APPENDIX K: ACOUSTICAL ANALYSIS REPORT

Acoustical Analysis Report

Overnight Solar Project

San Bernardino County, California

August 2024

Prepared for

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Acronyms and Abbreviations

µPa	microPascal
Overnight Solar	Overnight Solar, LLC
BESS	battery energy storage system
CadnaA	Computer Aided Noise Abatement
CEQA	California Environmental Quality Act
dB	decibel
dBA	A-weighted decibel
FTA	Federal Transit Administration
gen-tie	generation interconnect
ISO	International Organization for Standardization
kV	kilovolt
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
L_P	sound pressure level
L_w	sound power
kV	kilovolt
NSA	noise sensitive area
PPV	peak-particle velocity
project	Overnight Solar Project
PV	photovoltaic
RECE	Renewable Energy and Conservation Element
SR	State Route
Tetra Tech	Tetra Tech, Inc.
USEPA	United States Environmental Protection Agency
VdB	vibration decibel

1.0 OVERVIEW

Tetra Tech, Inc. (Tetra Tech) has prepared this acoustical analysis report for the Overnight Solar Project (project) to support an evaluation of compliance with applicable California Environmental Quality Act (CEQA) noise requirements and county noise ordinances, which are detailed in Section 2.0 of this report. Overnight Solar, LLC (Overnight Solar) is proposing to construct and operate the project, a utility-scale solar photovoltaic (PV) electricity generation and battery energy storage system (BESS) facility that would produce up to 150 megawatts of power and include up to 150 megawatts of battery storage capacity. A proposed generation interconnect (gen-tie) corridor, approximately 1.1 miles in length, will connect the proposed facility to an existing gen-tie line associated with the Mojave Solar Facility, which is just south of the existing Alpha Substation.

The property which the project would be built on consists of 822 acres of land in San Bernardino County. The project is being designed in accordance with San Bernardino County's Solar Ordinance (an ordinance amending Development Code Chapter 84.29, Renewable Energy Generation Facilities) and the General Plan Renewable Energy and Conservation Element (RECE), which strives to preserve the character of the project area and surrounding communities.

1.1 Project Setting

The project is generally bounded by the Lockhart Solar Facility to the north, the Mojave Solar Facility to the east, and vacant and undeveloped land to the south and west. The project is also located approximately 10 miles northwest of Hinkley, California, approximately 10 miles east of Kramer Junction, California, and approximately 6 miles north of the State Route (SR)-58 and Harper Lake Road junction.

In addition to the existing solar energy generating facilities and electrical transmission lines in the vicinity of the project, the surrounding area includes a patchwork of undeveloped Bureau of Land Management lands, other vacant lands, and other approved solar facilities. Several rural residences are located south and east of the project along Harper Lake Road. The closest residential location to the project is approximately 1 mile east of the proposed project site and the closest residential location to the gen-tie is approximately 0.3 mile south of the line. Sparse transportation infrastructure also exists in the project vicinity. SR-58 is approximately 5.6 miles south of the project site, and U.S. Route 395 is approximately 10.5 miles west. To the south of the project, running east and west, are SR-58 and SR-66, and running north to south is Interstate 15. Approximately 0.8 mile north of SR-58 and 5 miles to the south of the project is the Burlington Northern Santa Fe Railway with a Class I freight railroad. Edwards Air Force Base is roughly 30 miles west of the project, and the Barstow Marine Corps Logistics Base is approximately 30 miles to the southeast of the project.

The project parcel and proposed gen-tie are depicted in **Figure 1, Project Site Map**.

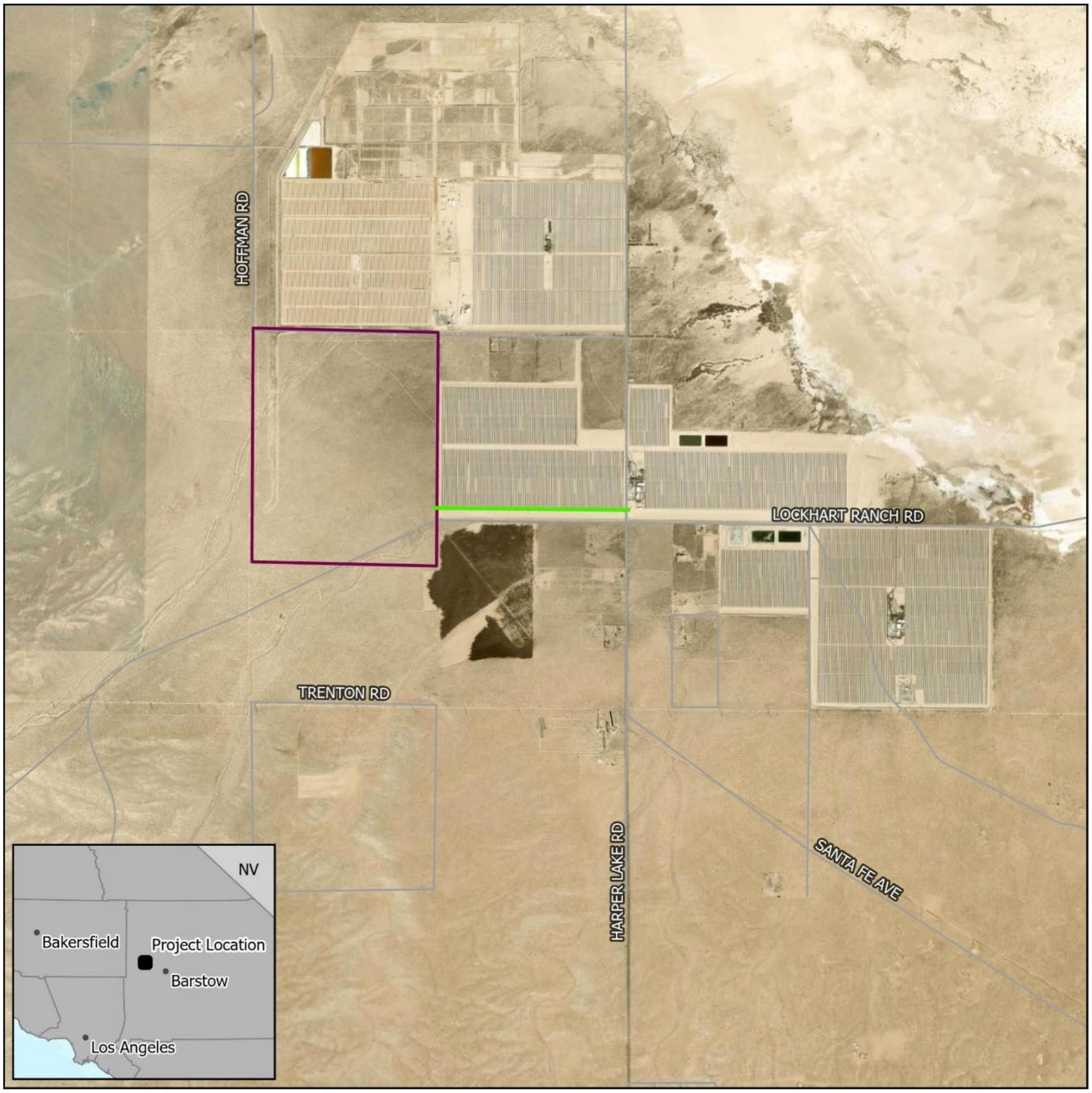

Figure 1
Project Site Map

Overnight Solar
Overnight Solar, LLC

Proposed Gen-tie
Project Parcel

TETRA TECH
1:50,000
0 0.5 1 Miles
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San Bernardino County, CA

1.2 Acoustical Metrics and Terminology

All sounds originate with a source, whether it is a human voice, motor vehicles on a roadway, or a combustion turbine. Energy is required to produce sound and this sound energy is transmitted through the air in the form of sound waves—tiny, quick oscillations of pressure just above and just below atmospheric pressure. These oscillations, or sound pressures, impinge on the ear, creating the sound we hear. A sound source is defined by a sound power level (L_W), which is independent of any external factors. By definition, sound power is the rate at which acoustical energy is radiated outward and is expressed in units of watts.

A source sound power level cannot be measured directly. It is calculated from measurements of sound intensity or sound pressure at a given distance from the source outside the acoustic and geometric near-field. A sound pressure level (L_P) is a measure of the sound wave fluctuation at a given receiver location and can be obtained through the use of a microphone or calculated from information about the source sound power level and the surrounding environment. The sound pressure level in decibels (dB) is the logarithm of the ratio of the sound pressure of the source to the reference sound pressure of 20 microPascals (µPa), multiplied by 20. The range of sound pressures that can be detected by a person with normal hearing is very wide, ranging from about 20 µPa for very faint sounds at the threshold of hearing, to nearly 10 million µPa for extremely loud sounds such as a jet during take-off at a distance of 300 feet.

Sound can be measured, modeled, and presented in various formats, with the most common metric being the equivalent sound level (L_{eq}). The L_{eq} has been shown to provide both an effective and uniform method for comparing time-varying sound levels and is widely used in acoustic assessments in the State of California. Another metric is the day-night sound level (L_{dn}) that measures the 24-hour average noise level at a given location. It was adopted by the United States Environmental Protection Agency (USEPA) for developing criteria for the evaluation of community noise exposure. The L_{dn} is calculated by averaging the 24-hour hourly L_{eq} levels at a given location after adding 10 dB to the nighttime period (10:00 p.m. to 7:00 a.m.) to account for the increased sensitivity of people to noises that occur at night. Estimates of noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented in **Table 1, Sound Pressure Levels and Relative Loudness of Noise Sources and Acoustic Environments**. **Table 2, Acoustic Terms and Definitions,** presents additional reference information on terminology used in the report.

Table 1. Sound Pressure Levels and Relative Loudness of Noise Sources and Acoustic Environments

Common Outdoor Activities	Noise Level (dB)	Common Indoor Activities
	110	Rock band
Jet flyover at 1,000 feet	100	
Gas lawn mower at 3 feet	90	
Diesel truck at 50 feet, at 50 mph	80	Food blender at 3 feet; garbage disposal at 3 feet
Noisy urban area, daytime; gas lawn mower at 100 feet	70	Vacuum cleaner at 10 feet
Commercial area; heavy traffic at 300 feet	60	Normal speech at 3 feet
Quiet urban, daytime	50	Large business office; dishwasher next room
Quiet urban, nighttime	40	Theater; large conference room (background)

Common Outdoor Activities	Noise Level (dB)	Common Indoor Activities
Quiet suburban, nighttime	30	Library
Quiet rural, nighttime	20	Bedroom at night; concert hall (background)
	10	Broadcast/recording studio
Lowest threshold of human hearing	0	Lowest threshold of human hearing

dBA – A-weighted decibel
Source: California Department of Transportation (2013)

Table 2. Acoustic Terms and Definitions

Term	Definition
Noise	Typically defined as unwanted sound. This word adds the subjective response of humans to the physical phenomenon of sound. It is commonly used when negative effects on people are known to occur.
Sound Pressure Level (L_P)	Pressure fluctuations in a medium. Sound pressure is measured in dB referenced to 20 μPa, the approximate threshold of human perception to sound at 1,000 Hz.
Sound Power Level (L_W)	The total acoustic power of a noise source measured in dB referenced to picowatts (one trillionth of a watt). Noise specifications are provided by equipment manufacturers as sound power as it is independent of the environment in which it is located. A sound level meter does not directly measure sound power.
Equivalent Sound Level (L_{eq})	The L_{eq} is the continuous equivalent sound level, defined as the single sound pressure level that, if constant over the stated measurement period, would contain the same sound energy as the actual monitored sound that is fluctuating in level over the measurement period.
A-Weighted Decibel (dBA)	Environmental sound is typically composed of acoustic energy across all frequencies. To compensate for the auditory frequency response of the human ear, an A-weighting filter is commonly used for describing environmental sound levels. Sound levels that are A-weighted are presented as dBA in this report.
Unweighted Decibels (dBL)	Unweighted sound levels are referred to as linear. Linear decibels are used to determine a sound's tonality and to engineer solutions to reduce or control noise as techniques are different for low and high frequency noise. Sound levels that are linear are presented as dBL in this report.
Propagation and Attenuation	Propagation is the decrease in amplitude of an acoustic signal due to geometric spreading losses with increased distance from the source. Additional sound attenuation factors include air absorption, terrain effects, sound interaction with the ground, diffraction of sound around objects and topographical features, foliage, and meteorological conditions including wind velocity, temperature, humidity, and atmospheric conditions.

1.3 Vibration Metrics and Terminology

Vibration is an oscillatory motion that is described in terms of displacement, velocity, or acceleration. Velocity is the most common descriptor used when evaluating human perception or structural damage. Velocity represents the instantaneous speed of movement and more accurately describes the response of humans, buildings, and equipment to vibrations.

Peak-particle velocity (PPV) and root mean square velocity are typical metrics used to describe vibration levels in units of inches per second in the United States. However, to evaluate annoyance to humans, the vibration dB (VdB) notation is commonly used. The decibel notation acts to compress the range of numbers required to describe vibration. In the United States, the accepted velocity reference for converting to dB is 1×10^{-6} inches per second. The abbreviation “VdB” is used for vibration dB to reduce the potential for confusion with sound decibels.

In contrast to airborne noise, ground-borne vibration is not an everyday occurrence for humans. The background vibration velocity levels within residential areas are usually 50 VdB or lower, which is well below the human perception threshold of approximately 65 VdB. However, human response to vibration is not usually significant unless the vibration exceeds 70 VdB. For a significant impact to occur, vibration levels must exceed 72 VdB during frequent events, 75 VdB for occasional events, and

80 VdB during infrequent events (FTA 2006). Outdoor sources that generate perceptible ground-borne vibrations are typically construction equipment, steel-wheeled trains, and traffic on rough roadways. **Table 3, Typical Levels of Ground-Borne Vibration,** provides common vibration sources as well as human and structural response to ground-borne vibrations.

Table 3. Typical Levels of Ground-Borne Vibration

Human/Structural Response	PPV (in/sec)	Velocity Level (VdB)[1/]	Typical sources (50 feet from source)
Threshold, Minor Cosmetic Damage, Fragile Buildings	0.4	100	Blasting from Construction Projects
	0.17-0.2	92-94	Heavy Tracked Construction Equipment
Difficulty with Tasks, Such as Reading a Computer Screen	0.125	90	
	0.074	85	Commuter Rail, Upper Range
Residential Annoyance, Infrequent Events	0.04	80	Rapid Transit, Upper Range
	0.013	75	Commuter Rail, Typical
	0.023	72	Bus or Truck Bump Over
Residential Annoyance, Frequent Events	0.013	70	Rapid Transit, Typical
Approximate Threshold of Human Perception	0.007	65	
	0.005	62	Bus or Truck, Typical
	0.0013	50	Typical Background Vibration Levels

1/ RMS Vibration Velocity in VdB reference to 10^{-6} inches/second
PPV – peak particle velocity; VdB – vibration decibel
Source: FTA (2006)

The degree of annoyance cannot always be explained by the magnitude of the vibrations alone. Phenomena, such as ground-borne noise and rattling, visual effects (e.g., movement of hanging objects), and time of day, all influence the response of individuals. The American National Standards Institute and the International Organization for Standardization (ISO) has developed criteria for evaluation of human exposure to vibrations. The recommendations of these standards and other studies evaluating human response to vibrations have been incorporated into the Federal Transit Administration's (FTA) Transit Noise and Vibration Impact Assessment (FTA 2006). The criteria within this manual are used to assess noise and vibration impacts from transit operations.

2.0 NOISE AND VIBRATION LEVEL REQUIREMENTS AND GUIDELINES

Potential noise impacts associated with the Project were evaluated with respect to the applicable CEQA noise requirements and the San Bernadino County Development Code. Details regarding each set of requirements are provided below.

2.1 California Environmental Quality Act

CEQA requires that significant environmental impacts be identified and that such impacts be eliminated or mitigated to the extent feasible. Appendix G of the CEQA Statutes and Guidelines (AEP 2023) sets forth a series of suggested thresholds for determining a potentially significant impact.

Under the thresholds suggested in Appendix G, the proposed project could be considered to have significant noise and vibration impacts if it results in one or more of the following:

a) Generation of substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or in other applicable local, state, or federal standards.

b) Generation of excessive groundborne vibration or groundborne noise level.

c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan had not been adopted, within two miles of a public airport or public use airport, the project exposes people residing or working in the project area to excessive noise levels.

2.2 State of California 2017 General Plan Guidelines

The California Governor's Office of Planning and Research's noise element guidelines include recommended exterior and interior noise level standards for local jurisdictions to identify and prevent the creation of incompatible land uses due to noise. The guidelines contain a table that describes the compatibility of various land uses with a range of environmental noise levels in terms of community noise equivalent level (CNEL). CNEL is a 24-hour weighted average measure of community noise. The computation of CNEL adds 5 dB to the average hourly noise levels between 7 p.m. and 10 p.m. (evening hours), and 10 dB to the average hourly noise levels between 10 p.m. and 7:00 a.m. nighttime hours). This weighting accounts for the increased human sensitivity to noise in the evening and nighttime hours. It is very similar to the L_{dn}; however, CNEL is a 24-hour weighted average measure of community noise. The computation of CNEL adds 5 dB to the average hourly noise levels between 7 p.m. and 10 p.m. (evening hours), and 10 dB to the average hourly noise levels between 10 p.m. and 7:00 a.m. nighttime hours). This weighting accounts for the increased human sensitivity to noise in the evening and nighttime hours. The L_{dn} is very similar to the CNEL; however it weighs only the nighttime hours and not the evening hours. **Table 4, Land Use Compatibility for Community Noise Environments,** presents guidelines for determining acceptable and unacceptable community noise exposure limits for various land use categories. The guidelines also present adjustment factors that may be used to arrive at noise acceptability standards that reflect the noise control goals of the community, the particular community's sensitivity to noise, and the community's assessment of the relative importance of noise pollution.

Table 4. Land Use Compatibility for Community Noise Environments

Land Use Category	Community Noise Exposure (L_{dn} or CNEL, dBA)			
	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable
Residential – Low Density, Single-Family, Duplex, Mobile Homes	50–60	55–70	70–75	75–85
Residential – Multiple Family	50–65	60–70	70–75	70–85
Transient Lodging – Motel, Hotels	50–65	60–70	70–80	80–85
Schools, Libraries, Churches, Hospitals, Nursing Homes	50–70	60–70	70–80	80–85
Auditoriums, Concert Halls, Amphitheaters	NA	50–70	NA	65–85

Land Use Category	Community Noise Exposure (L_{dn} or CNEL, dBA)			
	Normally Acceptable	Conditionally Acceptable	Normally Unacceptable	Clearly Unacceptable
Sports Arenas, Outdoor Spectator Sports	NA	50–75	NA	70–85
Playgrounds, Neighborhood Parks	50–70	NA	65–75	75–85
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50–70	NA	70–80	80–85
Office Buildings, Business Commercial and Professional	50–70	65–75	75–85	NA
Industrial, Manufacturing, Utilities, Agriculture	50–75	70–80	75–85	NA

Notes: NA – not applicable; L_{dn} – average day/night sound level; CNEL – community noise equivalent level

Normally Acceptable – Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

Conditionally Acceptable – New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

Normally Unacceptable – New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.

Clearly Unacceptable – New construction or development should generally not be undertaken.

Source: California Governor's Office of Planning and Research (2017)

2.3 San Bernardino Countywide Plan/Policy Plan

The purpose of the Countywide Plan/Policy Plan Noise Element is to limit the community's exposure to excessive noise levels. The element contains goals, policies, and programs that must be used to guide decisions concerning land uses that are common sources of excessive noise levels. The Countywide Plan/Policy Plan noise goals and policies most applicable to the proposed project are included below.

GOAL N 1 The County will abate and avoid excessive noise exposures through noise mitigation measures incorporated into the design of new noise-generating and new noise-sensitive land uses, while protecting areas within the County where the present noise environment is within acceptable limits.

Policy N 1.1 Designate areas within San Bernardino County as "noise impacted" if exposed to existing or projected future exterior noise levels from mobile or stationary sources exceeding the standards listed in Chapter 83.01 of the Development Code (Table 5).

Policy N 1.3 When industrial, commercial, or other land uses, including locally regulated noise sources, are proposed for areas containing noise sensitive land uses, noise levels generated by the proposed use will not exceed the performance standards shown in Table 4, above, within outdoor activity areas. If outdoor activity areas have not yet been determined, noise levels shall not exceed the performance standards listed in Chapter 83.01 of the Development Code at the boundary of areas planned or zoned for residential or other noise-sensitive land uses.

Policy N 1.5 Limit truck traffic in residential and commercial areas to designated truck routes; limit construction, delivery, and through-truck traffic to designated routes; and distribute maps of approved truck routes to County traffic officers.

Policy N 1.6	Enforce the hourly noise-level performance standards for stationary and other locally regulated sources, such as industrial, recreational, and construction activities as well as mechanical and electrical equipment.
GOAL N 2	The County will strive to preserve and maintain the quiet environment of mountain, desert and other rural areas.
Policy N 2.1	The County will require appropriate and feasible on-site noise attenuating measures that may include noise walls, enclosure of noise-generating equipment, site planning to locate noise sources away from sensitive receptors, and other comparable features.

The Countywide Plan/Policy Plan contains the Hazards Element, which includes the following policies related to noise:

Goal HZ-2	Human-generated Hazards. People and the natural environment protected from exposure to hazardous materials, excessive noise, and other human-generated hazards.
Policy HZ-2.7	Truck delivery areas. We encourage truck delivery areas to be located away from residential properties and require associated noise impacts to be mitigated.
Policy HZ-2.8	Proximity to noise generating uses. We limit or restrict new noise sensitive land uses in proximity to existing conforming noise generating uses and planned industrial areas.
Policy HZ-2.9	Control sound at the source. We prioritize noise mitigation measures that control sound at the source before buffers, soundwalls, and other perimeter measures.

2.4 San Bernardino County Development Code

The County's Development Code (Division 3, Countywide Development Standards; Chapter 83.01, General Performance Standards, Section 83.01.080, Noise) sets interior and exterior noise standards for specific land uses by type of noise source. Noise standards for stationary noise sources are summarized in **Table 5, Noise Standards for Stationary Noise Sources**. As shown, the noise standard for residential properties is not to exceed 55 A-weighted decibels (dBA) L_{eq} from 7 a.m. to 10 p.m. and 45 dBA L_{eq} from 10 p.m. to 7 a.m. For industrial properties, the noise standard from stationary noise sources is 70 dBA at any time of the day or night. Areas exposed to noise levels exceeding these standards are considered noise-impacted areas. The County's Development Code exempts noise from construction noise, provided that construction is limited to the hours between 7 a.m. and 7 p.m., except on Sundays or federal holidays, when construction is not allowed.

Table 5. Noise Standards for Stationary Noise Sources

Affected Land Uses (Receiving Noise)	7:00 a.m. - 10:00 p.m. L_{eq} (dBA)	10:00 p.m. - 7:00 a.m. Leq (dBA)
Residential	55	45
Professional Services	55	55
Other Commercial	60	60
Industrial	70	70

Source: San Bernardino County (2014), Development Code, Section 83.01.080, Table 83-2
Note: dBA – A-weighted decibel; L_{eq} – equivalent sound level

Development Code Section 83.01.090, Vibration, establishes standards for acceptable vibration levels. The section states that no ground vibration shall be allowed that can be felt without the aid of instruments at or beyond the lot line, nor shall any vibration be allowed which produces a particle velocity greater than or equal to two-tenths (0.20) inch per second measured at or beyond the lot line. Temporary construction, maintenance, repair, or demolition activities between 7 a.m. and 7 p.m. are exempt from this vibration limit, except on Sundays and federal holidays, when construction is prohibited.

3.0 EXISTING SOUND ENVIRONMENT

The most significant sources of noise in the vicinity of the project are other adjacent industrial land uses including existing solar operations. Aircraft using the Edwards Air Force Base also contribute to intermittent noise levels. Noise is also generated on individual parcels whether industrial, office, retail, or residential.

In 2022, Kimley-Horn and Associates conducted six short-term ambient noise measurements to quantify the existing ambient noise levels for the proposed Desert Breeze Solar Project (Kimley-Horn 2023). As part of that ambient survey, a measurement was taken along Hoffman Road immediately north of the project site boundary, and a measurement was taken along Edie Drive, approximately 2,000 feet east of the gen-tie boundary. These ambient measurements will be referred to as NM-1 and NM-2, respectively, within this report and can be seen in **Figure 2, Project Equipment Layout**. While there has been more development in the area since these measurements were taken, the development would only increase the ambient noise levels and, thus, these measurements would be a conservative representation of the project area's ambient noise levels. A summary of these measurements is shown below in **Table 6, Summary of Ambient Noise Measurements**.

Table 6. Summary of Ambient Noise Measurements

Noise Monitor	Location	L_{eq}, dBA	L_{min}, dBA	L_{max}, dBA	Peak, dBA
NM-1	Along Hoffman Road, immediately north of the project site boundary.	39	24	59	88
NM-2	Along Edie Drive, approximately 2,000 feet east of the gen-tie boundary.	55	46	64	79

Source: Kimley-Horn and Associates 2023

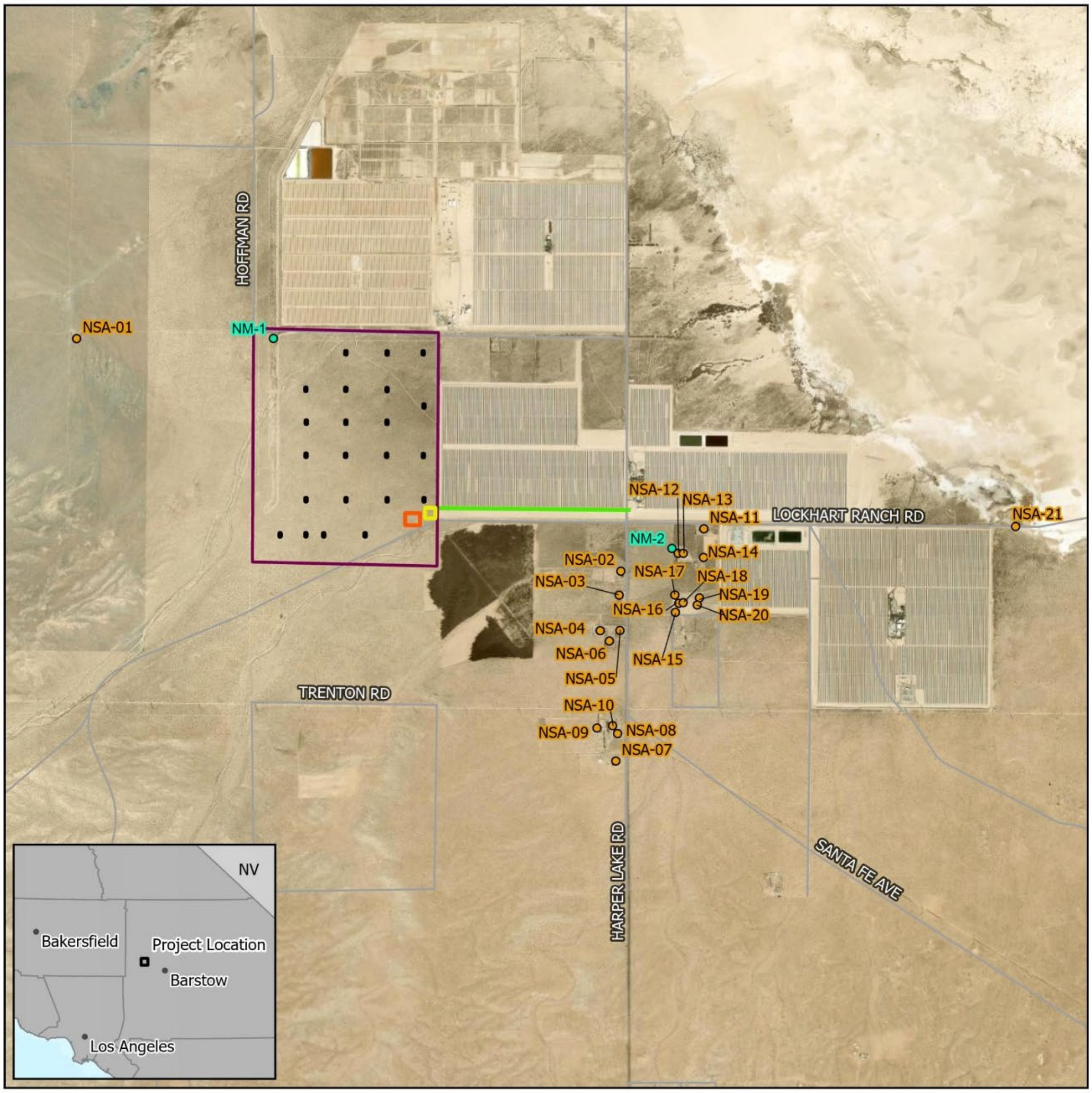

Figure 2
Project Equipment Layout

Overnight Solar
Overnight Solar, LLC

- Noise Sensitive Area (NSA)
- Noise Monitoring Location
- Proposed Gen-tie
- Project Parcel
- Proposed 230 kV Substation
- AC Storage Option
- Inverter Skid

TETRA TECH

1:50,000 — 0 0.5 1 Miles — N

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3.1 Noise-Sensitive Areas

Human response to noise varies considerably from one individual to another. Effects of noise at various levels can include interference with sleep, concentration, and communication, and can cause physiological and psychological stress and hearing loss. Given these effects, some land uses are considered more sensitive to ambient noise levels than others. In general, residences, schools, hotels, hospitals, and nursing homes are considered to be the most sensitive to noise. These locations are referred to as NSAs. Places such as churches, libraries, and cemeteries, where people tend to pray, study, and/or contemplate are also NSAs. Commercial and industrial uses are considered the least noise sensitive. As shown in **Figure 2**, there are multiple residences near the proposed project. A summary of the NSAs can been seen below in **Table 7, Summary of Noise Sensitive Areas**. As a conservative measure, all NSAs shown in **Figure 2** and **Table 7** were considered residential and inhabited.

Table 7. Summary of Noise Sensitive Areas

NSA	UTM Coordinates (meters)		Land Use	Distance to Project Site (feet)	Distance to Gen Tie (feet)	Representative Ambient Noise Monitoring Location
	Easting	Northing				
NSA-1	465026	3875896	Residential	5,900	11,500	NM-1
NSA-2	469812	3873851	Residential	5,280	1,585	NM-2
NSA-3	469797	3873641	Residential	5,725	2,400	NM-2
NSA-4	469630	3873328	Residential	5,725	3,500	NM-2
NSA-5	469804	3873330	Residential	6,200	3,400	NM-2
NSA-6	469711	3873237	Residential	6,100	3,800	NM-2
NSA-7	469768	3872182	Residential	8,700	7,300	NM-2
NSA-8	469783	3872423	Residential	8,100	6,500	NM-2
NSA-9	469602	3872472	Residential	7,600	6,300	NM-2
NSA-10	469739	3872493	Residential	7,825	6,300	NM-2
NSA-11	470542	3874224	Residential	7,750	2,500	NM-2
NSA-12	470316	3874008	Residential	7,050	1,900	NM-2
NSA-13	470361	3874008	Residential	7,225	2,000	NM-2
NSA-14	470539	3873972	Residential	7,800	2,500	NM-2
NSA-15	470292	3873489	Residential	7,425	3,200	NM-2
NSA-16	470322	3873569	Residential	7,375	3,000	NM-2
NSA-17	470287	3873642	Residential	7,225	2,700	NM-2
NSA-18	470360	3873574	Residential	7,550	3,100	NM-2
NSA-19	470503	3873616	Residential	7,950	3,200	NM-2
NSA-20	470484	3873554	Residential	7,950	3,400	NM-2
NSA-21	473284	3874244	Residential	16,725	11,200	NM-2

4.0 PROJECT CONSTRUCTION

4.1 Noise Calculation Methodology

Acoustic emission levels for activities associated with project construction were based upon typical ranges of energy equivalent noise levels at construction sites, as documented by the USEPA (1971) and the USEPA's "Construction Noise Control Technology Initiatives" (USEPA 1980). The USEPA methodology distinguishes between type of construction and construction stage.

The basic model assumed spherical wave divergence from a point source located at the closest boundary of the project site and gen-tie to each receptor structure. The calculated noise levels are based on the closest distance of the project site or gen-tie to the receptors. Furthermore, the model conservatively assumed that all pieces of construction equipment associated with an activity would operate simultaneously for the duration of that activity. An additional level of conservatism was built into the construction noise model by excluding potential shielding effects due to intervening structures and buildings along the propagation path from the site to receiver locations, such as residential buildings.

4.2 Projected Noise Levels During Construction

Construction of the project is expected to occur in one phase, over an approximately 26-month period beginning in 2024. The project would be constructed in multiple overlapping stages:

1. Site preparation and grading (including mobilization, site preparation, fencing, preparation of laydown areas, and trenching);
2. Solar array installation (including the installation of solar array structural components including cables, piles, racking systems, inverters, modules, and panels); and
3. BESS construction (including gen-tie, BESS, commissioning, and testing).

The second and third stage would involve pile driving for the installation and construction activities. The medium-voltage stations would sit on concrete foundations or driven piles, pending final design. The construction noise analysis conservatively assumes pile driving will be required for this activity as part of the second stage. The pile driver would be the worst-case option for noise as opposed to using concrete foundations.

Table 8, **Construction Equipment Noise Levels by Stage (dBA L_{max}),** summarizes the proposed equipment to be used for each stage and the associated noise level of the equipment. **Table 9**, **Received Construction Noise Levels by Stage (dBA L_{eq}),** summarizes the received construction noise levels at each NSA.

Table 8. Construction Equipment Noise Levels by Stage (dBA L_{max})

Construction Stage	Equipment			
	Equipment Type	Quantity	Usage Factor (%)	USEPA Construction Noise Level (50 feet), dBA L_{max}
Site Preparation/Grading (Stage 1)	Tractors/Loaders/Backhoes	1	40	80
	Off-Highway Trucks	1	40	55
	Scrapers	1	40	85
	Graders	2	40	85
	Bull Dozers	1	40	85
Solar Array Construction (Stage 2)	Cranes	1	16	85
	Forklifts	5	40	84
	Trenchers	2	40	85
	Loaders	2	40	80
	Generator Sets	12	50	82
	Bore/Drill Rigs	1	20	84
	Aerial Lifts	2	40	85
	Tractors/Loaders/Backhoes	1	40	84
	Welders	12	40	73
	Pile Driver	1	20	95
BESS Construction (Stage 3)	Cranes	2	16	85
	Forklifts	5	40	84
	Off-Highway Trucks	1	40	55
	Generator Sets	10	50	70
	Bore/Drill Rigs	1	20	84
	Trenchers	2	40	85
	Aerial Lifts	3	20	85
	Loaders	1	40	80
	Tractors/Loaders/Backhoes	3	40	84
	Welders	3	40	73
	Pile Driver	1	20	95

Notes: BESS – battery energy storage system; dBA – A-weighted decibel; L_{max} – maximum sound level; USEPA – U.S. Environmental Protection Agency
Gen-tie construction will occur during the BESS construction stage (Stage 3).

Table 9. Received Construction Noise Levels by Stage (dBA L_{eq})

NSA	UTM Coordinates (meters)		Stage 1 and 2 Distance to Construction (feet)	Stage 3 Distance to Construction (feet)	Construction Noise Levels		
					Stage 1	Stage 2	Stage 3
	Easting	Northing			L_{eq}	L_{eq}	L_{eq}
NSA-1	465026	3875896	5,900	11,500	46	53	46
NSA-2	469812	3873851	5,280	1,585	47	54	63
NSA-3	469797	3873641	5,725	2,400	46	54	60
NSA-4	469630	3873328	5,725	3,500	46	54	56
NSA-5	469804	3873330	6,200	3,400	46	53	57
NSA-6	469711	3873237	6,100	3,800	46	53	56

NSA	UTM Coordinates (meters)		Stage 1 and 2 Distance to Construction (feet)	Stage 3 Distance to Construction (feet)	Construction Noise Levels		
	Easting	Northing			Stage 1	Stage 2	Stage 3
					L_{eq}	L_{eq}	L_{eq}
NSA-7	469768	3872182	8,700	7,300	43	50	50
NSA-8	469783	3872423	8,100	6,500	43	51	51
NSA-9	469602	3872472	7,600	6,300	44	51	51
NSA-10	469739	3872493	7,825	6,300	43	51	51
NSA-11	470542	3874224	7,750	2,500	44	51	59
NSA-12	470316	3874008	7,050	1,900	44	52	62
NSA-13	470361	3874008	7,225	2,000	44	52	61
NSA-14	470539	3873972	7,800	2,500	44	51	59
NSA-15	470292	3873489	7,425	3,200	44	51	57
NSA-16	470322	3873569	7,375	3,000	44	51	58
NSA-17	470287	3873642	7,225	2,700	44	52	59
NSA-18	470360	3873574	7,550	3,100	44	51	57
NSA-19	470503	3873616	7,950	3,200	43	51	57
NSA-20	470484	3873554	7,950	3,400	43	51	57
NSA-21	473284	3874244	16,725	11,200	37	44	46

L_{eq} – equivalent sound level; NSA – noise sensitive area; UTM – Universal Transverse Mercator

Noise levels resulting from the construction activities would vary significantly depending on several factors such as the type and age of equipment, specific equipment manufacture and model, the operations being performed, and the overall condition of the equipment and exhaust system mufflers. Project construction would occur between 7:00 a.m. and 6:00 p.m. on weekdays. Although the County's ordinance may exempt daytime construction noise from the County's typical noise requirements, construction noise may still be considered an impact under CEQA. Therefore, the FTA has published construction noise impact criteria levels of an 80 dBA 8-hour L_{eq} for the day and a 70 dBA 8-hour L_{eq} for the night for residential land uses.

Table 9 shows that the highest construction noise levels at a receptor will be 63 dBA L_{eq} at NSA-2 during stage 3 construction. This level is below the FTA guidance level of 80 dBA L_{eq} and would occur during the daytime, which is in compliance with the County's Development Code Section 83.01.080. Due to these circumstances, the temporary increase in noise due to construction is considered to be a less than significant impact.

Construction activities would also cause increased noise along access routes to and from the project site due to the movement of equipment and workers. Construction vehicles would access the Project site from Harper Lake Road and SR-58. Traffic generated by construction of the project would occur primarily as a result of construction workers traveling to and from the Project's access points. Traffic would also be generated by heavy equipment. However, once the equipment is delivered to the site, they would generally stay on the site. Vehicle traffic would also be generated by construction material deliveries. The peak number of daily truck trips during construction would be 32.

A noise model was generated using Computer Aided Noise Abatement (CadnaA®) and the RLS-90 standard to estimate the noise impacts from construction related traffic. Traffic volumes for construction and existing conditions were taken from the Traffic Impact Study within Appendix K of the Draft Environmental Impact Report. A summary of the modeled traffic levels is shown below in **Table 10, Received Traffic Noise Levels (dBA L_{eq})**.

Table 10. Received Traffic Noise Levels (dBA L_{eq})

NSA	UTM Coordinates (meters)		Existing Traffic Conditions (dBA, L_{eq})	Construction Traffic Conditions (dBA, L_{eq})
	Easting	Northing		
NSA-1	465026	3875896	11	12
NSA-2	469812	3873851	47	56
NSA-3	469797	3873641	45	55
NSA-4	469630	3873328	39	47
NSA-5	469804	3873330	45	55
NSA-6	469711	3873237	40	50
NSA-7	469768	3872182	42	53
NSA-8	469783	3872423	43	54
NSA-9	469602	3872472	36	47
NSA-10	469739	3872493	41	51
NSA-11	470542	3874224	47	38
NSA-12	470316	3874008	39	42
NSA-13	470361	3874008	38	42
NSA-14	470539	3873972	36	39
NSA-15	470292	3873489	35	43
NSA-16	470322	3873569	35	43
NSA-17	470287	3873642	36	43
NSA-18	470360	3873574	35	42
NSA-19	470503	3873616	34	40
NSA-20	470484	3873554	34	40
NSA-21	473284	3874244	16	14

As shown in **Table 10**, some NSAs will be subject to increased noise levels due to construction traffic, with the greatest increase in noise level being 11 dBA at NSA IDs 7, 8, and 9. However, as indicated previously, construction-related traffic would be limited to 7:00 a.m. to 7:00 p.m. in compliance with the County's Development Code Section 83.01.080 and would cease upon completion of Project construction, and as such the temporary impacts would be less than significant.

4.3 Construction Best Practice Design Measures

As shown in Section 4.2, the noise generated from the construction of the project would not generate a significant impact. However, since construction machines operate intermittently, and the types of machines in use at the project site change with the stage of construction, noise emitted during construction would be mobile and highly variable. Therefore, to help minimize noise impacts, the project's construction management protocols would implement the following best practice noise reduction design measures:

- Maintain all construction tools and equipment in good operating order according to manufacturers' specifications.
- Limit construction activities to daytime hours (7:00 a.m. to 7:00 p.m.).
- Equip any internal combustion engine used for any purpose on the job or related to the job with a properly operating muffler that is free from rust, holes, and leaks.
- For construction devices that utilize internal combustion engines, ensure the engine's housing doors are kept closed, and install noise-insulating material mounted on the engine housing consistent with manufacturers' guidelines, if possible.
- Utilize a Complaint Resolution Procedure to address any noise complaints received from residents.

5.0 VIBRATION CALCULATION METHODOLOGY

Vibration levels for activities associated with project construction were based on the average of source levels in PPV published with the FTA (2006) Transit Noise and Vibration Impact Assessment, which documents several types of construction equipment measured under a wide variety of construction activities. Using the documented vibration levels as input into a basic propagation model, construction vibration levels were calculated at the nearest NSA structure.

5.1 Projected Vibration Levels During Construction

As discussed in Section 4.2, project construction would be completed in three work stages. This vibration analysis evaluated the worst-case vibration source, which would be the pile driver. Based on vibration propagation calculations, construction vibration levels are predicted to be 0.0030 PPV inch/second, or 58 VdB, at the nearest residential receptor from construction activities, which is approximately 1,585 feet from the gen-tie line. These levels are based on the worst-case vibration producing equipment and it is expected that other vibration generating equipment proposed for project construction would result in lower vibration levels. Vibration levels at the nearest sensitive receptor will be below the minimum vibration level for human perception of 65 VdB.

6.0 OPERATIONAL NOISE

This section describes the model utilized for the assessment; input assumptions used to calculate noise levels due to the project's normal operation; a conceptual noise mitigation strategy; and the results of the noise impact analysis.

6.1 Noise Prediction Model

The CadnaA computer noise model was used to calculate sound pressure levels from the operation of the project equipment in the vicinity of the project site. An industry standard, CadnaA was developed by DataKustik GmbH to provide an estimate of sound levels at distances from sources of known emission. It is used by acousticians and acoustic engineers for its capability to accurately describe noise emission and propagation from complex facilities consisting of various equipment types like the project and in most cases, yields conservative results of operational noise levels in the surrounding community.

The ISO standard for outdoor sound propagation, ISO 9613 Part 2 – "Attenuation of Sound during Propagation Outdoors," was used within CadnaA (ISO 1996). The method described in this standard calculates sound attenuation under weather conditions that are favorable for sound propagation, such as for downwind propagation or atmospheric inversion, conditions which are typically considered worst-case. The calculation of sound propagation from source to receiver locations consists of full octave band sound frequency algorithms, which incorporate the following physical effects:

- Geometric spreading wave divergence;
- Reflection from surfaces;
- Atmospheric absorption at 10 degrees Celsius and 50 percent relative humidity;
- Screening by topography and obstacles;
- The effects of terrain features including relative elevations of noise sources;
- Sound power levels from stationary sources;
- The locations of noise-sensitive land use types;
- Intervening objects including buildings and barrier walls, to the extent included in the design;
- Ground effects due to areas of pavement and unpaved ground;
- Sound power at multiple frequencies;
- Source directivity factors;
- Multiple noise sources and source type (point, area, and/or line); and
- Averaging predicted sound levels over a given time.

CadnaA allows for three basic types of sound sources to be introduced into the model: point, line, and area sources. Each noise-radiating element was modeled based on its noise emission pattern. Larger dimensional sources such as the transformers were modeled as area sources.

Off-site topography was obtained using the publicly available United States Geological Survey digital elevation data. A default ground attenuation factor of 0.5 was assumed for off-site sound propagation over acoustically "mixed" ground.

6.2 Input to the Noise Prediction Model

The project's general arrangement was reviewed and directly imported into the acoustic model so that on-site equipment could be easily identified, buildings and structures could be added, and sound emission data could be assigned to sources as appropriate. **Figure 2** shows the project equipment layout based on the Site Plan which was provided to Tetra Tech by Overnight Solar.

The primary noise sources during operations are the inverter skids consisting of one inverter and one transformer, the 230-megavolt-ampere substation transformer, and the BESS units. It is expected that all equipment would operate in a consistent manner during daylight hours; however, the inverter skids will not operate while the sun is down. While the inverter skids are not expected to operate while the sun is down, they may still operate during the early morning of the County's defined "nighttime" period (10 p.m. to 7 a.m.) due to fluctuating seasonal sunlight hours.

Reference sound power levels input to CadnaA were provided by Overnight Solar and equipment manufacturers and can be found in **Attachment A**. The sound levels used in the noise model are shown in **Table 11, Modeled Sound Power Level (L_w) for Major Pieces of Project Equipment**.

Table 11. Modeled Sound Power Level (L_w) for Major Pieces of Project Equipment

Sound Source	Sound Power Level (L_w) by Octave Band Frequency, Hz, dBL									Broadband Level, dBA
	31.5	63	125	250	500	1k	2k	4k	8k	
Inverter Skid	91	92	93	92	97	88	87	83	80	96
Substation Transformer	101	107	109	104	104	98	93	88	81	105
BESS Unit	87	88	89	88	93	84	83	79	76	92

BESS – battery energy storage system; dBA – A-weighted decibel; dBL – linear decibel; Hz – hertz

From the new project substation, a 230-kilovolt (kV) gen-tie line would be constructed to connect the solar facility to its point of interconnection, which would be an existing gen-tie line located approximately 1.1 miles east of the proposed solar facility, just south of the existing Alpha Substation. The Electric Power Research Institute has conducted several studies of corona effects (EPRI 1978, 1987). The typical noise levels for transmission lines with wet conductors are shown in **Table 12, Transmission and Sub-transmission Line Voltage and Audible Noise Levels**. It can be assumed that the proposed 230-kV gen-tie will produce a sound level of 40 dBA directly under the conductors during worst case wet conditions.

Table 12. Transmission and Sub-transmission Line Voltage and Audible Noise Levels

Line Voltage (kV)	Audible Noise Level Directly Below the Conductor (dBA)
138	34
240	40
360	51

dBA – A-weighted decibels; kV – kilovolt
Source: EPRI (1978, 1987)

6.3 Results of the Noise Prediction Model

Broadband (dBA) sound pressure levels were calculated for expected normal project operation assuming that all components identified previously are operating continuously and concurrently at the representative manufacturer-rated sound. The sound energy was then summed to determine the equivalent continuous A-weighted downwind sound pressure level at a point of reception. Sound contour plots displaying broadband (dBA) sound levels presented as color-coded isopleths are provided in **Figure 3**, **Project Operation, Received Sound Levels**. The sound contours are graphical representations of the cumulative noise associated with full operation of the equipment and show how operational noise would be distributed over the surrounding area of the project site. The contour lines shown are analogous to elevation contours on a topographic map, i.e., the noise contours are continuous lines of equal noise level around some source, or sources, of noise.

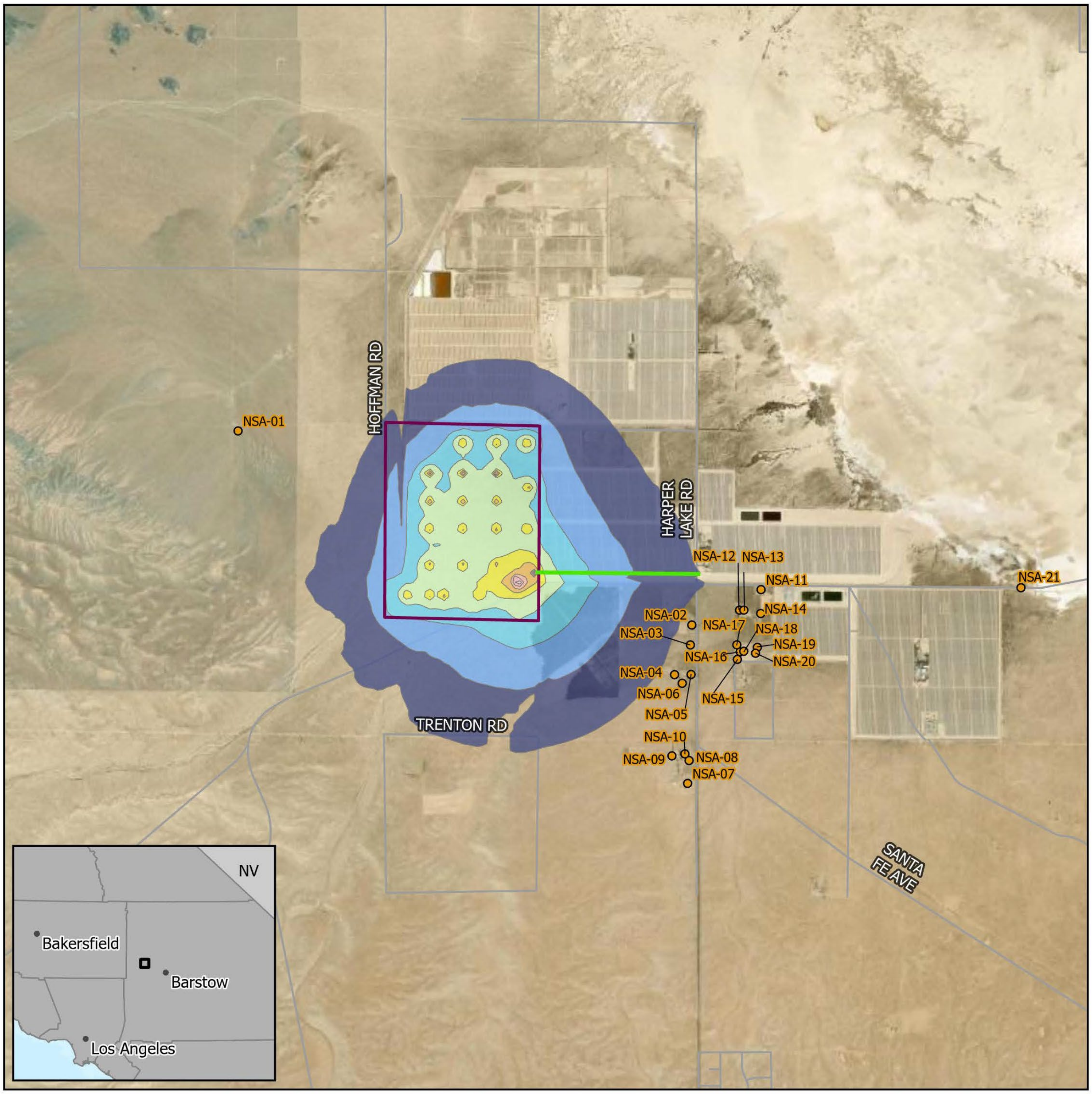

Figure 3
Project Operation, Received Sound Levels

Overnight Solar
Overnight Solar, LLC

- Noise Sensitive Area (NSA)
- Proposed Gen-tie
- Project Parcel

Received Sound Levels (dBA)

35.0-40.0	55.0-60.0	80.0-85.0
40.0-45.0	60.0-65.0	85.0-90.0
45.0-50.0	65.0-70.0	90.0-95.0
50.0-55.0	70.0-75.0	
	75.0-80.0	

TETRA TECH

1:60,000 0 0.5 1 Miles N

Revised: 6/11/2024 | NOT FOR CONSTRUCTION

San Bernardino County, CA

Path: Z:\Projects\1548_0001_Overnight_Solar\Layouts\AcousticTechnicalReport\AcousticTechnicalReport_CountyComments.aprx

Table 13, Operational Acoustic Modeling Results, dBA shows the projected exterior sound levels for full project operations at the property boundary of each NSA. While the inverter skids are not expected to operate while the sun is down, compliance for both daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) regulatory thresholds was assessed assuming full project operations as inverter skids will be operational while the sun is up, which would occur during the morning for the 10 p.m. to 7 a.m. nighttime period. The results indicate that the highest received noise level would be 34 dBA at NSA-2, NSA-3, and NSA-4 and that the project would comply with the San Bernardino County 55 dBA daytime and 45 dBA nighttime limits.

Table 13. Operational Acoustic Modeling Results, dBA

NSA	UTM Coordinates (meters)		Operational L_{eq}, dBA
	Easting	Northing	
NSA-1	465026	3875896	25
NSA-2	469812	3873851	34
NSA-3	469797	3873641	34
NSA-4	469630	3873328	34
NSA-5	469804	3873330	33
NSA-6	469711	3873237	33
NSA-7	469768	3872182	25
NSA-8	469783	3872423	26
NSA-9	469602	3872472	28
NSA-10	469739	3872493	27
NSA-11	470542	3874224	32
NSA-12	470316	3874008	32
NSA-13	470361	3874008	32
NSA-14	470539	3873972	31
NSA-15	470292	3873489	31
NSA-16	470322	3873569	31
NSA-17	470287	3873642	32
NSA-18	470360	3873574	31
NSA-19	470503	3873616	30
NSA-20	470484	3873554	30
NSA-21	473284	3874244	31

Notes: dBA – A-weighted decibel; L_{eq} – equivalent sound level; NSA – noise sensitive area; UTM – Universal Transverse Mercator

6.4 Maintenance Activities

Project maintenance activities would include solar panel washing as needed. These activities are expected to occur up to four times per year and would not generate a significant amount of traffic or create a substantial increase of vehicular noise in the area. Any increase in traffic would be minimal and sporadic; therefore, impacts from vehicular noise would be less than significant.

6.5 Decommissioning

Most of the components of the solar installation are composed of materials that can be easily recycled. If the panels can no longer be used in a solar array, the aluminum can be resold, and the glass can be recycled. Other components of the solar installation, such as the solar array structure and mechanical assemblies, can be recycled since they are made from galvanized steel. Equipment such as inverters and switchgears can be reused, or their components recycled. The equipment pads are made from concrete that can be crushed and recycled. Conduit and wire would be removed by uncovering trenches and backfilling when done. The electrical wiring is made from copper and/or aluminum and could also be reused or recycled.

Noise levels from decommissioning would be similar to those during construction. The same types of heavy equipment and vehicles would be used to decommission the site as were used to construct it. Decommissioning activities, like construction, would comply with County construction noise ordinance standards as detailed previously. Therefore, noise impacts from project decommissioning would be less than significant.

7.0 CONCLUSION

Project construction would occur between 7:00 a.m. and 6:00 p.m., in compliance with the San Bernardino County Ordinance Code, and is exempt from noise regulations during this time. The highest construction noise levels at a receptor would be 63 dBA L_{eq} at NSA-2 during stage 3 construction. This level is below the FTA guidance level of 80 dBA L_{eq} and would occur during the daytime in compliance with the County's Development Code Section 83.01.080. Due to these circumstances, the temporary increase in noise due to construction is considered to be a less than significant impact. There will also be temporary noise at NSAs associated with construction-related traffic but that is also considered temporary and a less than significant impact.

During project construction, the worst-case vibration source would be the pile driver. Based on vibration propagation calculations, construction vibration levels are predicted to be 0.0027 PPV inch/second, or 58 VdB, at the nearest residential receptor, which is approximately 1,585 feet from the gen-tie. These levels are based on the worst-case vibration producing equipment and it is expected that other vibration generating equipment proposed for the project construction would result in lower vibration levels. Vibration levels at the nearest receptor would be below the minimum vibration level for human perception of 65 VdB.

Normal project operations would occur during the daytime and nighttime periods. Noise modeling shows that the project would comply with the County's 55 dBA daytime and 45 dBA nighttime limits. The highest noise level associated with the project operations is 34 dBA at NSA-2, NSA-3, and NSA-4.

8.0 REFERENCES

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ATTACHMENT A: EQUIPMENT NOISE SPECIFICATIONS

SUNGROW USA CORP.
SOLAR INVERTER SKID
NOISE TEST
MODEL NO. SG3600UD
SERIAL NO. A2011215246

CSTI REPORT NO. R-1259-0
CSTI PROJECT NO. 6808

7 SEPTEMBER 2021

Prepared By:
CSTI acoustics

Prepared For:
Sungrow USA Corp.
575 Market Street
San Francisco, CA 94105

Revision History

Rev.	Date	Reason for Issue/Description of Changes	Prepared	Checked	Approved
0	7 Sep 2021	Initial Report Submittal	ASY	ASB	ASB

TABLE OF CONTENTS

TABLES

FIGURES

1. INTRODUCTION

Collaboration in Science and Technology Inc. (CSTI) was retained by Sungrow USA Corp. (Sungrow) to determine the sound levels of a Solar Inverter Skid with Model No. SG3600UD and Serial No. A2011215246 operating close to nominal power or >90% loading. The measurements and calculations were performed according to the ISO 3746:2010 standard.

Information on the test condition and test environment is presented in Section 2. The sound instrumentation is described in Section 3. The sound measurement data is presented in Section 4. Section 5 summarizes the results of the test. Appendix A presents the calibration certificates of the equipment. Appendix B presents one-third octave band sound data and sound power level calculations.

2. TEST CONDITION AND TEST ENVIRONMENT

Sound measurements were made around the field-installed Solar Inverter Skid while it was operating close to nominal power or >90% loading between 2:30 and 3:30 PM on 25 August 2021 at a location near Co. Rd. 322 in El Campo, Texas 77437. Adam Young of CSTI made the measurements.

The Solar Inverter Skid was about 20 ft (6.1 m) long by 8 ft (2.4 m) wide by 9.5 ft (2.9 m) tall. The skid was mounted on a platform that was roughly 3 ft. tall making the total height of the package roughly 12.5 ft. (3.7 m) tall.

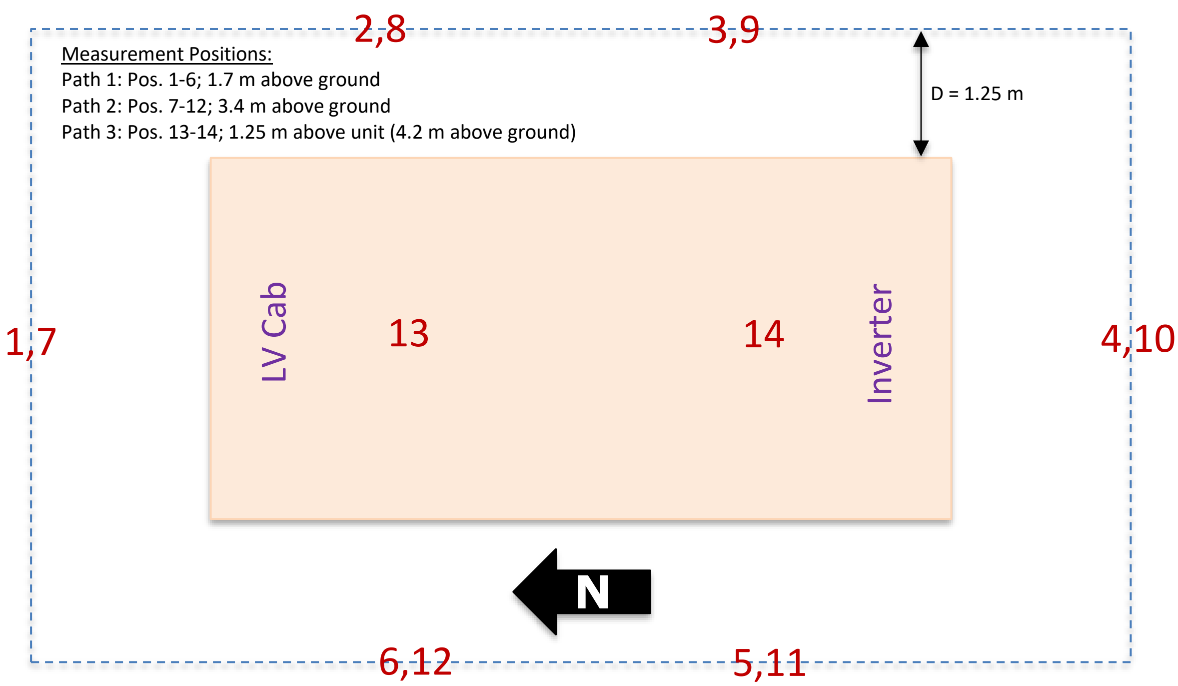
The outdoor test environment was free of significant reflecting surfaces.

Measurements of the background (ambient) sound level were made around the Solar Inverter Skid without the transformer fans running (the dominant sound source). However, it was not possible to shut off power to the transformers, and the associated “hum” was present during the ambient measurements. Therefore, ambient corrections were not made to the presented measured operating sound levels (presented in Table 1). The greatest source of actual ambient sound was insects, though a frequency analysis suggests insects did not significantly affect the operational noise measurements.

Figure 1 shows a photo of the Solar Inverter Skid. Figure 2 shows a drawing of an overhead view with the measurement positions marked. Sound measurements were made at 1.25 m from the equipment skid which is roughly the width of the worker access platform. Three measurement “paths” were made: one at a height of 5.5 ft. (1.7 m) above the ground, one at a height of 11 ft. (3.4 m) above the ground, and one at 1.25 m above the top of the unit (4.2 m above the ground).

Figure 1. Photo of Solar Inverter Skid (Looking East)

Figure 2. Measurement Positions, Overhead View



3. INSTRUMENTATION

Noise measurements were made using the following equipment:

- Rion NL-62 Sound Level Meter, S/N 01030561
- Rion NC-74 Sound Level Calibrator, S/N 34883949

The sound level meter meets the requirements for a Type 1 sound level meter per ANSI S1.4, American National Standard Specification for Sound Level Meters. The sound level meter was calibrated before and after the measurements with the calibrator and showed no significant variation. The calibration certificates for the meter and calibrator are presented in Appendix A.

4. SOUND DATA

Twenty-second samples of one-third octave-band and A-weighted sound pressure levels were measured at positions around the package while in operation as called for in the ISO 3746:2010 standard. The measurement positions are shown in Figure 2.

Ambient measurements were also made at the same locations shown in Figure 2, though we did not correct for the ambient due to the transformer noise present during those measurements.

Octave band, A-weighted, and unweighted (dBZ) data for each measurement position are presented in Table 1. Average sound pressure levels and sound *power* levels (L_W) are also presented. One-third octave band data and sound power level calculations are presented in Appendix B.

Table 1. Sound Measurement Data, dB

Position	Octave Band Center Frequency, Hz									dBA	dBZ
	31.5	63	125	250	500	1000	2000	4000	8000		
1	69	68	68	67	68	63	62	57	52	69.2	75.6
2	66	67	68	67	67	63	63	57	51	68.9	74.6
3	69	68	70	71	75	66	64	62	58	74.3	79.0
4	71	71	74	71	78	71	71	66	64	78.0	81.8
5	69	68	70	71	76	66	63	60	59	74.3	79.2
6	66	67	65	66	69	62	60	56	51	68.7	74.2
7	61	64	64	58	58	54	45	40	35	58.7	69.0
8	65	68	71	65	66	64	59	56	50	68.2	75.2
9	69	69	69	72	75	65	66	61	55	74.0	79.0
10	70	73	74	71	81	71	68	67	62	78.6	83.3
11	69	69	72	72	73	67	65	60	55	73.6	79.0
12	67	68	67	66	70	63	62	58	52	69.9	75.3
13	64	68	68	65	71	60	56	51	47	68.5	74.9
14	69	71	73	71	74	64	63	57	51	72.4	79.2
Average	**68**	**69**	**71**	**69**	**74**	**66**	**64**	**61**	**57**	**73.3**	**78.4**
L_W	**91**	**92**	**93**	**92**	**97**	**88**	**87**	**83**	**80**	**95.9**	**100.9**

The maximum A-weighted sound pressure level measured was 78.6 dBA, at position 10 on the South side of the package near the Inverter. The maximum A-weighted sound pressure level measured at 1.7 m (ear height) above the ground was 78.0 dBA, at position 4 (also near the Inverter.) The average of all fourteen measurements was 73.3 dBA. The A-weighted sound *power* level (L_W) for the package is 95.9 dBA.

5. SUMMARY

The sound levels from a Solar Inverter Skid with Model No. SG3600UD and Serial No. A2011215246 were measured.

The maximum A-weighted sound pressure level measured was 78.6 dBA, at position 10 on the South side of the package near the Inverter. The maximum A-weighted sound pressure level measured at 1.7 m (ear height) above the ground was 78.0 dBA, at position 4 (also near the Inverter.) The average of all fourteen measurements was 73.3 dBA. The A-weighted sound *power* level (L_W) for the package is 95.9 dBA.

APPENDIX A: CALIBRATION CERTIFICATES FOR EQUIPMENT

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.45459

Instrument: **Acoustical Calibrator**
Model: **NC-74**
Manufacturer: **Rion**
Serial number: **34889349**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:
Customer: **CSTI Acoustics**
Tel/Fax: **281-492-2784 / 281-492-1434**

Date Calibrated: **10/14/2020** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No
Address: **16155 Park Row Blvd., Suite 150, Houston, TX 77084-6971**

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 10/1/2010

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2019	Scantek, Inc./ NVLAP	Oct 31, 2020
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Oct 22, 2019	ACR Env. / A2LA	Oct 22, 2020
HM30-Thommen	Meteo Station	1040170/39633	Oct 24, 2019	ACR Env./ A2LA	Oct 24, 2020
140-Norsonic	Real Time Analyzer	1406423	Oct 31, 2019	Scantek / NVLAP	Oct 31, 2020
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	173368	Oct 23, 2019	Scantek, Inc. / NVLAP	Oct 23, 2020
1203-Norsonic	Preamplifier	14059	March 3, 2020	Scantek, Inc./ NVLAP	March 3, 2021

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	William D. Gallagher
Signature	Lydon Dawkins	Signature	William D. Gallagher
Date	10/14/2020	Date	10/14/2020

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
Document stored as: Y:\Calibration Lab\Cal 2020\RIONNC74-0.5in_34889349_M1.doc

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Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
CALIBRATION
NVLAP Lab Code: 200625-0

Calibration Certificate No.45457

Instrument: **Sound Level Meter**
Model: **NL62**
Manufacturer: **Rion**
Serial number: **01030561**
Tested with: **Microphone UC-59L s/n 00638**
Preamplifier NH26 s/n 00603
Type (class): **1**
Customer: **CSTI Acoustics**
Tel/Fax: **281-492-2784 / 281-492-1434**

Date Calibrated: **10/14/2020** *Cal Due:*

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No
Calibration service: __ Basic _X_ Standard
Address: **16155 Park Row Blvd., Suite 150, Houston, TX 77084-6971**

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 31, 2019	Scantek, Inc./ NVLAP	Oct 31, 2020
DS-360-SRS	Function Generator	33584	Oct 23, 2019	ACR Env./ A2LA	Oct 23, 2021
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Oct 22, 2019	ACR Env. / A2LA	Oct 22, 2020
HM30-Thommen	Meteo Station	1040170/39633	Oct 24, 2019	ACR Env./ A2LA	Oct 24, 2020
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Oct 23, 2019	Scantek, Inc./ NVLAP	Oct 23, 2020

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.2	100.00	51.8

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	William D. Gallagher
Signature	Lydon Dawkins	Signature	William D. Gallagher
Date	10/14/2020	Date	10/14/2020

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Document stored Y:\Calibration Lab\SLM 2020\RIONL62_01030561_M1.doc

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APPENDIX B: ADDITIONAL SOUND DATA AND CALCULATIONS

Position	One-Third Octave Band Center Frequency, Hz																											dBA	dBZ
	25	32	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.3k	1.6k	2k	2.5k	3.2k	4k	5k	6.3k	8k	10k		
1	65	65	63	62	64	63	58	67	58	59	64	63	65	64	60	58	59	58	55	59	57	53	47	55	48	46	46	69.2	75.6
2	59	62	61	61	62	64	58	67	58	59	63	63	63	63	59	57	59	57	54	61	56	52	47	55	49	45	45	68.9	74.6
3	64	66	63	64	64	63	62	67	66	63	66	68	71	72	65	63	62	58	57	61	60	60	51	58	53	53	53	74.3	79.0
4	67	67	64	65	67	68	69	71	65	63	65	69	76	73	68	69	64	62	63	67	67	62	56	64	59	60	60	78.0	81.8
5	65	65	63	63	64	63	62	68	65	63	66	68	73	72	67	63	60	59	58	58	59	58	51	55	56	53	53	74.3	79.2
6	58	62	61	61	62	63	55	62	60	59	62	63	65	66	58	59	57	57	54	56	53	51	47	53	48	45	44	68.7	74.2
7	55	57	57	57	58	61	55	63	51	51	52	55	57	52	47	48	50	49	41	41	38	36	29	37	31	29	30	58.7	69.0
8	61	61	60	61	65	64	61	70	59	57	58	63	64	60	59	62	56	56	54	55	54	50	45	55	48	43	44	68.2	75.2
9	65	64	64	65	64	64	62	65	65	66	65	69	72	71	65	62	60	60	59	63	61	57	52	57	53	50	48	74.0	79.0
10	65	66	65	66	70	69	69	73	64	63	65	70	79	75	68	69	65	62	62	64	63	64	57	63	59	55	56	78.6	83.3
11	63	65	64	65	65	64	63	71	64	66	66	69	70	69	65	63	63	60	60	62	60	57	52	56	52	49	48	73.6	79.0
12	63	62	60	63	64	62	58	66	60	58	61	63	67	65	62	60	57	58	56	59	55	54	48	56	50	46	45	69.9	75.3
13	58	59	60	64	64	60	61	67	60	59	58	61	68	66	58	55	56	55	51	51	51	48	42	47	44	40	39	68.5	74.9
14	63	65	65	66	67	66	67	70	67	65	64	68	72	68	61	60	60	57	56	60	58	55	48	52	48	46	44	72.4	79.2
Average	**63**	**64**	**63**	**64**	**65**	**65**	**64**	**68**	**63**	**62**	**64**	**67**	**72**	**69**	**64**	**63**	**60**	**59**	**58**	**61**	**60**	**57**	**51**	**57**	**53**	**52**	**51**	**73.3**	**78.4**
L_W	**86**	**86**	**85**	**86**	**87**	**87**	**86**	**91**	**86**	**85**	**86**	**89**	**94**	**92**	**86**	**86**	**83**	**81**	**80**	**83**	**82**	**80**	**73**	**80**	**76**	**74**	**74**	**95.9**	**100.9**

Unit Dimensions	in	m
l1	240	6.1
l2	96	2.4
l3	150	3.8

Meas. Distance, m		1.25
Measurement Surface Area		
a	4.3	m
b	2.5	m
c	5.1	m
S	179.4	m^2
L_W Corr.	22.5	dB

Noise Test Report for ST2752UX-US

1. Test information

Liquid-cooled ST2752UX-US energy storage container noise test, the test location is Sungrow factory Outdoor, the test time is October 13, 2021. The scene is shown in Figure 1, and the measurement point distribution and orientation definition are shown in Figure 2.

Figure 1. Field test picture

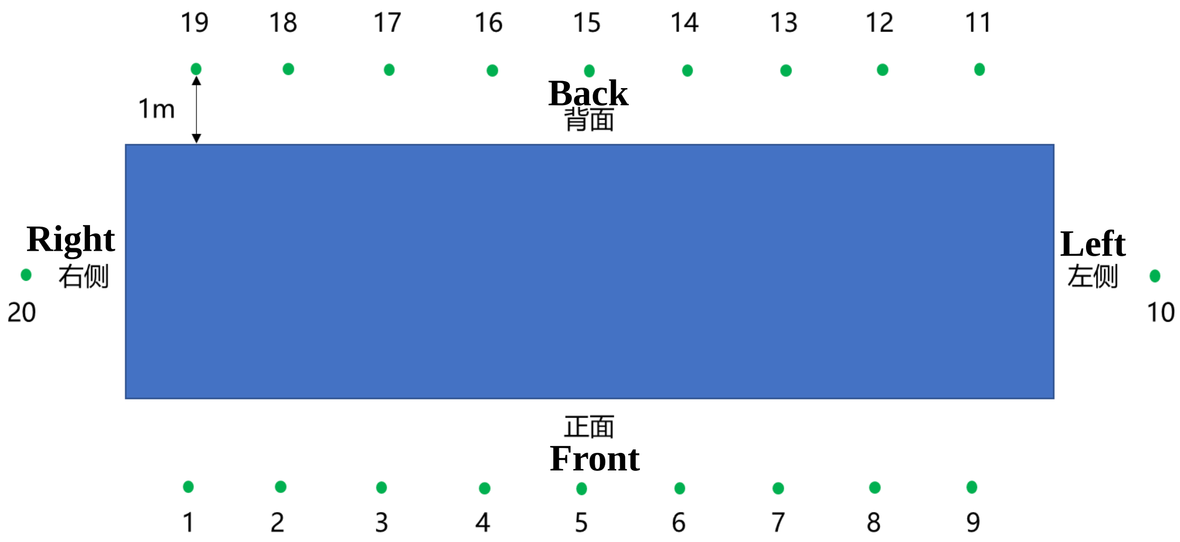


Figure 2. Schematic diagram of measuring point distribution and azimuth definition

2. Test conditions

2.1 Test information

- The whole machine runs at 100% power, reflecting the worst situation.
- Test the noise of each surface, and record the 1/3 octave frequency spectrum of each measurement point.

2.2 Testing process

Test the noise at each measuring point as shown in Figure 2 respectively. The noise sensor is arranged at a distance of 1 m from the wall of the whole machine and a height of 1.5 m.

3. Data processing results and analysis

The background noise test results are as follows, the background noise is 48.43dBA.

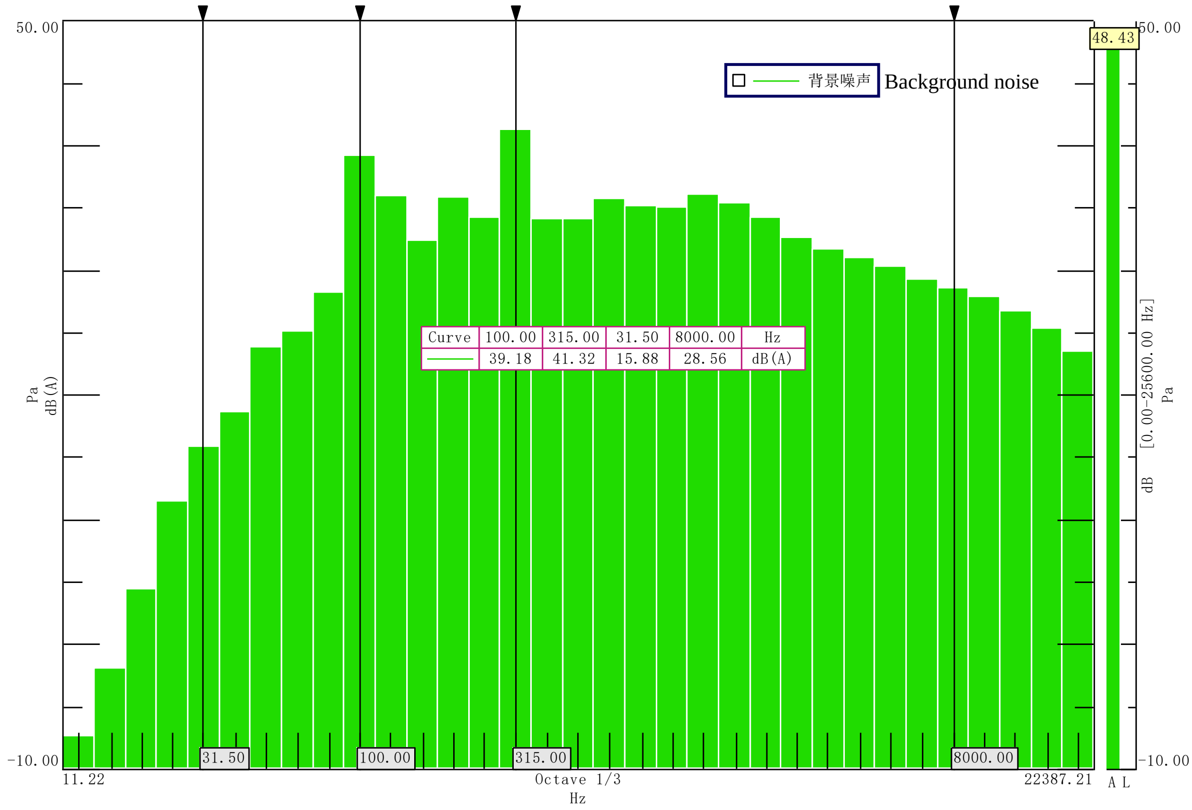
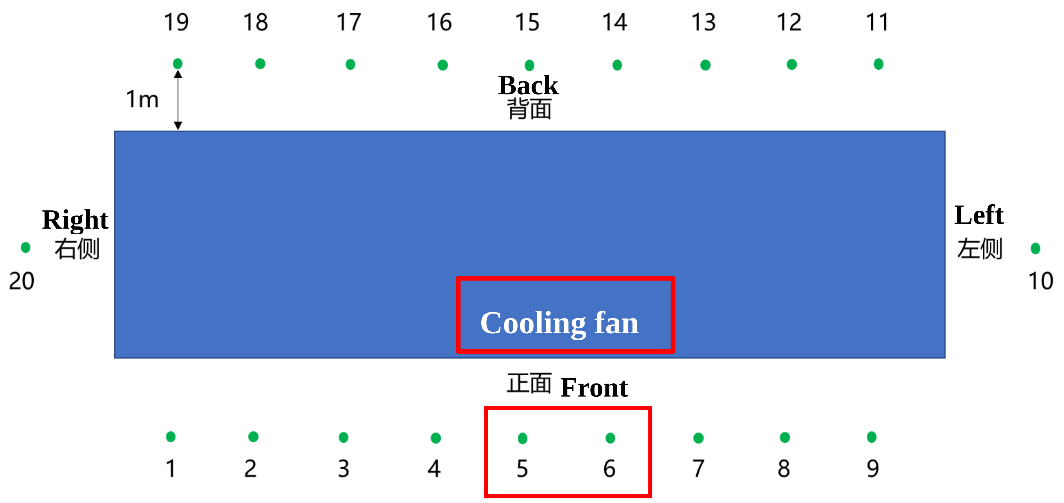


Figure 3. Background noise spectrum

The sound pressure level (dBA) test data of each measuring point is as follows, the noise of the measuring point is more than 10dBA larger than the background noise, no correction is needed:

Num.	Noise	Num.	Noise	Num.	Noise	Num.	Noise	Num.	Noise
1	68.91	5	74.68	9	69.04	13	72.34	17	70.04
2	69.39	6	74.81	10	69.21	14	72.42	18	67.93
3	70.28	7	72.92	11	70.63	15	72.07	19	67.88
4	71.9	8	71.1	12	70.44	16	71.96	20	62.66



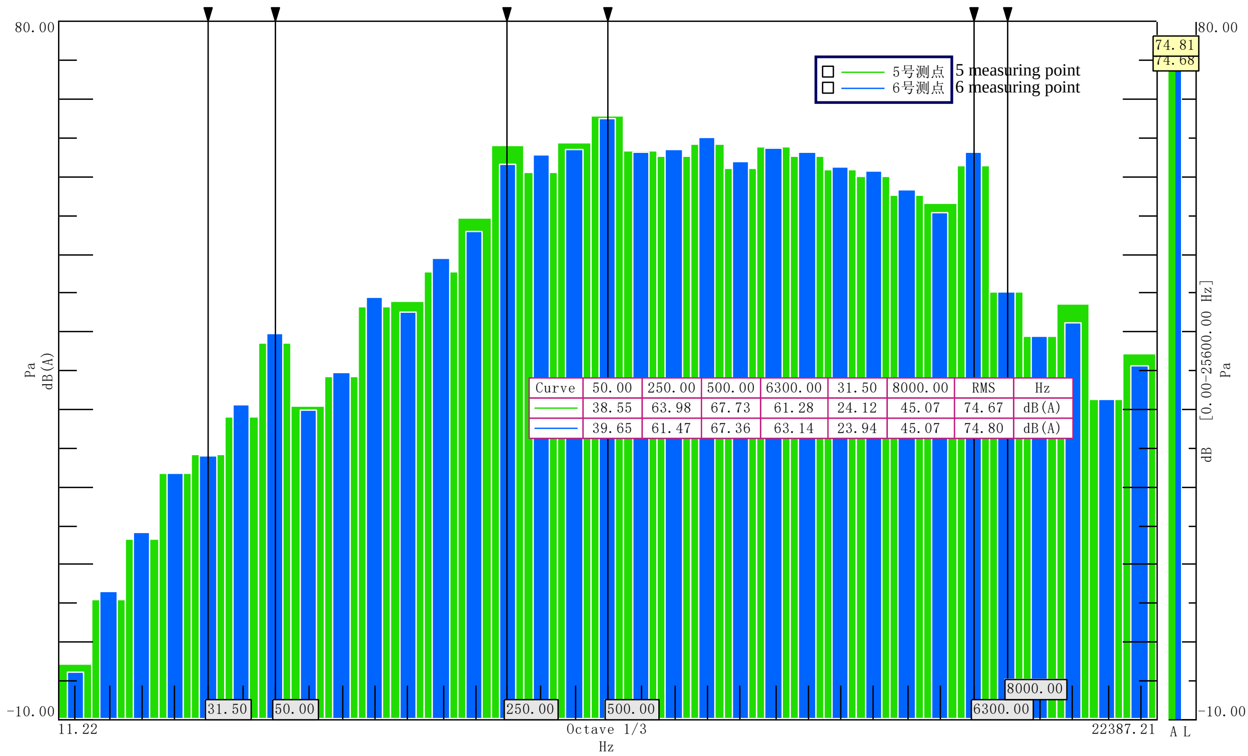


Figure 4. Maximum noise position (measurement points 5 and 6) 1/3 octave frequency spectrum

From the noise data of all measuring points, the main noise source is the cooling fan of the battery module. The maximum noise is at measuring points 5 and 6, which are 74.68dBA and 74.81dBA, respectively.