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Via Electronic Mail and Hand Delivery

January 14, 2022

Emma Rodvien, Coordinator
Energy Facility Siting Board
89 Jefferson Boulevard
Warwick, RI 02888

Re: **The Narragansett Electric Company**
(Portable LNG Vaporization Project Old Mill Lane, Portsmouth, RI)
EFSB Docket No. SB-2021-04
Responses to Record Requests from November 18, 2021 EFSB Hearing

Dear Ms. Rodvien:

I am enclosing for filing on behalf of The Narragansett Electric Company an original and seven (7) copies of the Responses to the Record Requests from the EFSB hearing held on November 18, 2021 in the above-referenced matter.

Very truly yours,

George W. Watson III

Enclosure

Copy to: Docket SB-2021-04 Service List (by electronic mail)

23988566-v1

SB-2021-04 The Narragansett Electric Company d/b/a National Grid Application for License to Mobilize and Operate a Liquified Natural Gas (LNG) Vaporization Facility at Old Mill Lane (Portsmouth, RI)

Updated October 1, 2021

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Laurie MacDonald	Macdonalds6@cox.net;

Record Request No. 1:

Provide copy of HDR noise memorandums. If not in the report provide the following:

a. Date studies were complete (include weather conditions), and
b. Location of test equipment ("dot on a map").

Response:

The Narragansett Electric Company provides copies of the following three memoranda that were prepared by HDR regarding noise at the Old Mill Lane site:

i. Letter Report, dated March 29, 2021 (Attachment RR-1a);
ii. Draft Memo, dated August 09, 2021 (Attachment RR-1b); and
iii. Draft Memo, dated October 08, 2021 (Attachment RR-1c).

The draft modeling results reported in the August 2021 and October 2021 memos were based on unlikely assumptions on which equipment was in operation, so they do not reflect the actual operation. The Memo dated August 9, 2021 assumed that all of the tested equipment was in operation, and the Memo dated October 8, 2021 assumed that the storage tank was in operation with the glycol vaporizer and pump trailer. As summarized in the Letter Report, the storage tank does generate noise, but this noise occurs when the tank is vented. However, the Company did not ask HDR to correct those assumptions and rerun its modeling because the Company shifted attention to the assessment of the long-term solution, which included a different footprint and thus a different noise profile. Accordingly, those memos remain in draft form.

a. The dates and weather conditions of HDR's noise study of the winter operations are as follows:

   Dates: March 4, to March 5, 2021
   Weather (as recorded by on-site HDR acoustician): 34 degrees Fahrenheit, 10MPH winds

b. An aerial map showing the location of the test equipment is provided as Attachment RR-1d.

Response prepared by or under the supervision of Nicholas Dube and Faye Brown

March 29, 2021

Mr. Brian Kirkwood
National Grid
Senior Supervisor, LNG Operations
1595 Mendon Road
Cumberland, RI 02864

Re: Noise Study for Old Mill Road LNG site

Dear Mr. Kirkwood,

HDR Engineering, Inc. (HDR) is pleased to submit this summary of noise monitoring and noise mitigation recommendations for the National Grid Liquid Natural Gas (LNG) processing facility at 112 Old Mill Road, Portsmouth, RI (Facility).

Introduction

HDR conducted a noise study at National Grid's LNG facility in Portsmouth, Rhode Island. The scope of this study included a long-term unattended outdoor noise measurement, several near field noise measurements of individual equipment around the site, and recommendations for noise mitigation.

Sound is made up of minute fluctuations in air pressure (called sound pressure levels) and most sound is comprised of different combinations of energy throughout the tonal spectrum (low, medium, and high frequencies). The humans hearing organs do not perceive all frequencies of sound equally. Humans do not hear low frequencies well, yet we hear some higher frequencies quite well. To account for this, the A-weighting scale mathematically puts more "weight" on frequencies that humans hear, and less "weight" on frequencies that humans do not hear well. Therefore, the A-weighting scale de-emphasizes low frequency noise (energy in the lower frequencies).

However, that energy does exist, and the C-weighting scale does not de-emphasize it. An A-weighted and C-weighted measurement of the same noise source will produce two different results, and when the difference between C and A-weighted measurement results approaches or exceeds 20 dB it is an indication that the noise source emits high levels of low frequency noise.

Other acoustical concepts used in this report include the following.

1601 Utica Avenue South, Suite 600, St. Louis Park, MN 55416-3400
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- Decibel (dB) = a unit of sound pressure
- dBA = A-weighted decibels
- dBC = C-weighted decibels
- Lmax = maximum instantaneous sound pressure level
- Lmin = minimum instantaneous sound pressure level
- Leq = the energy-equivalent noise level, mean average noise level over a period of time, i.e. one hour
- L50 = a statistical metric that represents the noise level exceeded N% of the hour, in this case 50% of the hour; also, a median average noise level over a period of time, i.e. one hour

The Portsmouth noise ordinance limits maximum allowable noise levels at residential receiving lands to 65 dBA during daytime (7:00 am to 10:00 pm) and 55 dBA during nighttime (10:00 pm to 7:00 am). HDR was not provided right of entry to measure existing noise levels at residences across the street. Therefore, the long-term noise measurement occurred on Facility property and does not represent noise levels at receiving land uses. Following are HDR's results and noise mitigation recommendations. The State of Rhode Island regulates environmental noise, but no quantitative[1] noise limits were identified, and it is thus not discussed further.

Results

Long-term Noise Monitoring

HDR performed an unattended long-term noise measurement at the Facility, in the northeast corner near the property line. A goal of this measurement was *to measure Facility-related noise during the quietest hours of the night, when background noise levels are lowest*. These conditions provide the most accurate measurement of Facility-related noise at the property line.

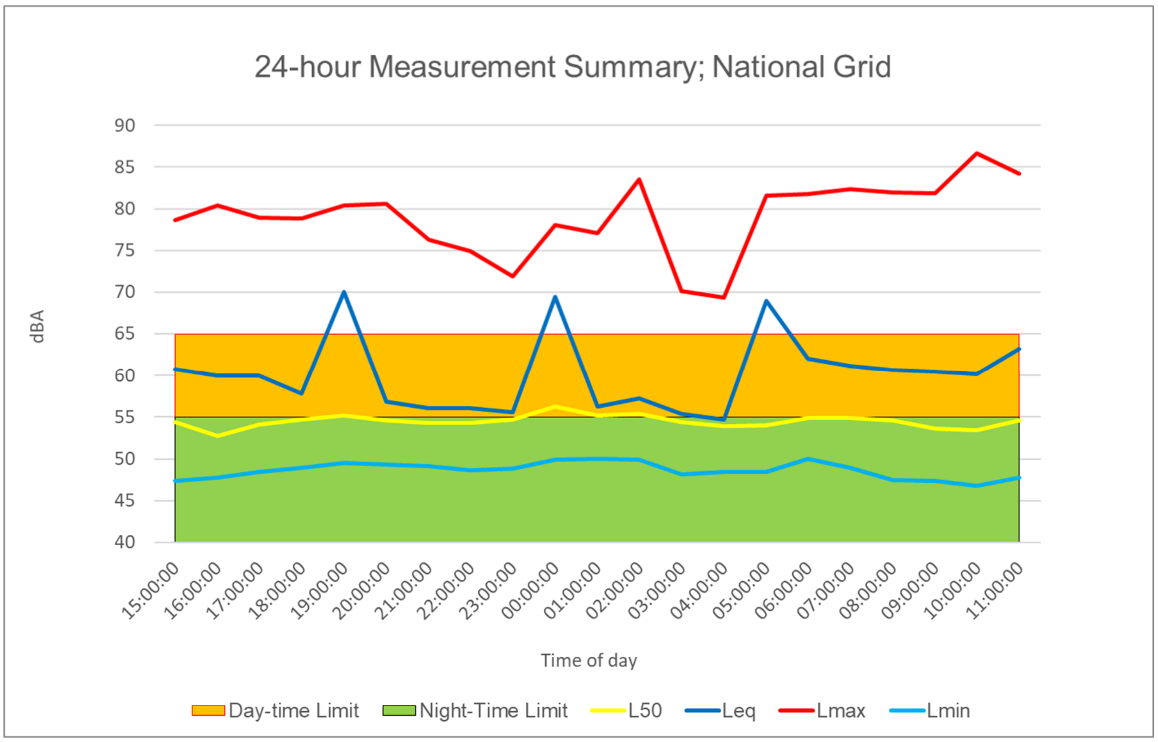
The noise measurement system consisted of a Larson Davis model LD831C sound level meter/real-time analyzer stored in a weather-resistant Pelican case, with an external microphone, preamplifier, and windscreen set up on a tripod. The meter was configured to store Lmin, Lmax, Leq, and statistical metrics including the L50. Measurement results were stored in the LD831C every second, and also summarized every hour on the hour.

[1] The State of Rhode Island noise rules limits low frequency noise (20-100Hz) qualitatively, but doesn't provide explicit noise limits

Figure 1 summarizes hourly measurement results and facilitates a comparison with the daytime and nighttime residential noise limits in the Portsmouth, Rhode Island noise ordinance. Noise measurements shown in Figure 1 include the Lmax, Lmin, Leq and L50. The Lmax can be compared directly with the daytime and nighttime noise limits. The Lmin is presented to help readers understand the overall range in measured noise levels (shown in green and gold bands).

The Leq and L50 are two different expressions of average noise levels. When there is little to no variation in noise levels, the Leq and L50 are usually with 3 dB of each other. The farther apart they are, the more variation there is in measured noise levels. In Figure 1, daytime ends and nighttime begins at 22:00. Daytime resumes again at 07:00.

Figure 1.
Summary of Long-Term Measurement Results



Source: HDR

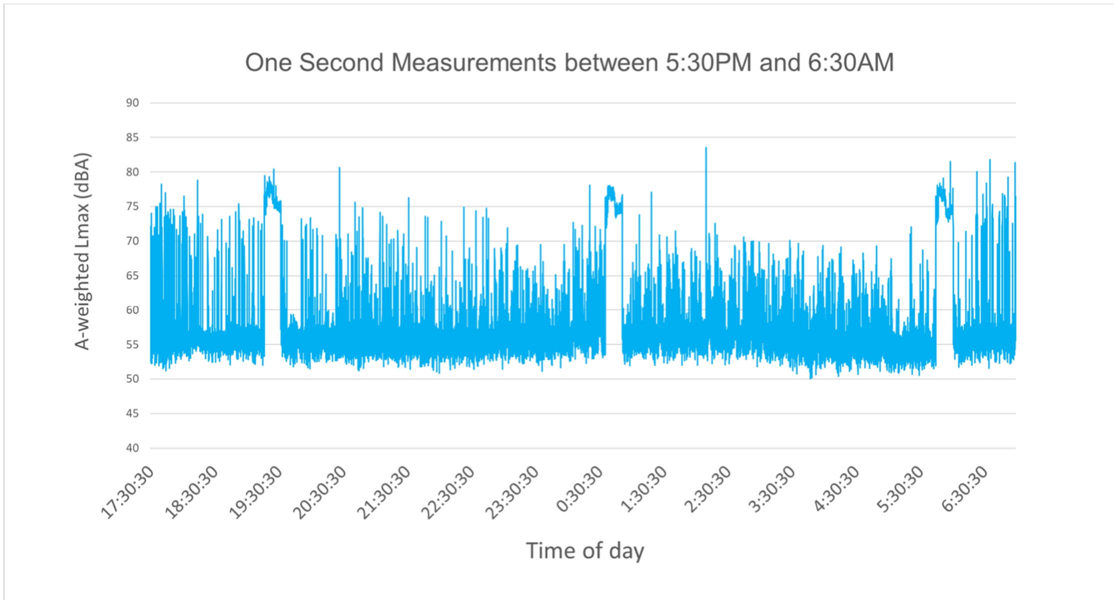
Focusing on the red line, the Lmax value, Figure 1 shows that the quietest daytime hour occurs around 10:00 pm (22:00), and the loudest daytime hour occurs around 10:00 am. Figure 1 also shows that the loudest nighttime hour occurred around 2:00 am, and the quietest nighttime hour occurs around 3:00 am. Additionally, Figure 1 shows that the 1-hour Lmax values exceed the noise ordinance in all measured daytime and nighttime hours. This is most likely due to noise from traffic on Old Mill Road. Figure 1 also shows that the mean noise level or Leq (dark blue) fluctuates considerably, with three substantial peaks that are discussed below.

The measured Lmax levels are above the maximum allowable limit, but this does not indicate that noise from the Facility exceeds limits in the noise ordinance. A compliance measurement would have to be performed approximately 100 feet across the street at a point approximately 20 feet away from the nearest residence (not on-site near the fence) and would require a detailed audio review to remove vehicle pass-by events. So, these results are indicative of noise levels where they were measured but not an indication of non-compliance with noise limits in the local noise ordinance.

The L50 (yellow line) is the median average noise level, and by definition half of the measurements were higher or lower than this level. The L50 is fairly constant throughout the measurement. The difference between the L50 and Leq from each hour is greater than 3 dBA for most hours. This indicates variability in the ambient noise levels, and HDR interprets that as variations in traffic pass-by events on Old Mill Road. The L50 and Leq exhibit a difference of less than 3 dBA during the hours between 8:00 pm and 11:00 pm, and 1:00 am and 5:00 am, and that tells us that ambient noise levels were steady and did not fluctuate a lot during these time periods.

Figure 2 shows a graph of Lmax levels stored every second for the entire long-term measurement.

Figure 2.
One Second Lmax Values

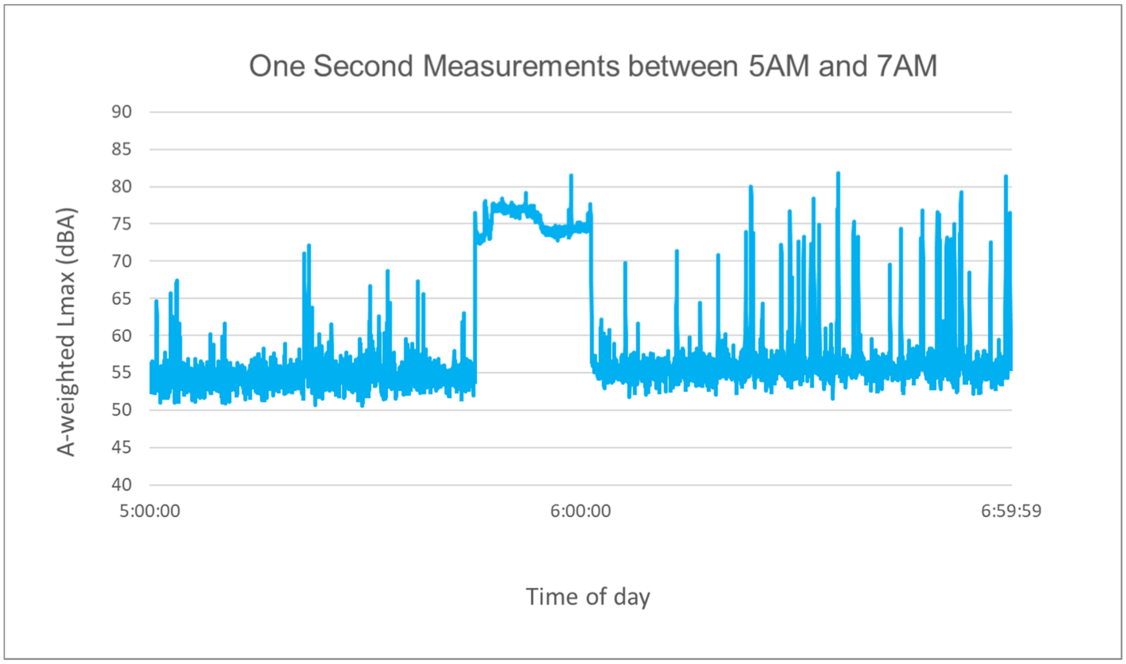


Source: HDR

The three Leq peaks shown in Figure 1 also appear in the graph of one-second Lmax values in Figure 2. These occur in the 7:00 pm hour, the midnight hour, and the 5:00 am hour. Their duration is approximately 10 minutes, and they could conceivably be caused by equipment cycling on and off. The fluctuations within each of the three peaks could be due to vehicle pass-by events happening at the same time although they exhibit similar patterns in each of the three instances.

The next figure shows a closer look at the Lmax measurements during one of the periods when elevated noise levels persisted for approximately 10 minutes. Figure 3 shows a closer look at measurement results during the Lmax spike that occurred between 5:00 am and 7:00 am.

Figure 3.
One-Second Lmax between 5:00 am and 7:00 am



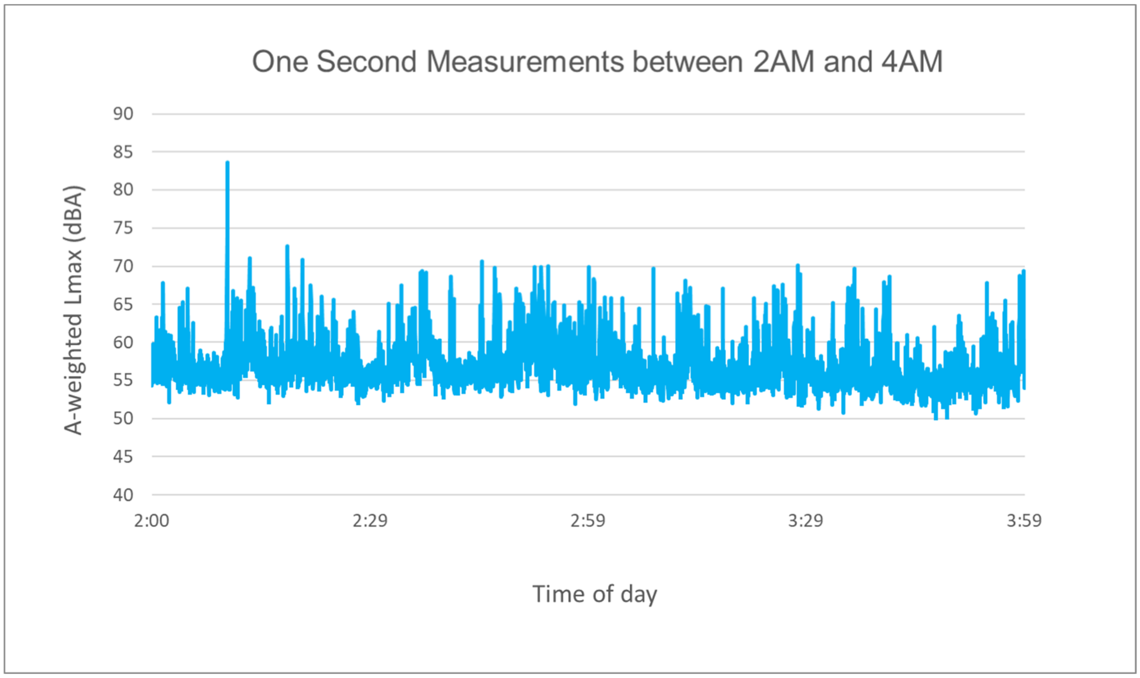
Source: HDR

Figure 3 shows a noise increase with a 16-minute duration roughly between 5:45 am and 6:05 am; this duration is much longer than a vehicle pass-by. It is conceivable that this is an equipment noise event. These measurement results are representative of the location in which they were measured, and do not indicate compliance or non-compliance at any location off-site. HDR suggests that National Grid review operating data in an attempt to determine if this and the other two episodes coincides with any Facility equipment cycling on and off.

The graph also shows a more constant background level that varies between approximately 52-57 dBA and is generally centered around 55 dBA. This appears to be the background noise level. Numerous short-term spikes are also visible in the graph, and HDR assumes they are vehicle pass-by events on Old Mill Road.

By comparison, Figure 4 shows a closer look at the Lmax measurements between 2:00 am and 4:00 am, which includes the 3:00 am hour, the quietest hour of the night.

Figure 4.
One-Second Lmax between 2:00 am and 4:00 am

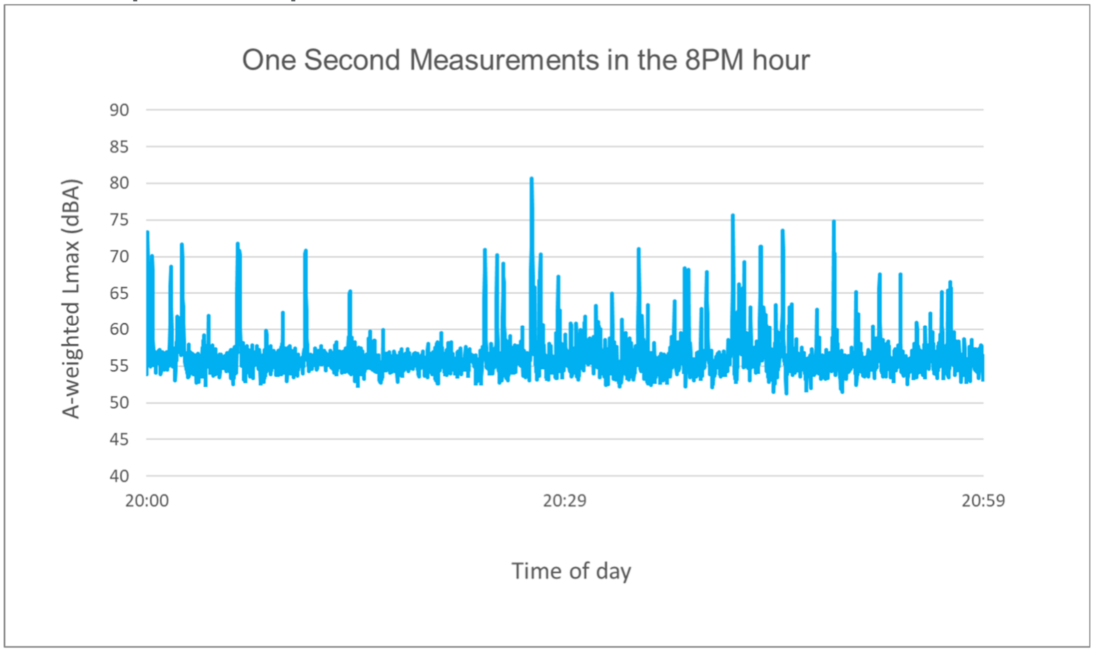


Source: HDR

One-second Lmax levels measured in the 2:00 to 4:00 AM hour show numerous short-duration increases or spikes, many peaking at 70 dBA. That much uniformity is unlikely to be due to vehicle traffic, and the short duration seems unlikely to have been caused by equipment cycling on and off. It could be due to insects, animals, wildlife. The repeated spikes that peak at 70 dBA could potentially be related to the Facility, but unless National Grid can explain otherwise the temporal distribution and uniform spike-like noise levels of those data seems more likely noise from a creature than equipment. The graph also shows constant background level that varies between approximately 55-62 dBA and is generally centered around 57 dBA.

The next graph, Figure 5 takes a closer look at the 8:00 pm hour, one of the quietest daytime hours based on HDR measurement results.

Figure 5.
Lmax Graph for 8:00 pm Hour



Source: HDR

One-second Lmax levels measured in the 8:00 pm hour also show numerous short-duration increases or spikes, many reach 70-80 dBA, and this variation suggests they are attributed to vehicle pass-by events and maybe the on-set of nighttime insect or animal noise. The graph also shows a more constant background level that varies between approximately 52-57 dBA and is generally centered around 55 dBA.

Near field Noise Measurements

HDR also performed near-field measurements of noise from specific equipment on-site. The near-field measurements were performed at a distance of approximately 3 feet to reduce the influence of noise from non-target noise sources. Table 1 presents measurements results expressed as the Lmax, both the A and C-weighted Leqs, and the difference between A- and C-weighted Leqs, sorted by A-weighted Lmax values.

HDR performed noise measurements around noise-emitting equipment in the four cardinal directions. In cases where HDR noted shielding or noise buildup from reverberation, additional measurements were at different locations for more accurate characterizations, as indicated in the 'Measurement Number' column.

Table 1.
Tabulated Summary of Near Field Measurement Results

Equipment Measured	Measurement Number	Lmax (dBA)	Leq		
			dBA	dBC	dBC minus dBA
Ambient Vaporizer	4	97	95	108	13
Ambient Vaporizer	5	96	90	97	7
Ambient Vaporizer	2	94	92	100	8
Glycol Vaporizer	1	94	91	97	9
Ambient Vaporizer	3	92	90	98	8
Storage tank (facing west 55" away)	1	90	89	89	-1
Glycol Vaporizer	2	90	86	95	10
Storage tank, facing north (55" away)	3	89	87	86	-1
Glycol Vaporizer	3	88	85	94	9
Ambient Vaporizer	1	88	87	97	10
Generator (facing west)	2	87	86	91	5
Storage tank (facing south	2	84	83	82	-1
Generator (facing south)	1	83	82	89	8
Glycol Vaporizer	4	79	76	86	10
Glycol Vaporizer	5	78	69	82	12
Glycol Vaporizer, far field	6	77	75	83	8
Pump Trailer (facing West)	2	76	58	64	6
Pump trailer (facing north)	1	74	69	70	1
Pump Trailer (facing south)	3	71	65	68	3
Pump Trailer (facing east)	4	66	63	64	1
Storage tank, facing west	4	65	63	69	6

Source: HDR

Measurement results in Table 1 indicate that the loudest pieces of equipment are the ambient vaporizer, glycol vaporizer and storage tank[2]. The ambient vaporizer also has major noise emission points at each end, and they also need to be addressed in the mitigation discussion. The glycol vaporizer is taller than the ambient vaporizer, and also has an exhaust stack that emits noise. While there were several storage tanks around the site, only one storage tank was being operated when the HDR acoustician was in the field,

[2] The storage tank measured was the one located furthest plan south on the site

thus only one storage tank was measured. Measurement results indicate that storage tanks are also a major noise source.

Noise Mitigation

Mitigation Assumptions

HDR used the following information to develop noise mitigation recommendations

- **Evaporators:** Dimensions of the evaporates are as follows; 50 feet long, 12 feet tall, 8 feet wide
- **Noise Mitigation Area/ square footage**: The area needed to cover the evaporators is approximately:
  - 50 feet long x 15 feet high.
  - The ends also need to be covered and an area of 15 feet tall x 20 feet wide on each end (wrap-around 'wings' on either side of the ambient vaporizer[3]).

Noise Mitigation Recommendations

This section discusses HDR's noise mitigation recommendations. The first step in the noise mitigation process is to establish a design goal, the target amount of noise reduction. HDR used the following general rules of thumb to identify the noise reduction design goal. During a hearing test in an audiology booth, a person with average hearing abilities can just barely discern an increase or decrease in noise levels of 3 db. A 5 dB increase or decrease is likely to be clearly discernable, and a 10 dB increase or decrease is likely to be very clearly noticeable and perceived as a doubling or halving of noise levels. The outdoor noise environment is not an ideal listening environment, like an audiology booth. But a 10-dB reduction would be clearly noticeable outdoors. Therefore, HDR recommends that the noise mitigation goal be a minimum of 10 dB of noise reduction at the residential land uses across Old Mill Road from the site.

Noise can be controlled at 3 different locations: at the noise source, between the source and the receiver (in the pathway), and at the receiver. Noise control at the receiver is not feasible, as these options are typically implemented on the receiver's land and require heavy coordination with landowners. Noise control at the source requires purchasing quieter equipment.

[3] These approaches are described in greater detail below

Noise control in the propagation pathway may be the most economically achievable approach. Therefore, HDR recommends the following noise mitigation options.

i) **Quilted Mass Loaded Vinyl draped over scaffolding**

This approach assumes that a scaffolding or a functionally similar metal framing is built to cover the ambient and glycol vaporizers and the pump unit. The framing would have to reach a minimum height of 15 feet above ground and also needs to be secured to the ground somehow. One option is to anchor the framing into concrete jersey barriers. HDR was unable to obtain a cost for having concrete jersey barriers delivered to the site. Other anchoring options may be available.

Once the framing is installed, commercially available industrial acoustical quilts would be draped over and secured to that framing. The acoustical quilts consist of a layer of mass-loaded vinyl with a minimum density of 1.0 or 2.0 pounds/square foot (psf) with fiberglass insulation on both sides, enclosed in a quilted weather-resistant material. The framing should also wrap around the ends of the vaporizers and pump tank, primarily to block noise propagation from the ends of the ambient vaporizer (leave the tops unenclosed for ventilation).

Kinetics Noise Control is a vendor for the 1 lb./sqft quilted mass-loaded vinyl product Sound Absorber/Noise Barrier Composite | KINETICS® KBC (kineticsnoise.com)) The unit cost for their quilted product is approximately $14/sqft. exclusive of framing and installation.

There would have to be a hole for the exhaust stack to protrude out of and above the glycol vaporizer, and the contractor/owner/operator of the glycol vaporizer would have to purchase and install a silencer for that stack from a noise control specialty firm like Kinetics (www.kineticsnoise.com).

Based on HDR's measurements, storage tanks are another noise source that may need controlling. However, HDR recommends that National Grid implement the initial mitigation measures and evaluate overall noise levels again, to determine the need for additional noise reduction.

ii) **Noise Walls**

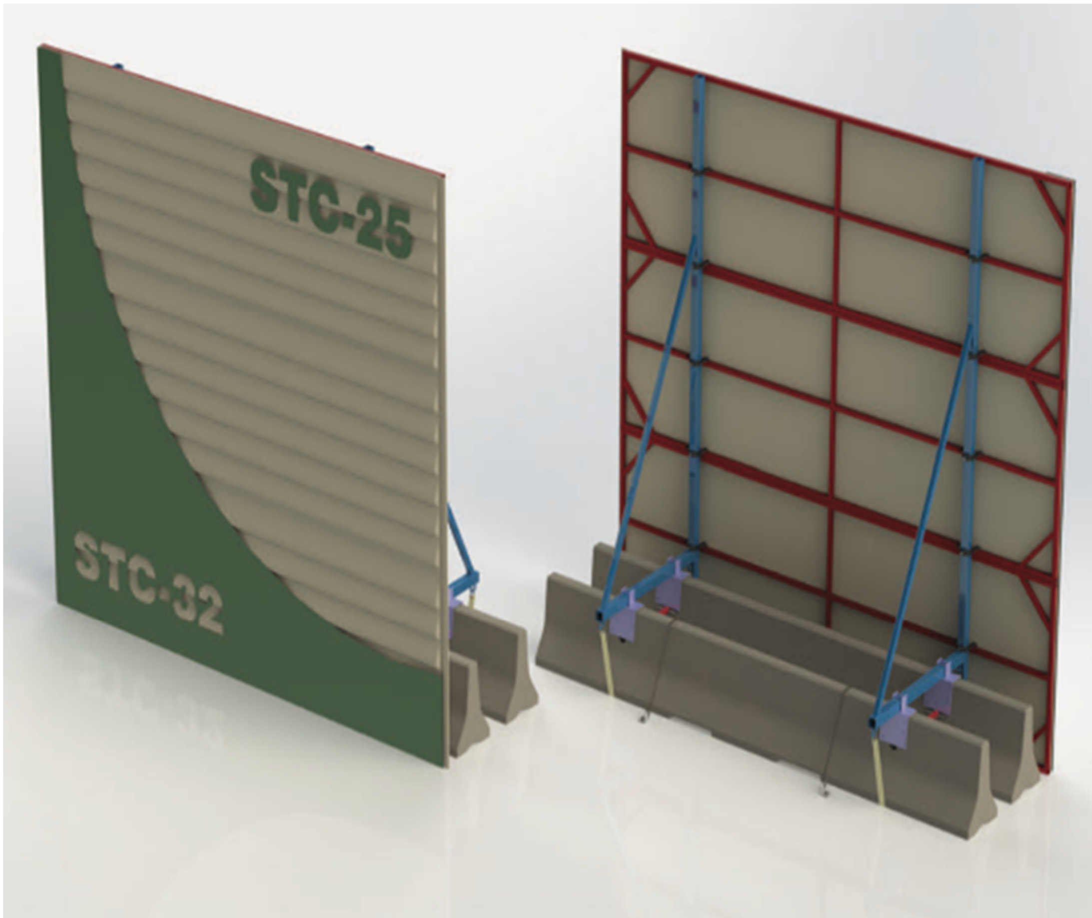
An alternative to the partial enclosure discussed above is use of a noise wall installed near the ambient vaporizer, with minimum height of 15 feet, and wide enough to block noise from both ends of the ambient vaporizer. This noise wall would also block sound propagation from the glycol vaporizer and pump tanks. Below are several noise wall options HDR explored, ranging from simple contractor-built constructions, to commercially available products.

- This wall could be constructed by local contractors using treated 2x6x12 ft. dimensional lumber (like highway noise walls) with all of the gaps between the boards sealed. Costs for this option include engineering, labor, and materials. Purchase price of material alone are estimated to be around $5,500 - $6,500 for the treated 2x6x12 ft. dimensional lumber. Engineering, footing, and labor costs would be additional.

- Another option is to use the quilted mass-loaded vinyl as the barrier and use commercially available framing to suspend it. The unit costs for the acoustical quilt alone is the $14/sqft value discussed above. For the concept discussed in this report, a rough estimate of the purchase price is $20,000 excluding engineering, framing, and assembly.

- Another option is temporary sound wall mounted on a Jersey barrier (the K-rail temporary sound wall) as shown in Figure 6. HDR coordinated with the vendor (Environmental Noise Control | Behrens and Associates (environmental-noise-control.com) and obtained the following rough cost estimate. For a 16-foot-high system, the unit cost is approximately $450-$510/linear foot. For the concepted discussed in this memo, a rough estimate of the purchase price is approximately $40,000 to $50,000. These costs do not include the purchase, delivery, or installation of concrete jersey barriers.

Figure 6.
K-Rail Mounted Barrier



Source: [K-Rail Mounted Temporary Sound Wall | Environmental Noise Control (environmental-noise-control.com)]

Another option are the free-standing SK8 noise barriers, as shown in Figure 7 below. These are produced by the same vendor as the K-rail mounted systems, and average about $1,875 per linear foot for a 20-foot tall system. For the concept discussed in this report, a rough estimate of purchase price is $170,000.

Figure 7.
SK-8 Barrier System

Source: [Freestanding "SK-8" Sound Barriers | Environmental Noise Control (environmental-noise-control.com)]

It is likely that the exhaust stack will require noise control, silencers are suitable approaches for this application. HDR does not have the engineering details needed to specify a particular silencer, however the contractor/owner/operator of that equipment may have the operating parameters of the stack and could work directly with a firm like Kinetics (www.kinetics.com) to select and purchase an appropriate silencer. It should also provide at least 10 dB of noise reduction.

These mitigation recommendations assume that controlling the loudest noise sources results in a noticeable noise reduction off-site. Post-installation measurements would be necessary to confirm the performance and determine if additional noise control is needed for tank trucks located farther from Old Mill Road than the loudest noise sources discussed in this report.

We appreciate the opportunity to have conducted this noise evaluation for National Grid and look forward to helping you with other noise challenges you may face. Please feel free to reach out to Tim Casey, HDR's Acoustics Program Manager at (763) 591-5450 to discuss questions on any of the above content.

Sincerely,
HDR Engineering, Inc.

Sanvisna Kogelen
Acoustical Specialist

Tim Casey, INCE
Acoustics Program Manager

Draft Memo

Date:	Monday, August 09, 2021
Project:	National Grid Portsmouth RI Portable LNG
To:	Nicholas Dube
From:	Sanvisna Kogelen, HDR; Benjamin Copenhaver, HDR
Subject:	Portsmouth, Rhode Island site Noise Modeling Results

Introduction

Project Background

National Grid hired HDR to perform a noise modeling analysis of their site on Old Mill Road in Portsmouth, Rhode Island. This memo discusses the ordinance, HDR's modeling methodology and the results of this analysis.

Technical Background

Noise is defined as unwanted sound and is comprised of small fluctuations in air pressure. Because the range of pressures that can cause audible sounds are large, sound is measured on a logarithmic scale in decibels (dB). A young, healthy human's range of hearing is between 20 and 20,000 Hertz (Hz) and is most sensitive between 500 and 4,000 Hz. To align with this selective sensitivity, the A-weighted scale (dBA) was developed and is frequently used for community noise assessments. The A-weighting scale puts more emphasis or "weight" on frequencies that humans hear well, and less emphasis or "weight" on frequencies we do not hear well (primarily low frequency noise).

The faintest sound that can be heard by a healthy ear approaches 0 dBA, while an uncomfortably loud sound is approximately 120 dBA. To provide a frame of reference, some common sound levels include:

- Jet flyover at 1,000 feet: 100 dBA
- Gas lawnmower at 3 feet: 90 dBA
- Food blender at 3 feet: 85 dBA
- Vacuum cleaner at 10 feet: 75 dBA
- Average speech at 3 feet: 60 dBA
- Quiet urban outdoor daytime: 50 dBA
- Quiet urban outdoor nighttime: 40 dBA
- Quiet suburban outdoor nighttime: 35 dBA

Other common terms used in this noise analysis are:

- Leq – The equivalent noise level over a specified period (e.g., 1 hour). It is a single sound level representing all the varying sound energy in a given duration.
- Ldn – The Day-Night Average Sound Level is the A-weighted sound level over a 24-hour period with a 10 dB penalty imposed on sounds that occur between 10 PM and 7 AM. Ldn was developed to evaluate community response to noise, and the nighttime penalty accounts for the additional nuisance or annoyance associated with nighttime noise events.
- A-weighting – The human ear hears all frequencies differently. The A-weighting scale mathematically adjusts sound in each frequency range to reflect the sensitivity of human hearing organs in each frequency range. A-weighting removes a lot of energy in the low frequency ranges.
- C-weighting – C-weighting is a different weighting scale, and it does not de-emphasize low frequency noise. It can be a useful indicator of the presence of low frequency noise. For example, when the mathematical difference between an A- and C-weighted noise approaches 20 dB, it's an indicator that the noise source has high levels of low frequency noise.
- Lmax – The maximum sound level is described as the highest sound level measured/emitted during a single noise event, in which the sound level changes value as time goes on[1].
- L50 – The L50 is a statistical noise metric. It is the 50th percentile noise value, i.e.: 50% of the noise readings in a particular time period (usually an hour) fall below this number, 50% fall above it
- Lmin – The minimum sound level is described as the lowest sound level measured/emitted during a single noise event, in which the sound level changes value as time goes on
- STC – Sound Transmission Class is a single integer rating used to roughly describe the performance of a wall or wall component in reducing the transmission of airborne sound.

Noise Ordinances

HDR reviewed the City of Portsmouth, Rhode Island noise ordinance, the municipality in which the site is. This ordinance limits the emission of any facility to not exceed a maximum sound pressure level of 65dBA in the daytime (between the hours of 7AM and 10PM) and 55dBA in the nighttime (between 10PM and 7AM the following day) when receiving land uses are residential. For situations in which tonal noise emissions are present, the sound level limits mentioned above are reduced by 5dBA.

HDR conducted a tonal noise analysis based on measured data and confirmed that at least 2 machines on the site emit tonal noise, thus these limits are effectively reduced to 60dBA in the daytime and 50dBA in the nighttime.

[1] *Federal Highway Administration*. Sound Level Descriptors in Alphabetical Order, fhwahep17053.pdf (dot.gov). Accessed 22Apr. 2021.

Noise Measurements

An HDR acoustician made a field visit to the site and measured noise emissions from every piece of equipment present on the site. Equipment included a Larson Davis 831 sound level meter, with a Larson Davis microphone and pre-amp. The sound level meter was set up on a typical camera tripod at a height of 5 feet.

The equipment on-site that were measured included an ambient vaporizer, a glycol vaporizer, a pump trailer, a storage tank and a backup generator. HDR performed noise measurements at a fixed distance of 3 feet from the closest radiating face of the equipment on all four sides of the equipment. HDR also measured the physical size of the equipment using a tape measure.

Figures 1 through 3 below show photographs taken while the measurements occurred.

Figure 1.
Equipment Noise Measurement

Figure 2.
Measuring Noise from the Generator

Figure 3.
Noise Measurement Between Equipment

Modeling Methodology

Methodology

HDR performed noise modeling using the industry accepted environmental noise propagation software, Cadna-A, which is based on the ISO 9613 environmental noise propagation standard. Meteorological settings were set at a constant 50 degrees Fahrenheit (°F) and 70 percent humidity, and downwind propagation conditions were conservatively assumed in all directions simultaneously.

HDR assigned an acoustical absorption ground factor of 0.5, to approximate the acoustically absorptive properties of grassland and lawns in the surrounding area. HDR also included topography of the general site in this noise model.

HDR modeled noise receivers at a height of 5 feet above ground on the property lines of the each receiving parcel off-site. As GIS parcel data was not publicly available or reasonably obtainable for this area, HDR estimated locations of property boundaries based on municipal GIS Webviewers[2]. Please note that this data is provided to the best of the city's ability and while appropriate for estimation, does not function as a replacement for purchased GIS parcel data which provide more accurate parcel line locations.

Noise Sources

Based on the equipment noise measurements, HDR calculated sound power level emissions for each piece of equipment. Using the sound pressure level measurement and physical size measurement of each piece of equipment, HDR calculated the sound power level of each side of the equipment. For all equipment stored side by side (except the storage tank), the acoustical measurement included some reverberation from the adjacent equipment. This reverberation artificially increased the measurement results. To account for this, HDR reduced the sound power level of each long side by 3dB. The top of the equipment was assumed to be equal to the logarithmic average of the 4 other faces. The SWLs of all 4 sides and the top were then summed up and modeled as a point source. The model did not account for any equipment-induced shielding provided by adjacent equipment.

HDR noticed that the storage tank only emitted noise through the exhaust stack. Because of this, HDR developed the sound power level spectrum for this source using data from one measurement point close to the exhaust stack, instead of four at each wall of the tank, and no adjustment for reverberation was necessary. Using these techniques each piece of equipment was modeled as a point source located at the center of the project site.

Table 1 shows the sound power levels of each machine.

[2] City of Portsmouth, RI GIS: Web GIS at MainStreetMaps - Town of Portsmouth, RI | Public by MainStreetGIS, LLC; City of Middletown, RI GIS: Middletown RI, Web GIS (tighebond.com)

Table 1
Sound Power Level Emissions of Noise Sources at the National Grid site

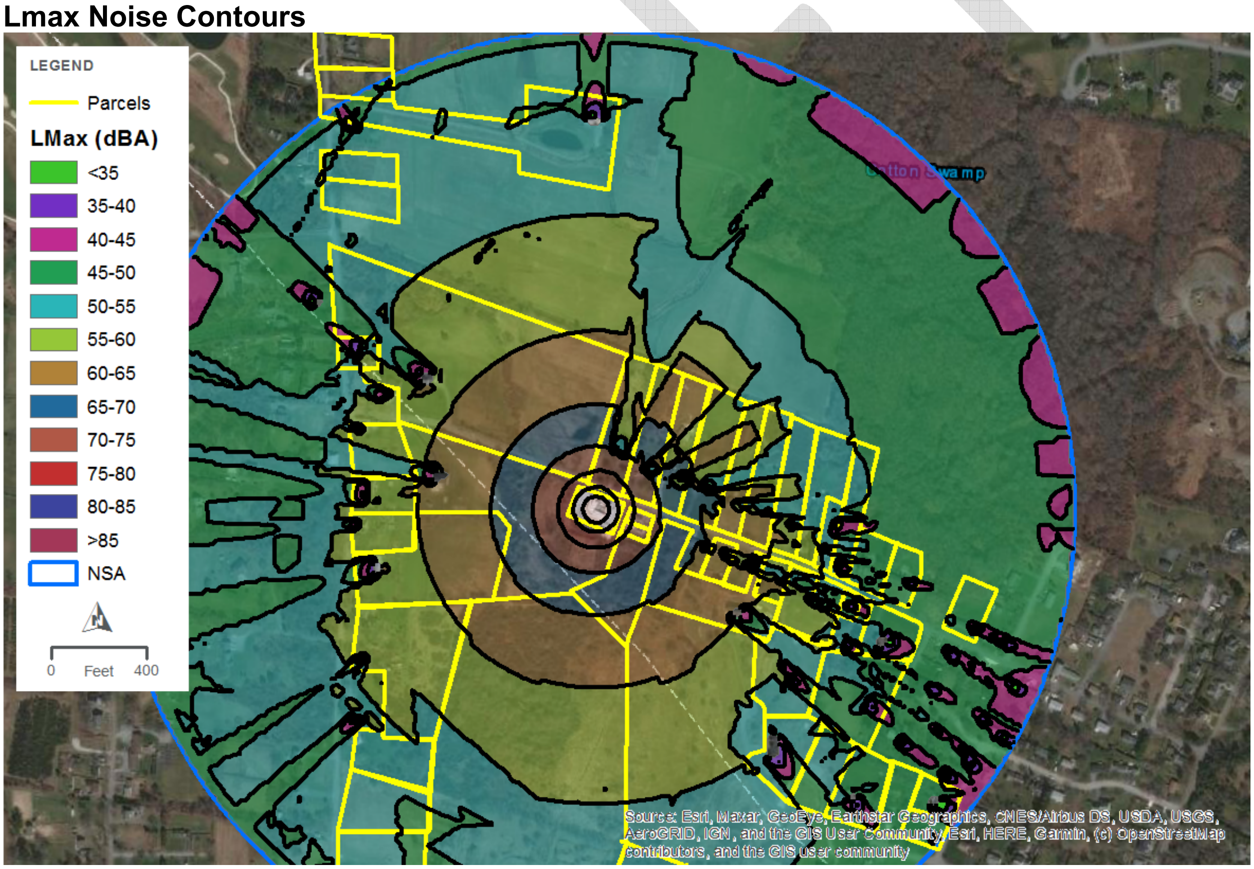
Source	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Overall (dBA)
Glycol Vaporizer	105	119	115	112	109	104	103	97	97	111
Ambient Vaporizer	128	118	116	116	111	108	106	105	107	115
Pump Trailer	97	95	95	94	94	90	87	87	75	96
Generator	103	105	105	108	103	97	92	90	88	104
Storage Tank	110	104	114	102	106	107	111	110	108	116

Source: HDR Engineering, Inc.

Results

Figure 4 shows noise contours that represent the modeled Lmax levels.

Figure 4.
Lmax Noise Contours



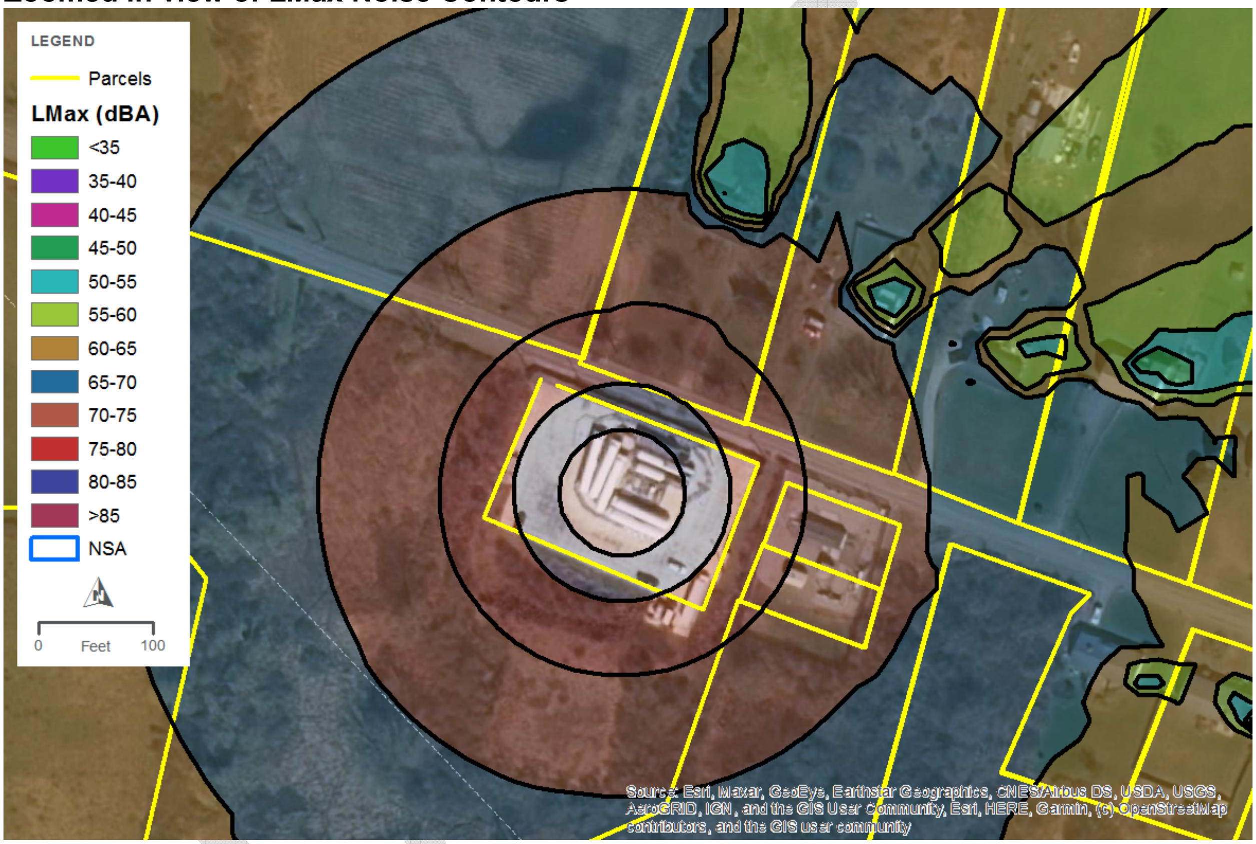
Source: HDR Engineering, Inc.

Figure 4 above shows that numerous homes in the vicinity of the site have modeled noise levels of greater than the 50dBA night-time limit in the vicinity at their property lines. Only at homes at the far side of the figure are modeled Lmax values less than 50dBA, indicating exceedances of Portsmouth, RI noise ordinances at several homes around the site.

The daytime limit of 60 dBA is exceeded only at a handful of homes around the site, indicating that limiting operation to daytime hours will result in less noise control being needed.

Figure 5 shows a zoomed in view of the site and surrounding parcels to illustrate the noise contours in greater detail.

Figure 5.
Zoomed in view of LMax Noise Contours



Analysis results indicate that at the parcel immediately across the street receives project-related noise between 75 and 80 dBA on an Lmax basis. A small part of the 80-85 dBA range clips the parcel line. Ambient noise measurements performed by HDR at 112 Old mill Road showed an Lmax of 79 dBA. Modeling results are within 1 dBA of measurement results which is well within the 3 dB tolerance of the propagation standard (ISO 9613) upon which the noise modeling software is built. This shows good agreement between measured data and modeled results.

Modeled noise levels decrease at locations farther from the project site. However modeled noise levels at all the parcel lines in this zoomed in view do not fall below 55 dBA, indicating potential exceedances of the Portsmouth, RI noise ordinance limits.

Table 1shows the partial levels[3], or source-specific contributions to the overall calculated level at the residential property line closest to the site.

Table 1
Partial level table

Source	Partial Level, LMax (dBA)
Glycol Vaporizer	72
Ambient Vaporizer	76
Pump Trailer	57
Generator	64
Storage Tank	77

Source: HDR Engineering, Inc.

Modeling results indicate that the loudest machine is the storage tank. The glycol vaporizer and ambient vaporizer also emit a lot of noise. These three items contribute the most noise to this receiver. Mitigation should be focused on this equipment, as these items dominate overall noise levels. Mitigating their noise will reduce overall noise levels more than if mitigation were focused on other equipment.

Conclusion

HDR performed a noise modeling exercise to simulate the Lmax levels around the National Grid site in Portsmouth, Rhode Island. HDR found that Lmax values at receiving property lines exceed the noise limits set forth by the city of Portsmouth noise ordinance. Mitigation modeling is recommended to develop noise control strategies for this site.

[3] Partial levels indicate the noise contribution of individual noise sources at a specific receiver. The sum of partial levels from all noise sources is the overall noise level

Draft memo

Date:	Friday, October 08, 2021
Project:	National Grid Portsmouth RI LNG
To:	National Grid
From:	Sanvisna Kogelen, HDR
Subject:	Portsmouth, Rhode Island site Noise Modeling Results

Introduction

Project Background

National Grid hired HDR to perform a noise modeling analysis of their site on Old Mill Road in Portsmouth, Rhode Island. This memo discusses then ordinance, HDR's modeling methodology and the results of this analysis.

Technical Background

Noise is defined as unwanted sound and is comprised of small fluctuations in air pressure. Because the range of pressures that can cause audible sounds are large, sound is measured on a logarithmic scale in decibels (dB). A young, healthy human's range of hearing is between 20 and 20,000 Hertz (Hz) and is most sensitive between 500 and 4,000 Hz. To align with this selective sensitivity, the A-weighted scale (dBA) was developed and is frequently used for community noise assessments. The A-weighting scale puts more emphasis or "weight" on frequencies that humans hear well, and less emphasis or "weight" on frequencies we do not hear well (primarily low frequency noise).

The faintest sound that can be heard by a healthy ear approaches 0 dBA, while an uncomfortably loud sound is approximately 120 dBA. To provide a frame of reference, some common sound levels include:

- Jet flyover at 1,000 feet: 100 dBA
- Gas lawnmower at 3 feet: 90 dBA
- Food blender at 3 feet: 85 dBA

1601 Utica Avenue South, Suite 600, St. Louis Park, MN 55416-3400
(763) 591-5400

- Vacuum cleaner at 10 feet: 75 dBA
- Average speech at 3 feet: 60 dBA
- Quiet urban outdoor daytime: 50 dBA
- Quiet urban outdoor nighttime: 40 dBA
- Quiet suburban outdoor nighttime: 35 dBA

Other common terms used in this noise analysis are:

- Leq – The equivalent noise level over a specified period (e.g., 1 hour). It is a single sound level representing all the varying sound energy in a given duration.
- Ldn – The Day-Night Average Sound Level is the A-weighted sound level over a 24-hour period with a 10 dB penalty imposed on sounds that occur between 10 PM and 7 AM. Ldn was developed to evaluate community response to noise, and the nighttime penalty accounts for the additional nuisance or annoyance associated with nighttime noise events.
- A-weighting – The human ear hears all frequencies differently. The A-weighting scale mathematically adjusts sound in each frequency range to reflect the sensitivity of human hearing organs in each frequency range. A-weighting removes a lot of energy in the low frequency ranges.
- C-weighting – C-weighting is a different weighting scale, and it does not de-emphasize low frequency noise. It can be a useful indicator of the presence of low frequency noise. For example, when the mathematical difference between an A- and C-weighted noise approaches 20 dB, it's an indicator that the noise source has high levels of low frequency noise.
- Lmax – The maximum sound level is described as the highest sound level measured/emitted during a single noise event, in which the sound level changes value as time goes on1[1].
- L50 – The L50 is a statistical noise metric. It is the 50th percentile noise value, i.e.: 50% of the noise readings in a particular time period (usually an hour) fall below this number, 50% fall above it
- Lmin – The minimum sound level is described as the lowest sound level measured/emitted during a single noise event, in which the sound level changes value as time goes on
- STC – Sound Transmission Class is a single integer rating used to roughly describe the performance of a wall or wall component in reducing the transmission of airborne sound.

[1] *Federal Highway Administration*. Sound Level Descriptors in Alphabetical Order, fhwahep17053.pdf (dot.gov). Accessed 22Apr. 2021.

Noise Ordinances

HDR reviewed the City of Portsmouth, Rhode Island noise ordinance, the municipality in which the site is. This ordinance limits the emission of any facility to not exceed a maximum sound pressure level of 65dBA in the daytime (between the hours of 7AM and 10PM) and 55dBA in the nighttime (between 10PM and 7AM the following day) when receiving land uses are residential. For situations in which tonal noise emissions are present, the sound level limits mentioned above are reduced by 5dBA.

HDR conducted a tonal noise analysis based on measured data and confirmed that at least 2 machines on the site emit tonal noise, thus these limits are effectively reduced to 60dBA in the daytime and 50dBA in the nighttime.

Noise Measurements

An HDR acoustician made a field visit to the site and measured noise emissions from every piece of equipment present on the site. Equipment included a Larson Davis 831 sound level meter, with a Larson Davis microphone and pre-amp. The sound level meter was set up on a typical camera tripod at a height of 5 feet.

The equipment on-site that were measured included an ambient vaporizer, a glycol vaporizer, a pump trailer, a storage tank, and a backup generator. HDR performed noise measurements at a fixed distance of 3 feet from the closest radiating face of the equipment on all four sides of the equipment. HDR also measured the physical size of the equipment using a tape measure.

Figures 1 and 2 below show photographs taken while the measurements occurred.

Figure 1. Noise Measurement Equipment recording noise from Site Machinery

Figure 2. Noise Measurement Equipment recording Site Machinery

Modeling Methodology

Methodology

HDR performed noise modeling using the industry accepted environmental noise propagation software, Cadna-A, which is based on the ISO 9613 environmental noise propagation standard. Meteorological settings were set at a constant 50 degrees Fahrenheit (°F) and 70 percent humidity, and downwind propagation conditions were conservatively assumed in all directions simultaneously.

HDR assigned an acoustical absorption ground factor of 0.5, to approximate the acoustically absorptive properties of grassland and lawns in the surrounding area. HDR also included topography of the general site in this noise model.

HDR modeled noise receivers at a height of 5 feet above ground on the property lines of the each receiving parcel off-site. As GIS parcel data was not publicly available or reasonably obtainable for this area, HDR estimated locations of property boundaries based on municipal GIS Webviewers2. Please note that this data is provided to the best of the city's ability and while appropriate for estimation, does not function as a replacement for purchased GIS parcel data which provide more accurate parcel line locations.

Noise Sources

Based on the equipment noise measurements, HDR calculated sound power level emissions for each piece of equipment. Using the sound pressure level measurement and physical size measurement of each piece of equipment, HDR calculated the sound power level of each side of the equipment. For all equipment stored side by side (except the storage tank), the acoustical measurement included some reverberation from the adjacent equipment. This reverberation artificially increased the measurement results. To account for this, HDR reduced the sound power level of each long side by 3dB. The top of the equipment was assumed to be equal to the logarithmic average of the 4 other faces. The SWLs of all 4 sides and the top were then summed up and modeled as a point source. The model did not account for any equipment- induced shielding provided by adjacent equipment.

HDR noticed that the storage tank only emitted noise through the exhaust stack. Because of this, HDR developed the sound power level spectrum for this source using data from one measurement point close to the exhaust stack, instead of four at each wall of the tank, and no adjustment for reverberation was necessary. Using these techniques each piece of equipment was modeled as a point source located at the center of the project site.

Table 1 shows the sound power levels of each machine.

Table 1. Sound Power Level Emissions of Noise Sources at the National Grid Site

Source	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Overall (dBA)
Glycol Vaporizer	105	119	115	112	109	104	103	97	97	111
Pump Trailer	97	95	95	94	94	90	87	87	75	96
Storage Tank	110	104	114	102	106	107	111	110	108	116

At the request of National Grid, two models were created to represent two different operating scenarios as listed below.

Model 1: Glycol Vaporizer, Pump Trailer and Storage Tank

Model 2: Storage Tank alone

The results for each model are discussed in the following section.

Results

Table 2 below shows the Lmax noise levels calculated at the residential property line directly across Old Mill Lane from the site.

Table 2. Modeled Lmax levels at Property Line of Nearest Residential Receiver

Model	Lmax at nearest receiver (dBA)
Model 1	78
Model 2	77

When all 3 sources are modeled, the calculated Lmax levels are 78 dBA at the nearest residential property line. When only the storage tank is modeled, the Lmax at this location is 77 dBA.

To illustrate noise levels further from the site, 2 sets of noise contour figures are discussed below.

Model 1

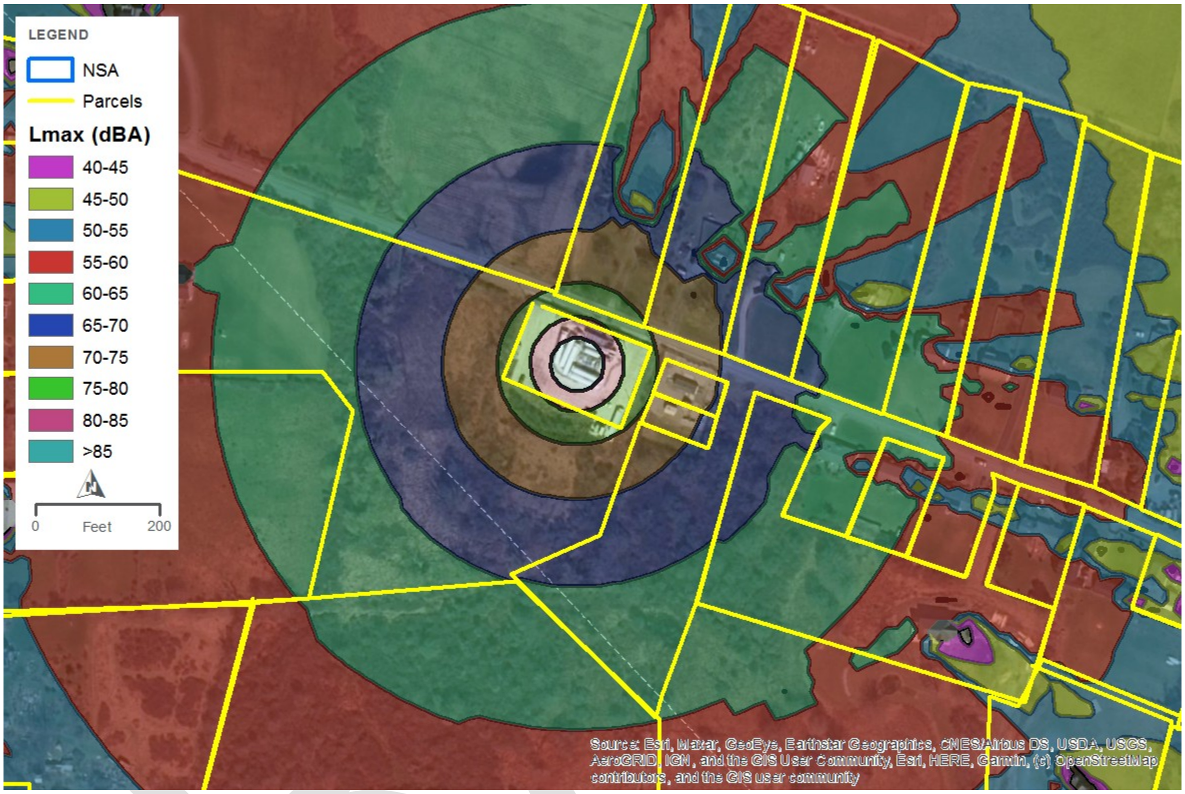
Figure 3. Modeled Lmax Noise Contours (Model 1)

Figure 3 shows that noise levels at residential property lines at the residences at the far ends on the south side of the site (approximately 1550 feet from site center) have modeled noise levels of 50 dBA and below, and thus comply with the Portsmouth, RI noise ordinance.

However, the homes on the north side, and homes that are nearer to the site (below 1550 feet from site center) all exceed the 50 dBA noise ordinance nighttime limit on at least one point of the property line.

Figure 4 below shows a zoomed-in view of the Model 1 noise contours.

Figure 4. Zoomed in view of Lmax Noise Contours (Model 1)



The figure shows that the property line of the residence immediately across the street from the site falls in the 75 dBA and 80 dBA Lmax range, aligning with the value reported in Table 2.

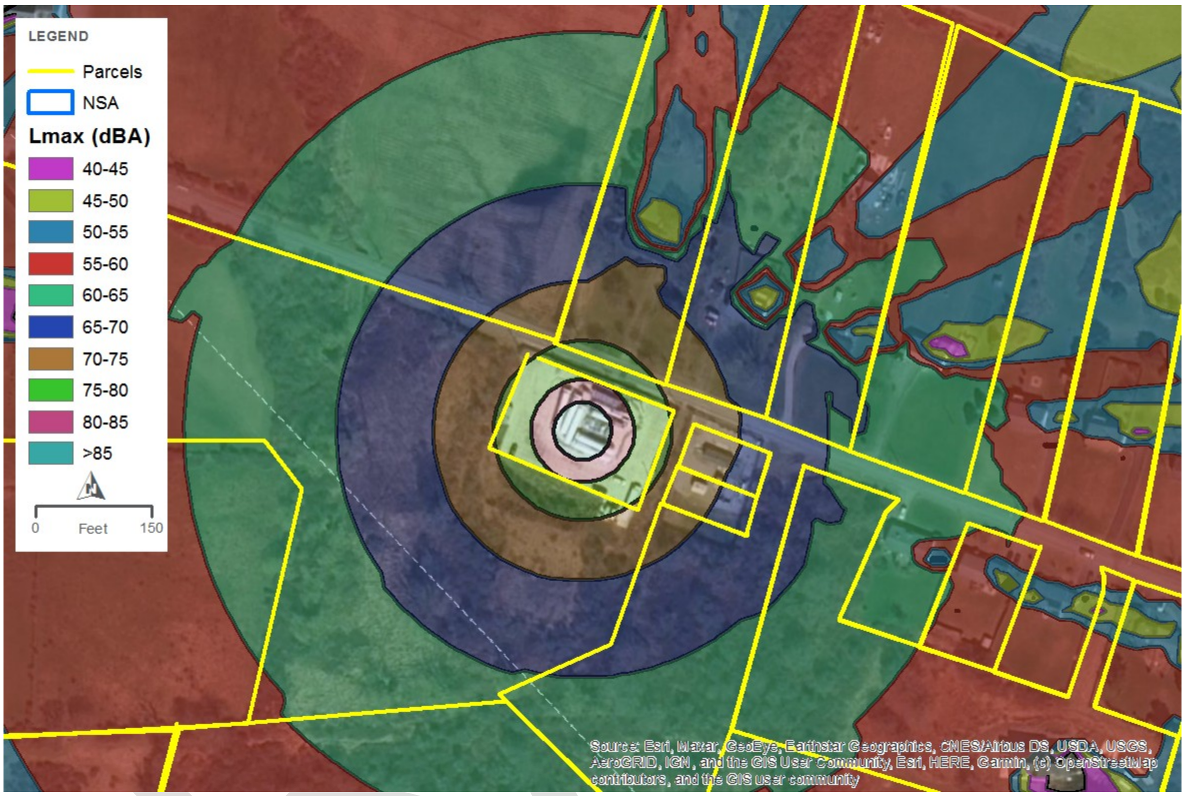
Model 2

Figure 5. Zoomed in view of Lmax Noise Contours (Model 2)

Figure 5 above shows modeled noise contours for Model 2. Similar to Model 1, the noise contours show that residences located at the far south side of the area meet Portsmouth, RI 50 dBA nighttime noise limit (approximately 1330 feet away from site center), but this is not the case for homes in the immediate vicinity.

Figure 6 below shows a zoomed-in view of the Model 2 noise contours.

Figure 6. Zoomed in view of Lmax Noise Contours (Model 2)



Similar to Model 1, the home directly across the street has calculated noise levels between 75-80dBA Lmax, consistent with values reported in Table 2. This again tapers off as we get further from the site.

For comparison, residences 3 doors down (148 Old Mill Lane) from the one immediately across the site have property line Lmax values between 60-65dBA, which is marginally lower than modeled noise levels for Model 1 at this location.

While Model 2 Lmax levels are less than Model 1 noise levels, neither model shows compliance with the Portsmouth, RI noise ordinance limits. This can be attributed to the proximity of the residences to the site, and the inherently high noise emissions of the machines on the site.

Conclusion

HDR performed a noise modeling exercise to simulate the Lmax levels around the National Grid site in Portsmouth, Rhode Island. Two configurations of noise models were prepared, one model with 3 noise sources, and a second with just one. Calculated noise levels from both models were marginally different, and typically fall between 1-2 dBA of one another. HDR found that neither model shows compliance with the Portsmouth, Rhode Island noise ordinance, which can be attributed to the proximity of the residences to the site and the high noise emissions of on-site machinery.


24 hour
Measurement
Location

Record Request No. 2:

Provide a risk assessment for operating from a cold start.

Response:

A “cold start” style operation of the Old Mill Lane portable vaporization facility introduces reliability risks to the gas distribution system, which is in direct conflict with the Company’s commitment to providing safe, reliable, and continuous service to all of its customers.

The operation at Old Mill Lane was designed to mitigate the risk of failure of service to Aquidneck Island from the primary source, i.e., the pipeline feeding the island. The Company mobilizes the vaporization equipment during the winter heating season when customers have a heightened need for gas service to ensure that natural gas can be delivered continuously, safely, and reliably when gas customers need it the most. The operation was put in place to optimize the Company’s ability to respond to known, as well as unknown, vulnerabilities on the primary gas supply source to the island. It is vital to keep the equipment in an operation-ready state throughout the entire seasonal mobilization period, from December 1 to March 31, should unknown operational issues arise. Minutes or hours spent getting equipment to an operational running state will have a direct impact on the magnitude of a supply limitation issue, and each minute that passes increases the potential for a loss of service to customers, and the number of customers potentially affected. Therefore, leaving the equipment offline and non-operational diminishes the efficacy of the site as a risk mitigation tool and must be avoided to maintain reliable service to the Company’s gas customers.

Shutting down the burners overnight forces the equipment to deviate from operational readiness in terms of bath temperature and also in terms of normal operation of the rotating equipment and electronic devices. The risk of a “cold start” was highlighted when Stabilis’ initial attempt to start the burners failed. The burner management systems would not allow start-up producing faults related to improper grounding. There are many devices connected to these systems, each of which could potentially cause such a fault, but Stabilis could not find any grounding problems. Later, inexplicably, and presumably after certain electronics were allowed to increase in temperature and/or decrease in moisture, the faults cleared. When the burners are operated in a more consistent and continuous manner, these types of faults are not encountered. In sum, the Company would not be amendable to a “cold start” operation because it introduces unacceptable risks.

Response prepared by or under the supervision of Nicholas Dube

Record Request No. 3:

Provide a drone aerial photo of the site when the equipment is on site.

Response:

See Attachments RR-3a and RR-3b for drone aerial photos of the site when the equipment is on the site. These photos were taken by National Grid's Aviation Department on December 14, 2021 at approximately 1 PM.

Record Request No. 4:

Perform noise study once equipment is mobilized and operational and the temps are consistent with winter conditions on Aquidneck Island.

Response:

HDR acousticians are scheduled to perform the tests the week of January 10. The Company is planning to have the system in standby mode for 24 hours during the noise study.

The noise study will include one attended measurement system which will be used to measure the storage tank noise emissions (as the storage tank has now been modified) and another unattended measurement system that will be deployed at a home in the vicinity to measure project related noise.

Record Request No. 5:

Provide sound tables of common interior and exterior sounds with dBA levels and include the modelled levels for the facility so they can be easily compared.

Response:

Common Indoor and Outdoor noise sources, with corresponding Sound Pressure Levels in dBA

Sound Source (Outdoor)	Sound Source (Indoor)	Sound Pressure Level, dB(A)
Air Raid Siren at 50 feet		120
Maximum Levels at Rock Concerts (Rear Seats)		110
On Platform by Passing Subway Train		100
On Sidewalk by Passing Heavy Truck or Bus		90
	Food Blender at 1m (~3ft)	85
On Sidewalk by Typical Highway		80
On Sidewalk by Passing Automobiles with Mufflers	Vacuum Cleaner at 3m (~10ft)	70
Typical Urban Area		60–70
Typical Suburban Area		50–60
	Dishwasher in next room	50
Quiet Suburban Area at Night		40–50
	Library environment	40
Typical Rural Area at Night		30–40
Isolated Broadcast Studio		20
Audiometric (Hearing Testing) Booth		10

Sources: Cowan, James P. Handbook of Environmental Acoustics. Van Nostrand Reinhold, New York, 1994. Egan, M. David, Architectural Acoustics. McGraw-Hill Book Company, 1988; Minnesota Pollution Control Agency website, Noise Pollution (Noise pollution | Minnesota Pollution Control Agency (state.mn.us))

Response prepared by or under the supervision of Sanvisna Kogelen (HDR).

National Grid Site Sources with HDR modeled Sound Pressure Levels in dBA

Source	Sound Pressure Levels (dBA)
Glycol Vaporizer at 3.3ft	102
Ambient Vaporizer at 3.3ft*	106
Pump Trailer at 3.3ft	87
Generator at 3.3ft*	95
Storage Tank at 3.3ft**	107

* These sources are backup equipment that are not part of the planned operation so they were not included in the modeling discussed in the HDR memo dated 10/08/2021.

** The operation of this source changed this year when the Company added a vapor recovery system. The Storage Tank sound levels are from the venting procedure. The sound levels from venting into the vapor recovery system have not been tested, but they are expected to be lower.

Sound Pressure Levels are reported as functions of distance - they change as the distance of an observer from a noise source changes. Sound Power Levels are not dependent on distance from a noise source. The Sound Pressure Levels of the noise sources in the table above are derived from the Sound Power Levels reported in the HDR Noise Memorandums (August 2021 and October 2021).

For ease of comparison, the sound power levels of each source are provided in the table below.

National Grid Site Sources with HDR modeled Sound Power Levels in dBA

Source	Sound Power Level (dBA)
Glycol Vaporizer	111
Ambient Vaporizer	115
Pump Trailer	96
Generator	104
Storage Tank	116

Response prepared by or under the supervision of Sanvisna Kogelen (HDR).

Record Request No. 6:

How long does it take to bring glycol up to temperature?

Response:

During the initial startup of the equipment for this winter's mobilization at Old Mill Lane it took approximately 45 minutes to bring the glycol bath from 32°F up to the operating temperature of 125°F. That represents a heating rate of approximately 2°F per minute. The bath temperature set point of 125°F is the typical setting for winter operations. The initial startup occurred on November 30, 2021 at approximately 8 AM. The weather conditions affect the heating rate, and on that day the conditions were cloudy with an outside ambient temperature in the mid-30s°F.

Response prepared by or under the supervision of Nicholas Dube

Record Request No. 7:

a. Identify the ambient temperature or temperature range at which the Company or its contractor Stabilis is comfortable turning off the vaporizer heating and cycling.

b. Identify the ambient temperature at which the Company or its contractor Stabilis would need to restart the vaporizer heating and cycling.

Response:

a. Stabilis recommends that the vaporizer not be turned off at any time during the contracted period for any reason other than maintenance. Thus, Stabilis has never identified an ambient temperature or temperature range at which it is comfortable turning off the vaporizer heating and cycling. Nevertheless, in an effort to limit the noise created by the burner cycling during nighttime hours, Stabilis agreed, at National Grid's direction, to turn the glycol vaporizer off in the evening and back on the following morning. National Grid acknowledges that it is taking a risk by taking this action. The threshold ambient temperature range that the Company has decided to use to determine when to take this action is the 45HDD (20 deg F) obligation for vulnerability need. Ultimately, Gas Control determines the potential need to operate based on forecasting. The vaporizer will not be turned off at night if either: (i) the average 24-hour ambient temperature is forecasted to be equal to or lower than 20 deg F or (ii) Gas Control instructs the Old Mill Lane site to operate in a standby mode or to vaporize.

b. The Company and its contractor would immediately restart the vaporizer if the average 24-hour ambient temperature is forecasted to be at or below the 45HDD (20 deg F) obligation or if Gas Control instructs the Old Mill Lane site to operate in a standby mode or to vaporize.

Response prepared by or under the supervision of Nicholas Dube

Record Request No. 8:

Maintain records regarding the vaporizer cycling for this season: start time; end time; ambient temperature.

Response:

The operator shift rounds sheet has been updated to record Ambient Temperature and Weather Conditions. This data will be captured once during every 8-hour shift. The operators have begun logging when Stabilis turns the glycol vaporizer off in the evening and when they turn it back on in the morning.

The glycol vaporizer burner cycling start and stop times are not currently being recorded because, although the cycling of the burner does create audible noise, the office trailer on site is well insulated making it very difficult for the operator to hear the noise associated with the cycling. There are also no controls in the trailer that indicate the vaporizer burner status.

Stabilis, however, is working to capture this data automatically via instrumentation. The glycol vaporization trailer does not include a programmable logic controller (PLC) which would provide the ability for automated data logging. However, Stabilis has ordered a device which will allow the bath temperature to be shared with an external data collection system (*e.g.*, the one on the pump trailer). Stabilis will pursue installing this device and associated wiring and revising the pump trailer's programming as necessary. The device is expected to be installed mid-February 2022.

Response prepared by or under the supervision of Nicholas Dube