Power Acoustics, Inc.
CONSULTANTS IN ACOUSTICS AND NOISE CONTROL

Noise Study and Acoustical Analysis of the
KYMEA RICE Power Project
Report Number 24-0702-04
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Prepared at the request of:
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For
Kentucky Municipal Energy Agency (KYMEA)

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1.0 INTRODUCTION

Kentucky Municipal Energy Agency (KYMEA) intends to develop a Reciprocating Internal Combustion Engine (RICE) Power Facility (the Facility) near the intersection of Bean Cemetery Rd. and A C Slaton Rd, in Hopkins County, Madisonville, Kentucky. Power Acoustics, Inc. was contracted to measure existing sound in the area, assess/develop acoustical design recommendations relative to existing specification requirements and determine impacts of the new equipment on nearby residential community properties.

The acoustical study consisted of:

1.) Measuring the ambient sound levels at six (6) representative critical residential use property locations located closest to the new RICE equipment. The baseline ambient sound survey data was used as the basis of determining the sound from the existing Waste Water Treatment Plant and other existing ambient sounds.
2.) Setting noise goals for the new Facility based on KYMEA's specification requirements and providing additional criterion to assess community noise impacts.
3.) Estimating the sound levels generated by the Standard RICE equipment.
4.) Generate/estimate a conceptual noise abatement design to reduce community noise impact.

Power Acoustics obtained ambient sound data over a period of three (3) calendar days from June 23rd through 25th 2024. The data include sound measured at the closest residential locations in multiple directions from the Facility.

2.0 EXECUTIVE SUMMARY

The overall character of the existing sound surrounding the proposed RICE Facility is typical of rural or very quiet suburban areas. The existing lowest A-weighted LA_{90} sound levels (the residual sound levels where people perceive the quietness of the area) were found to range between 25 to 33 dB(A) for each of the six monitoring locations and the existing time averaged LA_{eq} sound levels, measured over the entire measurement period, were found to range between 47 and 62 dB(A).

A Base Option with minimal noise abatement and a Low Noise Option, with substantial noise abatement, has been evaluated for the proposed RICE Facility by Power Acoustics, Inc.

A summary of the existing sound and estimated Base and Low Noise Option RICE Facility sound levels are provided in Table 2.1. The Low Noise Option design results in about a 20 dB(A) reduction relative to the minimally silenced Base Option RICE Facility.

The Facility's property line specification requirement of 70 dB(A) is estimated to be achievable with the Low Noise Option. The Facility is estimated to be below the World Health Organization's 50 dB(A) daytime criteria for the onset of moderate annoyance at all framed residences. All framed homes closest to the Facility are estimated to at or below the Federal Energy Regulatory Commission's recommended criterion of 55 DNL (Day/Night Average Sound Level) or an equivalent 24-hour time averaged sound level (LA_{eq}) of 48 dB(A) for continuous 24-hour operation.

Table 2.1. Sound Estimates of RICE Facility

Measurement Location	Existing dB(A) LA90/LAeq	Estimated Plant LAeq dB(A) With Base Level Noise Controls	Estimated Plant LAeq dB(A) With Low Noise Option
M-1	25/62	63	43
M-2	28/60	68	47
M-3	33/47	59	37
M-4	30/51	60	40
M-5*	31/48	70	50
M-6**	27/50	75	54

***Hunting Cabin, ** Mobile/Manufactured Home**

Sound levels during construction will be highest during the earliest stages of the project and will decrease as the project progresses. The maximum and average property line sound level is estimated to be about 82 dB(A) max / 72 dB(A) average during the site balancing and underground utilities work, but will decrease to about 77 dB(A) max / 67 dB(A) average after the construction of the pre-engineered metal building is completed. Sound levels at the closest residential use property will be approximately 12 dB(A) quieter than the property line estimates.

3.0 WÄRTSILÄ 18V50SG BASED RICE FACILITY

Kentucky Municipal Energy Agency (KYMEA) is planning to build a simple cycle reciprocating internal combustion engine (RICE) power plant near Madisonville, KY[1]. The Facility will contain four (4) medium speed RICE engines providing a nominal output of 74 MW. The Facility will operate as necessary during peak power requirements. Peak power requirements typically occur during the afternoon and early evening hours during the summer and at nighttime during the winter. Although unlikely, the Facility can run 24-hours per day, 365 days per year.

The KYMEA RICE Power Facility, will be located directly east of the existing Waste Water Treatment Plant as shown in Figure F3-1. The Facility property is rezoned as General Industrial use property.

Discussion of the Facility's sound levels, as presented in this report, are based on a conservative case with all RICE units operating at full load and all cooling fans and equipment running at maximum speeds and loads. As an example, the main power transformer is assumed to run with all cooling fans at maximum nameplate capacity. However, the main transformer is expected to only run about 65-85% load without requiring the cooling fans to operate. Similarly, the sound from the radiators is estimated when operating at the highest rated ambient temperature (104°F). The radiators, however, will be controlled with variable frequency drives (VFD) and will operate at slower fan speeds 99% of the time. The radiators typical sound levels will then be quieter during times when ambient temperatures are cooler than 104°F, such as most days and particularly during the nighttime hours of operation.

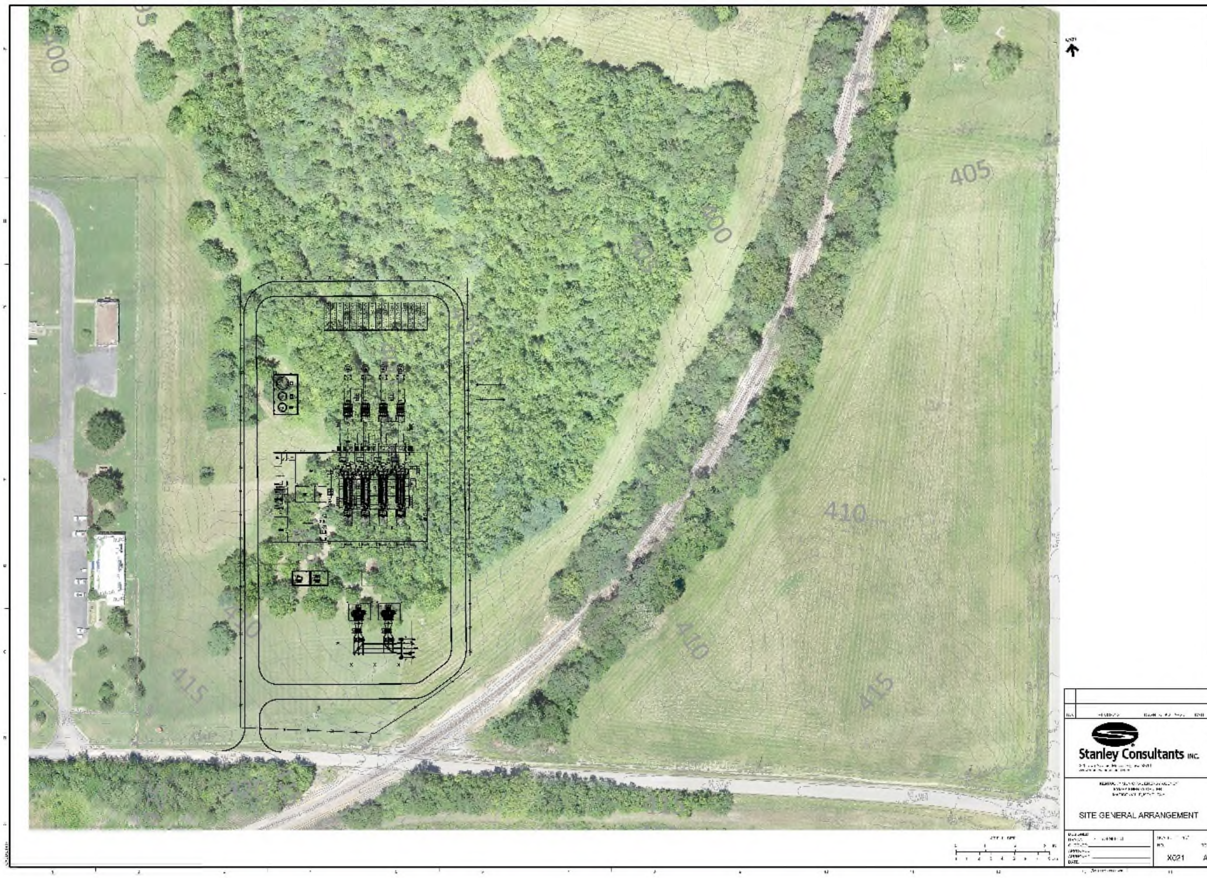

Figure F3-1. Layout Used for the KYMEA RICE Facility Noise Evaluation

4.0 MEASUREMENT METHODOLOGY, INSTRUMENTATION AND CONDITIONS

4.1 Sound Measurements and Methodology

The existing background ambient sound levels, which define the baseline noise for the Facility design, were measured over a three-calendar day period from June 23rd through 25th 2024. The ambient sound levels were measured at representative community locations that have a potential impact from the proposed RICE equipment. The sound survey principles were based on the ANSI, ASME and ASTM standards such as ASTM E 1503 "*Standard Test Method for Conducting Outdoor Sound Measurements Using a Digital Statistical Sound Analysis System*" [2,3,4,5].

The metrics used* for evaluating the ambient sound include:

- A-weighted and C-weighted time averaged (equivalent) sound levels, (LA_{eq}, LC_{eq}),
- A-weighted statistical sound levels,
- 1/3 and 1/1 Octave Band (frequency spectrum) analysis.

* See Appendix B for definitions of acoustical terminology.

4.2 Sound Measurement Instrumentation

The community sound level measurements were made using RION NL-52ex and Norsonic NOR140 Precision Sound Level Meters and Frequency Analyzers. Sound analyzers were equipped with a half-inch microphones and windscreens. The instrumentation meets ANSI Sl.4 [2] Type 1 (precision) requirements for acoustical measuring devices. Specific equipment used in the measurements is shown in Table 4.1.

Table 4.1. Sound Measurement Equipment Model and Serial Numbers

Equipment	Model	Serial Number	Last Laboratory Calibration	Location Used
Norsonic Field Calibration Source	1251	32841	05/08/2024	All
RION Type 1 Logging SLM	NL-52ex	00610182	11/29/2023	M-1
RION Type 1 Logging SLM	NL-52ex	00610181	11/29/2023	M-2
RION Type 1 Logging SLM	NL-52ex	00610180	11/30/2023	M-3
RION Type 1 Logging SLM	NL-52ex	00610179	11/30/2023	M-4
Norsonic Type 1 SLM	N140	1403594	05/08/2024	M-5
Norsonic Type 1 SLM	N140	1404365	05/08/2024	M-6
Norsonic Type 1 SLM	N140	1404507	11/29/2023	Property Line

The sound measurement equipment was field calibrated immediately before and after each survey. The post calibration check indicated the measurement equipment had no significant drift in sensitivity (≤0.5 dB). All sound measurement equipment conforms to manufacturer's recommended intervals and standard practices for laboratory calibration. Copies of laboratory certificates of calibration are on file and available for review upon request.

4.3 Personnel Performing the Sound Survey and Analysis

All Sound Survey measurements were made by David Parzych, INCE.Bd.Cert., Principal Consultant, Power Acoustics, Inc. Qualifications and résumé are provided in Appendix A.

4.4 Weather Conditions

The weather was warm (74 to 93 °F) with wind generally below 10 mph. There was no precipitation during the testing and the relative humidity was below 90%.

5.0 SOUND MEASUREMENT RESULTS

5.1 Measurement Locations

Community sound level measurements were made at six (6) representative locations (M-1, M-2, M-3, M-4, M-5 and M-6. Locations M-1through M-4 are representative of existing residential framed housing structures. Location M-5 is a small cabin used on occasion for hunting/fishing. Location M-6 represents a mobile/manufactured home that is currently permanently occupied.

The approximate UTM coordinates are shown in Table 5.1. The corresponding locations are presented in Figure F5-1

Table 5.1. Location of Noise Measurement

Measurement Location	UTM Coordinates, Zone 16S	
M-1	450082E	4130487N
M-2	451475E	4129886N
M-3	453044E	4130617N
M-4	451165E	4132127N
M-5	450655E	4130469N
M-6	451318E	4130315N

The microphones were located on tripods approximately 5 feet above the ground.

Figure F5-1. Ambient Sound Measurement Locations

Sound level measurements were also made on the property boundary as shown in Figure F5-2.

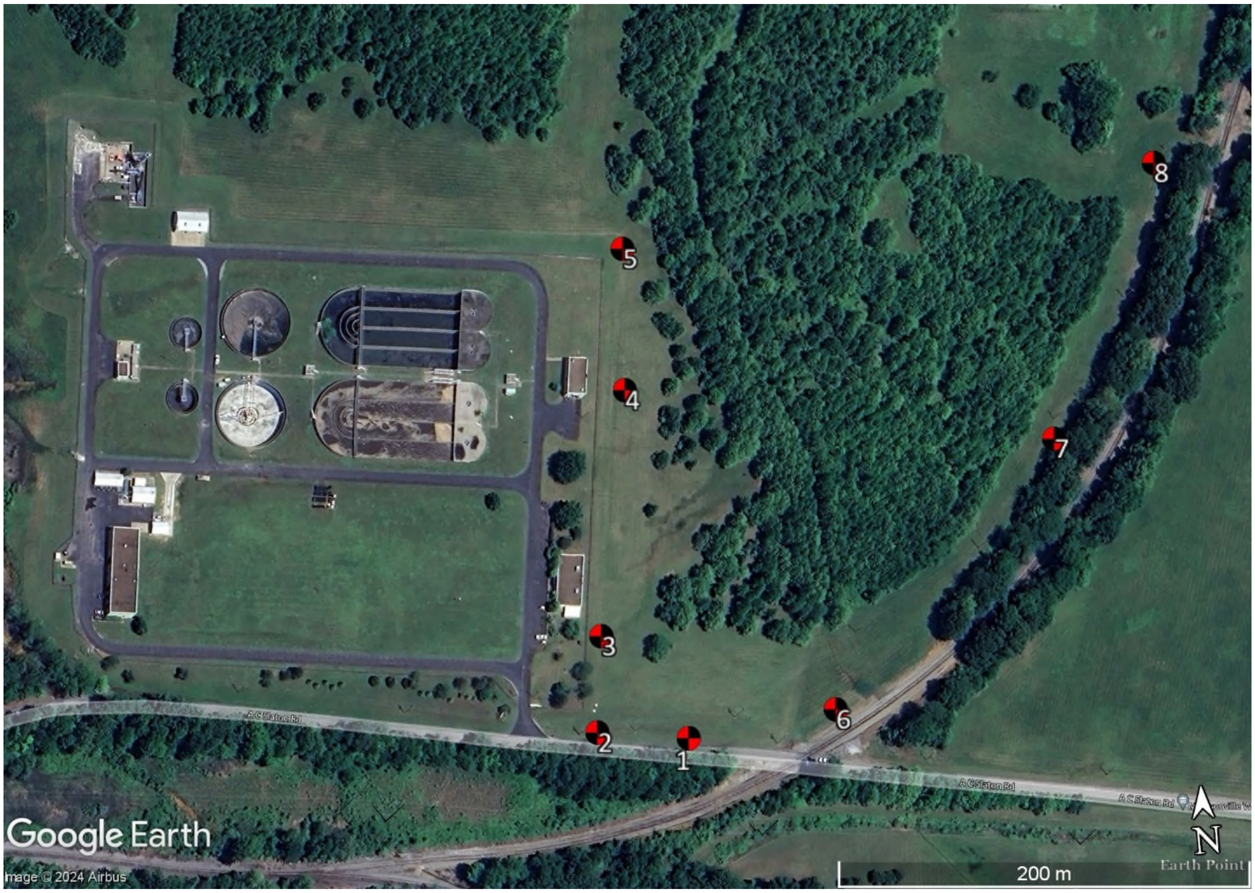

Figure F5-2. Ambient Sound Measurement Locations at Property Boundaries

5.2 Sound Level Data

Ten (10) minute time averaged A-weighted, C-weighted and A-weighted statistical sound level time histories are shown in Figure F5-3 through F5-8 for locations M-1, M-2, M-3, M-4, M-5 and M-6 respectively. The ambient C-weighted sound levels are representative of wind and transient noise sources and were found to be mostly below 65 dB(C). C-weighted sound is useful for determining the impacts of low frequency infrasound (airborne noise induced vibration) cause by power plant equipment, but is typically not indicative of the loudness of the sound we hear.

A-weighted sound corresponds to the sound we normally hear. The LA_{90} is the quietest minute of the 10-minute data sample and tends to correspond to the "human" perceived quietness of the area. Other than intermittent or transient sounds, the area is currently very quiet. The LA_{eq} is the time averaged sound level during the measurement sample. When the LA_{90} and LA_{eq} and other statistical sound levels converge, it is related to a fixed continuous sound. The nighttime sound is mostly dominated by nighttime fauna like frogs or insects as indicated by the convergence of the statistical data. When the LA_{90} and LA_{eq} diverge, the dominant noise source is variable or intermittent – like traffic noise, aircraft flyovers, train engine/horns or yard maintenance equipment. The residual LA_{90} sound level, however, removes the variability of the intermittent noise and leaves a sound level that is closer to the steady state sound in the area. Short duration noise "spikes" can greatly impact the average LA_{eq} sound levels and therefore LA_{eq} sound can incorrectly indicate that the area is perceived as noisy. As a simple example, a train horn can generate 80 dB(A) for 10 seconds during a 10-minute (600 second) data sample. If it is followed by 590 seconds of 35 dB(A), the resulting 600 second data sample's "average" LA_{eq} is 62.2 dB(A).

The overall character of the property is typical of rural or quiet suburban residential use property. Except for the property directly south of the proposed RICE site (M-6), the Waste Water Treatment Plant wasn't noticeably audible.

The lowest of the ten (10) minute data LA_{90} residual A-weighted sound levels are summarized in Table 5.2 for each sound monitoring location as well as the nominal 2-day average sound level LA_{eq}. It should be noted that it is likely that there would be lower sound levels measured during the spring, fall or winter months where there is less outdoor activity and fauna are not active and generating noise.

Table 5.2. Representative Sound Levels Measured at Each Monitoring Location

Measurement Location	Minimum LA90 dB(A)	2-Day LAeq Average dB(A)
M-1	25	62
M-2	28	60
M-3	33	47
M-4	30	51
M-5	31	48
M-6	27	50

The short duration sound measurements taken on the property boundary are presented in Table 5.3. The Waste Water Treatment Plant is clearly audible along its' eastern boundary, but less noticeable along the other boundaries. Sound levels were measured to be below 52 dB(A) at all locations.

Table 5.3. Representative Sound Levels Measured at the Property Boundary

Measurement Location	LAeq dB(A)
1	40
2	41
3	45
4	49
5	51
6	42
7	41
8	43

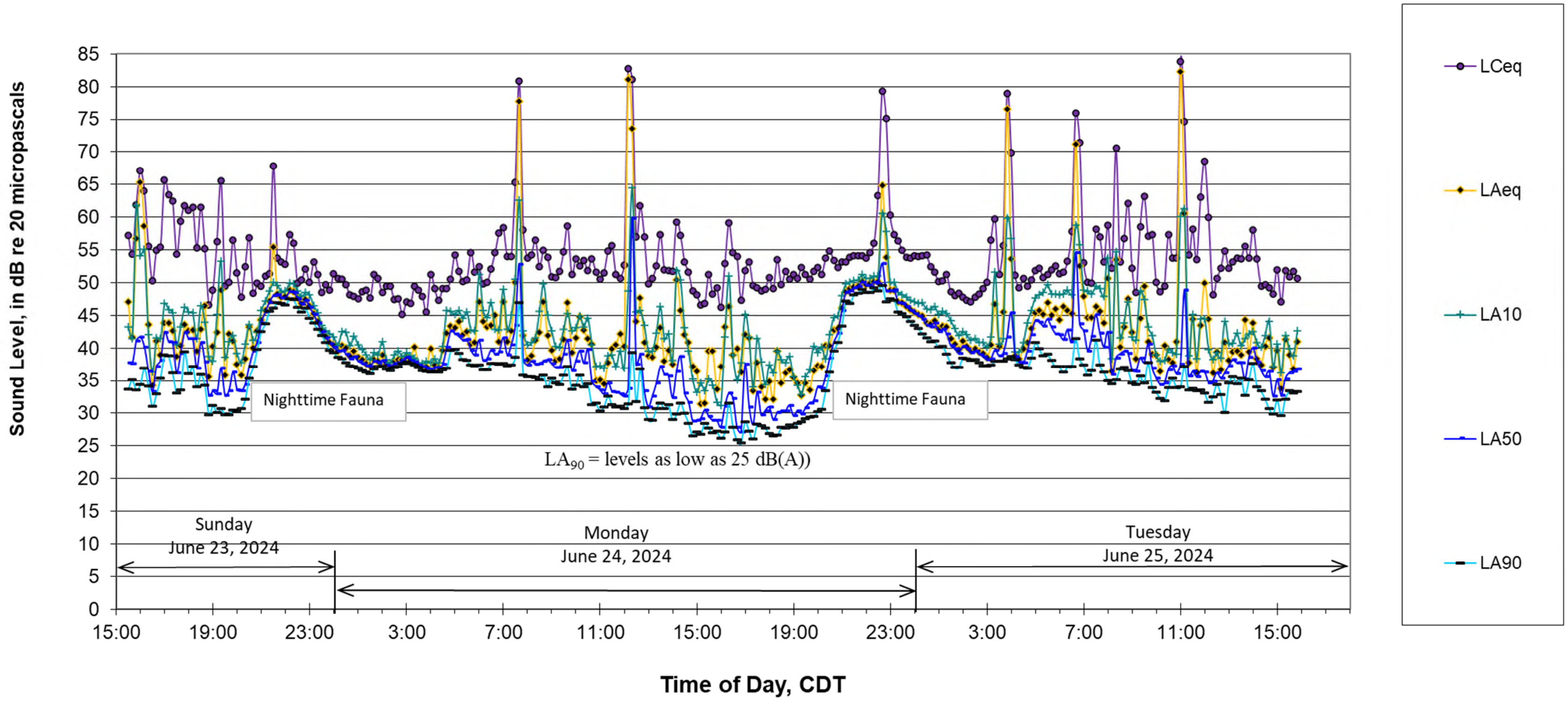

Figure F5-3. Location M-1 A-weighted and C-weighted Sound Levels

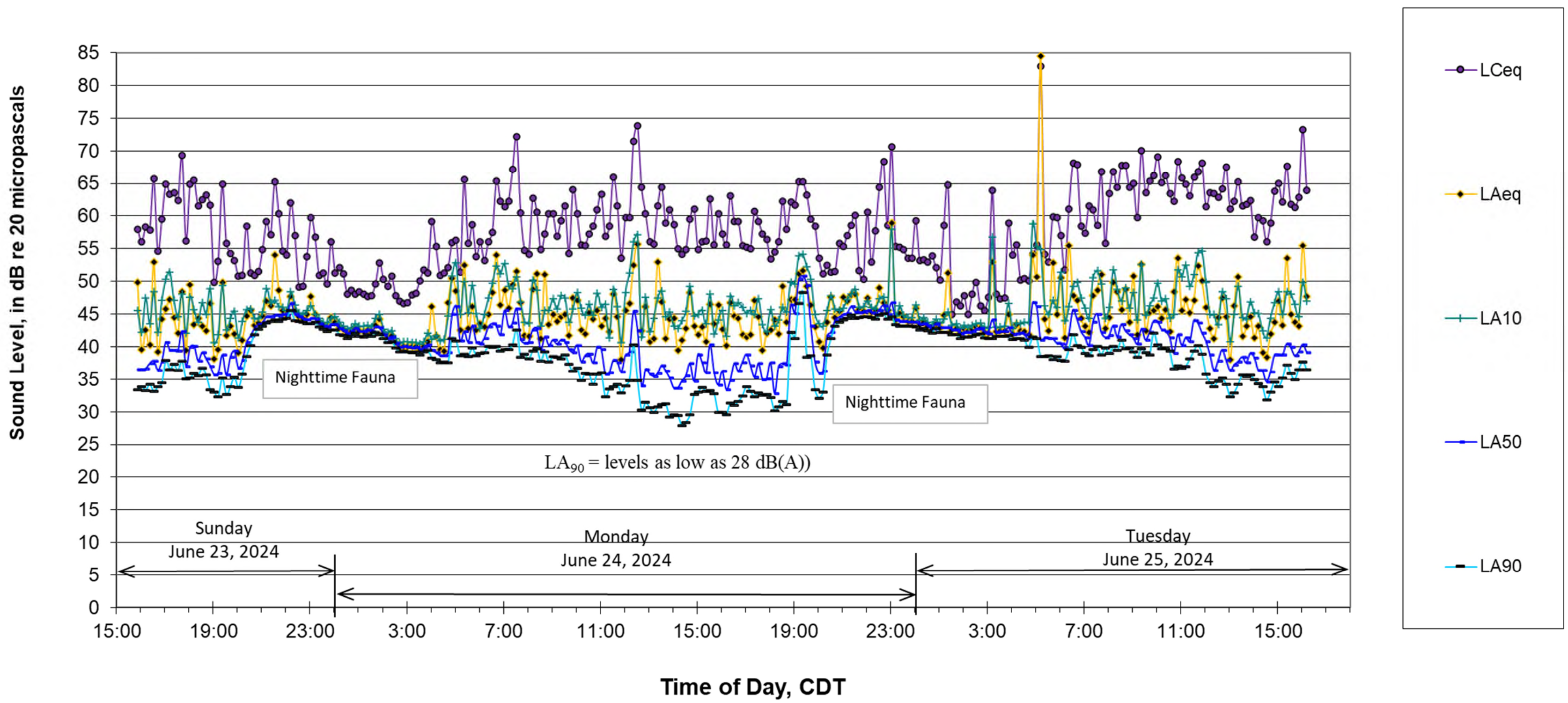

Figure F5-4 Location M-2 A-weighted and C-weighted Sound Levels

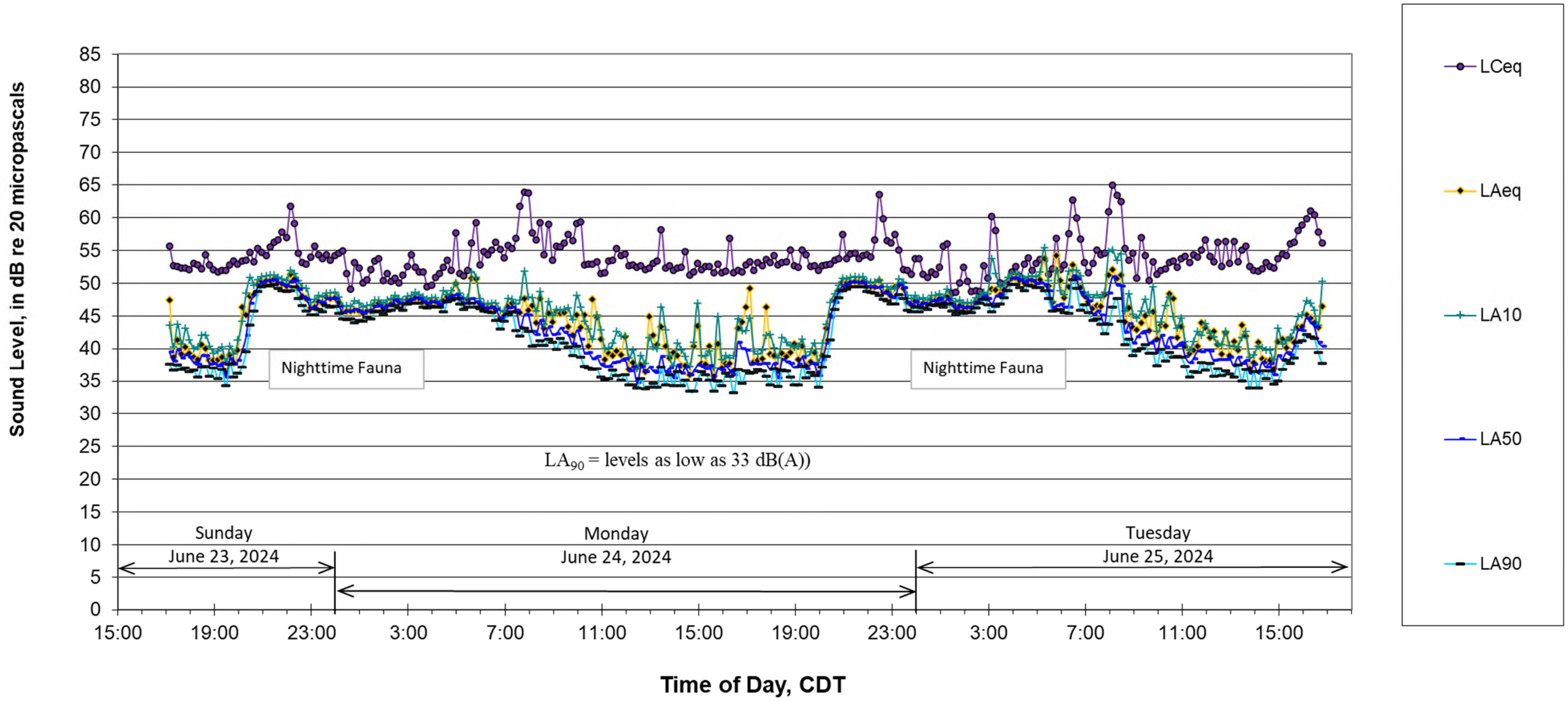

Figure F5-5. Location M-3 A-weighted and C-weighted Sound Levels

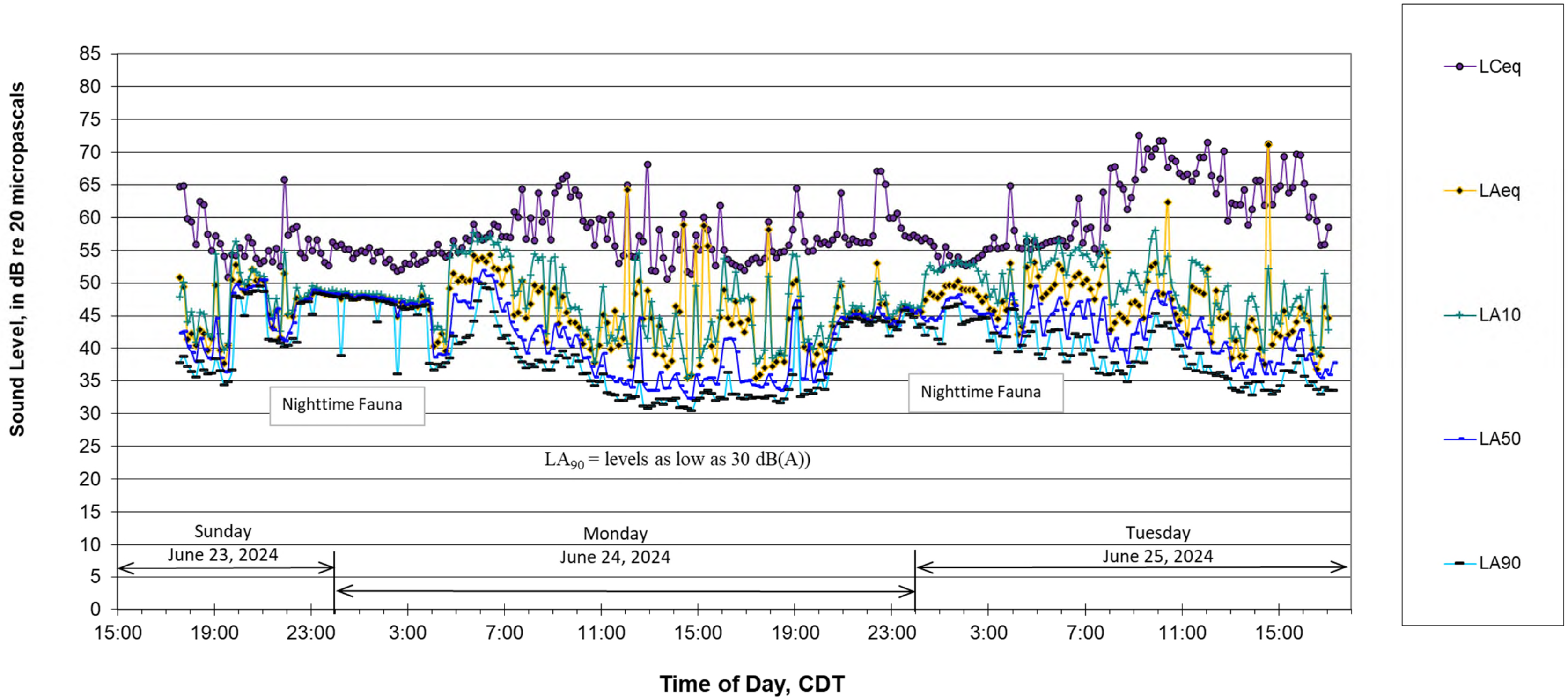

Figure F5-6. Location M-4 A-weighted and C-weighted Sound Levels

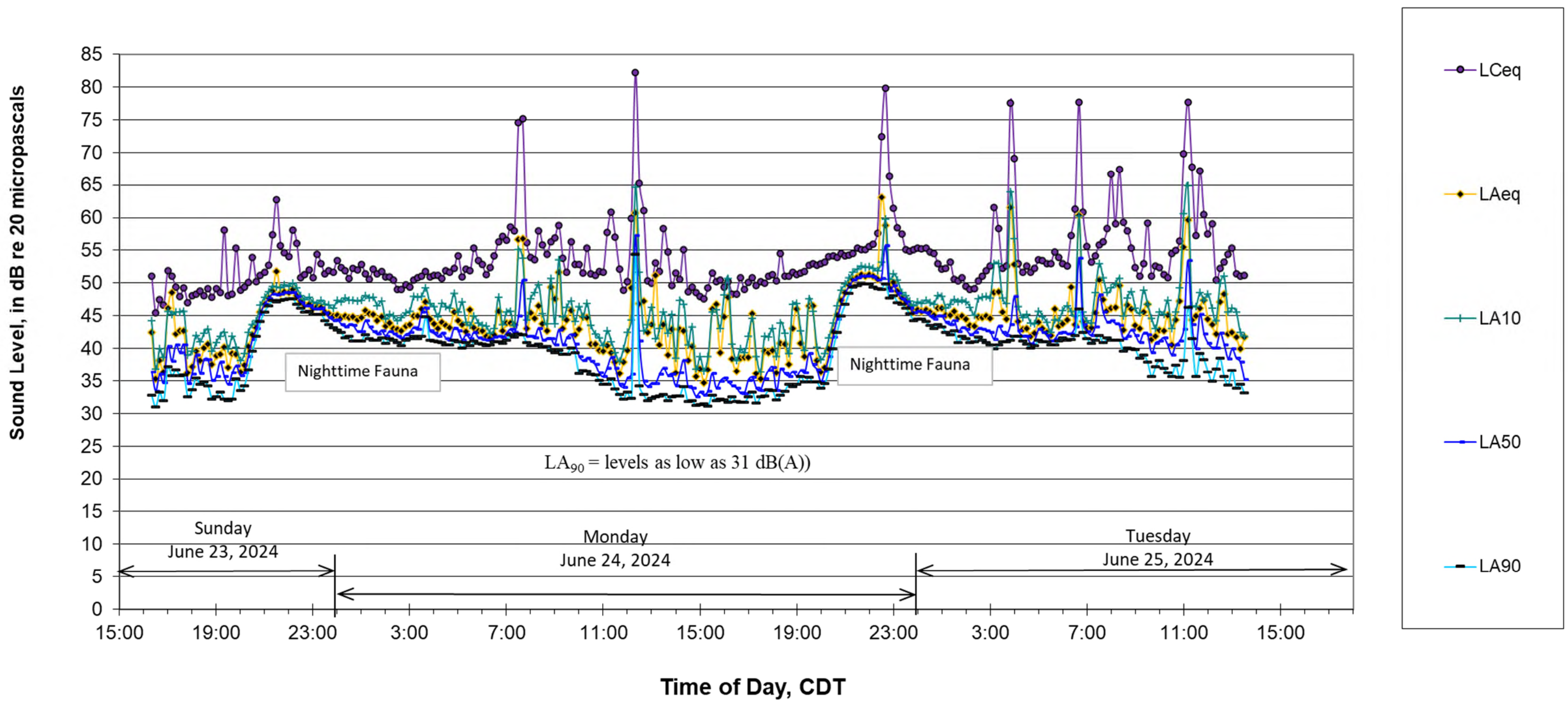

Figure F5-7. Location M-5 A-weighted and C-weighted Sound Levels

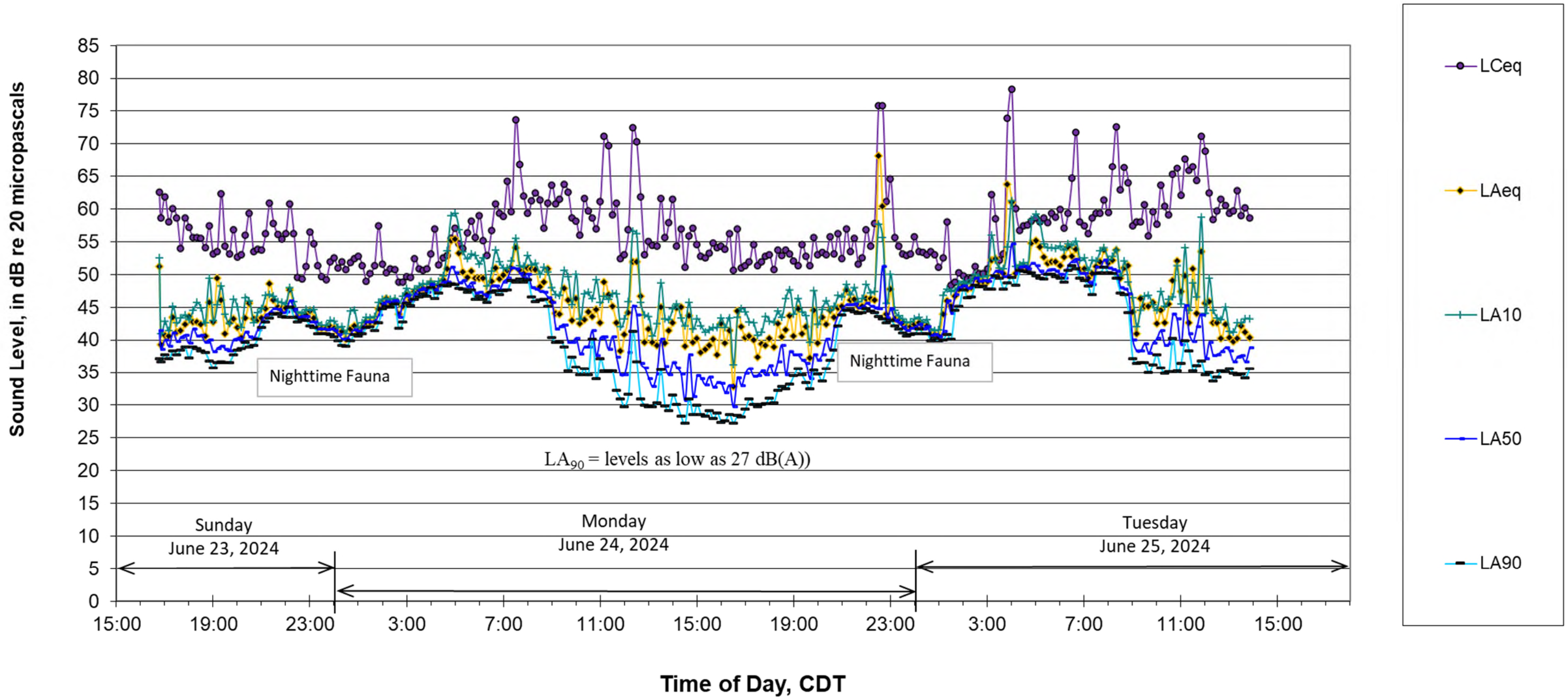

Figure F5-8. Location M-6 A-weighted and C-weighted Sound Levels

6.0 PROJECT NOISE REQUIREMENTS

The project noise requirements are specification based [1] and presented herein. The local noise ordinance(s) are nuisance based requiring the use of judgment. The determination of nuisance provided herein is based on generally accepted American and International acoustical standards[6,7,8,14]. This can result in community noise requirements with ranges of acceptable sound levels as discussed in Sections 6.2 through 6.5.

6.1 Specification Requirements

A. EPC Contract Requirements:

The far field noise design criteria for the Project operating at 100 percent of total capacity shall not exceed 70 dBA or 3 dBA above the background levels if the background noise already exceeds 70 dBA measured prior to starting construction.

B. Local Jurisdiction

1. **Hopkins County Ordinance: Section 12-22:**

a. It shall be unlawful for the owner, occupant, or person having control or management of any land within the county to permit a public nuisance or health hazard to develop thereon. The following conditions are declared to be public nuisances:

Noise. Emission of noise that is noxious enough to destroy the enjoyment of dwellings or other uses of property in the vicinity by interfering with the ordinary comforts of human existence.

2. **Madisonville City Ordinance: § 92.03 CERTAIN CONDITIONS DECLARED A NUISANCE.**

a. It shall be unlawful for the owner, occupant, or person having control or management of any land within the city to permit a public nuisance to develop thereon. The following conditions are declared to be public nuisances:

Noise. Emission of noise which is noxious enough to destroy the enjoyment of dwellings or other uses of property in the vicinity by interfering with the ordinary comforts of human existence.

C. Kentucky Administrative Rules

278.708 Site assessment report -- Consultant -- Mitigation measures

a. Evaluation of anticipated peak and average noise levels associated with the Facility's construction and operation at the property boundary.

6.2 USEPA and American National Standards Institute (ANSI) Acceptable Audible Sound

The USEPA [6] has published a report to define applicable goals for community noise levels. The report, often referred to as "the levels document," defines sound levels in terms of day/night average sound level, or DNL, for compatible land uses. The American National Standard, ANSI S12.9-2007(R2012), "Quantities and Procedures for Description and Measurement of Environmental Sound - Part 5: Sound Level Descriptors for Determination of Compatible Land Use"[7], uses an updated database to expand the EPA guidelines.

The day/night average sound level, DNL, is a 24-hour measurement with a mathematical weighting or penalty of 10 dB(A) applied to sound levels generated at nighttime between the hours of 10 PM and 7 AM. Effectively, DNL limits are 55 dB(A) (LA_{eq}) during daytime hours and 45 dB(A) (LA_{eq}) during nighttime hours, or equivalently a 24-hour A-weighted allowable continuous sound level (LA_{eq}) of approximately 48 dB(A). <u>Note that DNL and LA_{eq} are NOT directly interchangeable metrics (see Appendix B for a detailed explanation).</u>

The American National Standard ANSI 12.9-Part 5 suggests yearly adjusted DNL, as shown in Figure F6-1, for a variety of land uses.

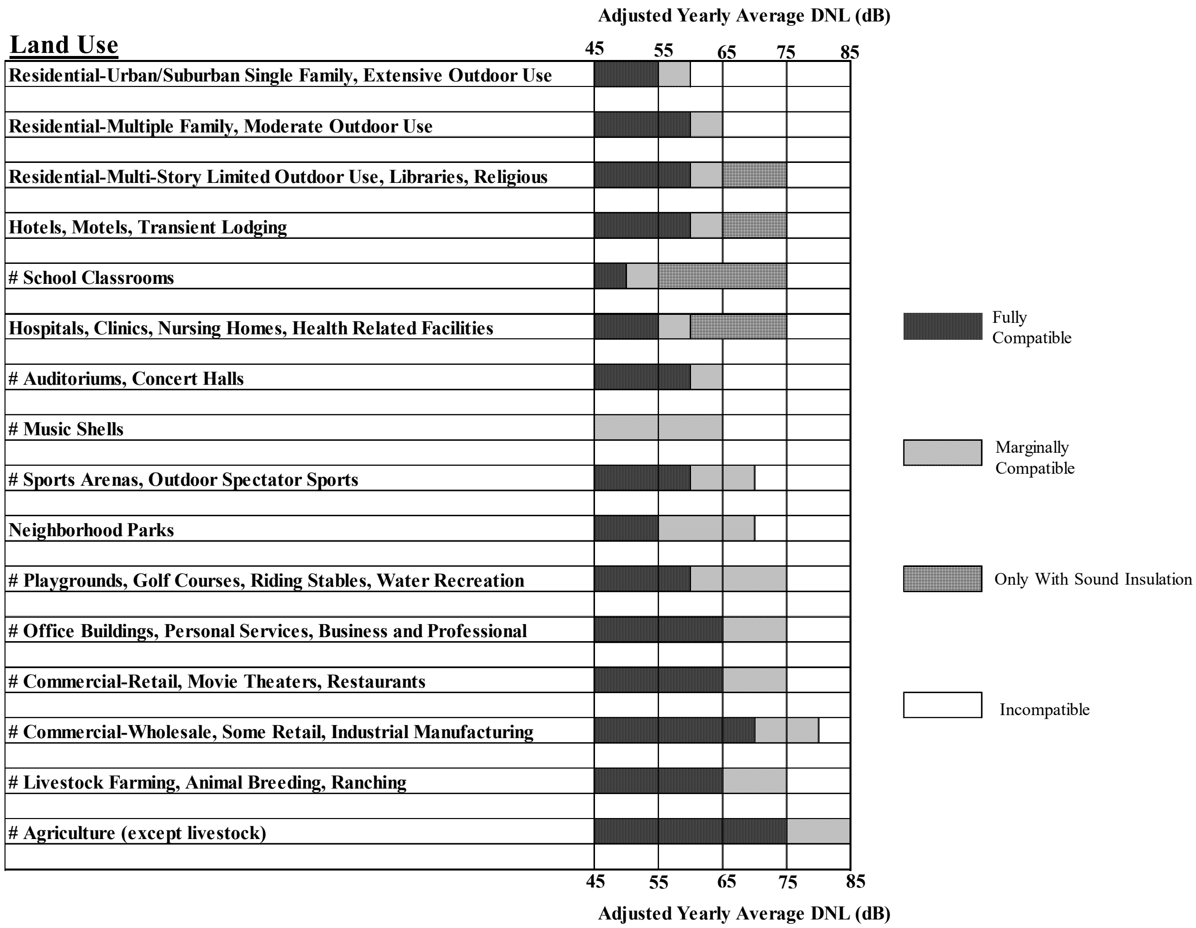

Figure F6-1. ANSI S12.9-2007(R2012)/Part 5 Compatible Land Use Chart

Although atypical, the new RICE Facility could operate 24-hours per day. Therefore, to account for the DNL 10 dB(A) nighttime penalty, the Facility would need to achieve the criterion shown in Figure F6-1 less 7 dB(A) to achieve a "Fully Compatible" rating. For instance, Residential Suburban homes with extensive outdoor use would be fully compatible with the ANSI S12.9 part 5 requirements if its DNL was below 55 DNL. For a power plant that can operated 24-hours per day, this translates into a continuous 24-hour A-weighted allowable sound level (LA_{eq}) of approximately 48 dB(A). A continuous 48 dB(A) sound level is what is used by the Federal Energy Regulatory Commission for projects such as gas compressor stations.

6.3 World Health Organization Criteria

A World Health Organization (WHO) report [14] has defined the impact of noise on outdoor and indoor living spaces as summarized in Table 6.1.

Table 6.1. WHO Guidelines For Community Noise In Specific Environments

Specific Environment	Critical health effect(s)	LAeq [dB(A)]	Time base [hours]
Outdoor living area	Serious annoyance, daytime and evening Moderate annoyance, daytime and evening	55 50	16 16
Dwelling, indoors Inside bedrooms	Speech intelligibility & moderate annoyance, daytime & evening Sleep disturbance, nighttime	35 30	16 8
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8

The World Health Organization defines outdoor daytime and evening sound levels exceeding 55 dB(A) as a "serious annoyance" and levels above 50 dB(A) as a "moderate annoyance" to some people. Existing daytime sound levels at the existing homes are currently less than the 55 or 50 dB(A) WHO criterion for "serious or moderate annoyance."

The WHO suggests outdoor levels should not exceed 45 dB(A) at night to reduce chances of sleep disturbances when windows are opened at nighttime.

6.4 Low Frequency Infrasound

RICE units can produce substantial levels of low frequency airborne sound (Infrasound) that can potentially induce vibration in structures. The low frequency sound is generally not heard, but felt as vibration in the structure. According to ASME's B133.8 - 2011(R2022)[8], "*Gas Turbine Installation Sound Emissions, Nonmandatory Appendix B, Guide To Determining Specified C-Weighted Sound Levels,*" the C-weighted sound level outside the nearest framed structure with noise sensitive receptors should not exceed an upper limit of 75 dB(C) to 80 dB(C). The range of values is given because there is some uncertainty as to the sound level required to induce structural vibration in a specific framed structure since vibration is dependent on both sound level and the response of the structure. Lightweight structures, like manufactured homes or cabins, would be more likely to have infrasound induced vibration than more substantial framed permanent structures.

6.5 Tonal/Impulsive Noise

Reciprocating Internal Combustion Engine facilities generally do not produce significant tonal or impulsive sounds in the community.

7.0 NOISE MODEL AND ESTIMATED SOUND LEVELS

The environmental noise modeling was performed with a 3-D computer-based sound propagation model for calculating outdoor noise propagation in community and industrial environments. The computer model is based on the International Standard ISO 9613, parts 1 and 2[9,10]. The worldwide accepted standard specifies methods for calculating noise attenuation of outdoor (environmental) noise sources at specified distances from a large variety of equipment under favorable (downwind) noise propagation conditions. Predictions made under favorable noise propagation conditions result in predicted sound levels that are usually conservatively high. However, there are anomalous situations that can occur that could result in occasional higher sound levels than those predicted. This would be associated with combinations of atmospheric conditions such as a temperature inversion combined with downwind conditions or sound traveling over a body of water that is cooler than the air above it.

The sound propagation model accounts for the following attenuation and reinforcement of sound:

- Spherical (or Hemispherical) Divergence.
- Atmospheric Absorption.
- Ground Absorption.
- Screening (sound barriers).
- Sound Reflections.

7.1 Noise Model Geometric Representation of the RICE Facility

The geometric representation of the sound sources and structures considered are shown in Figure F7-1. Each sound source is modeled as a three-dimensional surface source. Large surfaces, such as the buildings, are modeled as surfaces that create sound barriers and sound reflectors to the RICE Facility's other noise sources. All sound receivers are modeled to be 5 feet above ground unless noted. The analytical noise model includes the RICE equipment[11] and associated compressors, coolers and transformers, etc. [12,13] only (i.e. no noise is modeled or included from the existing Waste Water Treatment Plant, road or air traffic, or other non-Facility sounds in the acoustical computer model).

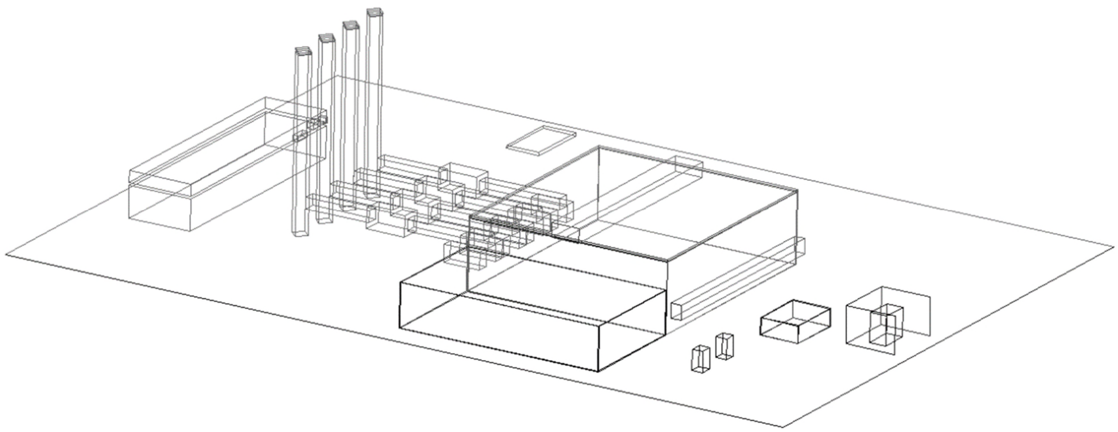

Figure F7-1. Wireframe of 3-D Analytical Acoustical Model Representing the RICE Facility

7.2 Base Option - Estimated Sound Levels of RICE with Minimal Noise Controls

The Base Option RICE Facility modeling assumes four RICE units operating at 100% capacity load conditions. The building wall and roof were modeled to have a Sound Transmission Class (STC) of 24 or greater and have hard walls, but exposed ceiling insulation providing a Noise Reduction Coefficient (NRC) of 0.85. This type of building could be a standard insulated steel building design or a well-designed 22 Ga polycore type wall/roof design. The average building internal sound levels are estimated to be about 108 dB(A). The building wall and roof ventilation is unsilenced. The RICE units are estimated without an exhaust silencer. The Radiators modeled/included are standard 6-fan units. Other equipment sound levels were based on estimates from previous projects and available literature [12,13].

The estimated A-weighted sound contours of the Base Option design are shown in Figure F7-2. Sound levels at the six specific monitoring measurement positions and comparisons with existing sound are provided in Table 7.1. With standard equipment, the property line 70 dB(A) specification requirement is not obtained at any property line location.

Table 7.1 Base Option - Estimated Sound Levels at the Six Reference Noise Monitoring Locations

Measurement Location	Existing LA_{90} dB(A)	Existing 2-day LA_{eq} dB(A)	Estimated Plant dB(A)	Estimated Plant dB(C)
M-1	25	62	63	81
M-2	28	60	68	85
M-3	33	47	59	78
M-4	30	51	60	79
M-5	31	48	70	87
M-6**	27	50	75	92

**** calculation at the home not monitor**

Figure F7-2. Analytically Estimated A-weighted Sound Levels of a Minimally Silenced RICE Facility

A breakdown of the noise components at location M-2 (the closest framed home structure) is provided in Table 7.2. The equipment listed at the top of the table contribute the most and must be abated first to optimize the plant's overall noise reduction. The A-weighted sound levels of the RICE Facility are dominated by the Exhaust stack exits to atmosphere, the Building Ridge Vent, Radiator, Generation Building walls/roof, and wall ventilation. The C-weighted sound levels are also dominated by the same sound sources. The sources corresponding to the highest A, and C-weighted sound levels need to be treated first to obtain any significant noise reduction.

Table 7.2 Sound Pressure Level Estimates of the Base Option RICE Design at Location M-2

Location M-2	Octave Band Center Frequency									
	31.5	63	125	250	500	1000	2000	4000	8000	dB(A)	dB(C)
Total of Sources	**85.7**	**79.2**	**77.4**	**72.6**	**64.4**	**55.6**	**50.3**	**35.4**	**0**	**67.8**	**85.2**
Stack Exit	79.4	73.1	71.4	66.6	58.1	46.6	26.3	9.7	0	61.5	79
Stack Exit unit #2	79.4	73.1	71.3	66.6	58.1	46.6	26.2	9.6	0	61.5	78.9
Stack Exit unit #3	79.3	73.1	71.3	66.5	58	46.5	26.1	9.5	0	61.5	78.9
Stack Exit unit #4	79.3	73	71.2	66.5	58	46.5	26.1	9.3	0	61.4	78.9
Ridge Vent	69.3	57.9	50.5	48.6	48.4	48.4	47.8	33.8	0	53	67.1
RADIATOR (All Cells)	57.8	56.8	52.6	48.2	48.8	46.6	36.3	16.6	0	50.2	60.3
BLDG Wall Vents (east)	70	58.3	49.7	46.3	45.1	44	43.5	29.7	0	49.2	67.7
Generation BLDG Walls	68.5	51.8	47.3	40.2	36	42.9	40.1	11.8	0	45.9	65.7
Generation BLDG Roof	65.4	49.9	45.9	38.8	34.7	41.5	38.7	10.3	0	44.4	62.8
GSU B	33	38.8	37.1	31.1	31.8	26.7	19	2.9	0	32.2	41.9
GSU A	33	38.8	37.1	31.1	31.8	26.7	19	2.9	0	32.2	41.9
Duct After SCR	42.6	37.3	22.2	18.7	22.4	26.2	10.1	0	0	27.4	41.6
Initial Exhaust Duct unit #3	45.4	39.5	23.7	19.7	22.8	25.4	8.3	0	0	27	44.1
Initial Exhaust Duct unit #4	45.3	39.5	23.7	19.8	22.4	25.3	8.3	0	0	26.8	44
Initial Exhaust Duct	45.4	39.6	23.8	19.7	22.2	25	8	0	0	26.6	44.1
Gas Yard (lagged)	47.7	51.3	31.7	18.9	9.3	13.6	14.7	1.8	0	26.6	51.5
Initial Exhaust Duct unit #2	45.4	39.6	23.7	19.7	22.2	25	7.9	0	0	26.6	44.1
Duct After SCR unit #2	39.5	34.3	19.4	16.8	21.1	25.3	9.5	0	0	26.3	38.6
Duct After SCR unit #3	38	33	18.5	16.5	21	25.2	9.4	0	0	26.3	37.3
Duct After SCR unit #4	37.9	33	18.5	16.5	21	25.2	9.4	0	0	26.2	37.3
SCR	38.6	33.4	18.2	14.8	18.4	22.3	6.2	0	0	23.4	37.6
SCR unit #3	35.3	30	14.9	11.8	15.7	20	4.1	0	0	21	34.3
SCR unit #2	35.3	30.1	14.9	11.8	15.6	19.9	4.1	0	0	21	34.3
SCR unit #4	35.2	30	14.8	11.7	15.5	19.8	3.9	0	0	20.9	34.3
Stack Wall	34.6	29.4	14.6	11.1	14.8	18.6	2.5	0	0	19.8	33.6
Stack Wall unit #2	34.6	29.3	14.6	11.1	14.8	18.6	2.4	0	0	19.8	33.6
Stack Wall unit #3	33.1	28	13.6	10.9	14.7	18.5	2.3	0	0	19.6	32.3
Stack Wall unit #4	33.1	27.9	13.5	10.9	14.6	18.4	2.2	0	0	19.6	32.2
Lube Oil Unloading Pumps	14.3	16.2	13.7	11.8	11.9	12.9	9.8	0	0	16.3	21.1
Charge Air B unit #2	45.4	39.3	19.8	0	0	0	0	0	0	14.6	43.9
Charge Air A unit #3	45.4	39.3	19.8	0	0	0	0	0	0	14.6	43.9
Charge Air B unit #3	45.4	39.2	19.7	0	0	0.1	0	0	0	14.6	43.9
Charge Air A unit #4	45.3	39.2	19.7	0	0	0.3	0	0	0	14.6	43.8
Charge Air B unit #4	45.3	39.2	19.7	0	0	0.4	0	0	0	14.6	43.8
Charge Air A	45.4	39.3	19.8	0	0	0	0	0	0	14.6	43.9
Charge Air A unit #2	45.4	39.3	19.8	0	0	0	0	0	0	14.6	43.9
Charge Air B	45.4	39.3	19.8	0	0	0	0	0	0	14.6	43.9
Lube Oil Forwarding Pumps	12.6	14.5	12	10.1	10.2	11.1	8.1	0	0	14.5	19.4
Aux Transformer B	9.7	15.6	16.5	9.5	9.7	4.8	0	0	0	10.3	20
Aux Transformer A	9.9	15.9	13.7	6.6	9.6	4.7	0	0	0	9.8	18.9
Urea Forwarding Pumps	19.8	18.8	20.3	4.4	0.4	3.4	0	0	0	8.4	23.4

7.3 Low Noise Option - Estimated Sound Levels of RICE Facility

The Low Noise Option RICE Facility modeling assumes four RICE units operating at 100% capacity load condition. The building wall and roof were modeled to have a high Sound Transmission Class (STC) of 38 or greater. The ceiling has exposed insulation providing a Noise Reduction Coefficient (NRC) of 0.82. The average building internal sound levels are estimated to be about 108 dB(A). Silencers are included on the building wall ventilation and roof ridge vent. The RICE exhaust is silenced by a low noise "45 dB(A)" silencer as defined by Wärtsilä. The Radiators modeled included Wärtsilä optional silencing. Other equipment sound levels were based on estimates from previous projects and available literature [12,13]. Note the mitigation technologies discussed are representative and minor changes may result from final design and equipment selection.

The estimated A-weighted sound contours of the Low Noise Option design are shown in Figure F7-3. Sound levels at the specific measurement points and comparisons with existing sound are provided in Table 7.3. The three inner contour rings (orange, pink and red) represent 60 dB(A), 65 dB(A) and 70 dB(A), respectively. The 70 dB(A) specification requirement is obtained at all property boundaries.

Table 7.3 Low Noise Option - Estimated Sound Levels at the Six Reference Noise Monitoring Locations

Measurement Location	Existing LA_{90} dB(A)	Existing 2-day LA_{eq} dB(A)	Estimated Plant dB(A)	Estimated Plant dB(C)
M-1	25	62	43	68
M-2	28	60	47	73
M-3	33	47	37	65
M-4	30	51	40	66
M-5	31	48	50	74
M-6**	27	50	54	79

** calculation at the home not monitor

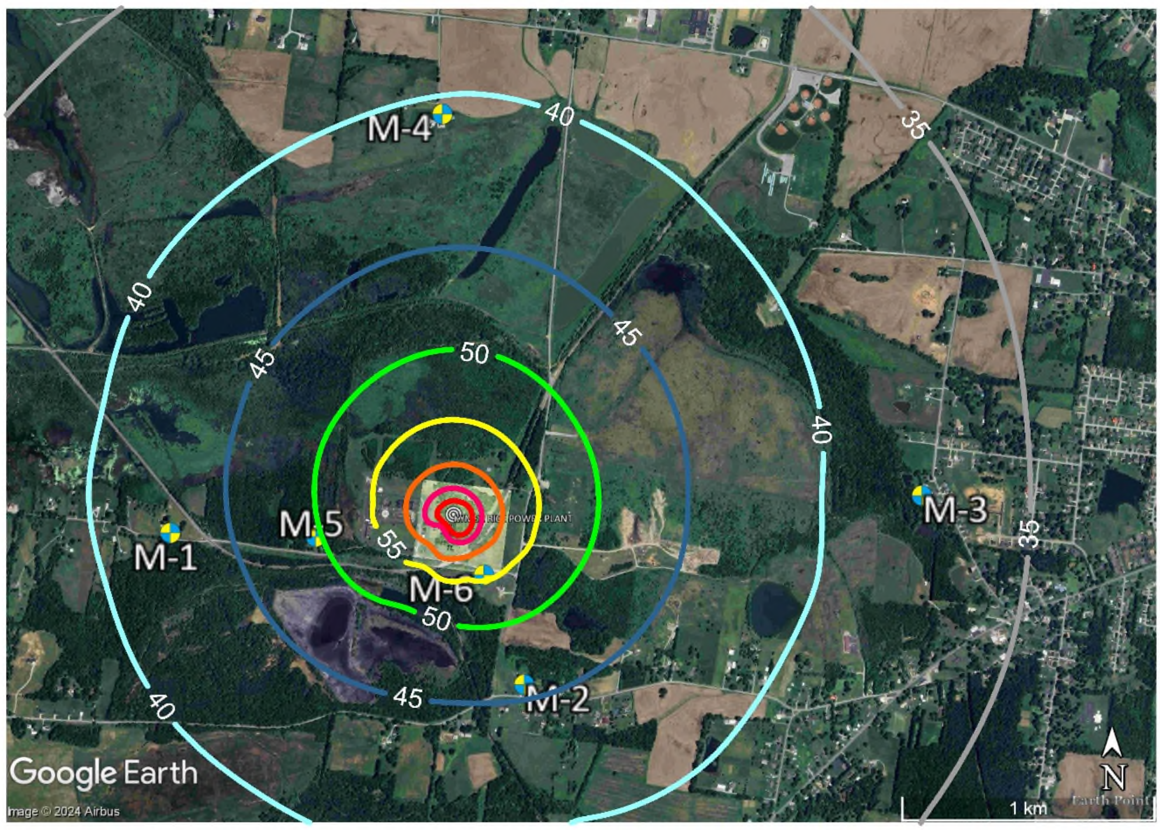

Figure F7-3. Analytically Estimated A-weighted Sound Levels of the Future Low Noise Option RICE Facility

A breakdown of the noise components at location M-2 (sorted noisiest to quietest) is provided in Table 7.4. Location M-2 is the closest framed residence. Again, the equipment listed at the top of the table contribute the most to the A-weighted sound levels. The A-weighted sound levels of the RICE Facility are estimated to be dominated by the radiators. However, the radiators will likely be quieter when operating under the control of the VFD when temperatures are below 104 degrees Fahrenheit and could result in as much as a 3 dB(A) reduction of the overall Facility sound levels. The roof vent is the next noisiest sound source. The C-weighted sound levels are dominated by the ridge and wall vents and the exhaust stack's exits.

Table 7.4 Sound Pressure Level Estimates of the Low Noise Option RICE Design at Location M-2

Location M-2	Octave Band Center Frequency										
	31.5	63	125	250	500	1000	2000	4000	8000	dB(A)	dB(C)
Total of Sources	**75.4**	**62**	**52.1**	**48**	**43.5**	**40.1**	**33**	**18.1**	**0**	**46.5**	**72.8**
RADIATOR (All Cells) low noise	56.6	50.6	46.4	46	41.6	37.4	31.1	14.4	0	43.3	56.3
Ridge Vent	69.4	53.9	44.6	35.7	28.4	18.4	17.9	12.8	0	35.3	66.6
Generation BLDG Walls (STC 38)	64.5	46.8	41.3	37.1	29.9	19.6	23.1	3.2	0	33.7	61.7
BLDG Wall Vents (south)	70.1	53.3	38.8	29.4	12.1	6	8.5	4.7	0	33.1	67.3
GSU A	33	38.8	37.1	31.1	31.8	26.7	19	2.9	0	32.2	41.9
GSU B	33	38.8	37.1	31.1	31.8	26.7	19	2.9	0	32.2	41.9
Generation BLDG Roof (STC 38)	61.4	44.9	39.9	35.7	28.6	18.2	21.7	1.7	0	32.1	58.7
Stack Exit (silenced)	64.4	52.1	40.4	32.6	23.1	1.6	0	0	0	31.3	61.8
Stack Exit (silenced) unit #2	64.4	52.1	40.3	32.6	23.1	1.6	0	0	0	31.3	61.8
Stack Exit (silenced) unit #3	64.3	52.1	40.3	32.5	23	1.5	0	0	0	31.2	61.8
Stack Exit (silenced) unit #4	64.3	52	40.2	32.5	23	1.5	0	0	0	31.2	61.7
Duct After SCR	42.6	37.3	22.2	18.7	22.4	26.2	10.1	0	0	27.4	41.6
Initial Exhaust Duct unit #3	45.4	39.5	23.7	19.7	22.8	25.4	8.3	0	0	27	44.1
Initial Exhaust Duct unit #4	45.3	39.5	23.7	19.8	22.4	25.3	8.3	0	0	26.8	44
Initial Exhaust Duct	45.4	39.6	23.8	19.7	22.2	25	8	0	0	26.6	44.1
Gas Yard (lagged)	47.7	51.3	31.7	18.9	9.3	13.6	14.7	1.8	0	26.6	51.5
Initial Exhaust Duct unit #2	45.4	39.6	23.7	19.7	22.2	25	7.9	0	0	26.6	44.1
Duct After SCR unit #2	39.5	34.3	19.4	16.8	21.1	25.3	9.5	0	0	26.3	38.6
Duct After SCR unit #3	38	33	18.5	16.5	21	25.2	9.4	0	0	26.3	37.3
Duct After SCR unit #4	37.9	33	18.5	16.5	21	25.2	9.4	0	0	26.2	37.3
SCR	38.6	33.4	18.2	14.8	18.4	22.3	6.2	0	0	23.4	37.6
SCR unit #3	35.3	30	14.9	11.8	15.7	20	4.1	0	0	21	34.3
SCR unit #2	35.3	30.1	14.9	11.8	15.6	19.9	4.1	0	0	21	34.3
SCR unit #4	35.2	30	14.8	11.7	15.5	19.8	3.9	0	0	20.9	34.3
Stack Wall	34.6	29.4	14.6	11.1	14.8	18.6	2.5	0	0	19.8	33.6
Stack Wall unit #2	34.6	29.3	14.6	11.1	14.8	18.6	2.4	0	0	19.8	33.6
Stack Wall unit #3	33.1	28	13.6	10.9	14.7	18.5	2.3	0	0	19.6	32.3
Stack Wall unit #4	33.1	27.9	13.5	10.9	14.6	18.4	2.2	0	0	19.6	32.2
Lube Oil Unloading Pumps	14.3	16.2	13.7	11.8	11.9	12.9	9.8	0	0	16.3	21.1
Charge Air B unit #2	45.4	39.3	19.8	0	0	0	0	0	0	14.6	43.9
Charge Air A unit #3	45.4	39.3	19.8	0	0	0	0	0	0	14.6	43.9
Charge Air B unit #3	45.4	39.2	19.7	0	0	0.1	0	0	0	14.6	43.9
Charge Air A unit #4	45.3	39.2	19.7	0	0	0.3	0	0	0	14.6	43.8
Charge Air B unit #4	45.3	39.2	19.7	0	0	0.4	0	0	0	14.6	43.8
Charge Air A	45.4	39.3	19.8	0	0	0	0	0	0	14.6	43.9
Charge Air A unit #2	45.4	39.3	19.8	0	0	0	0	0	0	14.6	43.9
Charge Air B	45.4	39.3	19.8	0	0	0	0	0	0	14.6	43.9
Lube Oil Forwarding Pumps	12.6	14.5	12	10.1	10.2	11.1	8.1	0	0	14.5	19.4
Aux Transformer B	9.7	15.6	16.5	9.5	9.7	4.8	0	0	0	10.3	20
Aux Transformer A	9.9	15.9	13.7	6.6	9.6	4.7	0	0	0	9.8	18.9
Urea Forwarding Pumps	19.8	18.8	20.3	4.4	0.4	3.4	0	0	0	8.4	23.4

7.4 Summary and Additional Discussion of the RICE Facility

A summary of the existing sound and estimated Base and Low Noise Option RICE Facility sound levels are provided in Table 7.5 along with the anticipated noise control options. The Low Noise Option design results in about a 20 dB(A) reduction relative to the minimally silenced Base Option RICE Facility.

Per KYMEA, nighttime operation is expected to be limited to very hot and cold periods or energy emergencies based on power market conditions. During cold winter conditions, persons would not be sleeping with windows open and as mentioned earlier, radiators would be running about 1/3 speed and producing much lower sound levels as the top sound contributor. During summer conditions, persons would generally be utilizing air conditioning with windows closed. Radiators would run at approximately 2/3 speed and produce lower sound level. However, even if the radiators produced no noise at all, the overall A-weighted sound level would be reduced by about 3 dB(A). If the Facility were to run during summertime nights, summertime fauna would be comparable in sound level to the RICE Facility's sound.

Table 7.5. Sound Estimates and Noise Control Options

Measurement Location	Existing dB(A) LA90/LAeq	Estimated Base Plant LAeq dB(A) With Minimal Noise Controls	Estimated Option Plant LAeq dB(A) With Substantial Noise Controls
M-1	25/62	63	43
M-2	28/60	68	47
M-3	33/47	59	37
M-4	30/51	60	40
M-5*	31/48	70	50
M-6**	27/50	75	54
Sound Reduction Equipment			
Building Walls/Roof (STC)		24/24	38/38
Exposed Insulation		Ceiling	Ceiling
Wall Vent Silencers		None	Yes
Roof Vent Silencer		None	Yes
Exhaust Stack Silencers		None	-45 dB(A)
Radiator Option Level		Standard 6-fan cooling radiator	Low noise design

***Hunting Cabin, ** Mobile/Manufactured Home**

8.0 CONSTRUCTION NOISE - ESTIMATED SOUND LEVELS

The following noise suppression techniques should be employed, when possible, during the construction, startup, and commissioning phases of the Facility:

- Construction activities will be limited to daytime hours between 7 AM to 5 PM.
- Mufflers and engine shrouds are required on all trucks and other engine-powered equipment;
- Trucks and other engine-powered equipment shall observe all posted speed limits and limit idling;
- Vehicles' horns shall only be used when absolutely necessary;
- If possible, strobe lights or broadband audio backup signals should be considered in lieu of tonal backup alarms for construction equipment used at the site.

A typical list of all construction equipment and their corresponding sound levels can be seen in Table 8.1 below for the Facility. Sound levels of construction equipment can vary widely and were based on various sources of information within the consultant's database and that provided by the Federal Highway Administration found in references [12,15].

Note all equipment listed in the table will not be operating for all phases of the project. The specific equipment used during various phases of the project can be found in Appendix C.

Table 8.1 Approximate Maximum Sound Level Estimates of the Construction Equipment Measured at 50 feet from the Noise Source

Equipment List	7 AM to 5 PM Maximum Instantaneous dB(A) at 50 ft
Skytrak	80
F250 (per vehicle)	74
D8 Dozer	82
Water Truck	80
Two Wheel Vibratory Roller	74
Cat Loader	85
Semi Truck & Trailer	88
Cat 336 Excavator	81
Vibratory Plate Compactor	83
Concrete Truck	79
Grout Pump	80
Bauer Drill Rig BG28	79
Cat 328 Long Stick	81
Concrete Pump Truck	81
80 Ton Rough Terrain Crane	85
80' Boom Lift (per lift)	80
Diesel Welding Machine	80
Electric Scissor Lift (per lift)	72

The estimated maximum sound levels at various stages (months) of the project are presented in Figure F8-1 for four (4) different distances from the Facility. The distance adjustments are based on a simple extrapolation of reducing sound levels by 6 dB(A) per doubling of distance. Please note that these are the estimated maximum A-weighted construction sound levels with all equipment used in the particular construction phase in operation simultaneously. A more likely operating scenario would result in average hourly sound levels that are about 10 dB(A) or more quieter than those presented below.

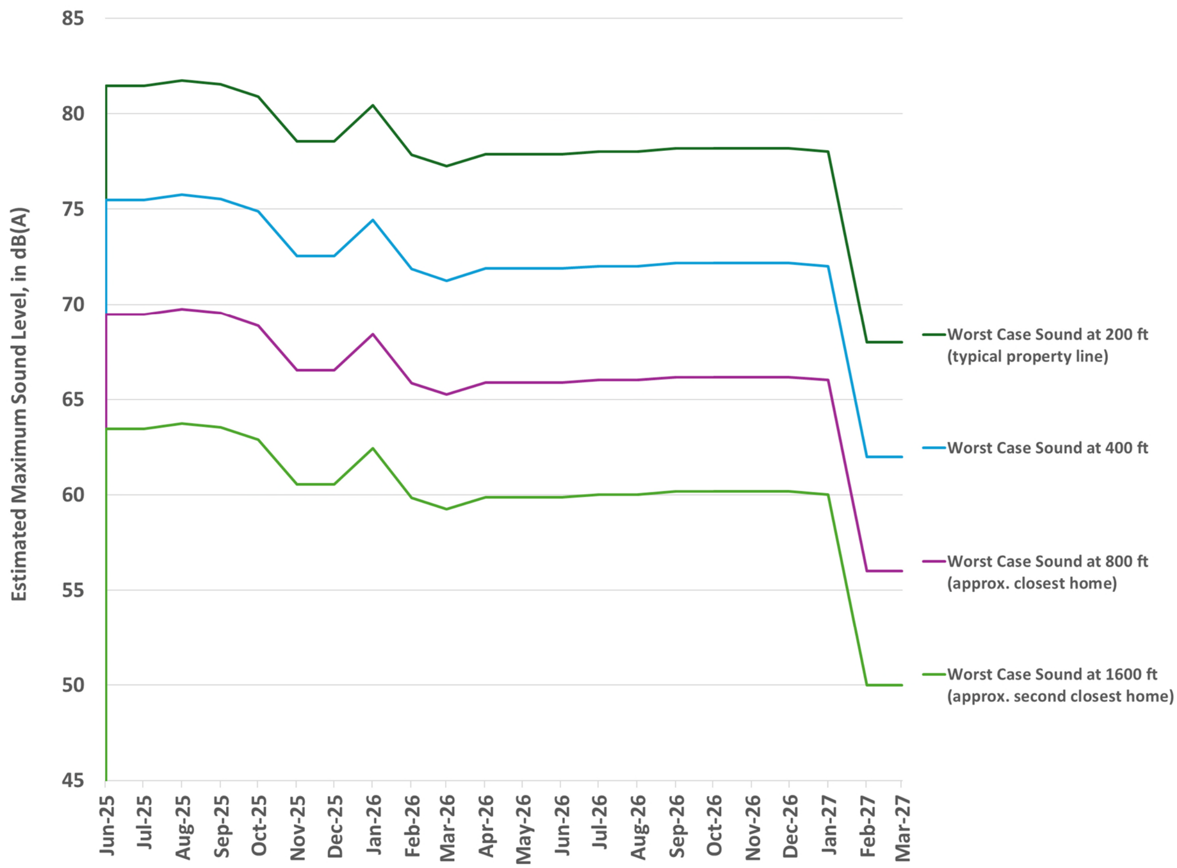

Figure F8-1. Estimated Maximum A-weighted Construction Sound Levels With Various Construction Phase Equipment in Simultaneous Operation

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APPENDIX A - Reporting Consultant's Résumé

DAVID J. PARZYCH
Power Acoustics, Inc.

March 1998 to present

Dave Parzych has over 30 years of experience in acoustical engineering and noise control design and is the principal and founder of Power Acoustics, Inc. Since 1998, he has provided a full range of acoustical consulting services for over 300 clients and several hundred projects including; sound measurements, analytical modeling studies and working as an expert witness in industrial, commercial, transportation and residential applications. Mr. Parzych has also developed a commercial software package, SPM9613, used worldwide in community noise modeling.

He is known as an expert in outdoor sound propagation and modeling, power plant noise and Gas Turbine silencing. He has developed suitable community noise criteria, designed noise controls for and/or verified Facility acoustical compliance through specialized sound tests for several dozen power plants situated throughout the world. He has also designed noise abatement for many industrial, commercial and residential buildings.

Dave has been an invited speaker and author in conference sessions sponsored by the Acoustical Society of America and the Institute of Noise Control Engineering on noise modeling and measurements of power plants, industrial facilities and modeling the performance of sound barrier walls. He has testified in several court cases, including Federal court, on noise prediction, acoustical measurements and data interpretation.

October 1992 to February 1998

Mr. Parzych was a Senior Noise Control Engineer and Technical Group Leader of Acoustics in the Environmental Engineering group at Westinghouse Power Generation. From 1992 through February of 1998 he led the development of noise control and state-of-the-art research in modeling and diagnostics techniques. Mr. Parzych was responsible for the acoustical silencing and design of combustion turbines, aerodynamic source modeling of turbo-machinery noise, overall acoustical design of combustion turbine, steam turbine and cogeneration projects and environmental modeling to determine community impacts and worker noise exposure.

October 1983 to October 1992

From 1983 to 1992, Mr. Parzych gained experience in aircraft noise through an intensive effort to develop a quiet counter-rotating Prop-Fan aircraft engine as an Analytical Acoustical Engineer at United Technologies Corp., Hamilton Standard Division. Mr. Parzych has been an investigator on several NASA funded research projects involving acoustics and unsteady aerodynamics of propellers, Prop-Fans and wind turbines.

May 1982 to October 1983
Dave began his professional career as an acoustical engineer in 1982 with General Dynamics, Electric Boat Division in Groton, Connecticut working in airborne and structureborne silencing for the on-board nuclear power plants used in the US NAVY submarine fleet.

EDUCATION

Bachelor of Science in Engineering, Acoustics, University of Hartford 1982
Continuing education in acoustics and noise control including aero-acoustics offered at the Catholic University in Washington D.C. and many seminars and conferences on acoustics and noise control.

CERTIFICATION AND PROFESSIONAL ACTIVITIES

- Board Certified - Institute of Noise Control Engineering
- Licensed Professional Engineer, State of Oregon, with specialty in Acoustical Engineering (PE18940)
- Full Member Acoustical Society of America
- Principal/Firm Member National Council of Acoustical Consultants
- Full Member ASME
- Full Member ASTM
- Chairman of ANSI B133.8, subcommittee 7, Gas Turbine Installation Sound Emissions (1997-2000)
- Member of ANSI B133.8, subcommittee 7, Gas Turbine Installation Sound Emissions (2000-2008)
- Member ASTM E33 Committee on Environmental Noise (current)
- Chairman ASME Codes and Standards Committee PTC-36 "Measurement of Industrial Sound" (2012-2015), Vice Chair (2015-2018)

PATENTS

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APPENDIX B - Discussion of Acoustical Terms

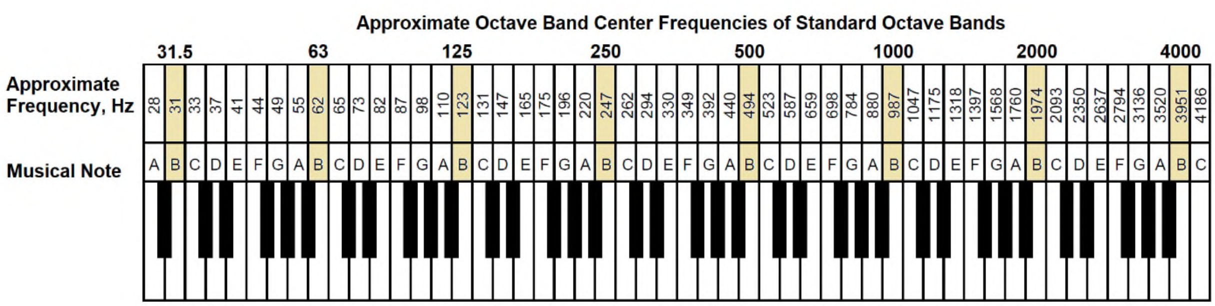
Assessing sound requires relationships between the physical properties of sound, which can be measured by instruments, and the corresponding human reaction through empirical means. Discussed within this Appendix is a description of terms necessary to understand the report.

Sound Level (Decibel)

Current sound measurement standards use a logarithmic decibel (dB) scale, which compares the measured sound pressure to a reference pressure of 20 micropascals. A sound pressure of zero (0) dB is approximately the lowest sound level humans can hear. Actual sounds, however, often cannot be distinguished if they are substantially below the existing ambient sound. As a basis of comparison, a 10 dB increase of a ***steady state sound*** (continuous, non-varying sound) is generally perceived as a doubling of sound level while increases in steady state sounds of 3 dB are considered to be just perceivable. Note sound levels described in decibels do not add arithmetically but the "sound pressures" do. Therefore, two sounds of equal magnitude will be 3 dB louder than a single sound source - i.e. 50 dB + 50 dB = 53 dB – not 100 dB and ten sound sources of equal magnitude will be 10 dB louder than a single sound source.

Sound Spectrum (Frequency)

Sound is comprised of a broad range of frequencies. The frequencies typically heard by humans are considered to range between 20-20,000 cycles per second (cps). A cycle per second is also called a "Hertz" or abbreviated as "Hz". To illustrate typical audible frequencies, we've annotated a piano keyboard as shown below. An increase in frequency of one octave means the frequency has doubled.



Range of Frequencies on a Standard Piano Keyboard

For scientific and industrial use, fixed "bands" or ranges of frequencies are used to describe the summation of many frequencies of the sound. Standardized octave band center frequencies are 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 8000 Hz. The lower range of the frequency is the octave band center frequency times √2/2 (0.707) and the upper range is the octave band center frequency times the √2 (1.414). The frequency content of noise sources is necessary to develop appropriate noise control.

A-weighting (Simulated Perceived Loudness By Humans)

The A-weighted sound level, dB(A), simulates (electronically through a filter network) the perceived response of the human ear. A-weighting deemphasizes very low frequencies and very high frequencies where humans hear the poorest. Although all frequencies of sound contribute to the A-weighted level, sounds between 250 Hz to 4000 Hz generally have the largest impact on measured A-weighted sound levels.

C-weighting (Often Used for Assessing Infrasound Induced Vibrations)
The C-weighted sound level, dB(C), is primarily a "flat frequency weighting" and is often used to characterize the effects of very low frequency sound (Infrasound) and its potential to induce vibration in structures.

Time Averaging of Sound and Statistics L_{eq}, L_{10}, L_{50}, and L_{90}
The equivalent sound pressure level, or L_{eq}, is the time-averaging of a fluctuating sound. The L_{eq} has the equivalent sound level as a steady state or non-varying sound that would be observed over the same period of time that the fluctuating sound was measured.

When evaluating ambient noise or sound that is influenced by transient or moving sources, statistical sound data are often used. Statistical sound data allows extraneous sounds to be deemphasized or shorter term transient sounds to be extracted. Sound statistics often used in evaluating environmental noise are L_{10}, L_{50}, and L_{90}. These statistics correspond to the sound level exceeded 10% of the time, the sound exceeded 50% of the time (the median sound level) and the sound exceeded 90% of the time respectively. Note the average or equivalent sound level, (L_{eq}), can be substantially different than the median sound level (L_{50}).

L_{90}, or the sound level exceeded 90 percent of the time, is commonly used to understand community sound levels since it tends to reduce the effect of short duration extraneous sounds not necessarily typical of the environment being measured. The L_{90} is thought of as the residual or broad area sound level in the community – basically the sound you hear when all the local traffic passes, no airplanes are overhead and localized human or mechanical noise are minimal. Think of the brief moment of quiet when you only hear the sound of distant road traffic. Another way of thinking about L_{90} is that data taken over a measurement time of 10 minutes would provide sound levels at or below the L_{90} for a total duration of only one (1) minute. Nine (9) minutes of the ten (10) minute data sample time, the sound level will exceed the L_{90} level.

L_{10}, or the sound exceeded 10% of the time, indicates that 1 minute out of ten, the sound level was equal to or higher than the value given. The L_{10} is useful in defining sounds that change in level due to transient sound sources, such as nearby movement of vehicles.

L_{50} is the "median sound level." Half the time the sound level was lower than the reported L_{50} and half the time it is higher than the reported L_{50}.

Compounding of Sound Descriptors
The use of dB(A) or dBA indicates the sound pressure level (in dB) has been A-weighted. Similarly, the use of LA_{eq}, LA_{10}, LA_{50}, and LA_{90} indicates the average or statistical values reported have been "**A-weighted**" where standard L_{eq}, L_{10}, L_{50}, and L_{90} represent unweighted or linear sound levels. Occasionally, a more cumbersome description, such as "A-weighted L_{xx}" or other statistic is used represent the LA_{eq}, LA_{10}, LA_{50}, or LA_{90}

Day Night Average Sound Level (DNL or Ldn)

Day Night Average Sound Level (DNL or Ldn) is a calculated noise metric used to reflect a person's cumulative exposure to sound over a 24-hour period. DNL takes into account the amount of noise (LA_{eq}) occurring throughout the day and night, but applies an additional 10dB weighting for nighttime between 10 PM and 7 AM. Unlike LA_{eq}, DNL is not a directly measured quantity, but rather is calculated metric using the mathematical equation shown below:

$$DNL = Ldn = 10\log_{10}\frac{1}{24}\left(\sum_{d=1}^{15} 10^{[Leq(d)]/10} + \sum_{n=1}^{9} 10^{[Leq(n)+10]/10}\right)$$

Sound Power Level

Sound power is the rate which sound energy is emitted per unit time. Sound power is not dependent on distance from the sound source or the environment the sound source is in. On the other hand, sound pressure is highly sensitive to its environment and distance from the sound source. Sound power is analogous to the power rating on a light bulb. For a given type of light bulb technology, a bulb with a higher power rating would produce more light. However, the environment the light bulb is put in (room paint color, lamp shape, distance from the light bulb, etc.) will determine how much light is ultimately observed.

When sound power is presented as a "level", it shares the same logarithmic decibel (dB) scale as sound pressure level but uses a reference of 1 picowatt as its basis.

Sound Losses, Noise Reduction or Attenuation

In an overly simplistic view, sound attenuation is the difference, in dB, between the sound incident on a device (such as a wall or muffler) and the sound that is transmitted through the device. It is typically reported as a function of frequency.

Some typical losses include:

- Transmission Loss (TL) is used to describe effectiveness in reducing noise from walls, silencers or enclosures after corrections for the influences of the environment have been made.

- Sound Transmission Class (STC) is a single number descriptor of Transmission Loss values that have been curve fit to a prescribed frequency spectrum shape. Higher numerical ratings are generally better at reducing noise than lower numerical ratings are but the detail of the reduction at individual frequencies is lost in the simplification.

- Noise Reduction (NR) is used to describe the in-situ difference of sound on the source side and receiver side of a noise control device.

- Insertion Loss (IL) and Dynamic Insertion Loss (DIL), which includes flow effects and flow noise, is used to describe the difference of sound measured or calculated on the receiver side of a noise control device before and after the noise control device was put into service (before and after insertion).

Examples of Common Noise Sources

COMMON OUTDOOR ACTIVITIES	NOISE LEVEL dB(A)	COMMON INDOOR ACTIVITIES
	---110---	Rock Band
Jet Fly-over at 1000 ft		
	---100---	
Gas Lawn Mower at 3 ft		
	---90---	
Diesel Truck at 50 ft, at 50 mph		Food Blender at 1 m (3 ft)
	---80---	Garbage Disposal at 1 m (3 ft)
Noise Urban Area (Daytime)		
Gas Lawn Mower at 100 ft	---70---	Vacuum Cleaner at 10 ft
Commercial Area		Normal Speech at 3 ft
Heavy Traffic at 300 ft	---60---	
		Large Business Office
Quiet Urban Daytime	---50---	Dishwasher Next Room
Quiet Urban Nighttime	---40---	Theater, Large Conference Room
Quiet Suburban Nighttime		(Background)
	---30---	Library
Quiet Rural Nighttime		Bedroom at Night, Concert Hall
	---20---	(Background)
	---10---	
	---0---	
Lowest Threshold of Human Hearing		Lowest Threshold of Human Hearing
Source: California Dept. of Transportation Technical Noise Supplement, Oct. 1998, Page 18.		

APPENDIX C – Typical Construction Equipment Operation on a Monthly Basis

	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25	Nov-25	Dec-25	Jan-26
	Site Balancing	Site Balancing	Site Balancing					
			Site UG Utilities	Site UG Utilities				
				Deep Foundations	Deep Foundations			
					Electrical UG	Electrical UG	Electrical UG	Electrical UG
						Foundations	Foundations	Foundations
								PEMB Erection
Expected Hours (NTE)	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**
Common Equipment	Skytrak	Skytrak	Skytrak	Skytrak	Skytrak	Skytrak	Skytrak	Skytrak (2)
Common Equipment	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)
Equipment	D8 Dozer	D8 Dozer	D8 Dozer					
Equipment	D8 Dozer	D8 Dozer	D8 Dozer					
Equipment	Water Truck	Water Truck	Water Truck					
Equipment	Two Wheel Vibratory Roller	Two Wheel Vibratory Roller	Two Wheel Vibratory Roller	Two Wheel Vibratory Roller	Two Wheel Vibratory Roller	Two Wheel Vibratory Roller	Two Wheel Vibratory Roller	Two Wheel Vibratory Roller
Equipment	Cat Loader	Cat Loader	Cat Loader	Cat Loader				
Equipment	Semi Truck & Trailer	Semi Truck & Trailer	Semi Truck & Trailer	Semi Truck & Trailer	Semi Truck & Trailer			
Equipment	Semi Truck & Trailer	Semi Truck & Trailer	Semi Truck & Trailer	Semi Truck & Trailer	Semi Truck & Trailer	Semi Truck & Trailer	Semi Truck & Trailer	Semi Truck & Trailer
Equipment			Cat 336 Excavator	Cat 336 Excavator	Cat 336 Excavator	Cat 336 Excavator	Cat 336 Excavator	Cat 336 Excavator
Equipment			Vibratory Plate Compactor	Vibratory Plate Compactor	Vibratory Plate Compactor	Vibratory Plate Compactor	Vibratory Plate Compactor	Vibratory Plate Compactor
Equipment				Concrete Truck	Concrete Truck	Concrete Truck (One day a week)	Concrete Truck (One day a week)	Concrete Truck (One day a week)
Equipment				Concrete Truck	Concrete Truck	Concrete Truck (One day a week)	Concrete Truck (One day a week)	Concrete Truck (One day a week)
Equipment				Grout Pump	Grout Pump			
Equipment				Bauer Drill Rig BG28	Bauer Drill Rig BG29			
Equipment				Cat 328 Long Stick	Cat 328 Long Stick			
Equipment						Concrete Pump Truck (One day a week)	Concrete Pump Truck (One day a week)	Concrete Pump Truck (One day a week)
Equipment								80 Ton Rough Terrain Crane
Equipment								80' Boom Lift (2)
Equipment								Diesel Welding Machine

Feb-26	Mar-26	Apr-26	May-26	Jun-26	Jul-26	Aug-26	Sep-26	Oct-26
Foundations								
PEMB Erection	PEMB Erection	PEMB Erection	PEMB Erection					
		Building Interior Systems	Building Interior Systems	Building Interior Systems				
				Engine Set	Engine Set	Engine Set		
						MEP Installation	MEP Installation	MEP Installation
7 AM to 5 PM	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**
Skytrak (2)	Skytrak	Skytrak (2)	Skytrak (2)	Skytrak (2)	Skytrak (2)	Skytrak (2)	Skytrak (2)	Skytrak (2)
F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)
Concrete Truck (One day a week)								
Concrete Truck (One day a week)								
Concrete Pump Truck (One day a week)								
80 Ton Rough Terrain Crane	80 Ton Rough Terrain Crane	80 Ton Rough Terrain Crane	80 Ton Rough Terrain Crane	80 Ton Rough Terrain Crane	80 Ton Rough Terrain Crane	80 Ton Rough Terrain Crane	80 Ton Rough Terrain Crane	80 Ton Rough Terrain Crane
80' Boom Lift (2)	80' Boom Lift (2)	80' Boom Lift (2)	80' Boom Lift (2)	80' Boom Lift (2)	80' Boom Lift (2)	80' Boom Lift (2)	80' Boom Lift (2)	80' Boom Lift (2)
Diesel Welding Machine	Diesel Welding Machine	Diesel Welding Machine	Diesel Welding Machine	Diesel Welding Machine	Diesel Welding Machine	Diesel Welding Machine	Diesel Welding Machine	Diesel Welding Machine
		Electric Scissor Lift (2)	Electric Scissor Lift (2)	Electric Scissor Lift (2)	Electric Scissor Lift (4)	Electric Scissor Lift (4)	Electric Scissor Lift (6)	Electric Scissor Lift (6)

Nov-26	Dec-26	Jan-27	Feb-27	Mar-27
MEP Installation	MEP Installation	MEP Installation	MEP Installation	MEP Installation
7 AM to 5 PM	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**	**7 AM to 5 PM**
Skytrak (2)	Skytrak (2)	Skytrak (2)	Skytrak	Skytrak
F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)	F250 (5 ea)
80 Ton Rough Terrain Crane	80 Ton Rough Terrain Crane			
80' Boom Lift (2)	80' Boom Lift (2)	80' Boom Lift (2)		
Diesel Welding Machine	Diesel Welding Machine	Diesel Welding Machine	Diesel Welding Machine	Diesel Welding Machine
Electric Scissor Lift (6)	Electric Scissor Lift (6)	Electric Scissor Lift (4)		