Attachment 9

Prepared For: **HiAxiom, Inc.**

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Subject: **York Correctional Institution**
Airborne Noise Assessment
201 West Main Street
Niantic, CT 06357

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Summary

This document makes a positive acoustic assessment that should assist in meeting any acoustic noise concerns during the operation of two HiAxiom 460 KW fuel cells on the site at 201 West Main Street in Niantic, CT. An acoustic assessment plan was developed and executed to acquire airborne acoustic information useful in explaining and mitigating the potential airborne noise issues during operation of the two 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 HiAxiom fuel cells operating at the Niantic site were simulated by exciting a Soundboks speaker at 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 18 to 21 dB higher than the levels measured for a single HiAxiom 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 20 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 400 meters from the proposed fuel cell location. The speaker produced overall A-weighted sound pressure levels of 89 to 92 dBA at 5 meters and 83 to 86 dBA at 10 meters (reference 20 microPascals) at the proposed fuel cell locations. The airborne noise levels from the speaker received at nearby properties were measured at noise levels of 37 to 53 dBA. Residential measurement locations to the north and west were too far away to be able to measure the airborne noise with the speaker on. Analysis of the speaker data indicated propagation losses of at least 30 to 49 dB from the fuel cells' location to the nearby properties. Based on the operation of a HiAxiom fuel cell 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.[3]

The measurements at Niantic were taken at various distances from the speaker and then corrected to estimate the expected noise from two fuel cells. The predicted airborne noise levels are all below 40 dBA, at least 5 dB below the lowest residential night time noise limit. Locations other than the AHEPA apartments are expected to be below 30 dBA depending on how close the locations are to the two fuel cells. Operation of the two HiAxiom fuel cells will have no significant acoustic impact at all of the nearby properties adjacent to the HiAxiom fuel cell site on West Main Street.

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

Introduction

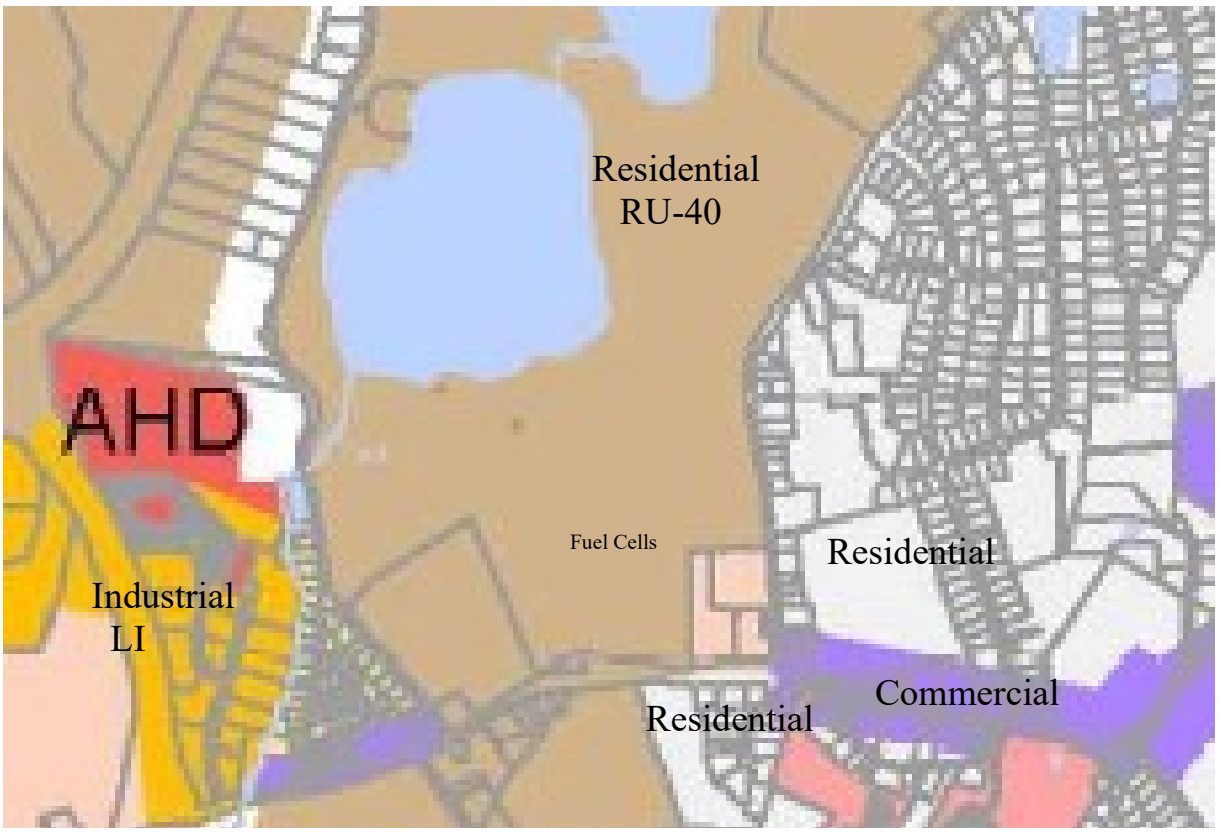
Acoustical Technologies Inc. was tasked as part of a HiAxiom site permitting process with an assessment of potential acoustic issues associated with fuel cell airborne noise reaching the properties adjacent to the York Correctional Institution site at 201 West Main Street in Niantic, CT. Responding to a request from Walter Bonola, a site visit was made on January 30, 2024. During the visit, a survey of the airborne noise levels produced by a Soundboks speaker simulating the airborne noise produced by a HiAxiom 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 speaker off. This document provides an acoustic assessment to assist in meeting acoustic noise concerns during the permitting process for the siting of two HiAxiom fuel cells at the 201 West Main Street site.

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 two HiAxiom 460 KW fuel cells at the York Correctional Institution site on West Main Street. The proposed site at 201 West Main Street is located in a Rural Residential Zone (RU-40). This Residential Zone is surrounded by other Residential Zones to the north, east and south. The south easterly direction has a small Special Use Zone (SU) with elderly housing that is closest to the fuel cell site. The westerly direction has a Light Industrial Zone (LI). Figure 1 shows a section of the East Lyme zoning map. It is important to determine whether the airborne noise generated by the two HiAxiom fuel cells will impact these neighbors.

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 HiAxiom 460 KW fuel cell are available (Reference 3). 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 Niantic site the speaker output will be increased to a level more than 15 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[1] and the Town of East Lyme Noise Ordinance[2] 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 two fuel cells comes near or exceeds the noise requirements at the neighbors' property lines.

Figure 1. Southern Part of East Lyme Zoning Map Showing the Area near the Two Fuel Cells



Acoustic Measurement Program

The acoustic data necessary to assess the impact of two 460 KW HiAxiom Fuel Cells are described below: Airborne sound pressure measurements were conducted at the 201 West Main Street site on January 30, 2024 during the afternoon hours (1 to 5 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 53997) were powered by two Wilcoxon P702B power supply/amplifiers (s/n 1992 and 1995 respectively). The PCB microphones were also calibrated prior to and after the test with the Quest model QC-10 Calibrator (s/n Q19080194). A Hewlett Packard model HP3561A Dynamic Signal Analyzer, s/n 2338A00659, was used to perform 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 dB reference 20 microPascals.

One minute of background noise data was also analyzed at 5 and 10 meters with the same speaker positions and at seven of the eight nearby property lines. Vehicle traffic at P8 on West Main Street was too heavy for meaningful acoustic measurements. At a distance of 400 meters the speaker noise was not audible, even during the brief moments when no traffic was present.

See the Google satellite map in Figure 2 for the approximate measurement locations.
The speaker was located near the proposed southeast Cooling and Power Module units. Sound pressure data were taken with the ExTech sound level meter. Figures 3 and 4 provide photographs of two measurement location for the Southeast position. At these locations, a one-minute record of the acoustic noise was analyzed for the speaker in the "on" condition.

In Niantic "speaker on" and background airborne noise measurements were taken at 5 and 10 meters from the proposed 460 KW fuel cell site and at the following seven nearby properties.

Location	**Business**	**Distance**	**Zone**	**Type**
1 – Cooling Module SE	HiAxiom	5 meters	RU-40	Residential
2 – Cooling Module SE	HiAxiom	10 meters	RU-40	Residential
3 – Power Module SE	HiAxiom	5 meters	RU-40	Residential
4 – Power Module SE	HiAxiom	10 meters	RU-40	Residential
P1 – AHEPA 250-1 North	Apartment	172 meters	SU	Residential
P2– AHEPA 250-1 South	Apartment	225 meters	SU	Residential
P3 – AHEPA 250-V	Apartment	205 meters	SU	Residential
P4 – 252 Roxbury Road	Home	257 meters	RU-40	Residential
P5 – 254 Roxbury Road	Home	262meters	RU-40	Residential
P6 – 258 Roxbury Road	Home	264 meters	RU-40	Residential
P7 – Samuel M. Peretz Park	Ball Field	235 meters	RU-40	Residential
P8 – 208 W Main Street	Home	400 meters	RU-80	Residential

The grounds at York Correctional Institution are shown in Figure 5. The large size of the York property and the location of the fuel cells in the south east corner of the property means the fuel cell noise will not be an issue to the northern and western neighbors. The boundary to the north is Interstate 95 about 2000 meters away while the boundary to the west is about 700 meters. The eastern and southern boundaries start at about 150 meters to the east and 320 meters to the south.

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 in Niantic for the acoustic measurements on January 30, 2024. Measurements were taken over the period from 1:00 pm until 5:00 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 West Main Street and Roxbury Road was heavy. Many of the measurements on Roxbury Road had to be delayed until all visible traffic was absent.

Because of the distant traffic noise, background noise levels at all of the property line measurement positions were moderate with levels from 35 to 46 dBA. At all but one of the measurement locations it was possible to audibly hear the airborne noise from the speaker over the background noise. Airborne noise loss versus range was determined at all these locations.

Figure 2. Google Map Showing Measurement Positions P1 through P6

The highest airborne noise levels were obtained at the AHEPA 250 apartments for both the two speaker locations. These transfer functions were then applied to the 460 KW data from Montville[3] in order to estimate the received levels for the new 460 KW fuel cells in Niantic. Two fuel cells could make as much as 3 dB more noise than one fuel cell if they were both 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 relative distances to the property line for each of the locations. Each cooling module will be modeled at a 10-meter source level of 65 dBA while each power module will be modeled at a 10-meter source level of 61 dBA.[3]

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

$$Ls = 10*\log (10^{(65/10)} + 10^{(65/10)} +10^{(61/10)} +10^{(61/10)}) = 69.5 \text{ dBA}$$

Figure 3. P1 Measurement Location Looking West at AHEPA 250-1 Towards the Speaker

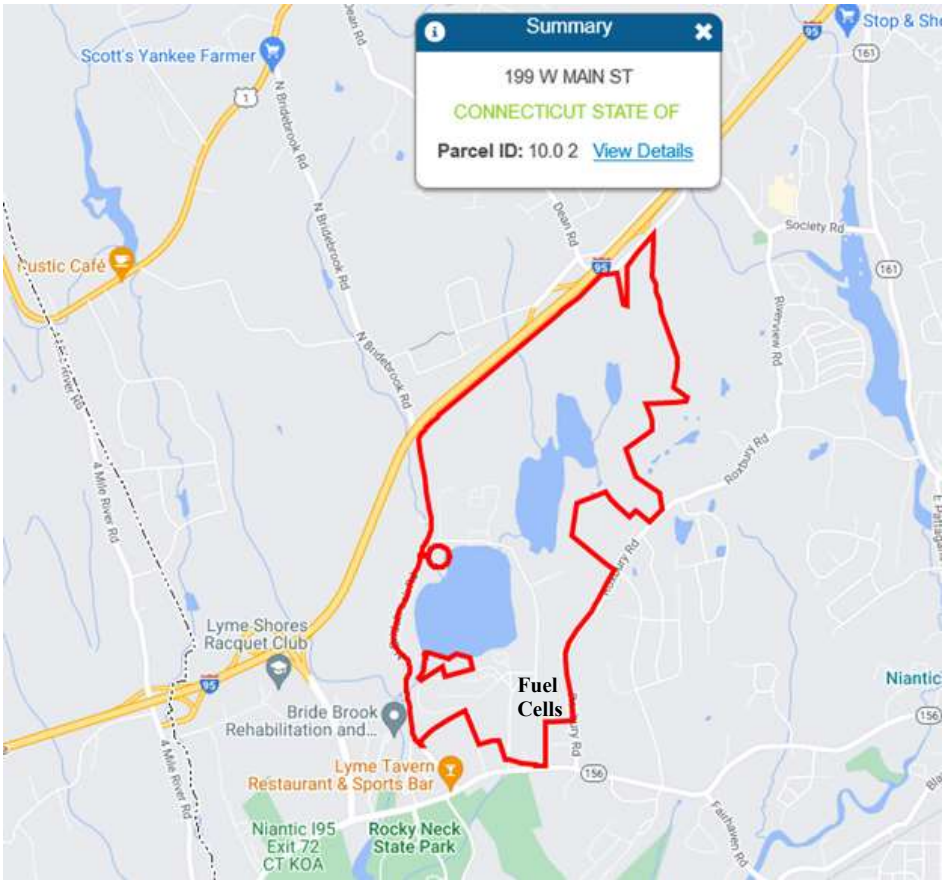
Each property line requires a combination of cooling module and power module noise. The east direction will produce the highest property line noise levels since the property lines are closest (about 172 meters). The south property line to the closest Peretz field is about 235 meters away and should have noise levels slightly lower. The airborne noise at the closest property line on Roxbury Rod is calculated by combining two power modules and two cooling modules. Calculations are made for the seven property lines using the Niantic measured transfer functions and the Montville measured fuel cell noise levels (69.5 dBA – transfer function).

Figure 4. P7 Measurement Location Looking North at Peretz Field Towards the Speaker

Table 1. Weather Data near Niantic on January 30, 2024
https://www.wunderground.com/history/daily/us/ct/groton/KGON

Time (EST)	Temp. (°F)	Humidity (%)	Dew Point (°F)	Barometer (in HG)	Wind Speed (mph)	Wind Direction	Condition
12:56 PM	34 °F	73 %	26 °F	30.23 in	8 mph	NE	Cloudy
1:32 PM	34 °F	70 %	25 °F	30.21 in	9 mph	ENE	Cloudy
1:39 PM	34 °F	70 %	25 °F	30.21 in	7 mph	ENE	Cloudy
1:56 PM	34 °F	70 %	25 °F	30.21 in	8 mph	ENE	Cloudy
2:08 PM	34 °F	70 %	25 °F	30.21 in	8 mph	ENE	Cloudy
2:51 PM	34 °F	70 %	25 °F	30.20 in	9 mph	ENE	Cloudy
2:56 PM	33 °F	72 %	25 °F	30.21 in	7 mph	ENE	Cloudy
3:56 PM	33 °F	70 %	24 °F	30.21 in	9 mph	NE	Cloudy
4:06 PM	33 °F	70 %	24 °F	30.22 in	6 mph	ENE	Cloudy
4:56 PM	31 °F	76 %	24 °F	30.22 in	9 mph	E	Cloudy
5:56 PM	31 °F	72 %	23 °F	30.22 in	8 mph	E	Cloudy
12:56 PM	34 °F	73 %	26 °F	30.23 in	7 mph	E	Cloudy

Figure 5. York Correctional Institution Property Map Showing Fuel Cell Location



Data Analysis

This section analyzes the airborne noise levels measured at the Niantic site and then estimates the received level and transmission loss to nearby properties expected during actual fuel cell operation. These estimated levels will be compared to the noise limits in the Connecticut and East Lyme noise ordinances. Speaker operating noise levels at the Niantic site are reported in Table 2. Background noise levels at the Niantic 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 for the two new 460 KW fuel cells.

Figure 6. Proposed Layout of the Two Fuel Cells in Niantic

Figure 6 illustrates how the two-fuel cell cooling and power modules will be located at the York site. The power modules will block some of the airborne noise coming from the cooling modules and heading to the north. The higher cooling module noise is not blocked heading to the east so the source level of 69.5 dBA is appropriate for a conservative estimate. If necessary, some mitigation could be obtained by rearranging the two units so the power modules block the cooling module sound headed in the easterly direction toward the AHEPA apartments.

A Noise Tools Model[4] was used to study the effect of the trees between the fuel cell site and the apartments. The 83.3 dBA speaker source level at 10 meters requires a 110.3 dB reference 1 picoWatt power level. See Figure 7 for a sample calculation for location P1 that is 172 meters away and 15 meters higher. The actual measured level was 52.8 dBA versus the 58.1 dBA Noise Tools estimate. It appears the trees add about 5 dB of mitigation even without leaves.

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 M	5	South	91.8	92.2	92.5	**91.7**
Speaker On – Cooling M	10	South	86.2	87.5	85.8	**86.0**
Speaker On – Power M	5	North	88.9	89.2	88.7	**88.8**
Speaker On – Power M	10	North	83.7	83.7	83.1	**83.3**
Cooling M Speaker						
P1 – AHEPA 250-1 North	172	East	53.4	57.2	52.8	**52.9**
P2 – AHEPA 250-1 South	225	East	49.9	51.2	49.2	**49.4**
P3 – AHEPA 250V	205	East	51.7	53.2	50.9	**51.1**
P4 – 252 Roxbury Road	257	East	41.2	47.2	39.1	**39.8**
P5 – 254 Roxbury Road	262	East	41.2	85.0	39.6	**39.9**
P6 – 258 Roxbury Road	264	East	41.8	52.4	38.4	**38.8**
P7 – Samuel M. Peretz Park	235	South	48.3	65.1	43.0	**44.8**
Power M Speaker						
P1 – AHEPA 250-1 North	172	East	53.9	57.6	53.3	**53.5**
P2 – AHEPA 250-1 South	225	East	50.9	52.8	50.0	**53.2**

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.
L10 - 10% percentile sound level –L10 is the noise level that is exceeded only 10% of the time.
L90: - 90% percentile sound level –L90 is the level that is exceeded 90% of the time.
The CT State Noise Ordinance[1] identifies the L90 acoustic calculation as useful in determining background airborne noise. **This value will be used as the background noise level.**

The overall airborne noise levels are 18 dB to 21 dB higher for the speaker as compared to what was measured from the HiAxiom 460 KW cooling module at Montville, CT. These 18 to 21 dB differences in level were subtracted from the Niantic 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 two fuel cells in shown in column 6. The 10-meter Montville airborne noise levels were used with the Niantic transmission loss data to estimate the expected two fuel cell airborne noise at the seven nearby neighbors. Only the locations closest to the fuel cells at the AHEPA apartments are near the night time 45 dBA noise limit. The highest expected level at the closest location is 5.7 dB below the 45 dBA requirement.

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

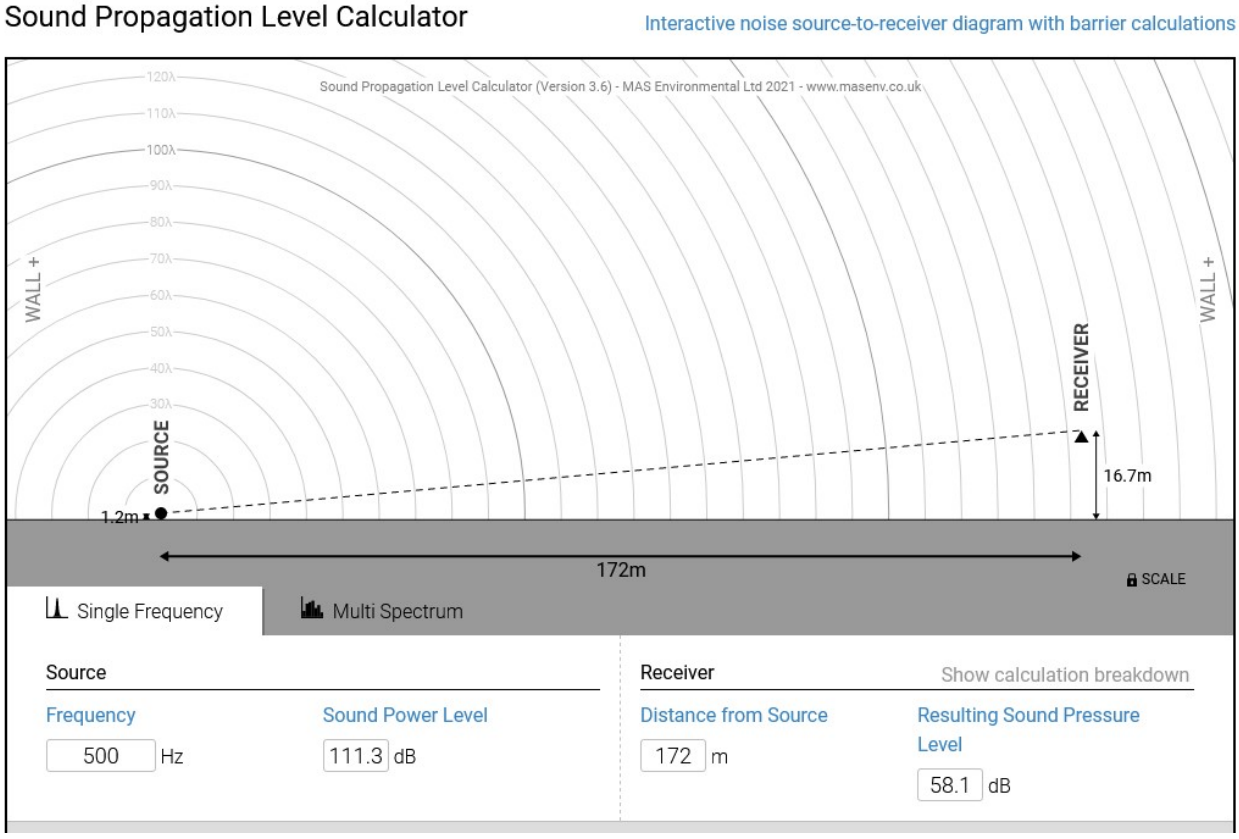
Location	Range in Meters	Direction	Leq	Max	Min	L90
Speaker On – Cooling M	5	South	44.6	46.2	43.7	**44.0**
Speaker On – Cooling M	10	South	45.0	48.9	44.2	**44.6**
Speaker On – Power M	5	North				
Speaker On – Power M	10	North				
Cooling M Speaker						
P1 – AHEPA 250-1 North	172	East	44.3	48.3	41.4	**41.9**
P2 – AHEPA 250-1 South	225	East	47.1	56.8	45.5	**45.8**
P3 – AHEPA 250V	205	East	47.4	54.4	43.5	**43.8**
P4 – 252 Roxbury Road	257	East	37.2	79.2	33.8	**34.5**
P5 – 254 Roxbury Road	262	East	39.1	40.3	38.3	**38.3**
P6 – 258 Roxbury Road	264	East	39.6	75.9	35.9	**36.3**
P7 – Samuel M. Peretz Park	235	South	44.7	49.7	39.6	**41.0**
Power M Speaker						
P1 – AHEPA 250-1 North	172	East	43.4	46.0	42.3	**42.8**
P2 – AHEPA 250-1 South	225	East				

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
Cooling M Speaker			In dBA	In dB	dBA	dBA
AHEPA 250-1 N	172	East	52.6	33.4	36.1	-8.9
AHEPA 250-1 S	225	East	47.8	38.2	31.3	-13.7
AHEPA 250V	205	East	50.4	35.6	33.9	-11.1
252 Roxbury	257	East	38.7	47.3	22.2	-22.8
254 Roxbury	262	East	36.9	49.1	20.4	-24.6
258 Roxbury	264	East	36.9	49.1	20.4	-24.6
Peretz Park	235	South	43.3	40	29.5	-15.5
Power M Speaker						
AHEPA 250-1 N	172	East	53.1	30.2	39.3	-5.7
AHEPA 250-1 S	225	East	52.8	30.5	39.0	-6.0

The Power Module transfer function appears to be about 3 to 5 dB stronger than the Cooling Module transfer function causing the closest property line to reach 39 dBA at P1. Locations other than the AHEPA apartments will meet the requirement by more than 15 dB.

Figure 7. Noise Tool Model of Speaker Transmitting to Location P1 without Trees



The airborne noise levels to be produced by the HiAxiom fuel cells are shown in Table 4. For each of the seven locations the Niantic measurements are corrected to account for the higher speaker levels. The fuel cell's noise correction for the first speaker location is estimated to be about 18 dB because the speaker levels are that much higher than the Montville Cooling Module levels. The speaker at the second location was estimated to be 21 dB higher than the Montville Power Module levels.

The measurements at Niantic were taken at various distances from the speaker and then corrected to estimate the expected noise from two fuel cells. The predicted airborne noise levels are all below 40 dBA, at least 5 dB below the lowest residential night time noise limit. Locations other than the AHEPA apartments are expected to be below 30 dBA depending on how close the locations are to the two fuel cells.

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 HiAxiom 460 KW Fuel Cells. (The East Lyme noise ordinance has the same noise limits.) Following sections discuss each type of noise using the results obtained from the January 30, 2024 speaker measurements in Niantic and the HiAxiom 460 KW fuel cell test in Montville, CT reported on July 13, 2020.

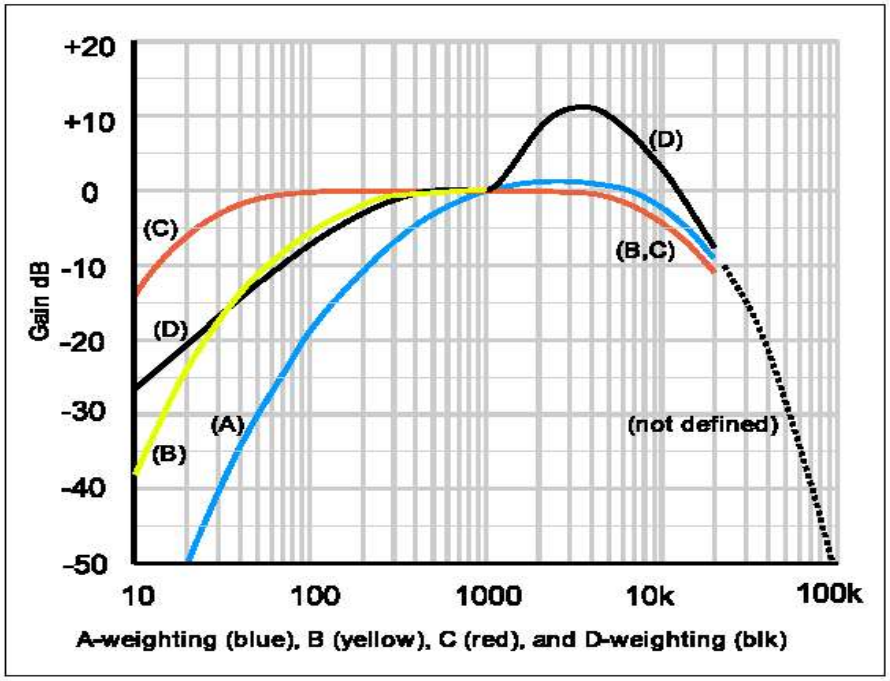
As stated above, the Niantic site is located in a Residential Zone on West Main Street and is surrounded by Residential Zones. The closest residential zone is only about 150 meters away. Based on the analysis resulting in Table 4 the airborne noise from the two new fuel cells should be below the 45 dBA noise limit at distances greater than 100 meters. All other nearby residential properties at 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 East Lyme noise ordinance sets the same limits for Impulse Noise.

Figure 8. Acoustic Airborne Noise Weighting Curves

http://upload.wikimedia.org/wikipedia/commons/3/39/Acoustic_weighting_curves_(1).svg



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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[3]. 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 Niantic property showed 30 dB of transmission loss so the highest expected level would be below 50 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 East Lyme's impulse noise requirements.

A few words are in order to discuss the difference between A-weighted and un-weighted impulse noise. A-weighting emphasizes the middle and higher frequencies while reducing the influence of the low frequencies. Figure 8 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 56 dB reference 20 microPascals. The impulse noise levels at the AHEPA apartments should be no higher than 60 dB reference 20 microPascals, well below 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 Niantic 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 55dBA 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 East Lyme 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 3 Montville testing. The data is the maximum level received in 1/30 octave bands for frequencies from 0.32 to 100,000 Hz. Figure 9 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 HiAxiom Fuel Cell Cooling and Power Modules. The eight 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 properties gives the A-weighted levels in the last three rows of Table 5 after the 3 dB correction for two units is added. All the frequencies at the nearest residences have levels that are below the 40 dBA requirement in a Residential Zone by at least 12 dB. All the nearby residential properties 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 properties.

Figure 9. Montville Tones 460 KW Fuel Cell Cooling & Power Modules in 1-30th octave bands

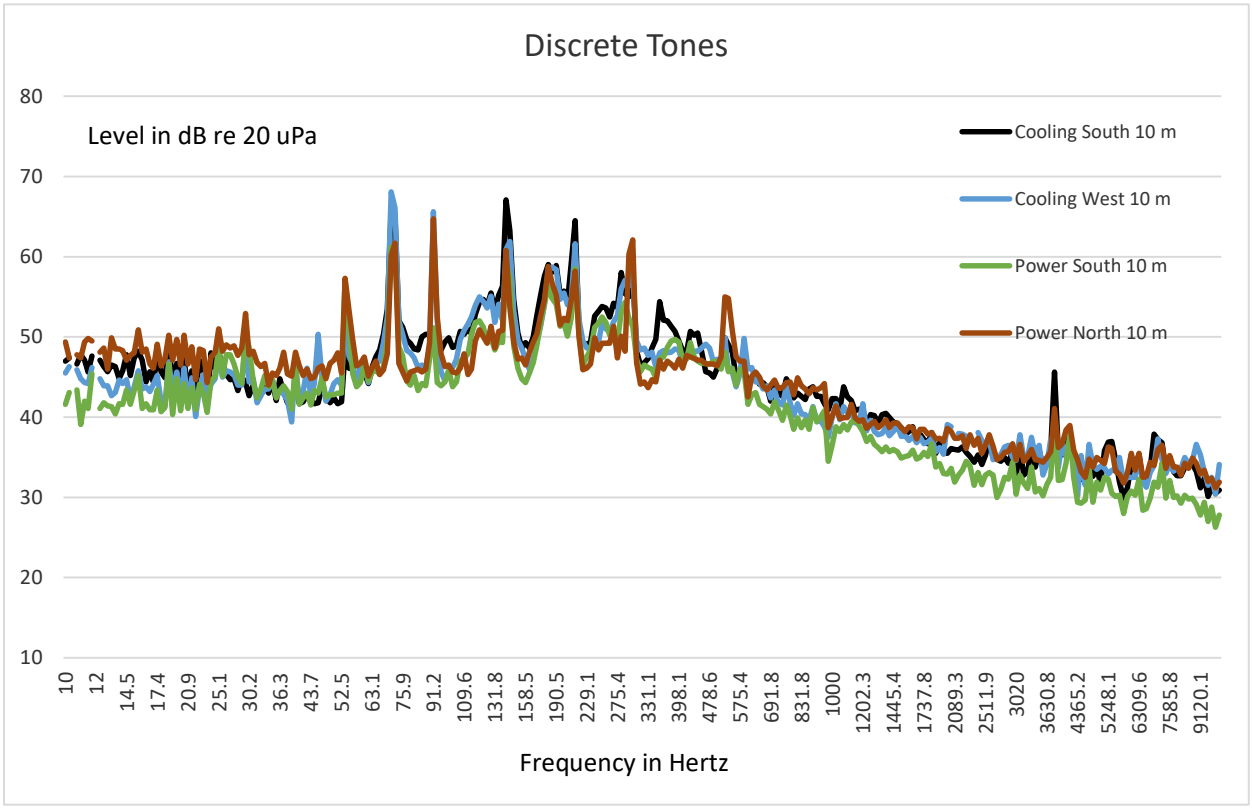


Table 5. Peak Discrete Sound Pressure Level Estimates in dB ref. 20 microPascals

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
Niantic 1 unit	10	28.3	43.8	45.1	52.4	54.3	55.1	46.6	39.9
2 Fuel Cells	10	31.3	46.8	48.1	55.4	57.3	58.1	49.6	42.9
P1– AHEPA N	172	1.1	16.8	17.9	25.2	27.1	27.9	19.4	12.7
P2– AHEPA S	225	0.8	13.3	17.6	24.9	26.8	27.6	19.1	12.4
P3– AHEPA V	205	-4.3	11.2	12.5	19.8	21.7	22.5	14.0	7.3
P7 – Peretz P	235	-8.7	3.8	5.1	15.4	17.3	9.6	19.0	2.9

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. There is no mention in the East Lyme Noise Ordinance that limits infrasonic or 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 10 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 30.2 dB for the maximum transfer function correction at Point P1, the closest site, and adding the gain of 3 dB for two units, the 42.8 dB level is well below the Infrasonic requirement of 100 dB for the Niantic site. The noise levels at all the other nearby residential neighbors 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 11. 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 30.2 dB for the maximum transfer function correction at Point P1, the closest site, and adding the gain of 3 dB for two units, the ultrasonic level of about 34.8 dB is well below the requirement of 100 dB for the Niantic site. The noise levels at all the other nearby residential neighbors will be lower and there should be no issue with ultrasonic noise at any of the neighboring properties.

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

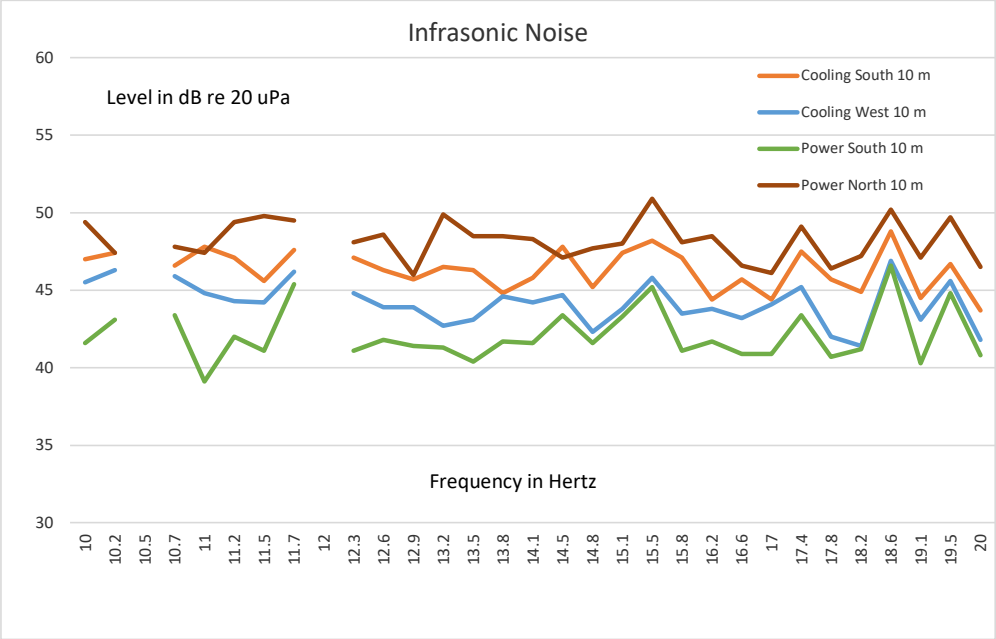
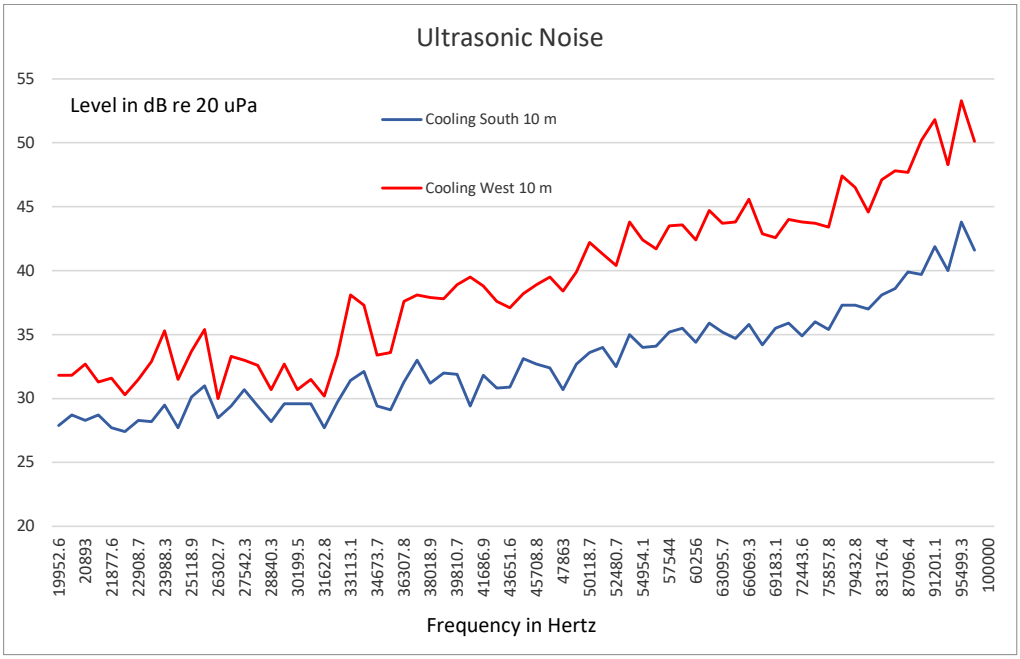


Figure 11. Ultrasonic Noise from Montville Fuel Cell Cooling Modules in 1-30th octave bands



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 Niantic site is 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. The Commercial Zone limit is also 55 dBA.

The estimated overall A-weighted sound pressure levels for two fuel cells in dBA reference 20 microPascals are given in column 6 of Table 4 using the background corrected measurements made on January 30, 2024. The second column gives the approximate distance from the fuel cells to the measurement location, with locations identified by a P number in Figure 2.

Column 3 gives the direction from the fuel cell to the property. 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 property lines. The values in column 6 provide the predicted airborne noise levels at the property lines with two fuel cells operating. The values are all below the residential zone noise limit for both day time and night time operation. The increasing loss with distance to the surrounding residential properties means all should be lower than 40 dBA reference 20 microPascals.

Operation of the two HiAxiom fuel cells will have no significant acoustic impact at all the nearby properties adjacent to the HiAxiom fuel cell site on West Main Street.

The properties close to the fuel cells should see overall airborne noise levels from the fuel cells below the 45 dBA airborne noise requirement. Some of these properties may be able to hear the fuel cells when the background noise ate below 40 dBA (no traffic is present). Residential properties on West Main Street in the Commercial and Residential Zones are not expected to hear the fuel cells. All of the nearby residential, commercial and industrial properties should not be affected by the operation of the two fuel cells.

Conclusions

The purpose of this effort is to evaluate the acoustical environment at the Niantic site during operation of the two HiAxiom 460 KW fuel cells. This effort has been accomplished and the results show that the operation of the two HiAxiom 460 KW fuel cells will meet all of the State of Connecticut and Town of East Lyme airborne noise requirements at all the nearby properties. 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 at distances greater than 250 meters should not hear the operating 460 KW fuel cells during conditions of low background noise.

Acoustical Technologies Inc.

References

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

2) East Lyme Noise Ordinance, http://portal.ct.gov/East LymeNoiseOrdinancepdf.pdf

3) Town of Montville Water Pollution Control Authority Airborne Noise Test

   At 83 Pink Row, Acoustical Technologies Inc., July 13, 2020

4) https://noisetools.net/barriercalculator was used in the sound pressure calculations