

**TOWN OF NEEDHAM
MASSACHUSETTS**



500 Dedham Avenue
Needham, MA 02492
781-455-7550

PLANNING BOARD

APPLICATION FOR SITE PLAN REVIEW

Project Determination: (circle one) Major Project Minor Project

This application must be completed, signed, and submitted with the filing fee by the applicant or his representative in accordance with the Planning Board's Rules as adopted under its jurisdiction as a Special Permit Granting Authority. Section 7.4 of the By-Laws.

Location of Property 400 First Avenue, Needham, MA
Name of Applicant Walter Bonola
Applicant's Address 101 East River Drive, East Hart Pond, CT
Phone Number 860.250.3776

Applicant is: Owner _____ Tenant _____
Agent/Attorney X Purchaser _____

Property Owner's Name: Needham Travel Property LLC
Property Owner's Address 1370 Avenue of the Americas, 21st Floor, New York, NY
Telephone Number 212-581-4540

Characteristics of Property: Lot Area 73835 SF Present Use Office
Map # 300 Parcel # 0028 Zoning District New England Business center

Description of Project for Site Plan Review under Section 7.4 of the Zoning By-Law:

Installation of fuel cell power plant
on structural steel platform over
loading dock area

Signature of Applicant (or representative) _____

Address if not applicant _____

Telephone # 860.250.3776

Owner's permission if other than applicant _____

SUMMARY OF PLANNING BOARD ACTION

Received by Planning Board _____ Date _____

Hearing Date _____ Parties of Interest Notified of Public Hearing _____

Decision Required by _____ Decision/Notices of Decision sent _____

Granted _____

Denied _____

Fee Paid _____ Fee Waived _____

Withdrawn _____

NOTE: Reports on Minor Projects must be issues within 35 days of filing date.



Doosan Fuel Cell America, Inc.
101 East River Dr
East Hartford, CT 06108
T - 860 727 2200

September 3, 2020

BY FEDEX AND ELECTRONIC MAIL

Needham Planning Board Members
500 Dedham Ave
Needham, MA 02492
Attn: Lee Newman, Planning Director

Re: Normandy Real Estate Partners
Major Project Special Permit No. 2012-07
Application for Further Site Plan Review

400 First Ave, Needham, MA (Map 300, Parcel 28)

Dear Planning Board Members,

The purpose of this letter is to provide the Planning Board with additional information in connection with the above-described Project. This application for further site plan review of Major Site Plan Special Permit No. 2012-07 dated October 16, 2012, amended and restated April 2, 2013, and amended on September 17, 2013, January 6, 2015, April 28, 2015 and November 10, 2015. I have structured this letter to conform to the review criteria for Site Plan Review, as set forth in Section 7.5.6 of the Zoning By-Law. As fuel cell technology may be new to some members of the board, I have also included a brief description of Doosan's Model 400 fuel cell system and the purpose of this project.

Fuel Cell System and Project Goals

Doosan's PureCell® Model 400 is a stationary phosphoric acid fuel cell (PAFC) power plant intended for distributed generation (DG) and combined heat and power (CHP) applications. It is capable of producing ultra-clean, reliable electric power (460 kW in the first year and greater than 400 kW continuously for 10 years), and over 1.78 MMBtu/h of useful thermal energy. This heat can be used for space heating, hot water applications, and for driving an absorption chiller to provide cooling. With an optional grid-independent switchboard and controls, the Model 400 can also provide backup power when the electric utility service fails. As long as natural gas is available, electric power and heat can be generated.

Natural gas is first converted to hydrogen in the fuel processing system (FPS) through a process known as catalytic steam reformation. Hydrogen and air are then supplied to four phosphoric acid fuel cell stacks, in which hydrogen and oxygen combine electrochemically to produce direct current (DC) electricity, heat, and water. Finally, alternating current (AC) electricity is produced through



Doosan Fuel Cell America, Inc.
101 East River Dr
East Hartford, CT 06108
T - 860 727 2200

an on-board DC to AC inverter. Heat generated in the fuel cell process generates steam, which is returned to the FPS for use in the steam reformation process.

The purpose of this project is to reduce electrical and heating costs while also reducing emissions of greenhouse gases and other air pollutants. The fuel cell will provide 460 kw of clean renewable electric power and 1.8 million BTU/hour of available thermal energy to the building infrastructure reducing Trip Advisor's reliance on Electric Grid power and significantly reducing consumption of Natural gas for heating the facility. The system will also allow TripAdvisor to qualify for various state and utility green energy incentives.

Site Plan Review Criteria

The following are the criteria for the Planning Board to consider during the site plan review process pursuant to Section 7.4.6 of the Zoning By-Law, and the description of how this Project meets those criteria.

a) Protection of adjoining premises against seriously detrimental uses by provision for surface water drainage, sound and sight buffers and preservation of views, light, and air;

Adjoining premises will be protected against any seriously detrimental uses of the proposed project by minimizing new impervious soil, screening with louvers, and acoustical levels that meet all state of Massachusetts airborne noise requirements.

The fuel cell will be mounted on a structural steel platform spanning the loading dock area across B street from the Coca-Cola bottling facility. The platform will be screened using aluminum louvers specifically designed for mechanical screening. The louvers and the platform steel will be painted to match adjacent building envelope materials. The cooling module and purge gas manifold will be placed on the ground adjacent to the generator fuel tank and will be screened using the existing cedar fencing and an additional twenty feet of new fencing. Any landscaping plants removed for construction will be replaced once construction is complete.

An acoustical study is included as part of this application. The acoustical study shows the project will be in compliance with all State of Massachusetts airborne noise requirements at all nearby properties.

b) Convenience and safety of vehicular and pedestrian movement within the site and on adjacent streets, the location of driveway openings in relation to traffic or to adjacent streets and, when necessary, compliance with other regulations for the handicapped, minors and the elderly;



Doosan Fuel Cell America, Inc.
101 East River Dr
East Hartford, CT 06108
T - 860 727 2200

The proposed fuel cell will be mounted on a structural steel platform spanning the loading dock area some twenty feet in the air. The cooling module and purge gas manifold will be placed on the ground adjacent to the generator fuel tank and will be screened using the existing cedar fencing and an additional twenty feet of new fencing. The structural supports for the steel platform will be constructed in a manner to allow adequate pedestrian and vehicular traffic on the existing side-walks adjacent to the loading dock and will be protected by 12" concrete filled steel bollards. The proposed project will have no impact to vehicular or pedestrian movement within the site or on the adjacent streets.

c) Adequacy of the arrangement of parking and loading spaces in relation to the proposed uses of the premises;

The proposed project will have no impact on the arrangement of parking and loading spaces on the premises. During operation it is expected that a Doosan service vehicle will visit the project location approximately once per month, having no impact on the adequacy of parking and loading for the existing facility.

d) Adequacy of the methods of disposal of refuse and other wastes resulting from the uses permitted on the site;

Any waste generated during normal servicing of the fuel cell system will be disposed of by Doosan's technicians in accordance with all state and federal laws. A minimal amount of material is expected to be generated through normal replacement of internal components. This waste generation will not have an adverse impact on the facilities ability to dispose of refuse and waste. The fuel cell system does not produce any hazardous waste.

e) Relationship of structures and open spaces to the natural landscape, existing buildings and other community assets in the area and compliance with other requirements of this By-Law;

The fuel cell will be mounted on a structural steel platform spanning the loading dock area across B street from the Coca-Cola bottling facility. The platform will be screened using aluminum louvers specifically designed for mechanical screening. The louvers and the platform steel will be painted to match adjacent building envelope materials. The cooling module and purge gas manifold will be placed on the ground adjacent to the generator fuel tank and will be screened using the existing cedar fencing and an additional twenty feet of new fencing. Any landscaping plants removed for construction will be replaced once construction is complete.

f) Mitigation of adverse impacts on the Town's resources including the effect on the Town's water supply and distribution system, sewer collection and treatment, fire



Doosan Fuel Cell America, Inc.
101 East River Dr
East Hartford, CT 06108
T - 860 727 2200

protection, and streets; and may require when acting as the Special Permit Granting Authority or recommend in the case of minor projects, when the Board of Appeals is Town of Needham MA Zoning By-Law, printed April 2018 215 acting as the Special Permit Granting Authority, such appropriate conditions, limitations, and safeguards necessary to assure the project meets the criteria of a through f.

The proposed project will not have an adverse effect on the Town's resources, including the Town's water supply and distribution system, sewer collection and treatment, fire protection and streets.

The proposed project will connect to the towns water system and use approximately 3,000 gallons per year of water at a maximum flow of 2 gallons per minute, a minor impact to the Town's water system. The Fuel Cells are certified by CSA international to meet strict ANSI/CSA FC-1 2014 safety standards to protect against risks from electrical, mechanical, chemical, and combustion safety hazards. This project has been designed in accordance with NFPA 853 for the safe installation of stationary fuel cell systems. An emergency response plan will be shared with the fire marshal as part of the building permit application process. The proposed project will have no appreciable generation of motor vehicle traffic, with approximately one service vehicle visiting per month.

The fuel cell system will provide 460 kW of clean renewable electric power and 1.8 million BTU/hour of available thermal energy to the building infrastructure reducing Trip Advisor's reliance on electric grid power and significantly reducing consumption of natural gas for heating the facility all without combustion of any kind. With heat and electricity utilized the installation will achieve a total efficiency of 78% and utilizing state of Massachusetts and power company incentives will result in a significant long term cost savings to Trip Advisor and a reduction in their carbon footprint.

The addition of this system will have a positive impact on the Town, both from improving the financial performance of a key employer in town and providing a reduction in carbon footprint.

If you have any questions, please do not hesitate to contact me.

Respectfully Submitted,
Doosan Fuel Cell America, Inc.

Walter Bonola
Installation Project Manager
Walter.bonola@doosan.com
Doosan Fuel Cell America, Inc.



Doosan Fuel Cell America, Inc.
101 East River Dr
East Hartford, CT 06108
T - 860 727 2200

Trip Advisor Planning Board Attachments

- 1 – Signed application
- 2 – DRB presentation documents M-700.00a2 and M-703.00a2
- 3 – Full set of “For Permit” Construction drawings
- 4 – Acoustical test report dated August 25, 2020
- 5 – Copy of Planning Board Fee check (PDF)

Prepared For: Doosan Fuel Cell America Inc.

Point of Contact: Walter Bonola

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

**Subject: Trip Advisor LLC
 460 KW Fuel Cell
 Airborne Noise Assessment
 At 400 1st Avenue, Needham, MA**

Author: Carl Cascio

Date: August 25, 2020

Revision: 1

Table of Contents

	Page
Summary	3
Introduction	4
Development of the Acoustic Assessment Plan	4
Acoustic Measurement Program	5
Data Analysis	9
Allowable Noise Levels	13
Prominent Discrete Tones	14
Conclusions	15
References	15

Country of Origin is the United States of America

Summary

This document makes a positive acoustic assessment that should assist in meeting any acoustic noise concerns during the operation of a Doosan 460 KW fuel cell at the Trip Advisor LLC site at 400 1st Avenue in Needham, MA. An acoustic assessment plan was developed and executed to acquire airborne acoustic information useful in explaining and mitigating the potential airborne noise issues associated with Trip Advisor LLC's operation of the Doosan 460 KW fuel cell. It is important to show that the airborne noise generated by the fuel cell will not significantly impact the facility's neighbors.

The airborne noise levels expected to be generated by the Doosan fuel cell operating at the Needham site were simulated by exciting a set of six co-located speakers at the fuel cell Cooling and Power Module positions. The six speakers produced an overall airborne noise level that was 16 to 20 dB higher than the levels measured for a similar Doosan Power Module installed at New Britain High School in New Britain, CT and the quiet retrofitted blower Cooling Module installed in Brooklyn, NY. One-third octave band analysis showed the speakers to be near the New Britain fuel cell airborne noise levels at frequencies up to 250 Hertz where the airborne noise levels were low and to exceed the fuel cell signature by 16 dB at higher frequencies where the fuel cell signature was higher in noise level. Airborne noise levels with the speakers operating were measured at distances from 5 to 134 meters from the proposed Cooling and Power Module locations at the Trip Advisor LLC site. The speakers produced A-weighted overall sound pressure levels of approximately 86 dBA at 5 meters and 82 dBA at 10 meters (ref. 20 microPascals) from the proposed fuel cell Power Module location. The airborne noise levels from the speakers at nearby property lines were measured at levels from 50 to 59 dBA. Residential measurement locations to the west were very quiet with levels estimated to be below 46 dBA with the fuel cell on. Analysis of the speaker data indicated propagation losses from 10 to 32 dB from the fuel cell location to the nearby Industrial property lines. The source level at 10 meters from the operation of a Doosan Power Module at New Britain High School was then used as a basis for making the Needham Power Module airborne noise estimates. The source level at 5 feet from the operation of a Doosan quiet Cooling Module in Brooklyn NY was used as a basis for making the Needham Cooling Module airborne noise estimates. These two components were then combined to produce estimates of the new Trip Advisor fuel cell's overall noise level.

Operation of the Doosan fuel cell should produce noise levels that are well below the Massachusetts Noise Code limit of 10 dBA above the background at all of the nearby Industrial and Residential property lines. All the expected maximum values (worse case between speaker locations) are shown in Table 4 below. On B Street the maximum airborne noise values are expected to be below 56 dBA at the closest location, below the 60 dBA allowed with the minimum 50 dBA measured background noise. Operation of the Doosan fuel cell will have no acoustic impact at all of the industrial and residential properties adjacent to the Trip Advisor site. No acoustic issues are expected during 24-hour operation of the fuel cell.

The Massachusetts's Noise Code (Reference 1) also calls for review of acoustic issues associated with prominent discrete tones. Operation of the fuel cell is expected to meet the discrete tone (no peak greater than 3 dB) requirement for the fuel cell's octave band noise signature.

Introduction

Acoustical Technologies Inc. was tasked as part of a Doosan site permitting process with an assessment of potential acoustic issues associated with fuel cell airborne noise reaching the properties adjacent to the Trip Advisor LLC site at 400 1st Avenue in Needham, MA.

Responding to a request from Walter Bonola, a site visit was made on August 18, 2020. During the visit, a survey of the airborne noise levels produced by a set of speakers simulating the airborne noise produced by a Doosan Fuel Cell was made in order to identify potential airborne noise issues. Airborne noise measurements were taken to quantify the propagation of the simulated fuel cell airborne noise to the adjacent properties. Background airborne noise levels were also made with the speakers off. This document provides an acoustic assessment to assist in meeting acoustic noise concerns during the permitting process for the siting of a 460 KW Doosan fuel cell at 400 1st Avenue in Needham, MA.

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 24-hour operation of a Doosan 460 KW fuel cell at the Trip Advisor facility. The site at 400 1st Avenue in Needham, MA is located in an Industrial Zone near Interstate I95 and is surrounded by a Residential Zone to the west, Commercial and Residential Zones (SRB) to the north, a Flood Zone to the south and the town of Newton to the east. (The Needham zoning map is given below.) It is important to determine whether the airborne noise generated by the Doosan fuel cell will impact these neighbors.

The acoustic impact is assessed in the following way. The 460-kW fuel cell is yet to be installed so there is no way to measure fuel cell operating airborne noise levels at the new site. The fuel cell airborne noise has been measured at other sites and both overall and octave band airborne noise data for Doosan 400-KW and 460-KW fuel cells are available (References 2, 3 and 4). The only difference between the 400 and 460-KW fuel cells is the electrical output of the cell stacks. The rest of the machine including fans and fan noise remain the same between the 400 and 460 KW models. Using this data, a set of six speakers have been programmed through a set of octave and one-third octave band filters to generate a noise spectrum similar to that of the new fuel cell. (It is assumed that the Cooling and Power Module noise in the measured units are similar to the new unit.) This spectrum will then be played through an audio amplifier to create the electrical voltage necessary to drive the six speakers. In order to overcome the potentially high background noise at the site the speaker output will be increased to a level more than 15 dB higher than the overall noise level measured on an existing fuel cell at a distance of 10 meters. With the six speakers on, this approach then follows the traditional “What is the airborne noise level at the neighbor’s property line?”. The six speakers were run and airborne measurements made near the proposed fuel cell location and at several of the nearest neighbor’s property lines. This measured site data can also be used to estimate noise levels at other neighbor’s property lines. The Town of Needham Noise Ordinance and the State of Massachusetts’s Noise Code will be consulted to assess the impact of the measured and estimated acoustic levels. Because of the closeness of the Trip Advisor fuel cell site to the nearest property line noise mitigation may be recommended if the airborne noise estimated for the fuel cell comes near or exceeds the airborne noise requirements at the neighbors’ property lines.

Acoustic Measurement Program

The acoustic data necessary to assess the impact of the 460 KW Doosan Fuel Cell are described below: Airborne sound pressure measurements were conducted at the Trip Advisor LLC site on and near 400 1st Avenue on August 18, 2020 during the daylight and evening hours. This testing established both background airborne noise levels and simulated airborne noise levels with the speakers operating. The overall A-weighted airborne noise measurements were made with an ExTech model 407780A Digital Sound Level Meter (s/n 140401544) that had been calibrated prior to, during 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) with the sound level meter in a Slow response mode. For reference noise level changes of 1 dB are equal to airborne sound pressure changes of 12.2 per cent. All measurements were made with the microphones at a height above ground between five and six feet.

At the Trip Advisor LLC site “speaker on” and background airborne noise measurements were taken at the following twelve nearby properties in the Industrial and Residential Zones:

Location	Business	Distance	Zone
A - 400 1st Avenue	Trip Advisor	5 & 10 meters	Industrial
B - 400 1st Avenue	Trip Advisor	5 & 10 meters	Industrial
P1 – 80 B Street	Residence Inn South	62 / 70 meters	Industrial
P2 – 80 B Street	Residence Inn North	69 / 84 meters	Industrial
P3 – 9 B Street	Coca-Cola West	60 / 50 meters	Industrial
P4 – 9 B Street	Coca-Cola Mid	33 / 22 meters	Industrial
P5 – 9 B Street	Coca-Cola East	66 / 71 meters	Industrial
P6 – 300 1 st Avenue	Mitt Comm	106 / 119 meters	Industrial
P7 – 235 A Street	Garage North	119 / 134 meters	Industrial
P8 – 235 A Street	Garage South	86 / 100 meters	Industrial
P9 – 81 Highland Terrace	Residence	740 / 755 meters	Residential SRB
P10 – 275 2 nd Avenue	Condominiums	440 / 454 meters	Residential SRB
P11 – 220 Hunting Road	Residence	262 / 252 meters	Residential
P12 – 228 Hunting Road	Residence	260 / 250 meters	Residential

The nearest residential area is more than 250 meters to the west across Interstate I95 behind a highway noise barrier and is sufficiently distant that the simulated fuel cell noise could not be heard. Background measurements were taken in the two closest residential zone areas (P9-P12).

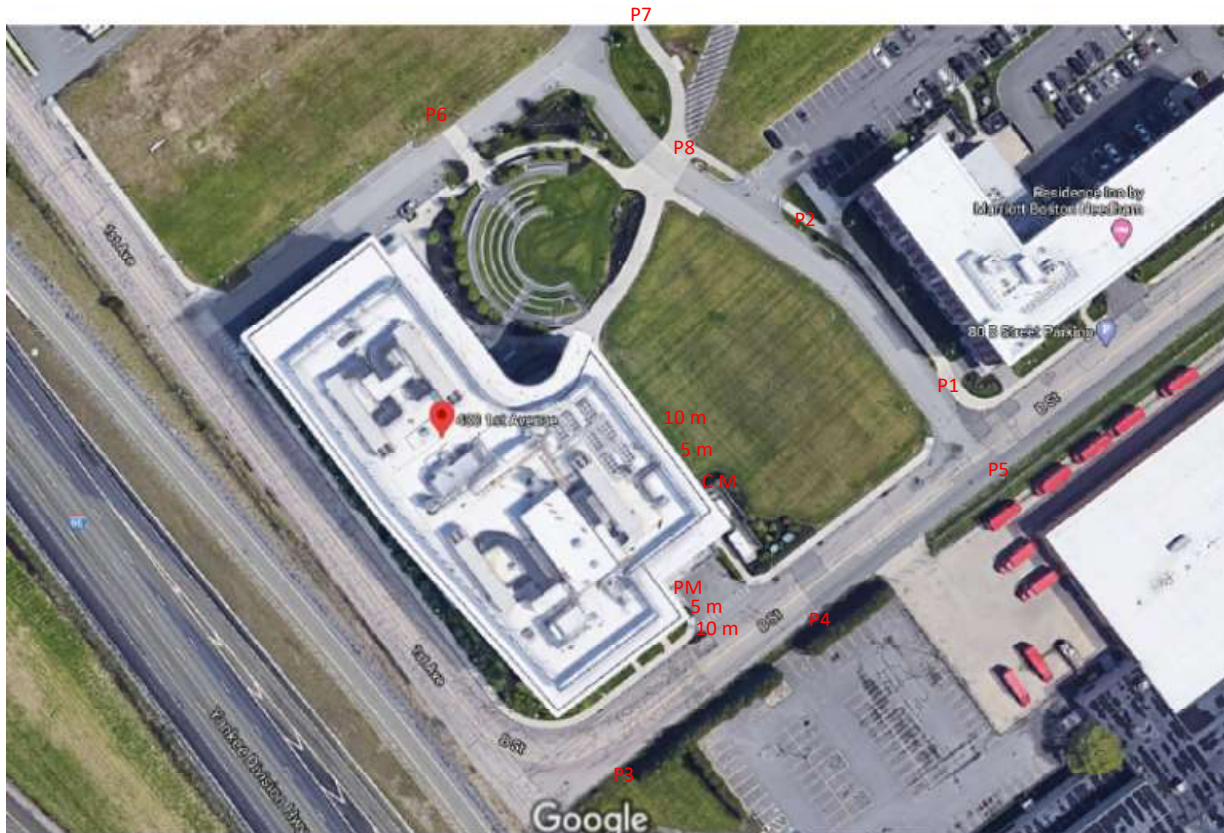
See the Google satellite map in Figure 1 for the approximate microphone measurement locations. Measurements near the proposed operating Cooling and Power Module sites at speaker positions A and B, respectively, were taken with the ExTech sound level meter. Figures 2, 3 and 4 provide photographs of the site locations for the Cooling and Power Modules as well as two sound level meter positions. At all the locations, a one-minute record of the acoustic noise was taken for the speakers in the “on” condition at the start and at the end of the property line airborne noise measurements. There is a very slight decrease of about 0.5 dB in sound output from the speakers as they warm up at the Cooling Module location. There was no change in level for the Power Module. Five minutes of background airborne noise data were also recorded at all the positions.

Acoustical Technologies Inc.

Figure 1. Trip Advisor LLC Site Map in Needham, MA from Google Maps

400 1st Ave

Travel Advisor Sensor Locations



Airborne noise measurements taken outside are corrupted by rain and wind so a day was selected when the winds were expected to be 10 miles per hour or less. Table 1 provides the weather data at Boston Airport (closest data to Needham) for the acoustic measurements on August 18, 2020. Measurements were taken over the period from 10:30 am until 11:30 am for the Cooling Module location and from 2:15 pm to 3:15 pm for the Power Module. Background data were taken from 11:30 am until 1 pm, from 4:45 pm to 5:45 pm and then again from 8 pm to 10 pm. The table below shows the temperature and wind speeds in hourly intervals. Wind conditions were good for most of the day with a few wind gusts of up to 22 mph from 2 pm to 3 pm. Acoustic measurements were suspended during the wind gusts and these short periods did not affect the operating and background airborne noise measurements. There was no rain during the testing on August 18. The motor vehicle traffic from Interstate I95 generated most of the background noise at the locations closest to the highway. The other locations (shielded by buildings) were reasonably quiet. At night the cicada at most locations and water sprinklers near the parking garage added additional background noise. Motor traffic along the nearby roads was light but many of the measurements near B Street had to be delayed until no traffic was present. Background noise levels at all of the measurement positions were acceptable with levels from 48 to 59 dBA. The locations closest to Interstate I95 had the highest levels with these locations seeing 4 to 5 dB noise reductions at night when less motor traffic was present on Interstate I95.

Acoustical Technologies Inc.

Figure 2. Doosan Cooling Module Location at the Trip Advisor LLC Site in Needham



Acoustical Technologies Inc.

Figure 3. Doosan Power Module Location at the Trip Advisor LLC Site in Needham



Figure 4. Trip Advisor LLC Building with Sound Level Meter at Location P8



Table 1. Approximate Needham Weather Data on August 18, 2020

<https://www.wunderground.com/history/daily/us/ma/boston/KBOS/date/2020-8-18>

Time (EST)	Temp. (°F)	Humidity (%)	Barometer (in HG)	Wind Speed (mph)	Wind Gust (mph)	Wind Direction	Condition
7:54 AM	67 F	87 %	29.78 in	10 mph	0 mph	SW	Partly Cloudy
8:54 AM	71 F	78 %	29.78 in	9 mph	0 mph	W	Fair
9:54 AM	76 F	67 %	29.79 in	8 mph	0 mph	W	Fair
10:54 AM	78 F	56 %	29.77 in	13 mph	0 mph	W	Fair
11:54 AM	80 F	52 %	29.77 in	9 mph	0 mph	WSW	Fair
12:54 PM	83 F	38 %	29.76 in	9 mph	0 mph	WSW	Fair
1:54 PM	82 F	35 %	29.76 in	14 mph	21 mph	W	Partly Cloudy
2:54 PM	84 F	31 %	29.75 in	14 mph	22 mph	W	Mostly Cloudy
3:54 PM	83 F	34 %	29.74 in	13 mph	0 mph	W	Partly Cloudy
4:54 PM	84 F	33 %	29.74 in	14 mph	0 mph	W	Partly Cloudy
5:54 PM	83 F	28 %	29.75 in	17 mph	0 mph	W	Fair
6:54 PM	81 F	30 %	29.77 in	13 mph	0 mph	W	Fair
7:54 PM	79 F	36 %	29.79 in	10 mph	0 mph	W	Partly Cloudy
8:54 PM	77 F	42 %	29.82 in	10 mph	0 mph	NW	Mostly Cloudy
9:54 PM	74 F	48 %	29.84 in	7 mph	0 mph	WNW	Fair
10:54 PM	73 F	51 %	29.85 in	6 mph	0 mph	WNW	Fair
11:54 PM	72 F	53 %	29.84 in	7 mph	0 mph	W	Fair

Data Analysis

This section analyzes the airborne noise levels measured at the Needham Trip Advisor LLC site and then estimates the source level and transmission loss to nearby property lines expected during actual fuel cell operation. These estimated levels will be compared to the noise requirements in the Massachusetts noise code. Both background noise levels at the Needham Trip Advisor LLC site and the measured speaker operating noise levels are reported in Table 2. The background data are used to correct the measured operating airborne noise levels providing estimates of only the speaker noise contribution at each location. Table 3 reports estimated fuel cell equipment operating noise levels individually for both the Cooling Module and the Power Module. Comparing these Trip Advisor LLC fuel cell estimated levels with the state noise code will identify which nearby locations do or do not meet the airborne noise requirements.

The complete set of overall A-weighted airborne noise levels that were measured in Needham are provided in Table 2 for the conditions with the speakers on and off. Figure 5 is a map showing the Needham zoning districts in the Trip Advisor area. The range from the speakers to the microphone locations that are shown in Table 2 were calculated using Google Maps. The estimates of the range in meters to each location are given in Table 2 and also in Table 3. Each value is the range to the center of Cooling and Power Module locations, respectively. The closest measurement location is P4 on B Street, which is about 33 meters to the Cooling Module and 22 meters to the Power Module. The Residence Inn and other Coca Cola property lines are 50 to 84 meters away. Other neighboring industrial properties are more than 100 meters away.

Acoustical Technologies Inc.

P12, the closest residential home is 250 meters away due west at 228 Hunting Street. Airborne noise at this and other residential locations could not be heard when the speakers were operating. The residential noise background noise levels were in the 48 to 53 dBA range.

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

Location	Range in Meters	Speakers Cooling Module	Background L90	Bkgd Corrected	Speakers Power Module	Background L90	Bkgd Corrected
Speaker East	5	74.7	53.2	74.7	85.7	55.8	85.7
Speaker East	10	69.2	53.8	69.1	82.0	55.0	82
Speaker South	5	88.8	51.5	88.8	83.8	55.9	83.8
Speaker South	10	-	-	-	79.3	56.7	79.3
P1-Res Inn S	62/70	60.4	55.0	58.9	58.7	52.2	56.3
P2-Res Inn N	69/84	59.7	54.2	58.3	56.0	51.6	41
P3-CocaCola E	60/50	60.7	59.1	55.6	64.7	54.0	64.2
P4-CocaCola M	33/22	60.4	55.0	58.9	71.7	51.4	71.6
P5-CocaCola W	66/71	59.0	54.1	57.3	64.0	50.7	63.6
P6-MittCom	106/119	56.0	55.0	49.2	54.3	50.0	-
P7-Garage N	119/134	56.2	55.3	49	57.2	50.3	52.7
P8-Garage S	86/100	56.8	56.1	< 45	55.5	50.8	-
P9-81 Highland	740/755		48.1	4:53 pm		-	
P10-275 2 nd Av	440/454		-			48.4	8:10 pm
P11-220Hunting	262/252		53.0	5:40 pm		52.9	10:05 pm
P12-228Hunting	260/250		51.9	5:36 pm		-	

A comparison of the airborne noise produced at 10 meters by the Doosan fuel cell at the New Britain High School site (Reference 2) with the airborne noise produced by the speakers at the Montville Water Authority site (Reference 3) is shown in Figure 6. The speakers slightly exceed the fuel cell airborne noise for frequencies below 250 Hertz and greatly exceed the fuel cell airborne noise at the middle frequencies where the fuel cell airborne noise levels are the highest. The speaker levels are lower above 2.5 KHertz. The noise levels are about 6.3 and 7.1 dB higher for the speakers at Site A and Site B locations, respectively, as compared to what is expected from the Doosan 400 KW fuel cell that was measured at New Britain High School in New Britain, CT. The 6 to 7 dB differences in level were then subtracted from the Montville measured speaker levels to estimate the Montville fuel cell's acoustic signature at each location.

The 10-meter New Britain fuel cell airborne noise levels for the Power Module were used with the Needham transmission loss data to estimate the expected Trip Advisor site Power Module airborne noise for nearby neighbors at the Needham property lines. The Cooling Module noise level was taken from the quiet retrofitted blower unit data in Reference 4. Adding the Needham transmission loss data to the Sound Sense measurements provided the Cooling Module estimates.

Acoustical Technologies Inc.

Figure 5. Needham Zoning Map Showing Speaker Location at Positions A & B

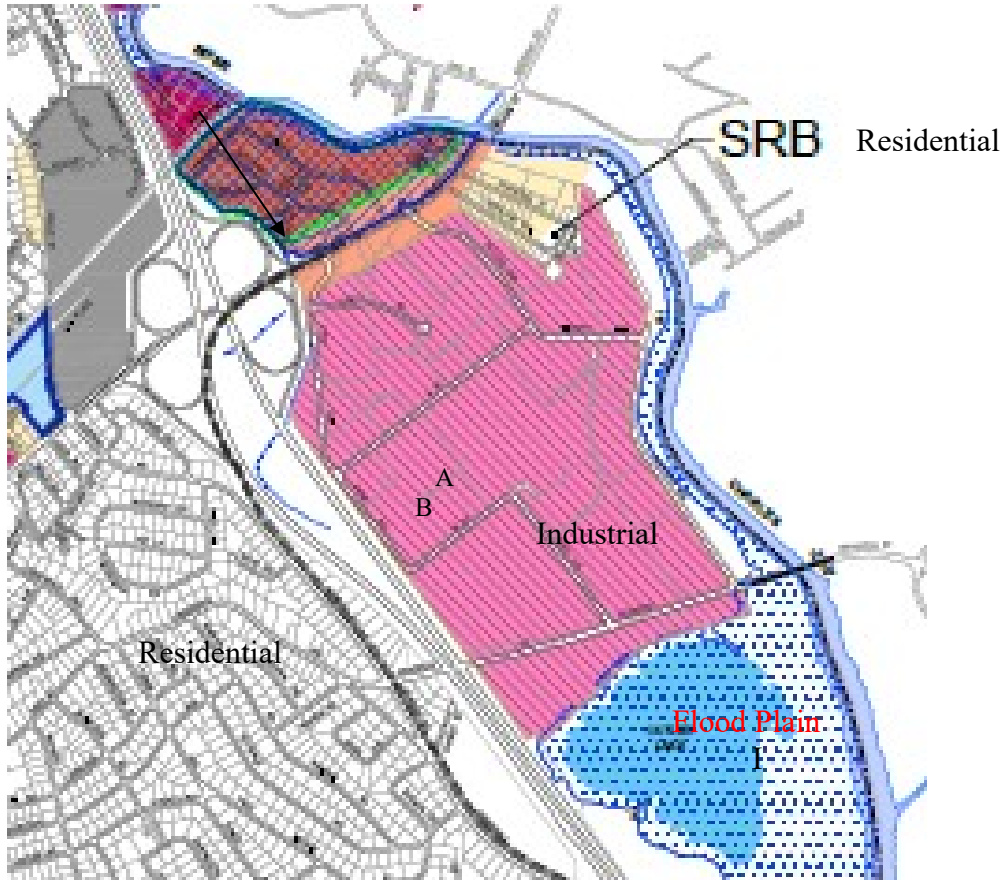
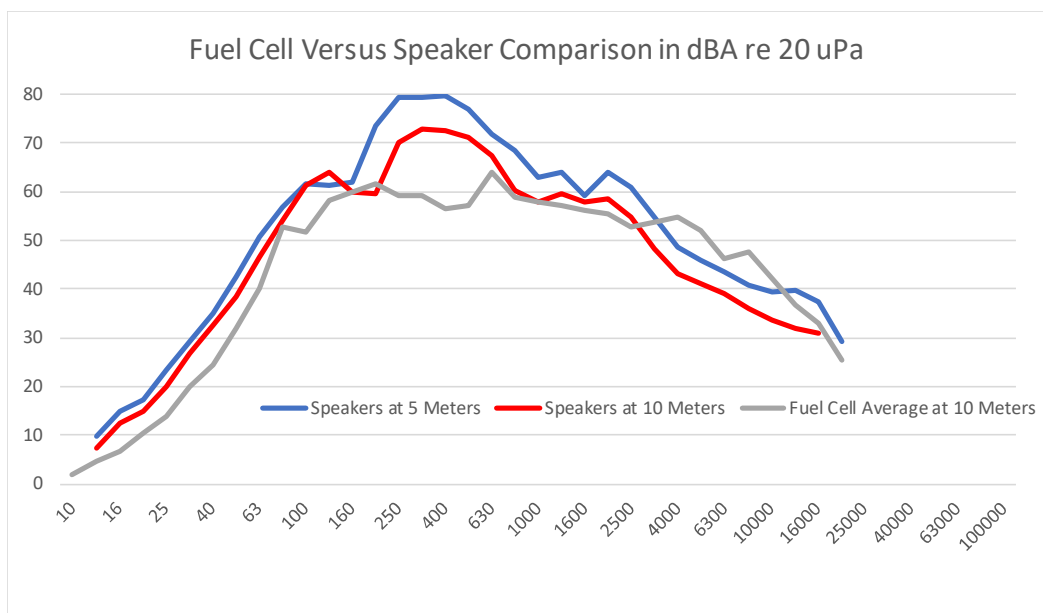


Figure 6. The Six Speakers Generate Airborne Noise Above That of a Single Fuel Cell



Acoustical Technologies Inc.

The estimated airborne noise levels to be produced by the Doosan Trip Advisor fuel cell modules are shown in Table 3. For each of the eight locations the Needham measurements are corrected to account for the higher speaker levels. The fuel cell noise correction at the Site A Cooling Module location is estimated to be 20 dB because the speaker levels are that much higher than the retrofitted blower noise levels. The speakers at the Site B Power Module were estimated to be 16 dB higher than the New Britain High School Power Module measurements. The two modules' contributions are combined in Table 4 to create a total overall fuel cell estimate.

The measurements at the Trip Advisor LLC site were taken at various distances from the speakers and then background corrected. Close to the speakers on B Street the maximum airborne noise values to the south east are expected to be below 56 dBA at the closest location. This level is due to the Power Module located directly across the street from the measurement position. Besides the adjacent Coca Cola property, the other industrial properties are expected to be below 41 dBA from the Power Module. All the industrial properties are expected to be below 40 dBA from the Cooling Module due to its quiet design, the amount depending on how close the locations are to the Cooling Module. The residential properties to the north and west are all expected to have airborne noise levels due to the Trip Advisor fuel cell that are below 46 dBA.

Table 3. Trip Advisor LLC Overall Sound Pressure Levels in dBA ref. 20 microPascals

Location	Range in Meters	Speakers Cooling	Correction	Cooling Mod Estimated SPL in dBA	Speakers Power	Correction	Power Mod. Estimated SPL in dBA
P1-Res Inn S	62/70	58.9	-20	38.9	56.3	-16	40.3
P2-Res Inn N	69/84	58.3	-20	38.3	41	-16	25.0
P3-CocaCola E	60/50	55.6	-20	35.6	64.2	-16	48.2
P4-CocaCola M	33/22	58.9	-20	38.9	71.6	-16	55.6
P5-CocaCola W	66/71	57.3	-20	37.3	63.6	-16	47.6
P6-MittCom	106/119	49.2	-20	29.2	-	-16	<39
P7-Garage N	119/134	49	-20	29	52.7	-16	36.7
P8-Garage S	86/100	< 45	-20	<25	-	-16	<40

Table 4. Expected Airborne Noise Levels from Operating a Doosan Fuel Cell (ref. 20 µPA)

P1	P2	Residence		P10	P12	
42.7 dBA	38.5dBA	Inn		41 dBA	45 dBA	Residential
Coca	Cola	Coca	MittComm	Parking	Garage	
P3	P4	P5	P6	P7	P8	Industrial
48.4 dBA	55.7 dBA	48 dBA	39.4 dBA	37.4 dBA	40.1 dBA	

Allowable Noise Levels

The Massachusetts regulation for the control of noise provides in [M.G.L. Chapter 111, Section 142A-M](#) (Reference 1) the requirements for noise emission in Massachusetts. *The Exterior Noise Code* states: ***A noise source will be considered to be violating the Department's noise regulation (310 CMR 7.10) if the source:***

- 1. Increases the broadband sound level by more than 10dB(A) above ambient, or*
- 2. Produce a "puretone" condition – when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.*

These criteria are measured both at the property line and at the nearest inhabited residence. "Ambient" is defined as the background A-weighted sound level that is exceeded 90% of the time, measured during equipment operating hours. "Ambient" may also be established by other means with consent of the Department.

Reference 5 discusses the interpretation of this policy indicating that:

A new noise source that would be located in an area that is not likely to be developed for residential use in the future, or in a commercial or industrial area with no sensitive receptors may not be required to mitigate its noise impact in those areas, even if projected to cause noise levels at the facility's property line to exceed ambient background by more than 10dB(A).

The Town of Needham Charter states in Section 3.8 its Noise Regulations as follows:

Except in an emergency, construction activity conducted pursuant to a building permit, which causes noise that extends beyond the property line, shall be limited to the hours of 7AM to 8PM unless authorized by rules or regulations adopted by the Select Board. The penalty for violation of this regulation shall be a \$50 fine.

The Massachusetts state ordinance will be used to evaluate the noise generated by the Doosan Fuel Cell. Following sections discuss the broadband sound and the pure tone data using the results obtained from the New Britain, Montville and Brooklyn fuel cell measurements as well as the Needham Trip Advisor speaker measurements.

The north eastern part of the Needham zoning map is given in Figure 5. As stated above, the Needham Trip Advisor LLC site at 400 1st Street is located in an Industrial Zone. This site is adjacent to a Residential Zone to the west and Commercial and Residential Zones to the north. The closest residence is at the Residence Inn 60 meters to the east in the Industrial Zone. The closest home is 250 meters away at 228 Hunting Street in a Residential Zone. The acoustic estimates from positions P1 and P2 in Table 4 show that the fuel cell noise is expected to drop below a level of 43 dBA between distances of 62 and 84 meters. (The levels in Table 4 are generated by combining the background corrected Cooling Module and Power Module estimates found in Table 3.) The fuel cell noise will be well below the 10 dBA increase allowed over the background noise. (The measured L90 background noise varied from 51 to 55 dBA at the two Residence Inn measurement locations.) While the afternoon and evening measurements on one

Acoustical Technologies Inc.

day are not fully representative of the likely variation in background noise, it is not expected that the background noise would ever drop below a level of 33 dBA thereby making the fuel cell noise 10 dBA higher than the background. Using the Needham speaker measurements, the airborne noise level expected at the other Industrial Zone property lines (at distances of 22 to 134 meters) should be below a level of 56 dBA. These levels are all below the maximum of 60 dBA allowed for background noise levels of 50 dBA, the minimum measured in the Industrial Zone. Other nearby residential properties at greater distances are also expected to be well below the Residential Zone background noise of 48 dBA measured in the Residential Zone. For example, at 250 meters the fuel cell noise is expected to be approximately 45 dBA at 228 Hunting Street, well below the background noise

Prominent Discrete Tones

The Massachusetts regulation for the control of noise states in [M.G.L. Chapter 111, Section 142A-M](#) that a puretone octave band level cannot exceed the two adjacent band levels by more than 3 decibels.

To address the discrete tone issue, we use measured data from the testing of a similar Doosan fuel cell in Montville CT (Reference 3). The data is an average that was measured at 5 meters from the fuel cell at three positions surrounding the fuel cell and is shown in Table 5 below. The noise levels at 10 meters from the Cooling Module, the dominant noise source, were about 5 dB lower (but data at only two locations was available). These airborne noise levels using the standard Cooling Module and not the quiet Brooklyn one, are 7 dB higher but still low enough to meet the Massachusetts noise code of less than a 10 dBA increase over the background noise.

Table 5. Measured Airborne Noise Levels from the Montville Doosan Fuel Cell (ref. 20 μ PA)

Octave	Band	Center	Frequency	in	Hertz		At	5	Meters
31.5	63	125	250	500	1000	2000	4000	8000	16000
Octave	Band	Level	In	dBA					
26.1	53.1	62.5	65	65.4	62.8	59.8	58.4	50.6	38.3
	Highest	Difference	in	dB					
			2.5	2.6	3.0	3.0			

In reviewing Table 5, it is clear that the airborne noise levels drop significantly below 125 Hertz and above 4000 Hertz. The peaks in the 125 to 4000 Hertz bands where the noise levels are highest show only minor differences that do not exceed the 3 dB limit in the Massachusetts noise code. There should be no concern about puretone issues. The sound generated by the fuel cell is more typical of random noise as produced by the cooling module with some lower level tones from the fans in the Power Module.

The fuel cell noise decreases in propagating to the nearby properties as the range increases. The highest property line background corrected speaker level was measured at 56 dBA at Position 4, the property line right adjacent to the Power Module. Because of the increasing reduction in

Acoustical Technologies Inc.

noise level with distance to the other industrial property lines the expected fuel cell noise levels will fall below 43 dBA for the other industrial properties. The residential properties to the west should all be lower than a level of 46 dBA. The residential properties to the north are at least twice as far away and will have even lower noise levels. All the expected maximum values (worse case between speaker locations) are shown in Table 4 above. All of the property line estimates will meet the requirement on not exceeding the background by more than 10 dBA. Operation of the Doosan fuel cell should have no acoustic impact at all of the industrial and residential properties adjacent to the Trip Advisor site. No acoustic issues are expected during 24-hour operation of the fuel cell.

Conclusions

The purpose of this effort is to evaluate the acoustical environment at the proposed Trip Advisor LLC fuel cell site in Needham, MA. This has been accomplished and the results show that the operation of a Doosan 460 KW fuel cell will meet all of the State of Massachusetts airborne noise requirements at all the nearby properties in the Industrial Zone. All residences to the west are also expected to meet all the noise requirements because they are at least 250 meters away from the new fuel cell. Residential properties to the north are even further away (440 meters or more) and will not be affected by the fuel cell 's airborne noise. The adjacent Residence Inn property to the east can be as close as 62 meters from the new fuel cell. Airborne noise from the fuel cell will reach levels of 42 dBA at the Residence Inn property line. This is well below the background noise levels of 51 to 55 dBA measured at the Residence Inn property line.

References

- 1) 1) Massachusetts Noise Laws, Exterior Noise Codes,
https://www.newenglandsoundproofing.com/town_noise_code
- 2) New Britain High School Fuel Cell Acoustic Assessment, Acoustical Technologies Inc.,
August 8, 2018
- 3) Montville Fuel Cell Test Report, Acoustical Technologies Inc., July 13, 2020
- 4) Acoustic Findings - 55 Meserole Street - Brooklyn NY – Verizon - Fluid Coolers Blower
Retrofit., Sound Sense, May 17, 2017
- 5) Noise Pollution Policy Interpretation - Mass.gov,
[www.mass.gov > files > documents > 2018/01/31 > noise-interpretation](http://www.mass.gov/files/documents/2018/01/31/noise-interpretation)
- 6) Town of Needham, General By-Laws, Charter, pg 34
[www.needhamma.gov > Town-Bylaws-Charter-PDF](http://www.needhamma.gov/Town-Bylaws-Charter-PDF)



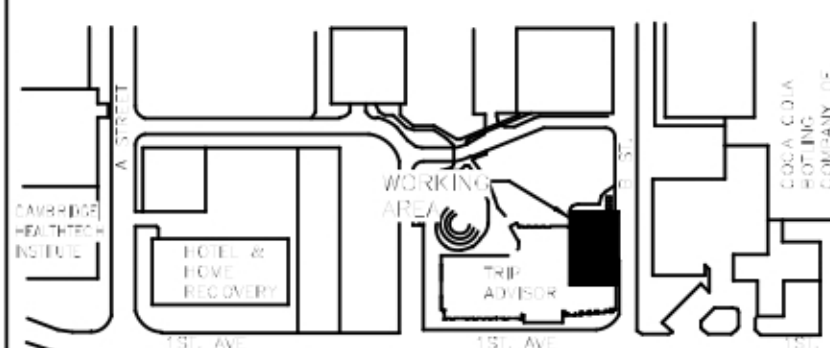
CLIENT

DOOSAN FUEL CELL

PROJECT NAME

TRIP ADVISOR
FUEL CELL INSTALLATION
400 1ST AVE, NEEDHAM, MA 02494

KEY PLAN:



	-	-
	08-07-2020	CONSTRUCTION DOCUMENTS
FIV.#	DATE	ISSUE DESCRIPTION

MEP ENGINEER



STRUCTURAL

RST Technical
Services, LLC

101 FELLOWSHIP ROAD
UNIT 43
UWCHLAND, PA 19480

DRAWING TITLE

COORDINATION DRAWING

JANUARY 2006	
DATE:	7/20/09
	TIME: 10:00 AM
	APPROVED:
	SUBMITTED BY: NAME
	SUBJECT: _____
	ISSUE: _____
	REMARKS: M-703.00
	DATE OF ISSUE: _____
	SIGNATURE: _____

COORDINATION DRAWING
N.T.S.

FULL SCALE DWG. SIZE	24"x36"
-------------------------	---------



**Town of Needham
Design Review Board
Application Review Form**

Applicant Name: Deerborn Fuel Cell

Property Location: Trip Avenue, 400 First Avenue

Type(s) of Application: (Circle all that apply)

Sign

Façade work

Exterior Lighting

Landscaping

Major/Minor Planning Board or Site Plan Review

Zoning Board of Appeals Review

Application Fee Due: 25

Send to: Planning & Community Development
Town of Needham
500 Dedham Avenue, Suite 118
Needham, MA 024924
ATTENTION: Elisa Litchman

Fee Explanation (if necessary):

Application Fee Amount Received: \$0 Not received yet 08-13-20 RMD

Mailing Address for Reviewed/Stamped Applications to be Returned:

6/16/2020

NEEDHAM DESIGN REVIEW BOARD • RECOMMENDED ACTION • APPROVAL: _____ APPROVAL WITH CONDITIONS: _____ <u>08-10-20 DRB Sec. RMD</u> DISAPPROVAL: _____ DATE: _____



TOWN OF NEEDHAM

DESIGN REVIEW BOARD

Public Service Administration Building
590 Dedham Avenue
Needham, MA 02492
Application and Report

stamp "approved with conditions"

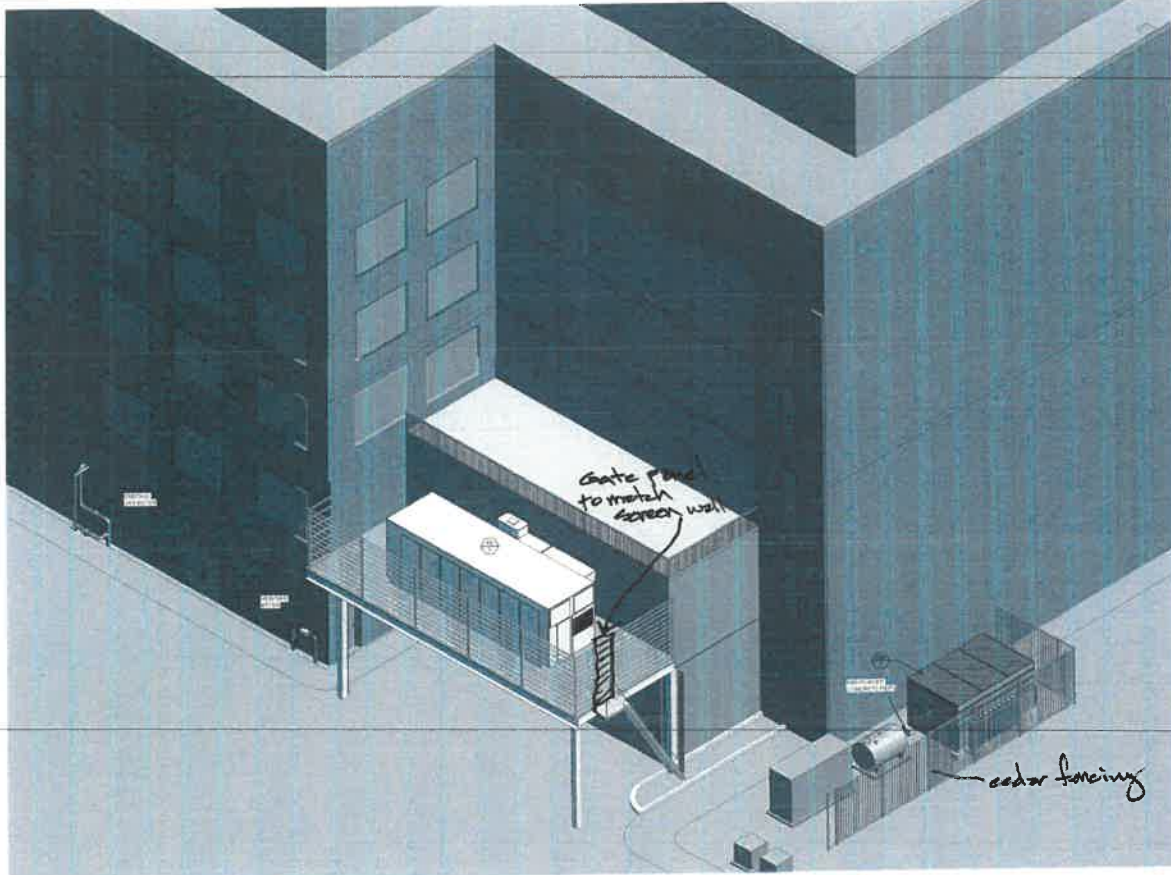
Location: 400 First Avenue Date: June 2, 2020
Owner: US Realty Advisors, LLC
Address: 1370 Avenue of the Americas, New York, New York. 10019
Street City State Zip
Telephone: 212.581.4540
Applicant: Doosan Fuel Cell America, Inc.
Address: 101 East River Drive, East Hartford, CT 06074
Street City State Zip
Telephone: 860.250.3776
Designer/Installer: Willdan Genesys Engineering
Address: 628 Fifth Ave. Bldg. 3 Suite 111 Pelham, NY 10803
Street City State Zip
Telephone: 914.833.6490

Type of Application
☐ Sign
☐ Minor Project
☐ Exterior Alterations
☐ Major Project
☐ Preliminary
☐ Final
☐ Flexible Subdivision
☐ Planned Residential Development
☐ Residential Compound

Brief description of sign or project:

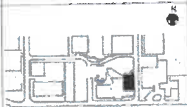
Installation of a Doosan Model 400 fuel cell power plant on a structural steel platform over the loading dock area. powerplant and associated equipment to be fully screened with screening painted to match building envelope.

NEEDHAM	
DESIGN REVIEW BOARD	
• RECOMMENDED ACTION •	
APPROVAL:	
APPROVAL WITH CONDITIONS:	X
08-10-20	
DISAPPROVAL:	
DATE:	



DOOSAN FUEL CELL

TRIP ADVISOR
FUEL CELL INSTALLATION
400 1ST AVE, NEEDHAM, MA 02454



RCM Technologies
The Power of Local Solutions

RST Technical Services, LLC
1000 CENTRE STREET, SUITE 200
NEEDHAM, MA 02454

COORDINATION DRAWING

M-703.03

COORDINATION DRAWING
NEEDHAM

DESIGN REVIEW BOARD

• RECOMMENDED ACTION •

APPROVAL: _____

APPROVAL WITH CONDITIONS: _____

See Notations [Install a gate that
Matches the Screen panel]

DISAPPROVAL: _____

DATE: 08-10-20 DRB Sec. RMD



DOOSAN FUEL CELL

TRIP ADVISOR
FUEL CELL INSTALLATION
400 1ST AVE NEEDHAM, MASSACHUSETTS



RCM Technologies
The Smartest Security Solution

RST Technical Services, LLC
INSTALLATION & MAINTENANCE
OF FUEL CELL SYSTEMS

PROJECT NO. 1001-1001
M-700 00

REFERENCE NOTES:

- 1. FUEL CELL SYSTEM SHALL BE INSTALLED IN THE LOCATION SHOWN.

NEEDHAM
DESIGN REVIEW BOARD

RECOMMENDED ACTION

APPROVAL:

APPROVAL WITH CONDITIONS:

08-10-20 DRB Sec.

DISAPPROVAL:

DATE:



NEEDHAM
DESIGN REVIEW BOARD

• RECOMMENDED ACTION •

APPROVAL: Mark Gueary

APPROVAL WITH CONDITIONS: _____

DISAPPROVAL: _____

DATE: 8.10.20

NEEDHAM

DESIGN REVIEW BOARD

• RECOMMENDED ACTION •

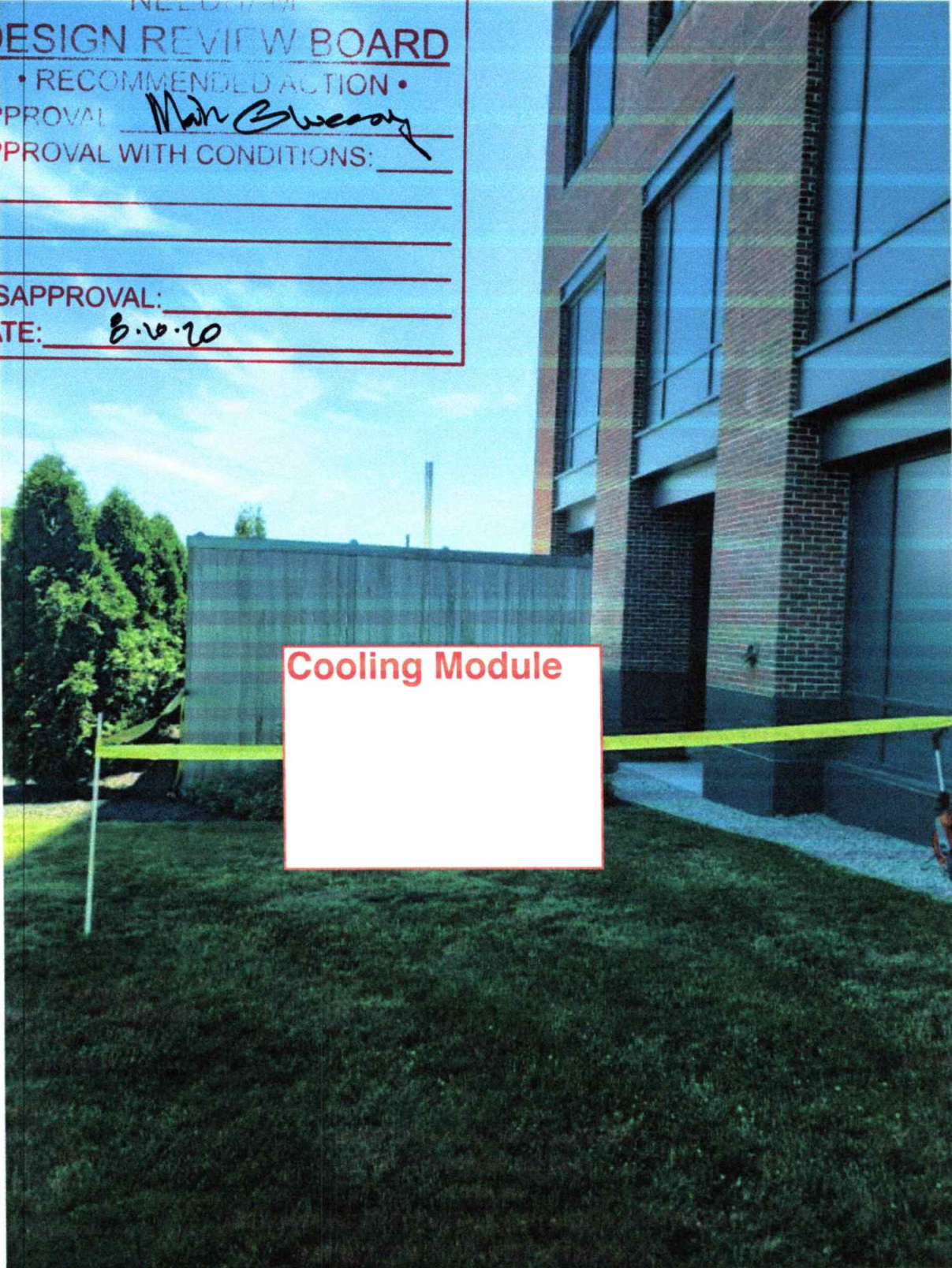
APPROVAL Mark Gueary

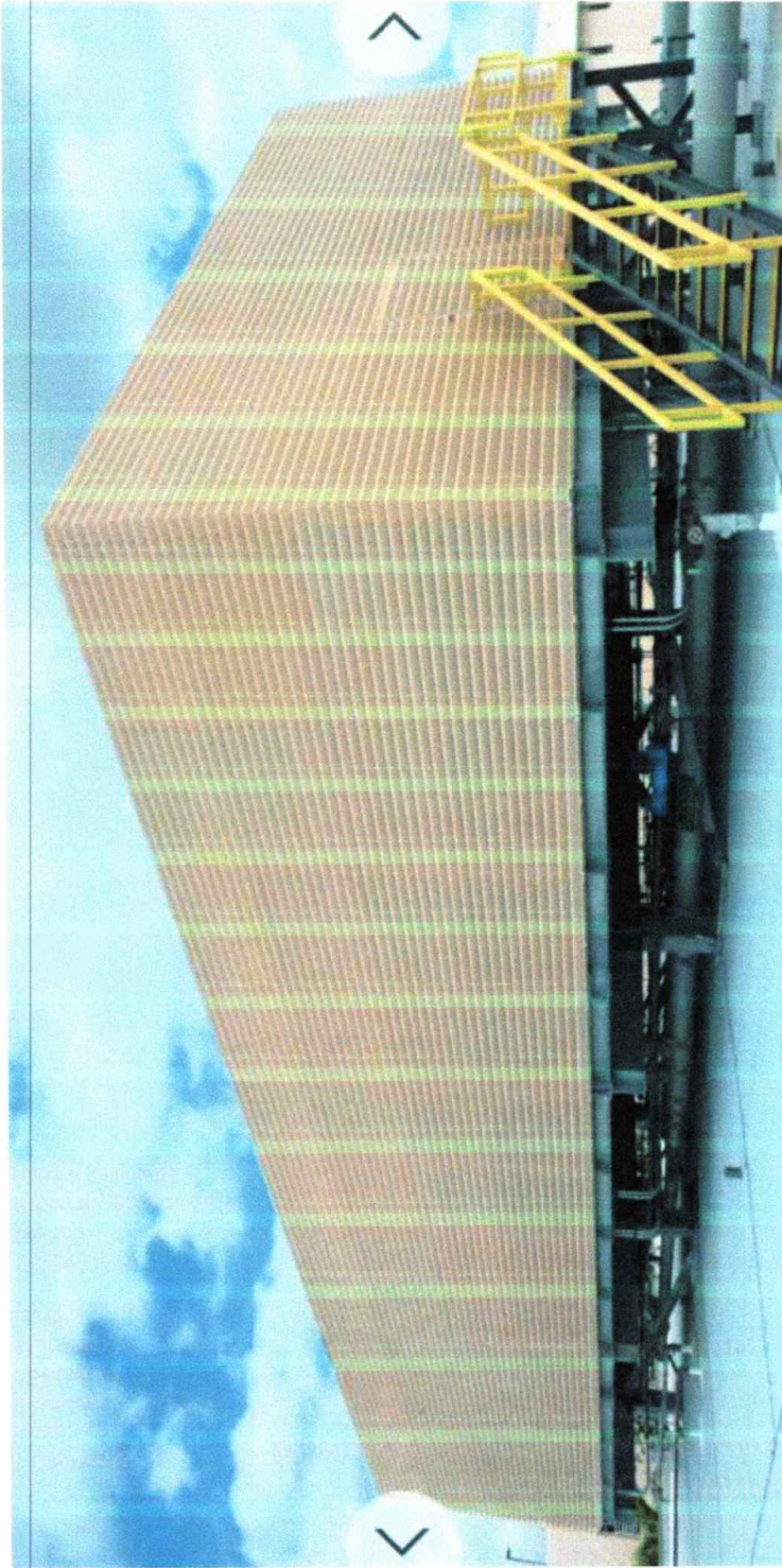
APPROVAL WITH CONDITIONS: _____

DISAPPROVAL: _____

DATE: 8.10.20

Cooling Module





NEEDHAM

DESIGN REVIEW BOARD

• RECOMMENDED ACTION •

APPROVAL: W. C. Green

APPROVAL WITH CONDITIONS: _____

DISAPPROVAL: _____

DATE: 8.10.10

DESIGN

• RECOMMENDED ACTION •

APPROVAL: _____

APPROVAL WITH CONDITIONS: _____

DISAPPROVAL: _____

DATE: _____