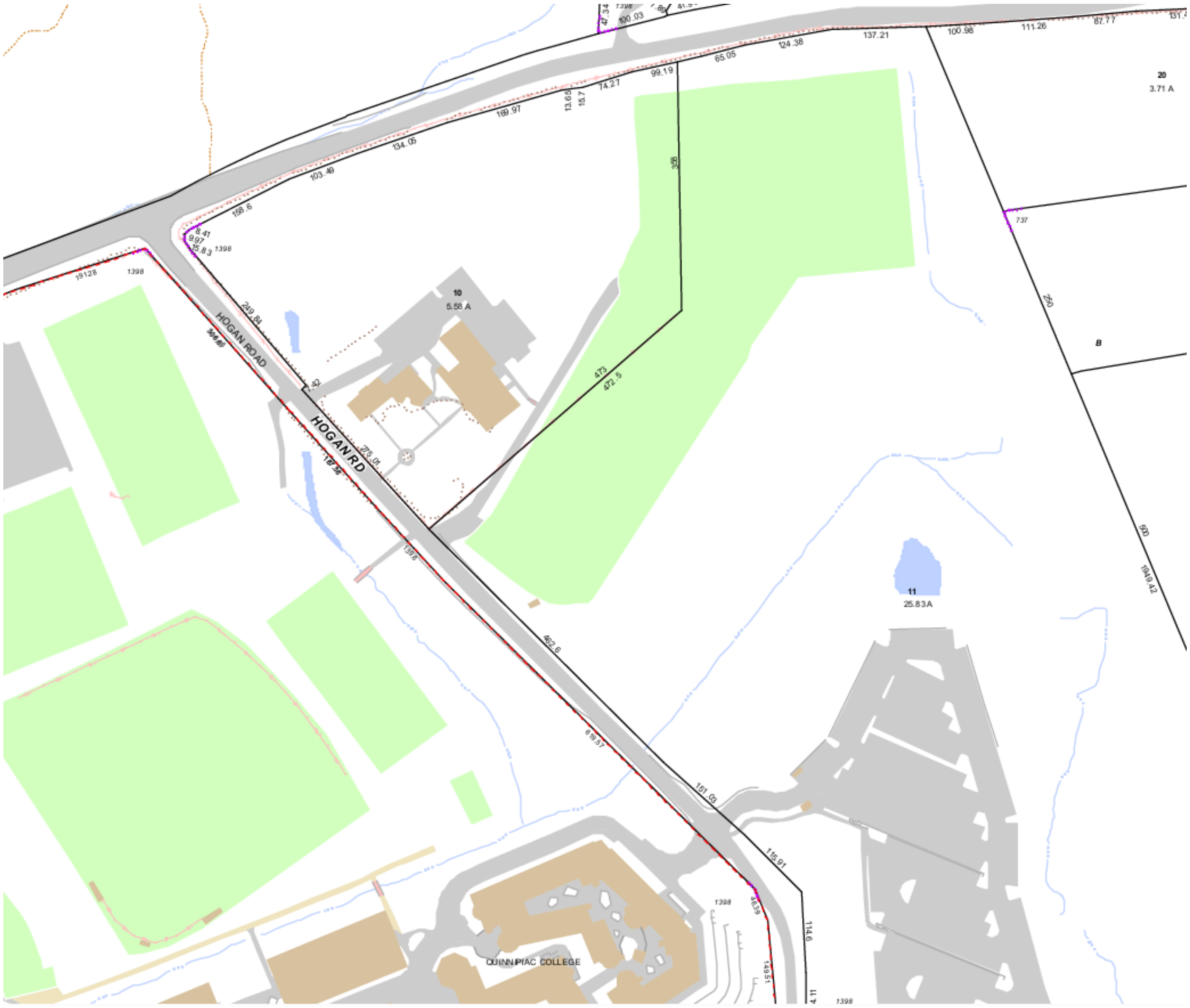

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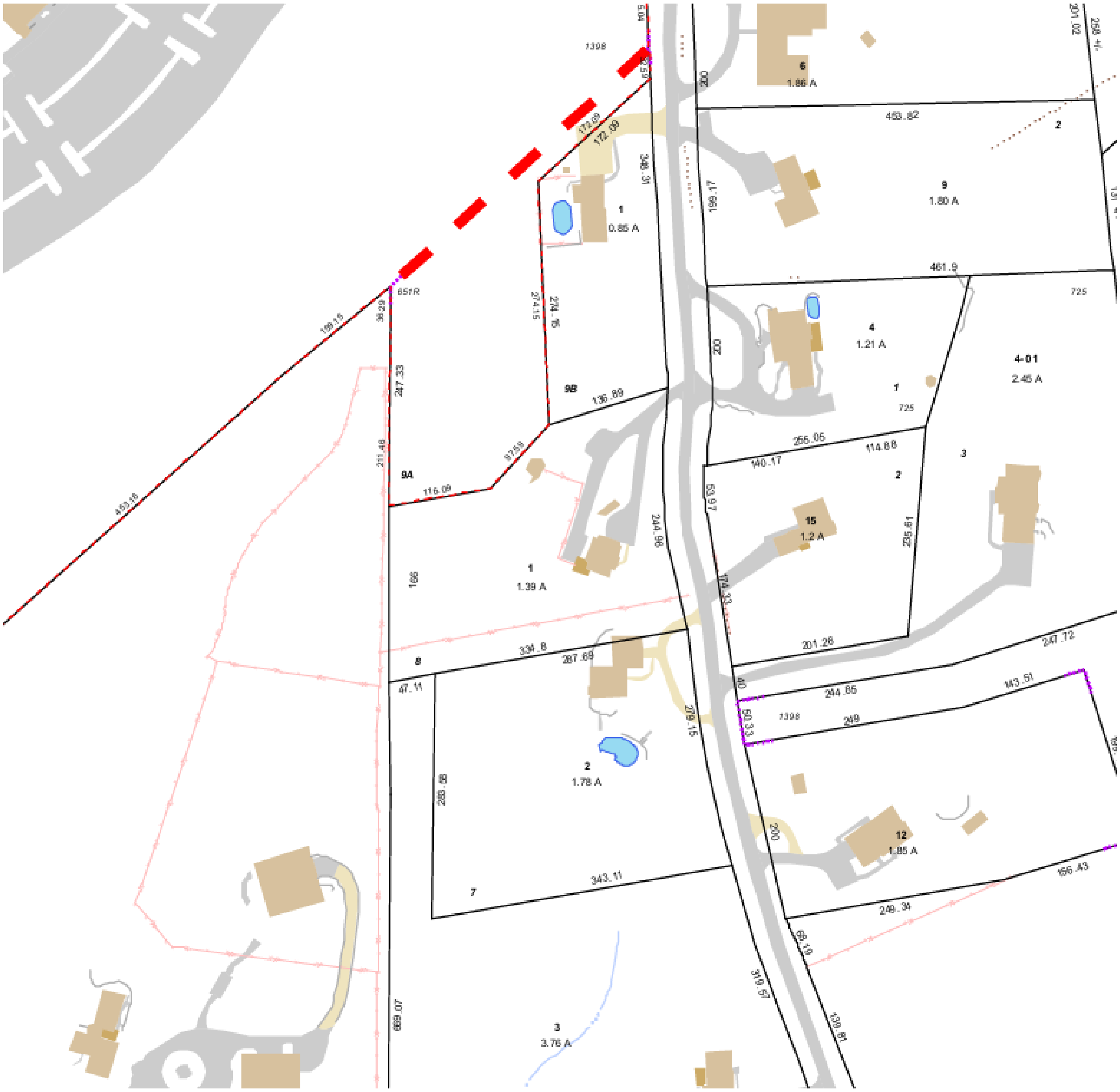
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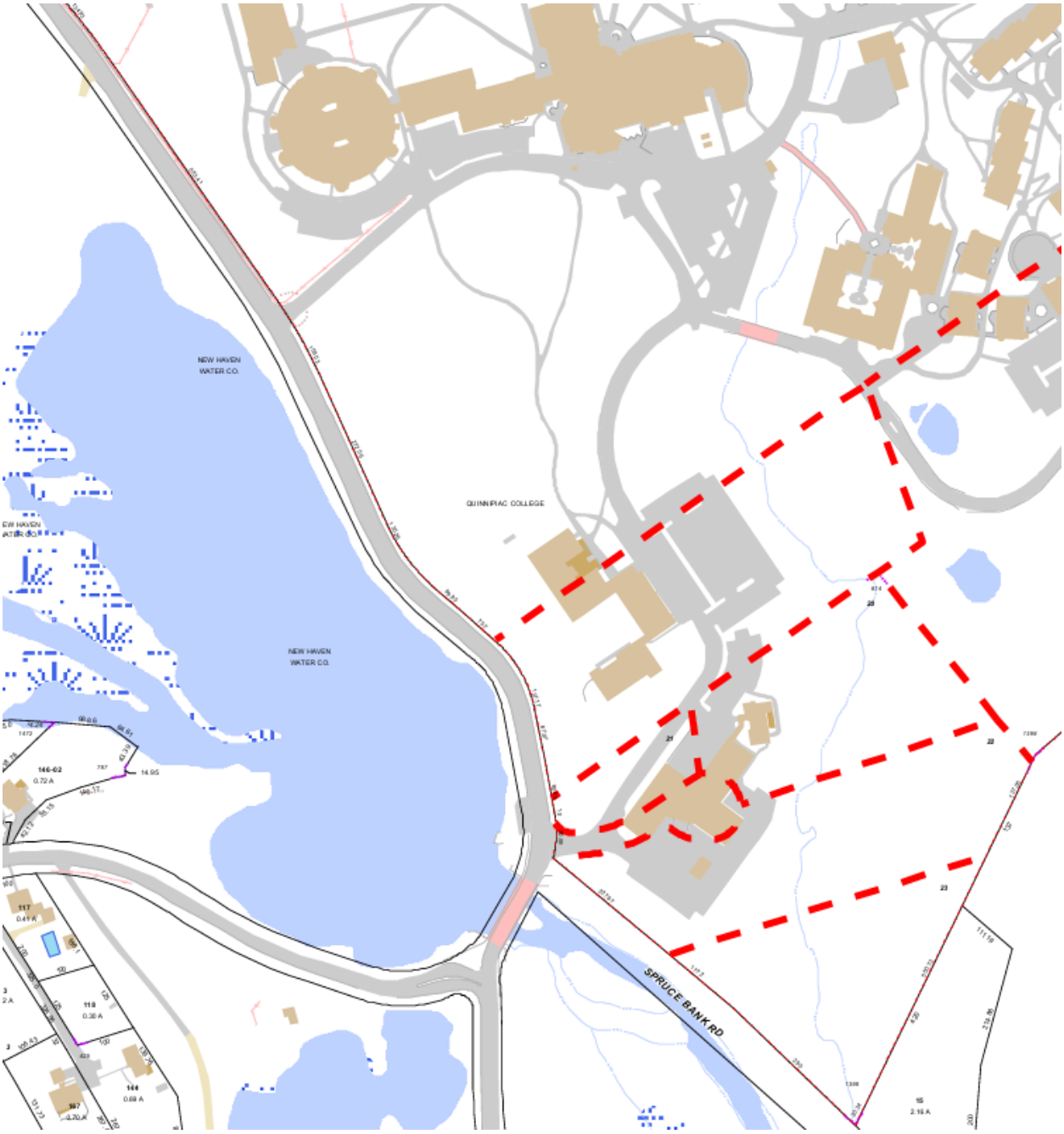
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4.	Department of Administrative Services 450 Columbus Blvd. Hartford, CT 06103				
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Name and Address of Sender	TOTAL NO. of Pieces Listed by Sender	TOTAL NO. of Pieces Received at Post Office™	Affix Stamp Here *Postmark with Date of Receipt.*
VFS, LLC. 5827 Terex Clarkstown, MI 48346	15		UNITED STATES POSTAL SERVICE® 0000 U.S. POSTAGE PAID VERNON ROCKVILLE, CT 06066 MAY 03, 25 AMOUNT $9.75 R2304N117555-02
	Postmaster, per *(name of receiving employee)*		

USPS® Tracking Number / Firm-specific Identifier	Address (Name, Street, City, State, and ZIP Code™)	Postage	Fee	Special Handling	Parcel Airlift
1.	JONES CHRISTOPHER G L & ROSA 300VINEYARD POINT RD GUILFORD CT 06437				
2.	BYERS BONNIE 300HOGAN RD HAMDEN, CT 06518				
3.	3032-011-00-0000 QUINNIPIAC UNIVERSITY 275MT CARMEL AVE HAMDEN CT 06518				
4.	3130-005-00-0000 LANDINO ROBERT E EST(INC) & KISSNER 8 BRIARCLIFFE BURLINGTON CT 06013				
5.	3031-021-00-0000 SOUTH CENTRAL CONN REGIONAL 90 SARGENT DR NEW HAVEN CT 06511				
6.	3032-002-00-0000 LINDENFELSER PETER 110 WHITEHORN DR GUILFORD, CT 06437				

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USPS® Tracking Number Firm-specific Identifier	Address (Name, Street, City, State, and ZIP Code™)	Postage	Fee	Special Handling	Parcel Airlift
1.	3032-012-00-0000 WADE DONNA L & RICHARD E 241 HOGAN RD HAMDEN CT 06518				
2.	3130-017-00-0000 HAMDEN HISTORICAL SOCIETY P O BOX 5512 HAMDEN CT 06518				
3.	3130-020-00-0000 DOWNING JEAN P TRUSTEE 580 NEW RD HAMDEN CT 06518				
4.	3132-004-00-0000 NAVARRETTA NANCY & DEMARSILIS 311 HOGAN RD HAMDEN CT 06518				
5.	3132-008-00-0000 KNUDSEN THOMAS F & FLORENCE M & 465HOGAN RD HAMDEN CT 06518				
6.	3132-025-00-0000 CONNECTICUT STATE OF 165 CAPITAL AVE HAMDEN CT 06518				

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USPS® Tracking Number Firm-specific Identifier	Address (Name, Street, City, State, and ZIP Code™)	Postage	Fee	Special Handling	Parcel Airlift
1.	3032-003-00-0000 BARKER ROBERT W III & GAMBARDELLA 236 HOGAN RD HAMDEN CT 06518				
2.	3132-006-00-0000 AXELROD LEONARD H TRUSTEE 425 HOGAN RD HAMDEN CT 06518				
3.	3132-004-01-0000 AGLAN MAHMMOUND 301 HOGAN RD HAMDEN CT 06518				
4.					
5.					
6.					

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VFS, LLC. 5827 Terex Clarkstown, MI 48346	42	Postmaster, per *(name of receiving employee)*	UNITED STATES POSTAL SERVICE® 0000 U.S. POSTAGE PAID VERNON ROCKVILLE, CT 06066 MAY 03, 25 AMOUNT $27.30 R2304N117555-02

USPS® Tracking Number / Firm-specific Identifier	Address (Name, Street, City, State, and ZIP Code™)	Postage	Fee	Special Handling	Parcel Airlift
1.	Rep. Josh Elliott Legislative Office Building, Room 4109 Hartford, CT 06106-1591				
2.	Sen. Martin M. Looney Legislative Office Building LOB Room 3300 Hartford, CT 06106-1591				
3.	US Senator Richard Blumenthal 90 State House Square 10th floor Hartford, CT 06103.				
4.	US Senator Chris Murphy Colt Gateway 120 Huyshope Avenue, Suite 401 Hartford, CT 06106.				
5.	US Rep. Rosa DeLauro 59 Elm Street New Haven, CT 06510				
6.	Mayor Lauren Garrett 2750 Dixwell Avenue Hamden, CT 06518				

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USPS® Tracking Number Firm-specific Identifier	Address (Name, Street, City, State, and ZIP Code™)	Postage	Fee	Special Handling	Parcel Airlift
1.	Town Clerk Karimah Mickens 2750 Dixwell Avenue Hamden, CT 06518.				
2.	Registrar of Voters Lushonda Howard 2750 Dixwell Avenue Hamden, CT 06518.				
3.	Registrar of Voters Laura Santino 2750 Dixwell Avenue Hamden, CT 06518.				
4.	Dominique Baez Council President 2750 Dixwell Avenue Hamden, CT 06518.				
5.	Bob Anthony At Large Council Member 2750 Dixwell Avenue Hamden, CT 06518.				
6.	Tom Figlar At Large Council Member 2750 Dixwell Avenue Hamden, CT 06518.				

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USPS® Tracking Number Firm-specific Identifier	Address (Name, Street, City, State, and ZIP Code™)	Postage	Fee	Special Handling	Parcel Airlift
1.	Tasha Hunt At Large Council Member 2750 Dixwell Avenue Hamden, CT 06518.				
2.	Katie Kiely At Large Council Member 2750 Dixwell Avenue Hamden, CT 06518				
3.	Laurie Sweet At Large Council Member 2750 Dixwell Avenue Hamden, CT 06518.				
4.	Sean Cardwell District 1 Council Member 2750 Dixwell Avenue Hamden, CT 06518.				
5.	Jeron Alston District 2 Council Member 2750 Dixwell Avenue Hamden, CT 06518.				
6.	Abdul Osmanu District 3 Council Member 2750 Dixwell Avenue Hamden, CT 06518				

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USPS® Tracking Number Firm-specific Identifier	Address (Name, Street, City, State, and ZIP Code™)	Postage	Fee	Special Handling	Parcel Airlift
1.	Sarah Gallagher District 4 Council Member 2750 Dixwell Avenue Hamden, CT 06518.				
2.	Rhonda Caldwell District 5 Council Member 2750 Dixwell Avenue Hamden, CT 06518				
3.	Paula Irvin District 6 Council Member 2750 Dixwell Avenue Hamden, CT 06518				
4.	Adrian Webber District 7 Council Member 2750 Dixwell Avenue Hamden, CT 06518.				
5.	Ted Stevens District 8 Council Member 2750 Dixwell Avenue Hamden, CT 06518.				
6.	Jim Anthony District 9 Council Member 2750 Dixwell Avenue Hamden, CT 06518				

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USPS® Tracking Number Firm-specific Identifier	Address (Name, Street, City, State, and ZIP Code™)	Postage	Fee	Special Handling	Parcel Airlift
1.	Fire Marshal Brian Dolans 750 Dixwell Avenue Lower level, Hamden Government Hamden, CT 06518.				
2.	Carlo Sarmiento Building Official Hamden Government Center 2750 Dixwell Avenue Hamden, CT 06518.				
3.	Stephen White Town Engineer Hamden Government Center 2750 Dixwell Avenue Hamden, CT 06518.				
4.	Planning & Zoning Department Hamden Government Center 2750 Dixwell Avenue Hamden, CT 06518				
5.	Economic & Community Development Director Jackie James 2750 Dixwell Avenue Hamden, CT 06518				
6.	Dept.of Energy and Environmental Protection Katie Dykes 79 Elm Street Hartford CT 06106.				

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1.	Department of Public Health Manisha Juthani, MD. 410 Capitol Ave Hartford CT 06134				
2.	Council on Environmental Quality Brenda Mallory, Chair 730 Jackson Place Washington DC 20006				
3.	Federal DEP David Cash 1 Ashburton Place Boston MA 02108				
4.	CT Historic Preservation Office Jonathan Kinney 450 Columbus Boulevard Suite 5 Hartford CT 06103				
5.	Department of Transportation Sean Duffy 1200 New Jersey Ave, SE Washington DC 2059				
6.	Office of Policy and Management Jeffrey Beckham 450 Capitol Ave Hartford CT 06106				

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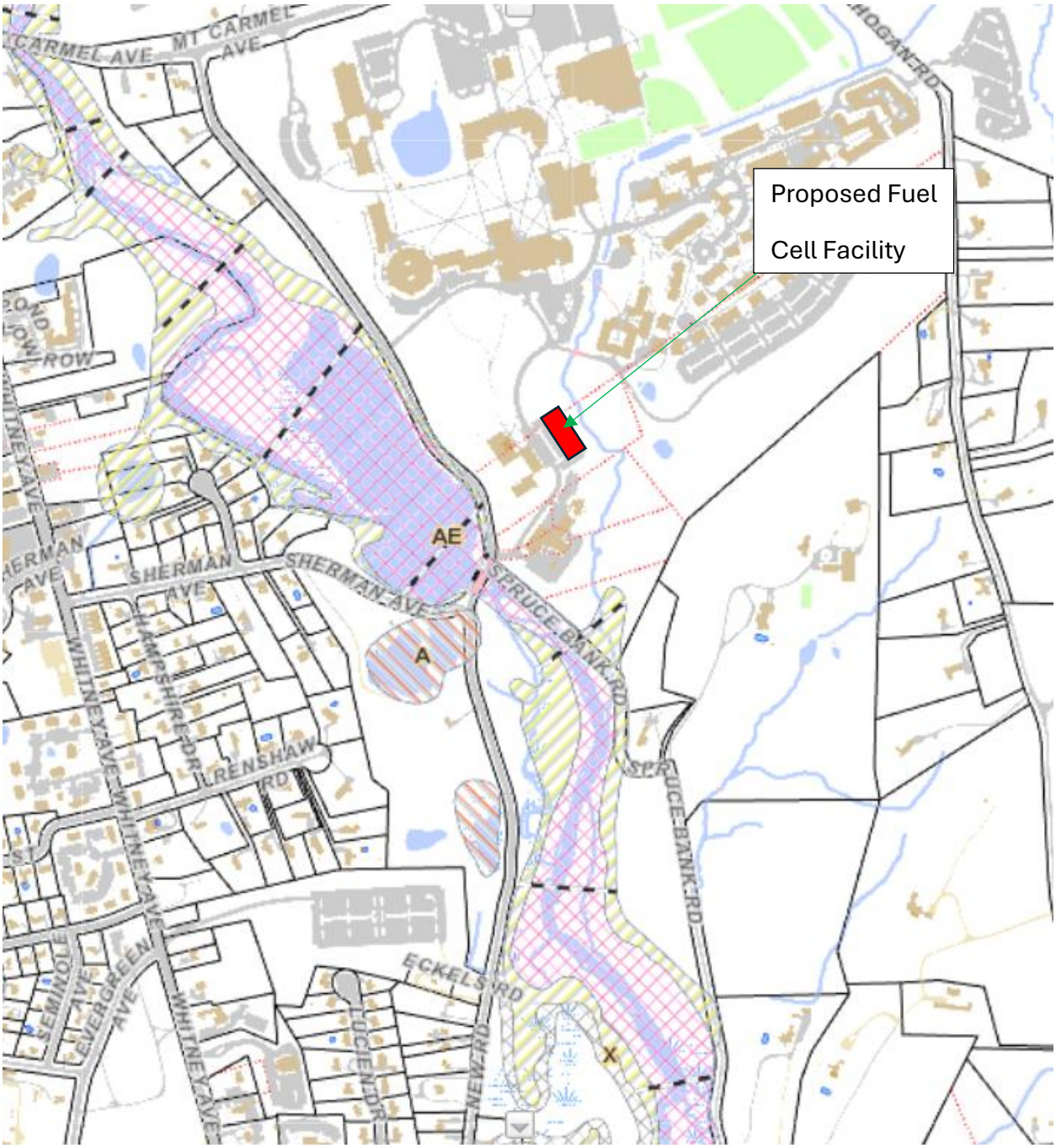
1.	South Central Regional Council of Governments 127 Washington Ave. 4th floor West North Haven, CT 06463				
2.	CT Attorney General William Tong 110 Sherman St Mackenzie Hall Hartford CT 06105-0000				
3.	Department of Transportation Garrett T. Eucalitto 2800 Berlin Turnpike Newington CT 06111-0000				
4.	Dept of Emergency Services and Public Protection, James Rovella 287 West St Rocky Hill CT 06067				
5.	Comptroller Sean Scanlon 165 Capitol Avenue Hartford CT 06106-0000				
6.	Dept. of Admin. Services and the Labor Dept. Dante Bartolomeo Commissioner 200 Folly Brook Blvd Wethersfield CT 06109				

FEMA Flood Map



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*

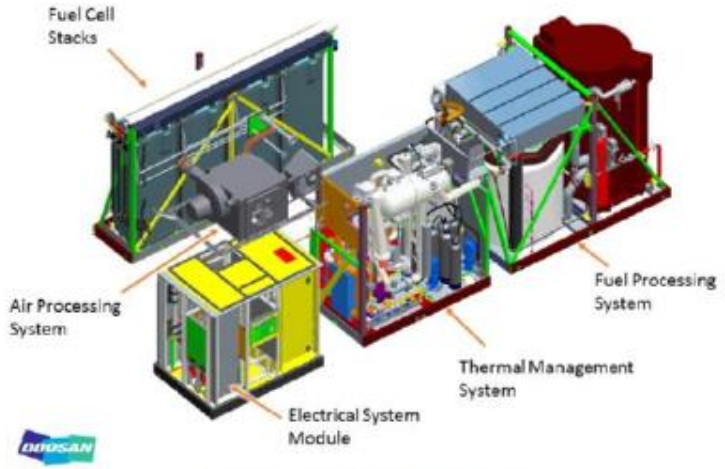


Figure 1. PureCell Model 400 Subsystems