# NOISE ASSESSMENT

## Desert Green Solar Farm
### Modification to MUP 09-012;
### ER. No. 09-05-001A (APN 141-230-26)

***Prepared For:***

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## GLOSSARY OF TERMS

**Sound Pressure Level (SPL):** a ratio of one sound pressure to a reference pressure ($L_{ref}$) of 20 µPa. Because of the dynamic range of the human ear, the ratio is calculated logarithmically by 20 log ($L/L_{ref}$).

**A-weighted Sound Pressure Level (dBA):** Some frequencies of noise are more noticeable than others. To compensate for this fact, different sound frequencies are weighted more.

**Minimum Sound Level ($L_{min}$):** Minimum SPL or the lowest SPL measured over the time interval using the A-weighted network and slow time weighting.

**Maximum Sound Level ($L_{max}$):** Maximum SPL or the highest SPL measured over the time interval the A-weighted network and slow time weighting.

**Equivalent sound level ($L_{eq}$):** the true equivalent sound level measured over the run time. Leq is the A-weighted steady sound level that contains the same total acoustical energy as the actual fluctuating sound level.

**Day Night Sound Level (Ldn)**: Representing the Day/Night sound level, this measurement is a 24 –hour average sound level where 10 dB is added to all the readings that occur between 10 pm and 7 am. This is primarily used in community noise regulations where there is a 10 dB "Penalty" for night time noise. Typically Ldn's are measured using A weighting.

**Community Noise Exposure Level (CNEL)**: The accumulated exposure to sound measured in a 24-hour sampling interval and artificially boosted during certain hours. For CNEL, samples taken between 7 pm and 10 pm are boosted by 5 dB; samples taken between 10 pm and 7 am are boosted by 10 dB.

**Octave Band**: An octave band is defined as a frequency band whose upper band-edge frequency is twice the lower band frequency.

**Third-Octave Band**: A third-octave band is defined as a frequency band whose upper band-edge frequency is 1.26 times the lower band frequency.

**Response Time (F,S,I)**: The response time is a standardized exponential time weighting of the input signal according to fast (F), slow (S) or impulse (I) time response relationships. Time response can be described with a time constant. The time constants for fast, slow and impulse responses are 1.0 seconds, 0.125 seconds and 0.35 milliseconds, respectively.

## EXECUTIVE SUMMARY

This noise study has been completed to determine the noise impacts associated with the development of the proposed Desert Green – Borrego Springs Solar Farm concentrated photovoltaic (CPV) solar project located on a single parcel totaling approximately 288 gross acres. The Project seeks the modification to a Major Use Permit (P09-012) previously approved by the County of San Diego to allow for the construction, operation, and maintenance of the renewable energy Project (Project). The Project is located in the unincorporated community of Borrego Springs in northeastern portion of San Diego County, CA.

Section 36.404 of the County of San Diego noise ordinance provides performance standards and noise control guidelines for determining and mitigating non-transportation, or stationary, noise source impacts to adjacent properties. The purpose of the noise ordinance is to protect, create and maintain an environment free from noise that may jeopardize the health or welfare, or degrade the quality of life. The County Noise Ordinance states that it shall be unlawful for any person to cause or allow the creation of any noise to the extent that the one-hour average sound level, at any point on or beyond the boundaries of the property exceeds the applicable limits. For this Project, the applicable limits are 50 dBA Leq during the daytime hours and 45 dBA Leq during the nighttime hours.

Based on the empirical data, the manufacture's specifications and the distances to the property lines the unshielded cumulative noise levels from the proposed transformers, inverters, the generator and the CPV track/blower motors were found to meet the most restrictive nighttime property line standard of 45 dBA at the nearest property line zoned RR.25. No impacts are anticipated and no mitigation is required.

The electric power produced by the Project will be feed into the existing system with either the incorporation of a new underground Gen-Tie transmission lines running from the site to the Borrego Substation (Borrego Valley Route) or via a 12 kV line extension under the authority of the CPUC. The proposed distribution lines will not create any noise or Corona Affect.

County Noise Ordinance Section 36.410, states that except for emergency work, it shall be unlawful for any person to operate construction equipment or cause construction equipment to be operated, that exceeds an average sound level of 75 decibels for an eight-hour period, between 7 a.m. and 7 p.m., when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is being received. At a distance as close as 95 feet the point source noise attenuation from the site preparation activities and the nearest property line is -5.6 dBA. This would result in an anticipated worst case eight-hour average combined noise level of 74.7 dBA at the property line. During the installation of the CPV panels at a distance of 275 feet would result in a noise level of 74.9 dBA. The installation

equipment is anticipated to average more than 150 feet from the nearest property line. Given the spatial separation of the equipment over site area, the noise levels of the grading and CPV panel installation are anticipated to comply with the County of San Diego's 75 dBA standards.

County Noise Ordinance Section 36.410, states that no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown of 82 dBA (at residential uses), when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25% of the minutes in the measurement period. To reduce the maximum noise level of 95 dBA to 82 dBA the pile driver, if utilized, would need to be located 215 feet from the nearest occupied residential property line or only operate 25% of the hourly or daily duration (15 minutes of any hour and 2 hours of a 8 hour work day) when located within that distance.

The properties adjacent the Project do not have legal dwelling units and therefore are exempt from Sections 36.409 and 36.410. The nearest occupied residential dwelling unit to the Project site is over 2,500 feet to the south and more than 1,500 feet in any other direction. At a distance of 1,500 feet, the point-source noise attenuation would be greater than 25 dBA and the construction related noise levels would be well below the Section 36.409 75 dBA standard and the 82 dBA impulsive threshold of Section 36.410.

# 1.0 INTRODUCTION

This noise study was completed to determine the noise impacts associated with the development of the proposed Desert Green – Borrego Photovoltaic Solar Farm Project. The Project is located at 33° 15′ 43″ N and 116° 19′ 35″ W, north of Palm Canyon Drive and east of Borrego Valley Road in the unincorporated community of Borrego Springs in northeastern San Diego County, CA. The general location of the Project is shown on the Vicinity Map, Figure 1-A below.

## 1.1 Project Description

Desert Green Solar Farm LLC is requesting a MUP modification to previously-approved MUP P09-12 on the 288-acre parcel. The previously-approved project included the 288-acre parcel and the 104-acre parcel located directly adjacent to the south (APN 141-230-33; P09-14). The proposed Desert Green Solar Farm does not include the 104-acre parcel (P09-014) as part of the Project, and is instead limited to development of the 288-acre parcel and additional lands for access/utility easement purposes. The Project would involve the construction of an approximately 45-acre solar energy electrical generation facility to provide electricity for public consumption. The proposed facilities would have an overall capacity of approximately 6.5 megawatts (MW), serving the Borrego Valley area. Of the 288 acres, the proposed development area where the trackers would be installed, the underground portion of the 12kV Gen-tie line/access route, and the temporary construction laydown area would total 50.63 acres. An additional 2.61 acres on the 288-acre parcel would be affected to allow for a 15-foot wide trail easement along the northern and western property boundaries (no improvements proposed at this time); however, the trail easement is not included as part of the Major Use Permit boundary. Additionally, 124.68 (or approximately 125) acres of the 288-acre parcel would be dedicated as undisturbed onsite open space for biological mitigation purposes (to remain unfenced with intermittent small-scale signage installed along the perimeter). The remainder of the parcel (approximately 110 acres) would remain undeveloped and in its current natural state (unfenced).

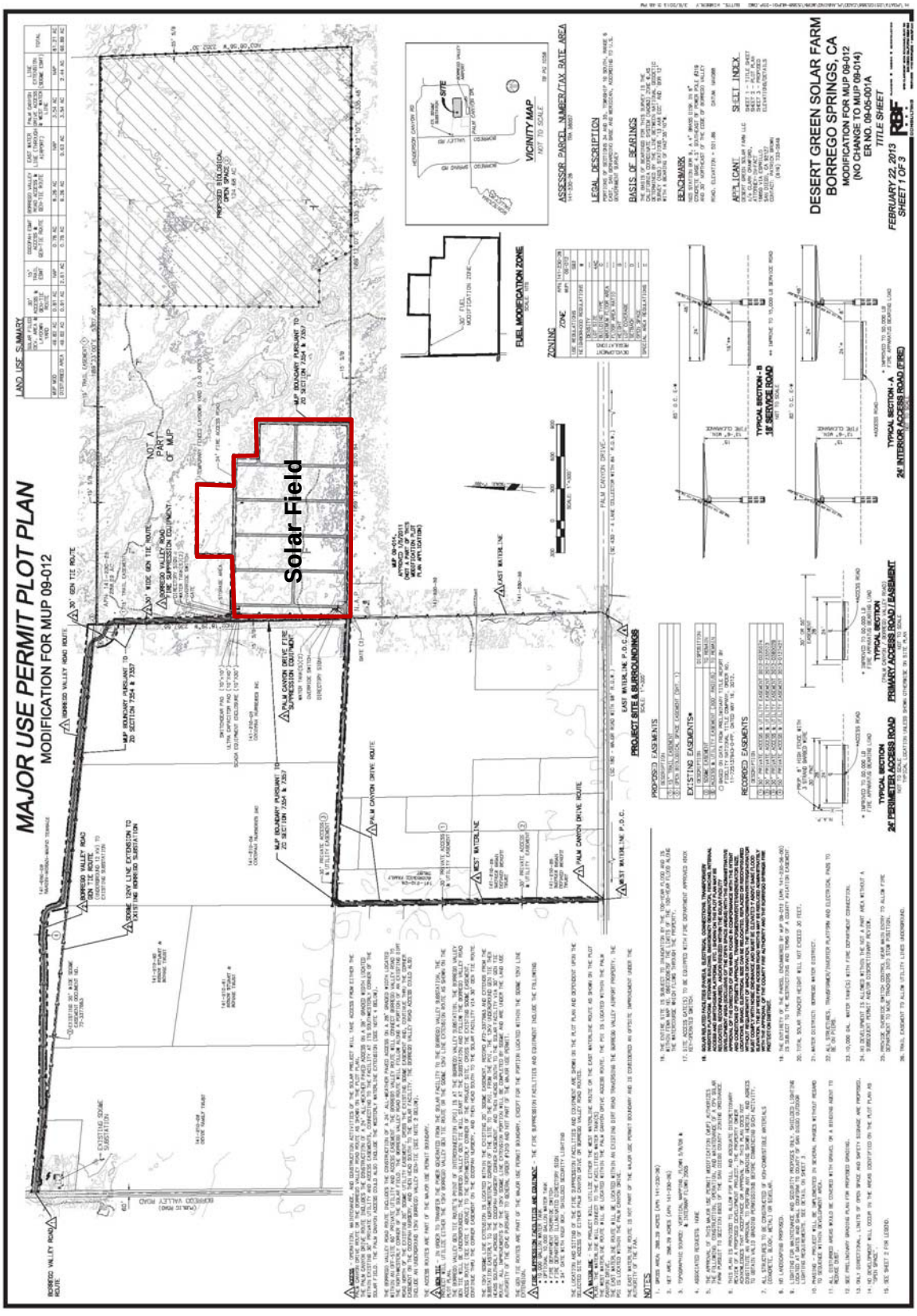
A total of 308 solar CPV systems are proposed. The solar CPV systems would be manufactured at an offsite location and transported to the Project site.

The solar arrays would track the sun and would rotate from east to west to ensure maximum absorption of sunlight. The face of each panel would measure 48 feet in length by 25 feet in height, for a total surface area of 1,200 square feet. The total height of the panels measured from ground surface to the top of the panel would be approximately 30 feet when the panels are in the vertical position, and 15 feet from ground surface to top of panel when horizontal. All panels would be elevated one foot above the base flood elevation (bfe), which is one foot above ground level, for a total of two feet. The arrays would be spaced approximately 69 feet apart along the north-

south axis (center to center) and 82 feet apart along the east-west axis (center to center), and would be installed using a concrete drilled pier or metal driven pile system. The ultimate arrangement/number of solar CPV systems, spacing of supporting racks, and rack pilings are subject to modification at final engineering design. Grading would require an estimated 93,300 cubic yards (c.y.) of balanced cut and fill.

**Figure 1-A: Project Vicinity Map**

## Figure 1-B: Overall Project Site Plan



Additional Project components would include up to five small-scale, metal structures (on a 10-foot by 40- foot pad) to house dual or triple invertors and transformers. The inverter/transformer pads would be covered by a shade structure to shield the equipment from the elements. Each inverter station would include a medium voltage transformer to step-up the voltage from the inverter to a nominal 12kV, which is compatible with the local San Diego Gas & Electric (SDG&E) distribution system. Additionally, the Project would include one unmanned 300 square foot (s.f.) onsite metal storage building (within a 1,000 s.f. fenced and screened storage yard); one generator pad (12 feet by 20 feet) to house one 100kW generator for emergency purposes; 12kV switchgear (constructed on a 10-foot by 10-foot pad) to protect the Project equipment from any short-circuits occurring on the Gen-tie line; a supervisory control and data acquisition (SCADA) equipment enclosure (10 feet by 30 feet); an ultra-capacitor storage unit on a 10 foot by 40 foot pad; a 10,000 gallon (15-foot diameter) water tank for fire and panel washing plus an optional 10,000 gallon tank; and, a 12kV Gen-tie line to the existing Borrego Substation. All structures would be constructed on piers and elevated one foot above the bfe. An illuminated fire department directory sign and switch (to stow the trackers) would be located inside of the fence at the entrance.

Energy generated by the Project would be transmitted to the existing Borrego Substation which lies approximately one mile to the west of the site, adjacent to the east side of Borrego Valley Road. The portion of the Gen-tie line located on the 288-acre parcel would be extended underground from the Project trackers to the northwestern corner of the parcel along a 30-foot wide Gen-tie route. The Gen-tie line would then trend westward along one of two proposed routes, as follows:

The Borrego Valley Road Gen-tie Route would be undergrounded and would cross the adjacent Cocopah nursery (APN 141-210-05) and the 20-foot wide SDG&E easement, then extend west to the Borrego Substation along the Borrego Valley Road Access route (see Access and Circulation, below). The point of interconnection (POI) for the Borrego Valley Road Route would occur at the Borrego Substation.

The SDG&E 12kV Line Extension Route would extend across the adjacent Cocopah nursery to the POI located near the northwestern corner of the Project site. The Gen-tie line would then run westerly within the existing 20-foot wide SDG&E easement (Record #72-3377663) to the Borrego Substation. All improvements for the SDG&E 12kV Line Extension would be completed by SDG&E and would be under the land use authority of the California Public Utilities Commission (CPUC), pursuant to General Order 131D. Therefore, the SDG&E 12kV Line Extension is not included as part of the Major Use Permit boundary because it is not within the County's land use jurisdiction.

Water for the purpose of Project maintenance would be provided to the site from one of two optional routes (West Water Line and East Water Line). Both routes would require extension of a 4-inch private line northward from Palm Canyon Drive to the southern Project boundary, as shown on the MUP Plot Plan.

The CPV facilities would be unmanned and operated remotely. The proposed facilities would be remotely monitored during operating (daylight) hours, even though the Project facilities would be capable of automatic start up, shutdown, self-diagnosis, and fault detection. Appropriate levels of shielded security lighting would be installed at the storage building and gated entrance. The site would be secured via remote security services with motion detection cameras. For security purposes, the parcel boundary would be fenced with a 6-foot high chain-link fence (breakaway fencing to allow for flood flows), topped with one foot of three-strand barbed wire. Routine maintenance would include periodic inspection and repairs on an as-needed basis, as well as washing of the solar CPV panels once every six to eight weeks.

Operation, maintenance, and construction activities for the Project would take access from either the proposed Palm Canyon Drive access route or the proposed Borrego Valley Road access route, as shown on the MUP Plot Plan. Both access routes are included as part of the Major Use Permit boundary.

The Palm Canyon Drive access route would include construction of a 24-foot wide all-weather paved access drive (in accordance with County of San Diego Fire Standards and capable of supporting 50,000 lbs) within a 28-foot wide graded width, located within an existing 30-foot wide private utility/access easement. This route would connect to the solar facility at the southwesterly corner of the solar field. The Palm Canyon Drive access route may also include construction of the West Water Line extension.

The Borrego Valley Road access route would include construction of a 24-foot wide all-weather paved access drive (in accordance with County of San Diego Fire Standards and capable of supporting 50,000 lbs) within a 28-foot wide graded width, located within a 50-foot wide private utility/access easement. The Borrego Valley Road access route would extend from Borrego Valley Road to the northwesterly corner of the solar field. This access route would follow along a portion of an existing dirt road located just north of the existing 20-foot wide SDG&E utility easement, cross the SDG&E easement near the northwest corner of the Project site, continue through the adjacent Cocopah nursery (APN 141-210-05), and then trend south to the proposed solar facility. The Borrego Valley Road access route would also include construction of the12kV Borrego Valley Road Gen-tie Route (underground).

A series of north/south interior fire access and perimeter loop roads would be constructed onsite to a width of 24 feet (fire access road widths may be administratively reduced with the approval of the County Fire Marshal and Borrego Springs Fire Protection District) with all-weather surfacing, in accordance with County of San Diego Fire Standards. The interior access roads would be designed and maintained to support imposed loads of fire service apparatus (not less than 50,000 lbs) and would have an approved surface so as to provide all-weather driving capabilities. These interior fire access roads would be constructed between every fourth

row of north-south trackers to facilitate a maximum fire hose pull of 160 feet. In addition, the Project includes east/west running fire access roads for connectivity and circulation. The purpose of the interior fire access roads are to allow for access of fire service apparatus throughout the Project site and in order to reach the inverter/transformer units.

On the north/south rows where the interior fire access roads are not proposed, service roads would be constructed to a width of 18 feet and would be constructed and maintained to support imposed loads of not less than 15,000 lbs and to support panel washing equipment vehicles. Service roads would run in a north-south direction along the west side of the columns of the CPV systems, except where there would be a fire access road that would facilitate access to the CPV systems and inverter/transformer units.

## 1.2 Environmental Settings & Existing Conditions

### a) Settings & Locations

The Project would consist of a CPV solar generation project for transport of the power generated to the existing Borrego Substation with an interconnection agreement with San Diego Gas & Electric (SDG&E). The County Assessor Parcel Number (APN) affected by the proposed Project is 141-230-26 (approximately 288 acres). The project access will be taken off of Palm Canyon Drive. The Project and surrounding properties are zoned General Rural (S92), Rural Residential (RR.25) and Limited Industrial (M52). Additionally, the Project lies within the influence of the Borrego Valley Airport Land Use Compatibility Plan (ALUCP).

### b) Existing Noise Conditions

The Project is located adjacent to the Borrego Valley Airport and Palm Canyon Drive, described as a community collector (2.1D) roadway in the County of San Diego's Circulation Element. Existing noise occurs mainly from vehicular traffic traveling on Palm Canyon Drive and air traffic from the adjacent County airport.

## 1.3 Methodology and Equipment

### a) Noise Measuring Methodology and Procedures

To determine the ambient noise environment and to assess potential noise impacts, measurements of the Corona Affect were taken along an existing SDG&E 69 kV distribution line located in the Borrego Springs area. This was done to determine the local conditions and to establish a baseline for the Corona Affect. The noise measurements were recorded on December 4, 2009 by Ldn Consulting, Inc. between approximately 9:30 a.m. and 10:00 a.m. in dry, calm and clear

conditions. The sound levels for the proposed on-site equipment were taken from the manufacture's specifications. Noise measurements were taken using a Larson-Davis Model LxT Type 1 precision sound level meter, programmed, in "slow" mode, to record noise levels in "A" weighted form. The LxT was set to record in the low range of -10 to 110 dBA. The sound level meter and microphone were mounted on a tripod, five feet above the ground and equipped with a windscreen during all measurements. The sound level meter was calibrated before and after the monitoring using a Larson-Davis calibrator, Model CAL 200.

The noise measurement location was determined based on access and low ambient conditions to capture only the potential distribution line noise levels. The 69 kV distribution line measurements were taken mid-span between two power poles along SDG&E easement. The noise measurement location is provided graphically in Figure 1-C, denoted by the SDG&E Easement marker.

**Figure 1-C: Corona Affect Noise Measurement Location**

b) Noise Calculations and Factors

Noise is defined as unwanted or annoying sound which interferes with or disrupts normal activities. Exposure to high noise levels has been demonstrated to cause hearing loss. The individual human response to environmental noise is based on the sensitivity of that individual, the type of noise that occurs and when the noise occurs.

Sound is measured on a logarithmic scale consisting of sound pressure levels known as a decibel (dB). The sounds heard by humans typically do not consist of a single frequency but of a broadband of frequencies having different sound pressure levels. The method for evaluating all the frequencies of the sound is to apply an A-weighting to reflect how the human ear responds to the different sound levels at different frequencies. The A-weighted sound level adequately describes the instantaneous noise whereas the equivalent sound level depicted as Leq represents a steady sound level containing the same total acoustical energy as the actual fluctuating sound level over a given time interval.

The Community Noise Equivalent Level (CNEL) is the 24 hour A-weighted average for sound, with corrections for evening and nighttime hours. The corrections require an addition of 5 decibels to sound levels in the evening hours between 7 p.m. and 10 p.m. and an addition of 10 decibels to sound levels at nighttime hours between 10 p.m. and 7 a.m. These additions are made to account for the increased sensitivity during the evening and nighttime hours when sound appears louder.

Because mobile/traffic noise levels are calculated on a logarithmic scale, a doubling of the traffic noise or acoustical energy results in a noise level increase of 3 dBA. Therefore the doubling of the traffic volume, without changing the vehicle speeds or mix ratio, results in a noise increase of 3 dBA. Mobile noise levels radiant in an almost oblique fashion from the source and drop off at a rate of 3 dBA for each doubling of distance under hard site conditions and at a rate of 4.5 dBA for soft site conditions. Hard site conditions consist of concrete, asphalt and hard pack dirt while soft site conditions exist in areas having slight grade changes, landscaped areas and vegetation. On the other hand, fixed/point sources radiate outward uniformly as it travels away from the source. Their sound levels attenuate or drop off at a rate of 6 dBA for each doubling of distance.

The most effective noise reduction methods consist of controlling the noise at the source, blocking the noise transmission with barriers or relocating the receiver. Any or all of these methods could be required to reduce noise levels to an acceptable level.

## 2.0 OPERATIONAL ACTIVITIES

### 2.1 Guidelines for the Determination of Significance

Section 36.404 of the County of San Diego noise ordinance provides performance standards and noise control guidelines for determining and mitigating non-transportation, or stationary, noise source impacts to adjacent properties. The purpose of the noise ordinance is to protect, create and maintain an environment free from noise that may jeopardize the health or welfare, or degrade the quality of life. The County Noise Ordinance states that it shall be unlawful for any person to cause or allow the creation of any noise to the extent that the one-hour average sound level, at any point on or beyond the boundaries of the property exceeds the applicable limits provided in Table 2-1.

**Table 2-1: Sound Level Limits in Decibels (dBA Leq)**

| ZONE | | APPLICABLE LIMIT ONE-HOUR AVERAGE SOUND LEVEL (DECIBELS) |
|---|---|---|
| R-S, R-D, R-R, R-MH, A-70, A-72, S-80, S-81, S-87, S-88, S-90, S-92, R-V, and R-U Use Regulations with a density of less than 11 dwelling units per acre. | 7 a.m. to 10 p.m.<br>10 p.m. to 7 a.m. | 50<br>45 |
| R-RO, R-C, R-M, C-30, S-86, R-V, R-U and V5. Use Regulations with a density of 11 or more dwelling units per acre. | 7 a.m. to 10 p.m.<br>10 p.m. to 7 a.m. | 55<br>50 |
| S-94, V4, and all other commercial zones. | 7 a.m. to 10 p.m.<br>10 p.m. to 7 a.m. | 60<br>55 |
| V1, V2<br>V1, V2<br>V1<br>V2 | 7 a.m. to 7 p.m.<br>7 p.m. to 10 p.m.<br>10 p.m. to 7 a.m.<br>10 p.m. to 7 a.m. | 60<br>55<br>55<br>50 |
| V3 | 7 a.m. to 10 p.m.<br>10 p.m. to 7 a.m. | 70<br>65 |
| M-50, M-52, M-54 | Anytime | 70 |
| S-82, M-58, and all other industrial zones. | Anytime | 75 |

Source: County of San Diego Noise Ordinance Section 36.404

The Project and surrounding properties are zoned General Rural (S92), Rural Residential (RR.25) and Limited Industrial (M52). Section 36.404 of the Noise Ordinance sets a most restrictive operational exterior noise limit for the S92 and RR.25 land uses of 50 dBA Leq for daytime hours of 7 a.m. to 10 p.m. and 45 dBA Leq during the noise sensitive nighttime hours of 10 p.m. to 7 a.m. as shown in Table 2-1 above. Most of the Project components will only operate during the daytime hours but a few may operate during nighttime hours and therefore the most restrictive and conservative approach is to apply the 45 dBA Leq nighttime standard at the property lines zoned S92 and RR.25. A standard of 70 dBA Leq anytime will be applied at the property lines zoned M-52.

## 2.2 Potential Operational Noise Impacts

This section examines the potential stationary noise source impacts associated with the operation of the proposed solar project. Specifically, noise levels from the proposed transformers, inverters, CPV tracker and dryer/blower motors, the back-up generator and distribution lines. The Project proposes the installation of up to 5 small-scale, above ground structures that would be located within the solar panel fields to hold the inverter/ transformers. These structures would be approximately 10 foot by 40 foot in size. Each of these locations will house dual 680kW transformers. The transformer and inverter locations will be spread out over the site with a transformer and an inverter grouped next to each other. The Project is also proposing a back-up 100kW generator which will be located near the northerly located transformer/invertor locations. Additionally, each proposed CPV will be equipped with a tracker motor to rotate the CPV panels and a blower for moister control. The proposed inverter/transformer and generator location for the project configuration can be seen in Figure 2-A below and for more details MUP Plot Plan Sheet 2 of 3.

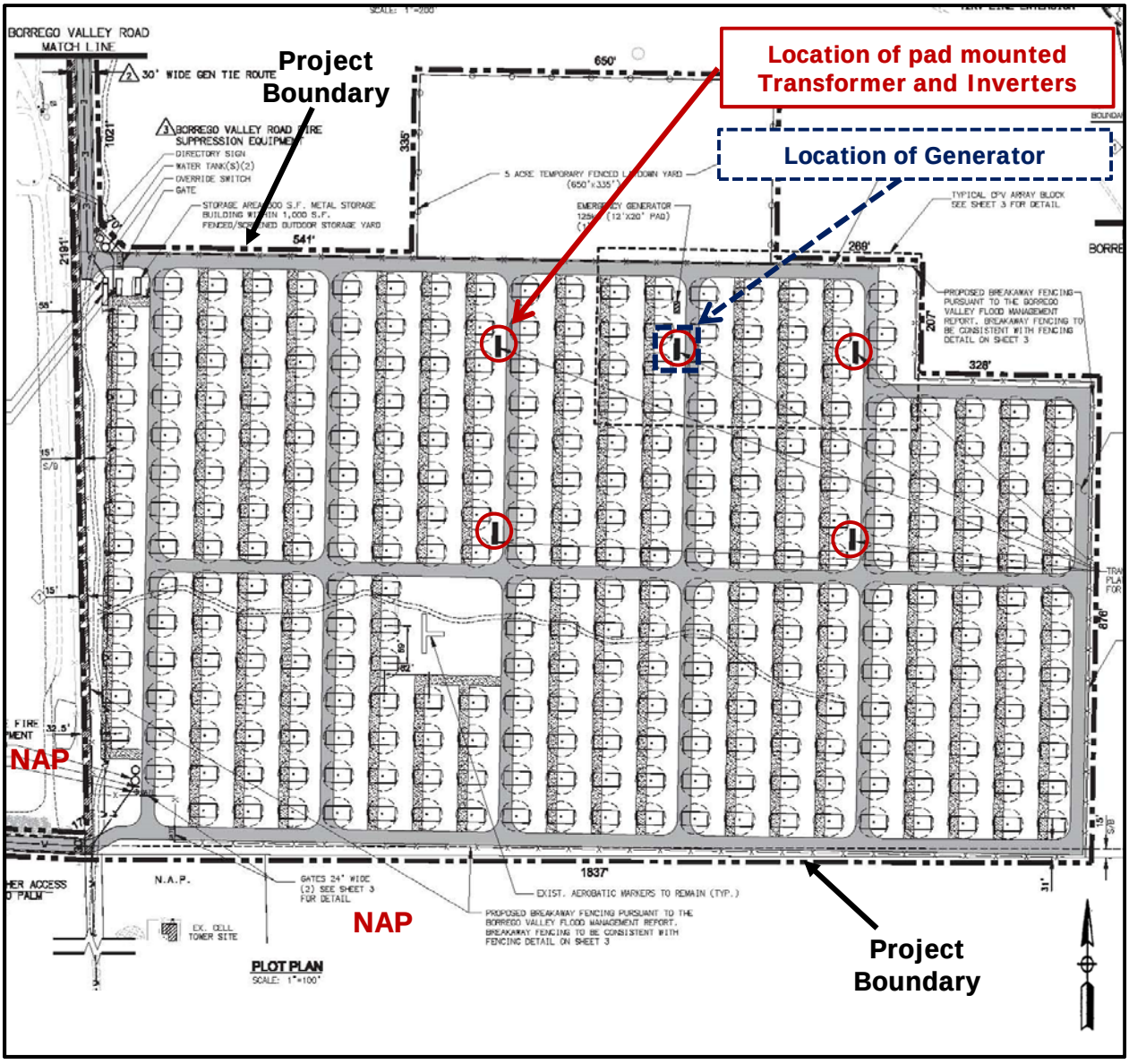
The electric power produced by the Project will be feed into the existing system with the incorporation of a new underground Gen-Tie transmission lines running from the site to the point of interconnect. The proposed distribution lines will not create any noise or Corona Affect. The operational noise levels from the proposed on site small-scale inverter/transformers, CPV tracking motors/blowers and the 100kW generator are analyzed below.

### 2.2.1 Operational Noise Levels On-site

The proposed Xantrex Inverters have a noise level rating of 77 dB at 6 feet (Schneider Electric 2011). There will be a transformer along with each pair of inverters. The proposed transformers have an unshielded noise rating of less than 60 dBA at 5 feet *(Source: National Electric Manufactures Association (NEMA) Publication No. TR 1-1993)*. The NEMA test results for the transformers and manufacturer's specifications for an equivalent inverter are provided in

***Attachment A***. Based upon the Project site layout and the adjacent property zoning the worst case location for a potential impact may occur along the southern portion of the site property line where the transformer/inverter locations are nearest the southern property line, and the CPV tracker motor/blowers are located along the southern property line. All proposed pieces of equipment on the site are located farther from all other property lines.

**Figure 2-A: Proposed Equipment Locations**



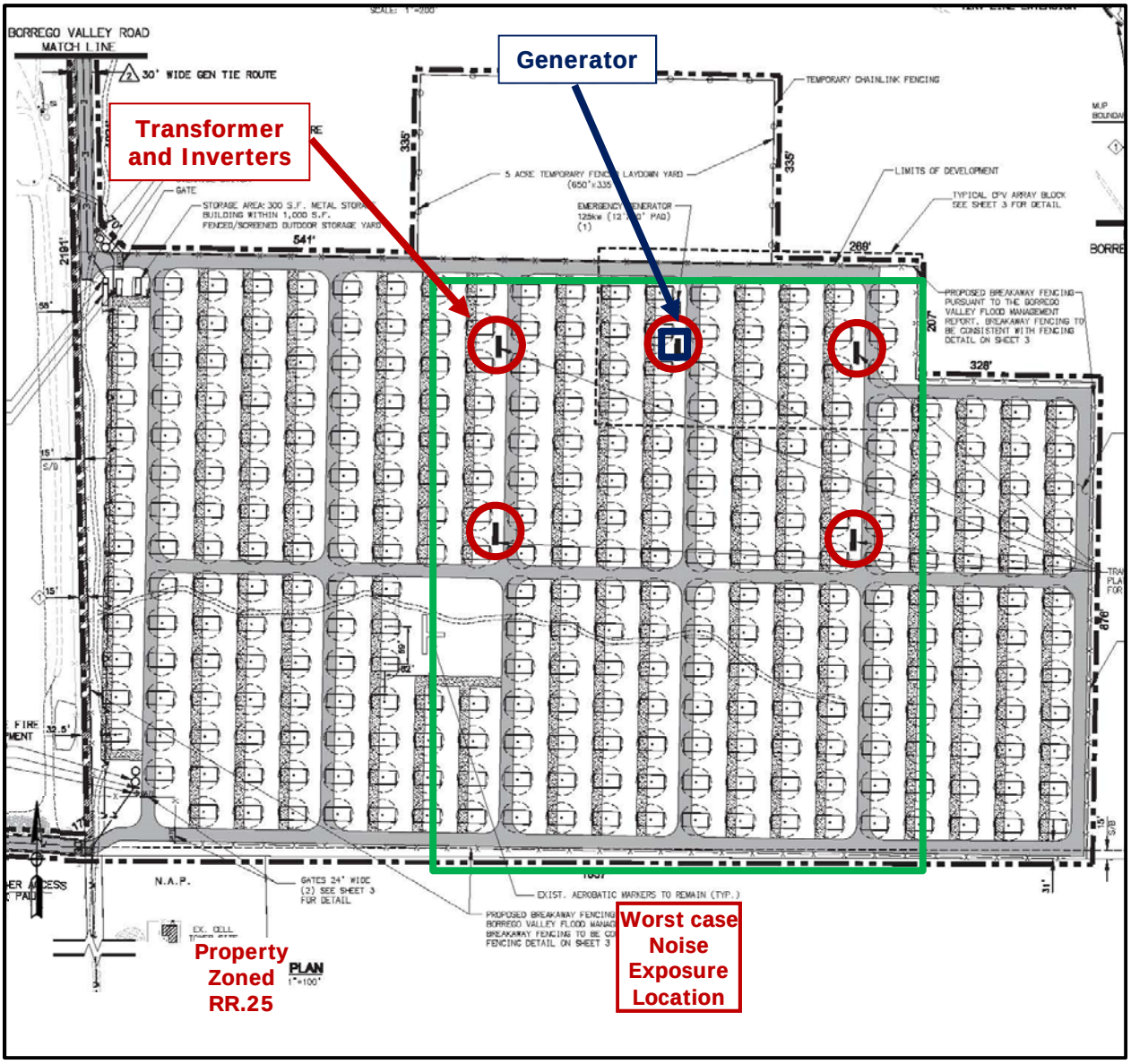
The worst case scenario at the southern property line was analyzed below to determine if impacts would occur and if additional analysis of more pieces of equipment is warranted and if any mitigation measures will be required. The noise levels from the proposed CPV tracker motors and blowers combined was found to be 38.0 dBA at 50 feet based on empirical data collected for the applicant by AECOM on September 30, 2011. This noise level would be the hourly level if the equipment were to operate for an entire hour. However, the required operation time of the tracker motor is anticipated to operate only 15-20 minutes of any given hour. Additionally, the required operation time of the blower would be dependent on the location (e.g., more humid locations would require more drying time than arid locations). Since the Project site is located in Borrego Springs which is an arid location the blower is anticipated to operate less than 30 minutes of any given hour.

As an example, if the equipment were to operate for only half an hour, then the hourly combined level of 38.0 dBA Leq for continuous operation would be reduced to 35.0 dBA Leq and if the equipment only operational for 15 minutes, then it would be further reduced to 32.0 dBA Leq. Therefore, a combined noise level of 35.0 dBA Leq was utilized. To determine the cumulative noise levels of multiple CPV trackers and blowers, the distances of an array of the 16 closest units at a common point, were measured and the noise levels were propagated to that common point. Based on the spacing of the units, the fifth unit over is 382 feet of more away and the noise level would drop below 10 dBA Leq and would not be audible.

The back-up generator will only be utilized if a complete power failure occurs to rotate the CPV panels into a horizontal position until power it restored. The generator is only anticipated to operate for less than 15 minutes in that situation (similar to a maintenance scheduled operation). Based on several manufacture's specifications the 100-125 kW generator has a noise level of 68-71 dBA at 23 feet. A generator having a noise level of 71 dBA was utilized and the sound level rating is shown in ***Attachment A*** (Source: Kohler Power, 2012). Since the generator will not operate continuously a 6 decibel reduction was accounted for in the analysis and hourly noise level of 65 dBA Leq was utilized.

The location and relationship to the worst case southern property line for the proposed equipment is shown in Figure 2-B below. Although, not all the equipment maybe operating at the same time, to be conservative it was assumed that it could happen even though if power were lost and the generator was required all the transformers, inverters and CPV blowers would shut down. The noise levels of the transformers, inverters, generator and multiple CPV tracker motors and blowers were combined and propagated out to the southern property line at a common location without any shielding. The results of the propagated noise levels are shown in Table 2-2.

**Figure 2-B: Worst Case Equipment and Property Line Orientation**




The equipment located the same distance from the common location was added together in Table 2-2, as can be seen in the third column. The combined noise level at the nearest property line was projected to be 45 dBA Leq or less since not all equipment will be simultaneously operating and no impacts are anticipated. Therefore, even with all the equipment operating, the Project will comply with the most restrictive nighttime property line standard of 45 dBA Leq and no mitigation or further analysis is needed.

**Table 2-2: Operational Noise Levels – Nearest Property Line**

| Source | Distance from Source to Measurement Location (Feet) | Sources at that Common Distance | Measured Noise Levels Combined (dBA) | Distance to Nearest Property Line (Feet) | Noise Reduction due to distance (dBA) | Resultant Noise Level @ Property Line (dBA Leq) |
|---|---|---|---|---|---|---|
| Transformer | 5 | 2 | 63 | 685 | -43 | 20 |
| Inverter | 6 | 4 | 83 | 695 | -41 | 42 |
| Transformer | 5 | 2 | 63 | 985 | -46 | 17 |
| Inverter | 6 | 4 | 83 | 995 | -44 | 39 |
| Transformer | 5 | 1 | 60 | 925 | -45 | 15 |
| Inverter | 6 | 1 | 77 | 935 | -44 | 33 |
| Generator | 23 | 1 | 65 | 1009 | -33 | 32 |
| Track/Blower | 50 | 2 | 38 | 84 | -5 | 34 |
| Track/Blower | 50 | 2 | 38 | 149 | -9 | 29 |
| Track/Blower | 50 | 2 | 38 | 224 | -13 | 25 |
| Track/Blower | 50 | 2 | 38 | 302 | -16 | 22 |
| Track/Blower | 50 | 2 | 38 | 150 | -10 | 28 |
| Track/Blower | 50 | 2 | 38 | 193 | -12 | 26 |
| Track/Blower | 50 | 2 | 38 | 255 | -14 | 24 |
| Track/Blower | 50 | 2 | 38 | 326 | -16 | 22 |
| Track/Blower | 50 | 2 | 38 | 217 | -13 | 25 |
| Track/Blower | 50 | 2 | 38 | 248 | -14 | 24 |
| Track/Blower | 50 | 2 | 38 | 299 | -16 | 22 |
| Track/Blower | 50 | 2 | 38 | 362 | -17 | 21 |
| Track/Blower | 50 | 2 | 38 | 285 | -15 | 23 |
| Track/Blower | 50 | 2 | 38 | 309 | -16 | 22 |
| Track/Blower | 50 | 2 | 38 | 351 | -17 | 21 |
| Track/Blower | 50 | 2 | 38 | 406 | -18 | 20 |
| Cumulative Noise Level @ Property Line (dBA Leq) | | | | | | 45 |

### 2.2.2 Corona Affect Noise Levels

The Corona Affect (Corona) is a phenomenon associated with the electrical ionization of the air that occurs near the surface of the energized conductor and suspension hardware due to very high electric field strength. This is audible power line noise that is generated from electric corona discharge, which is usually experienced as a random crackling or hissing sound. The amount of corona produced by a distribution line is a function of the voltage of the line, the diameter of the conductors, the locations of the conductors in relation to each other, the elevation of the line above sea level, the condition of the conductors and hardware, and the

local weather conditions.

Corona increases at higher elevations where the density of the atmosphere is less than at sea level. Audible noise will vary with elevation with the relationship of X/300 where X is the elevation of the distribution line above sea level measured in meters (EPRI 2005). Audible noise at 600 meters (~2,000 feet) in elevation will be twice the audible noise at 300 meters, all other things being equal. Typically for distribution lines of 138 kV and less, the maximum corona noise during wet weather conditions is usually less than 40 dBA at the edge of the ROW *(Source: Miguel-Mission 230 kV #2 Project, Aspen Environmental Group, 2004).* Corona typically becomes a design concern for distribution lines at 345 kV and above and is less noticeable from lines like those proposed for the Project that are operated at lower voltages.

The electric power produced by the Project will be feed into the existing system with either the incorporation of a new underground Gen-Tie transmission lines running from the site to the Borrego Substation (Borrego Valley Route) or via a 12 kV line extension under the authority of the CPUC. The proposed distribution lines will not create any noise or Corona Affect.

## 2.3 Conclusions

Based on the empirical data, the manufactures specifications and the distances to the property lines the unshielded cumulative noise levels from the proposed transformers, inverters, the generator and the CPV track/blower motors were found to meet the most restrictive nighttime property line standard of 45 dBA at the nearest property line zoned RR.25. No impacts are anticipated and no mitigation is required.

The electric power produced by the Project will be feed into the existing system with either the incorporation of a new underground Gen-Tie transmission lines running from the site to the Borrego Substation (Borrego Valley Route) or via a 12 kV line extension under the authority of the CPUC. The proposed distribution lines will not create any noise or Corona Affect.

## 3.0 CONSTRUCTION ACTIVITIES

### 3.1 Guidelines for the Determination of Significance

Construction Noise: Noise generated by construction activities related to the project will exceed the standards listed in San Diego County Code Sections as follows.

SEC. 36.408: HOURS OF OPERATION OF CONSTRUCTION EQUIPMENT

Except for emergency work, it shall be unlawful for any person to operate or cause to be operated, construction equipment:

a. Between 7 p.m. and 7 a.m.

b. On a Sunday or a holiday. For purposes of this section, a holiday means January 1st, the last Monday in May, July 4th, the first Monday in September, December 25th and any day appointed by the President as a special national holiday or the Governor of the State as a special State holiday. A person may, however, operate construction equipment on a Sunday or holiday between the hours of 10 a.m. and 5 p.m. at the person's residence or for the purpose of constructing a residence for himself or herself, provided that the operation of construction equipment is not carried out for financial consideration or other consideration of any kind and does not violate the limitations in sections 36.409 and 36.410.

SEC. 36.409: SOUND LEVEL LIMITATIONS ON CONSTRUCTION EQUIPMENT

Except for emergency work, it shall be unlawful for any person to operate construction equipment or cause construction equipment to be operated, that exceeds an average sound level of 75 decibels for an eight-hour period, between 7 a.m. and 7 p.m., when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is being received.

SEC. 36.410: SOUND LEVEL LIMITATIONS ON IMPULSIVE NOISE

In addition to the general limitations on sound levels in section 36.404 and the limitations on construction equipment in section 36.409, the following additional sound level limitations shall apply:

(a) Except for emergency work or work on a public road project, no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown in Table 36.410A (provided below), when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period, as described in subsection (c) below. The maximum sound level depends on the use being made of the occupied property. The uses in Table 36.410A are as described in the County Zoning Ordinance.

**TABLE 36.410A: MAXIMUM SOUND LEVEL (IMPULSIVE) MEASURED AT OCCUPIED PROPERTY IN DECIBELS (dBA)**

| OCCUPIED PROPERTY USE | DECIBELS (dBA) |
|---|---|
| Residential, village zoning or civic use | 82 |
| Agricultural, commercial or industrial use | 85 |

(b) Except for emergency work, no person working on a public road project shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown in Table 36.410B, when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period, as described in subsection (c) below. The maximum sound level depends on the use being made of the occupied property. The uses in Table 36.410B are as described in the County Zoning Ordinance.

**TABLE 36.410B: MAXIMUM SOUND LEVEL (IMPULSIVE) MEASURED AT OCCUPIED PROPERTY IN DECIBELS (dBA) FOR PUBLIC ROAD PROJECTS**

| OCCUPIED PROPERTY USE | dB(A) |
|---|---|
| Residential, village zoning or civic use | 85 |
| Agricultural, commercial or industrial use | 90 |

(c) The minimum measurement period for any measurements conducted under this section shall be one hour. During the measurement period a measurement shall be conducted every minute from a fixed location on an occupied property. The measurements shall measure the maximum sound level during each minute of the measurement period. If the sound level caused by construction equipment or the producer of the impulsive noise exceeds the maximum sound level for any portion of any minute, it will be deemed that the maximum sound level was exceeded during that minute.

## 3.2 Potential Construction Noise Impacts

Construction noise represents a short-term impact on the ambient noise levels. Noise generated by construction equipment includes haul trucks, water trucks, graders, dozers, loaders and scrapers can reach relatively high levels. Grading activities typically represent one of the highest potential sources for noise impacts. The most effective method of controlling construction noise is through local control of construction hours and by limiting the hours of construction to normal weekday working hours.

The U.S. Environmental Protection Agency (U.S. EPA) has compiled data regarding the noise generating characteristics of specific types of construction equipment. Noise levels generated by heavy construction equipment at a distance of 50 feet can range from 60 dBA for a small tractor up to 100 dBA for rock breakers. However, these noise levels diminish rapidly with distance from the construction site at a rate of approximately 6 dBA per doubling of distance. For example, a noise level of 87 dBA measured at 50 feet from the noise source would be reduced to 81 dBA at 100 feet from the source and be further reduced to 75 dBA at 200 feet from the source.

Using a point-source noise prediction model, calculations of the expected construction noise impacts were completed. The essential model input data for these performance equations include the source levels of each type of equipment, relative source to receiver horizontal and vertical separations, the amount of time the equipment is operating in a given day, also referred to as the duty-cycle and any transmission loss from topography or barriers. To determine the worst-case noise levels for the grading operations no topographic attenuation, duty-cycle reductions or barrier reductions were utilized.

According to the project applicant, the project site will be grubbed to remove vegetation and compacted in one phase followed by the installation of the CPV panels. The project construction period is expected to be 6 months and includes all site preparation, installation of the CPV panels and all utilities. The site preparation and subsequent installation of the CPV panels are discussed separately below.

The grading operation will utilize a total of up to three dozers, five graders, four loaders/backhoes and four water trucks during the mass grading activities. The noise levels utilized in this analysis based upon the anticipated list of equipment are shown in Table 3-1.

**Table 3-1: Construction Noise Levels**

| Construction Equipment | Quantity | Duty Cycle (Hours/Day) | Source Level @ 50-Feet (dBA) | Cumulative Noise Level @ 50-Feet (dBA Leq-8h) |
|---|---|---|---|---|
| Grader | 5 | 8 | 74 | 81.0 |
| Water Truck | 4 | 8 | 70 | 76.0 |
| Dozer | 3 | 8 | 75 | 79.8 |
| Loader | 4 | 8 | 73 | 79.0 |
| | | | Cumulative Levels @ 50 Feet (dBA) | 85.3 |
| | | | Distance To Property Line | 165 |
| | | | Noise Reduction Due To Distance | -10.4 |
| | | | NEAREST PROPERTY LINE NOISE LEVEL | 74.9 |

Most of the construction activities will consist of clearing and grubbing the site for the preparation of the PV panels. Based upon normal grading operations the equipment is anticipated to be spread out over the entire site; some equipment may be operating at or near the property line while the rest of the equipment may be located over 1,000-feet from the same property line. This would result in an acoustical center for the grading operation at approximately 500-feet to the nearest property line. As can be seen in Table 3-1, if all the equipment was operating in the same location, which is not physically possible, at a distance as close as 165-feet from the nearest property line the point source noise attenuation from construction activities is -10.4 dBA. This would result in an anticipated worse-case 8-hour average combined noise level of 74.9 dBA at the property line. Given this and the spatial separation of the equipment, the noise levels will comply with the County of San Diego's 75 dBA standard at all Project property lines.

The installation of the CPV panels may be installed using two drills with an auger or a total of two pile drivers to install the panel stands, two mobile cranes to move the CPV panel in position and two pneumatic tools to secure the panels to the stands. The drills would not result in an impulsive noise source, so pile driving is considered a worst case scenario. The noise levels utilized in this analysis based upon the anticipated list of equipment are shown in Table 3-2. Based upon normal installation procedures the equipment is anticipated to be spread out over the entire site with pile driving occurring first and then the installation of the CPV panels with a crane and pneumatic tool would follow. Some equipment may be operating at a distance of 84-145 feet from the property line while the rest of the equipment may be located over 500 feet from the other equipment and same property line. This would result in an acoustical center from the installation operations of at least 300 feet to the nearest property line around the perimeter of the site. The distance to the property lines would increase as the interior panels are installed and the noise levels would decrease due to distance.

**Table 3-2: CPV Panel Installation Noise Levels**

| Construction Equipment | Quantity | Duty Cycle (Hours/Day) | Source Level @ 50-Feet (dBA) | Cumulative Noise Level @ 50-Feet (dBA Leq-8h) |
|---|---|---|---|---|
| Pneumatic Tool | 2 | 8 | 82 | 85.0 |
| Mobile Crane | 2 | 8 | 78 | 81.0 |
| Pile Driver | 2 | 8 | 84 | 87.0 |
| | | | Cumulative Levels @ 50 Feet (dBA) | 89.8 |
| | | | Distance To Property Line (Feet) | 275 |
| | | | Noise Reduction Due To Distance | -14.8 |
| | | | NEAREST PROPERTY LINE NOISE LEVEL | 74.9 |

As can be seen in Table 3-2, if all the equipment was operating in the same location, which is not physically possible, at a distance as close as 275 feet from the nearest property line the point source noise attenuation from construction activities is -14.8 dBA. This would result in an anticipated worst case eight-hour average combined noise level of 74.9 dBA at the property line. Given this and the spatial separation of the equipment, the noise levels will comply with the County of San Diego's 75 dBA standard at all Project property lines.

Additionally, the County Noise Ordinance Section 36.410, states that except for emergency work or work on a public road project, no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown of 82 dBA (at residential uses), when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period. The maximum sound level and uses are shown above in Table 36.410A as described in the County Zoning Ordinance.

The installation of the PV panels will utilize a total of two pile drivers to install the panel stands that could produce impulsive noise. Some of the stands may be installed using a drill with an auger which would not result in an impulsive noise source, so pile driving is considered a worst case scenario. Based upon normal installation procedures the two pile drivers are anticipated to be separated on the site. A single pile driver would be operating at a distance of 100 feet from the property line for a short time to install a single panel stand. The pile driver would then move to set another panel stand and continue is this fashion. Each panel stand installation process is only anticipated to last 5 minutes or less. Pile drivers can produce maximum noise levels (Lmax) of 95 dBA at a distance of 50 feet when the drive head is operating (Source: Central Artery/Tunnel (CA/T) project in Boston, Massachusetts). Typically, a pile drive is not continuously operating at full power; this is referred to as the usage factor. The usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power. Based on empirical data collected CA/T project which was used to develop the Road Construction Noise Model (RCNM), a pile driver has a usage factor of 20%. Since the maximum noise level from a pile driver exceeds the County's maximum noise level threshold of 82 dBA the following recommendations are presented.

To reduce the maximum noise level of 95 dBA to 82 dBA the pile driver would need to be located 215 feet from the nearest occupied residential property line or only operate 25% of the hourly or daily duration (15 minutes of any hour and 2 hours of a 8 hour work day) when located within that distance. Based on these duration and distance parameters the impulsive noise levels are anticipated to be below the County's most restrictive 82 dBA threshold and no impacts are anticipated and no mitigation measures are required.

Additionally, the County Noise Ordinance, states that the 75 dBA threshold pertains to a property having an occupied structure. "Except for emergency work, it shall be unlawful for any person to operate construction equipment or cause construction equipment to be operated, that exceeds an average sound level of 75 decibels for an eight-hour period, between 7 a.m. and 7 p.m., when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is being received."

The properties adjacent to the Project do not have legal dwelling units and therefore are exempt from Sections 36.409 and 36.410. The nearest occupied residential dwelling unit to the Project site is over 2,500 feet to the south and more than 1,500 feet in any other direction. At a distance of 1,500 feet, the point-source noise attenuation would be greater than 25 dBA and the construction related noise levels would be well below the Section 36.409 75 dBA standard and the 82 dBA impulsive threshold of Section 36.410. The nearest existing occupied residential uses near the project site can be seen in Figure 3-A below.

**Figure 3-A: Existing Occupied Structures Near Project Site**

## 3.3 Construction Conclusions

At a distance as close as 95 feet the point source noise attenuation from the site preparation activities and the nearest property line is -5.6 dBA. This would result in an anticipated worst case eight-hour average combined noise level of 74.7 dBA at the property line. During the installation of the CPV panels at a distance of 275 feet would result in a noise level of 74.9 dBA. The installation equipment is anticipated to average more than 150 feet from the nearest property line. Given this and the spatial separation of the equipment over the large site area, the noise levels of the grading and CPV panel installation are anticipated to comply with the County of San Diego's 75 dBA standard at all Project property lines.

Additionally, the County Noise Ordinance Section 36.410, states that no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown of 82 dBA (at residential uses), when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25 percent of the minutes in the measurement period. To reduce the maximum noise level of 95 dBA to 82 dBA the pile driver, if utilized, would need to be located 215 feet from the nearest occupied residential property line or only operate 25% of the hourly or daily duration (15 minutes of any hour and 2 hours of a 8 hour work day) when located within that distance. Based on these duration and distance parameters the impulsive noise levels are anticipated to be below the County's most restrictive 82 dBA threshold and no impacts are anticipated and no mitigation measures are required.

The properties adjacent to the Project do not have legal dwelling units and therefore are exempt from Sections 36.409 and 36.410. The nearest occupied residential dwelling unit to the Project site is over 2,500 feet to the south and more than 1,500 feet in any other direction. At a distance of 1,500 feet, the point-source noise attenuation would be greater than 25 dBA and the construction related noise levels would be well below the Section 36.409 75 dBA standard and the 82 dBA impulsive threshold of Section 36.410.

## 4.0 SUMMARY OF PROJECT IMPACTS, MITIGATION & CONCLUSIONS

- Operational Noise Analysis

  Based on the empirical data, the manufactures specifications and the distances to the property lines the unshielded cumulative noise levels from the proposed transformers, inverters, the generator and the CPV track/blower motors were found to meet the most restrictive nighttime property line standard of 45 dBA at the nearest property line zoned RR.25. No impacts are anticipated and no mitigation is required.

  The measured Corona Affect noise levels were found to be below the County of San Diego's most restrictive nighttime standard of 45 dBA Leq. This was also consistent with previously measured and modeled noise levels on distribution line projects throughout California. No impacts from the Corona Affect are anticipated from existing distribution lines.

- Construction Noise Analysis

  At a distance as close as 95 feet the point source noise attenuation from the site preparation activities and the nearest property line is -5.6 dBA. This would result in an anticipated worst case eight-hour average combined noise level of 74.7 dBA at the property line. During the installation of the CPV panels at a distance of 275 feet would result in a noise level of 74.9 dBA. The installation equipment is anticipated to average more than 150 feet from the nearest property line. Given the spatial separation of the equipment over site area, the noise levels of the grading and CPV panel installation are anticipated to comply with the County of San Diego's 75 dBA standards.

  County Noise Ordinance Section 36.410, states that no person shall produce or cause to be produced an impulsive noise that exceeds the maximum sound level shown of 82 dBA (at residential uses), when measured at the boundary line of the property where the noise source is located or on any occupied property where the noise is received, for 25% of the minutes in the measurement period. To reduce the maximum noise level of 95 dBA to 82 dBA the pile driver, if utilized, would need to be located 215 feet from the nearest occupied residential property line or only operate 25% of the hourly or daily duration (15 minutes of any hour and 2 hours of a 8 hour work day) when located within that distance.

  The properties adjacent to the Project do not have legal dwelling units and therefore are exempt from Sections 36.409 and 36.410. The nearest occupied residential dwelling unit to the Project site is over 2,500 feet to the south and more than 1,500 feet in any other direction. At a distance of 1,500 feet, the point-source noise attenuation would be greater than 25 dBA and the construction related noise levels would be well below the Section 36.409 75 dBA standard and the 82 dBA impulsive threshold of Section 36.410.

## 5.0 CERTIFICATIONS

The contents of this report represent an accurate depiction of the existing and future acoustical environment and impacts within the proposed Desert Green Solar Farm Project Development modification to a Major Use Permit (P09-012). The report was prepared by Jeremy Louden; a County approved CEQA Consultant for Acoustics.

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Date February 20, 2013

**ATTACHMENT A**

MANUFACTURE'S SPECIFICATIONS AND NOISE DATA

**NEMA Standards Publication No. TR 1-1993 (R2000)**

*Transformers, Regulators and Reactors*

*Published by:*

**National Electrical Manufacturers Association**
1300 North 17th Street, Suite 1847
Rosslyn, VA 22209

# TABLE OF CONTENTS

## FOREWORD

The standards appearing in this publication have been developed by the Transformer Section and have been approved for publication by the National Electrical Manufacturers Association. They are used by the electrical industry to promote production economies and to assist users in the proper selection of transformers.

The Transformer Section is working actively with the American National Standards Committee, C57, on Transformers, Regulators and Reactors, in the development, correlation and maintenance of national standards for transformers. This Committee operates under the procedures of the American National Standards Institute (ANSI).

It is the policy of the NEMA Transformer Section to remove material from the NEMA Standards Publication as it is adopted and published in the American National Standard C57 series. The NEMA Standards Publication for Transformers, Regulators and Reactors references these and other American National Standards applying to transformers, and is intended to supplement, without duplication, the American National Standards.

The NEMA Standards Publication for Transformers, Regulators and Reactors contains provision for the following:

a. American National Standards adopted by reference and applicable exceptions approved by NEMA, if any.
b. NEMA Official Standards Proposals. These are official drafts of proposed standards developed within NEMA or in cooperation with other interested organizations, for consideration by ANSI. They have a maximum life of five years, during which time they may be approved as American National Standards or adopted as NEMA Standards, or rescinded.
c. Manufacturing Standards. These are NEMA Standards which are primarily of interest to the manufacturers of transformers and which are not yet included in an American National Standard.
d. Standards Which Are Controversial. These are NEMA Standards, on which there is a difference of opinion within Committee C57. The NEMA version will be included in the NEMA Standards Publication until such time as the differences between ANSI and NEMA are resolved.

NEMA Standards Publications are subject to periodic review and take into consideration user input. They are being revised constantly to meet changing economic conditions and technical progress. Users should secure latest editions. Proposed or recommended revisions should be submitted to:

Vice President, Engineering Department
National Electrical Manufacturers Association
2101 L Street, N.W.
Washington, D.C. 20037-1526

## SCOPE

This publication provides a list of all ANSI C57 Standards that have been approved by NEMA. In addition it includes certain NEMA Standard test methods, test codes, properties, etc., of liquid-immersed transformers, regulators, and reactors that are not American National Standards.

# PART 0
# GENERAL

The following American National Standards have been approved as NEMA Standards and should be inserted in this Part 0:

| | |
|---|---|
| ANSI/IEEE C57.12.00-1988 | *General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers* |
| ANSI/IEEE C57.12.01-1989 | *General Requirements for Dry Type Power and Distribution Transformers* |
| ANSI C57.12.10-1988 | *Requirements for Transformers 230,000 volts and below, 833/958-8333/10,417 kVA single-phase 750/862-60,000/80,000/100,000 kVA three phase, including supplements* |
| ANSI C57.12.70-1993 | *Terminal Markings and Connections for Distribution and Power Transformers* |
| ANSI/IEEE C57.12.90-1993 | *Test Code for Liquid-immersed Distribution, Power & Regulating Transformers and Guide for Short-Circuit Testing of Distribution & Power Transformers* |
| ANSI/IEEE C57.19.00-1992 | *General Requirements and Test Procedure for Outdoor Apparatus Bushings* |
| ANSI/IEEE C57.19.01-1992 | *Standard Performance Characteristics & Dimensions for Outdoor Apparatus Bushings* |
| ANSI/IEEE C57.92-1992 | *Guide for Loading Mineral-oil-immersed Power Transformers up to and including 100 MVA with 55C or 65C Average Winding Rise* |

The NEMA Standards TR 1-0.01 through TR 1-0.09 on the following pages (see Part 0 Pages 1–9) also apply generally to transformers.

## 0.01 PREFERRED VOLTAGE RATINGS

Preferred system voltages and corresponding transformer voltage ratings are given in the American National Standard for Electric Power Systems and Equipment--Voltage Ratings (60 Hz), C84.1-1989. It is recommended that these ratings be used as a guide in the purchase and operation of transformers.

## 0.02 FORCED-AIR (FA) AND FORCED-OIL (FOA) RATINGS

Under the conditions of par. 5.11 of American National Standard ANSI/IEEE C57.12.00-1988, the relationship between self-cooled ratings and forced-air-cooled or forced-oil-cooled ratings shall be in accordance with Table 0-1.

**Table 0-1**
**FORCED-AIR AND FORCED-OIL RATINGS RELATIONSHIPS**

| | Self-cooled Ratings* (kVA) | | Percent of Self-Cooled Ratings With Auxiliary Cooling | |
|---|---|---|---|---|
| Class | Single Phase | Three Phase | First Stage | Second Stage |
| OA/FA | 501-2499 | 501-2499 | 115 | -- |
| OA/FA | 2500-9999 | 2500-11999 | 125 | -- |
| OA/FA | 10000 and above | 12000 and above | 133-1/3 | -- |
| OA/FA/FA | 10000 and above | 12000 and above | 133-1/3 | 166-2/3 |
| OA/FA/FOA | 10000 and above | 12000 and above | 133-1/3 | 166-2/3 |
| OA/FOA/FOA | 10000 and above | 12000 and above | 133-1/3 | 166-2/3 |

*In the case of multi-winding transformers or autotransformers, the ratings given are the equivalent two-winding ratings.

# PERFORMANCE

## 0.03 RADIO INFLUENCE VOLTAGE LEVELS

The following values apply to liquid-filled transformers. They do not apply to load tap changing during switching or to operation of auxiliary relays and control switches.

### 0.03.1 Distribution Transformers

Radio influence voltage levels for distribution transformers, for systems rated 69 kV and less, shall not exceed 100 microvolts when measured in accordance with Section 7.01. The test voltage shall be the line-to-neutral voltage corresponding to 110 percent excitation of the transformer. This will be the coil voltage for wye connections and 1/3 times the coil voltage for delta connections.

## 0.04 POWER FACTOR OF INSULATION OF OIL-IMMERSED TRANSFORMERS

While the real significance which can be attached to the power factor of oil-immersed transformers is still a matter of opinion, experience has shown that power factor is helpful in assessing the probable conditions of the insulation when good judgement is used.

The proper interpretation of power factor of oil-immersed transformers is being given careful attention by manufacturers in connection with the problems of (1) selecting insulating materials, (2) sealing, and (3) processing the transformers. However, it is the comparative values which are guides for the successful solution for these problems rather than an absolute value of power factor.

The generally accepted factory tests for proving the insulation level are the prescribed low-frequency tests and impulse tests given in the American National Standard C57.12.90-1993.

When required, a factory power-factor test can be made, and this measurement will be of value for comparison with field power-factor measurements to assess the probable condition of the insulation. It is not feasible to establish standard power-factor values for oil-immersed transformers because:

a. Experience has definitely proved that little or no relation exists between power factor and the ability of the transformer to withstand the prescribed dielectric tests.
b. Experience has definitely proved that the variation in power factor with temperature is substantial and erratic so that no single correction curve will fit all cases.

When a factory power-factor measurement of a transformer is required, the measurement should be made with the insulation at room temperature, preferably at or close to 20°C.

## 0.05 AUDIBLE SOUND LEVELS

Transformers shall be so designed that the average sound level will not exceed the values given in Tables 0-2 through 0-4 when measured at the factory in accordance with the conditions outlined in ANSI/IEEE C57.12.90-1993.

The guaranteed sound levels should continue to be per Tables 0-2 through 0-4 until such time as enough data on measured noise power levels becomes available.

Sound pressure levels are established and published in this document. Sound power may be calculated from sound pressure, using the method described in C57.12.90-1993.

Rectifier, railway, furnace, grounding, mobile and mobile unit substation transformers are not covered by the tables. The tables do not apply during the time that power switches are operating in load-tap-changing transformers and in transformers with integral power switches.

# ble 0-2
# AUDIBLE SOUND LEVELS F .-IMMERSED POWER TRANSFORMERS

nn 1 - Class*OA, Ow and FOW Ratings
nn 2 - Class* FA and FOA First stage Auxiliary Cooling**†
nn 3 - Straight FOA* Ratings, FA* FOA* Second-stage Auxiliary Cooling*†

| erage Sound vel ††, cibels | Equivalent Two-winding Rating▲ | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 350 kV BIL and Below | | | 450, 550, 650 kV BIL | | | 750 and 825 kV BIL | | | 900 and 1050 kV BIL | | | 1175 kV BIL | | | 1300 kV BIL and Above | | |
| | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| | 700 | ... | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | 1000 | . | . . | ... | .. | .. | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | .. | . . | ... | 700 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | 1500 | . . | .. | 1000 | ... | ... | . . | .. | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | 2000 | . | . . | ... | ... | . | ... | ... | .. | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | 2500 | ... | ... | 1500 | ... | . | . | .. | .. | .. | ... | ... | ... | .. | .. | ... | ... | ... |
| | 3000 | ... | ... | 2000 | ... | .. | . . | ... | ... | ... | ... | . . | ... | .. | ... | ... | ... | ... |
| | 4000 | ... | ... | 2500 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | 5000 | ... | ... | 3000 | ... | ... | ... | ... | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... |
| | 6000 | ... | ... | 4000 | . | . | 3000 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | 7500 | 6250▲▲ | .. | 5000 | 3750▲▲ | .. | 4000 | 3125▲▲ | .. | .. | ... | . . | ... | .. | ... | ... | ... | ... |
| | 10000 | 7500 | | 6000 | 5000 | . | 5000 | 3750 | ... | . . | ... | . . | ... | .. | ... | ... | ... | ... |
| | 12500 | 9375 | . | 7500 | 6250 | .. | 6000 | 5000 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | 15000 | 12500 | . | 10000 | 7500 | .. | 7500 | 6250 | . . | ... | ... | ... | .. | . . | ... | ... | ... | ... |
| | 20000 | 16667 | | 12500 | 9375 | | 10000 | 7500 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| | 25000 | 20000 | 20800 | 15000 | 12500 | .. | 12500 | 9375 | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... |
| | 30000 | 26667 | 25000 | 20000 | 16667 | ... | 15000 | 12500 | ... | 12500 | ... | . . | ... | ... | .. | ... | ... | ... |
| | 40000 | 33333 | 33333 | 25000 | 20000 | 20800 | 20000 | 16667 | ... | 15000 | ... | ... | 12500 | ... | ... | ... | ... | ... |
| | 50000 | 40000 | 41667 | 30000 | 26667 | 25000 | 25000 | 20000 | 20800 | 20000 | 16667 | ... | 15000 | ... | ... | 12500 | ... | ... |
| | 60000 | 53333 | 50000 | 40000 | 33333 | 33333 | 30000 | 26667 | 25000 | 25000 | 20000 | 20800 | 20000 | 16667 | .. | 15000 | ... | ... |
| | 80000 | 66667 | 66667 | 50000 | 40000 | 41667 | 40000 | 33333 | 33333 | 30000 | 26667 | 25000 | 25000 | 20000 | 20800 | 20000 | 16667 | ... |
| | 100000 | 80000 | 83333 | 60000 | 53333 | 50000 | 50000 | 40000 | 41667 | 40000 | 33333 | 33333 | 30000 | 26667 | 25000 | 25000 | 20000 | 20800 |
| | ... | 106667 | 100000 | 80000 | 66667 | 66667 | 60000 | 53333 | 50000 | 50000 | 40000 | 41667 | 40000 | 33333 | 33333 | 30000 | 26667 | 25000 |
| | .. | 133333 | 133333 | 100000 | 80000 | 83333 | 80000 | 66667 | 66667 | 60000 | 53333 | 50000 | 50000 | 40000 | 41667 | 40000 | 33333 | 33333 |
| | ... | ... | 166667 | ... | 106667 | 100000 | 100000 | 80000 | 83333 | 80000 | 66667 | 66667 | 60000 | 53333 | 50000 | 50000 | 40000 | 41667 |
| | ... | ... | 200000 | ... | 133333 | 133333 | ... | 106667 | 100000 | 100000 | 80000 | 83333 | 80000 | 66667 | 66667 | 60000 | 53333 | 50000 |
| | .. | ... | 250000 | ... | ... | 166667 | ... | 133333 | 133333 | ... | 106667 | 100000 | 100000 | 80000 | 83333 | 80000 | 66667 | 66667 |
| | .. | ... | 300000 | ... | ... | 200000 | ... | ... | 166667 | ... | 133333 | 133333 | ... | 106667 | 100000 | 100000 | 80000 | 83333 |
| | .. | ... | 400000 | ... | ... | 250000 | ... | ... | 200000 | ... | ... | 166667 | ... | 133333 | 133333 | ... | 106667 | 100000 |
| | ... | ... | ... | ... | ... | 300000 | ... | ... | 250000 | ... | ... | 200000 | ... | ... | 166667 | ... | 133333 | 133333 |
| | ... | ... | ... | ... | ... | 400000 | ... | ... | 300000 | ... | ... | 250000 | ... | ... | 200000 | ... | ... | 166667 |
| | ... | ... | ... | ... | ... | ... | ... | ... | 400000 | ... | ... | 300000 | ... | ... | 250000 | ... | ... | 200000 |
| | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 400000 | ... | ... | 300000 | ... | ... | 250000 |
| | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... | ... | ... | ... | ... | 400000 | ... | ... | 300000 |
| | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 400000 |

Classes of cooling (see 2.6.1 of American National Standard C57.12.00-1988.
First- and second-stage auxiliary cooling (see TR 1.0.02).
For column 2 and 3 ratings, the sound levels are with the auxiliary cooling equipment in operation.
†For intermediate kVA ratings, use the average sound level of the next larger kVA rating.
The equivalent two-winding 55°C or 65°C rating is defined as one-half the sum of the kVA rating of all windings.
▲Sixty-seven decibels for all kVA ratings equal to this or smaller.

## Table 0-3
## AUDIBLE SOUND LEVELS FOR LIQUID-IMMERSED DISTRIBUTION TRANSFORMERS AND NETWORK TRANSFORMERS

| Equivalent Two-winding kVA | Average Sound Level, Decibels |
|---|---|
| 0–50 | 48 |
| 51–100 | 51 |
| 101–300 | 55 |
| 301–500 | 56 |
| 750 | 57 |
| 1000 | 58 |
| 1500 | 60 |
| 2000 | 61 |
| 2500 | 62 |

Small Transformer

## Table 0-4
## AUDIBLE SOUND LEVELS FOR DRY-TYPE TRANSFORMERS 15000-VOLT NOMINAL SYSTEM VOLTAGE AND BELOW

| Equivalent Two-Winding kVA | Average Sound Level, Decibels | | Equivalent Two-winding kVA | Average Sound Level, Decibels Ventilated Forced Air Cooled **,† |
|---|---|---|---|---|
| | Self-cooled Ventilated* | Self-cooled Sealed* | | |
| 0–50 | 50 | 50 | ... | ... |
| 51–150 | 55 | 55 | ... | ... |
| 151–300 | 58 | 57 | 3–300 | 67 |
| 301–500 | 60 | 59 | 301–500 | 67 |
| 501–700 | 62 | 61 | 501–833 | 67 |
| 701–1000 | 64 | 63 | 834–1167 | 67 |
| 1001–1500 | 65 | 64 | 1168–1667 | 68 |
| 1501–2000 | 66 | 65 | 1668–2000 | 69 |
| 2001–3000 | 68 | 66 | 2001–3333 | 71 |
| 3001–4000 | 70 | 68 | 3334–5000 | 73 |
| 4001–5000 | 71 | 69 | 5001–6667 | 74 |
| 5001–6000 | 72 | 70 | 6668–8333 | 75 |
| 6001–7500 | 73 | 71 | 8334–10000 | 76 |

* Class AA rating

**Does not apply to sealed-type transformers

†Class FA and AFA ratings

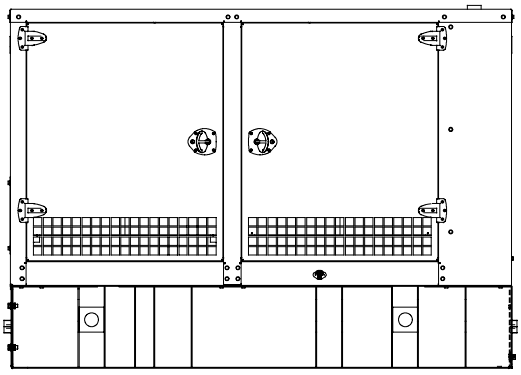
KOHLER POWER SYSTEMS

# Weather/Sound Enclosure and Subbase Fuel Tank Package

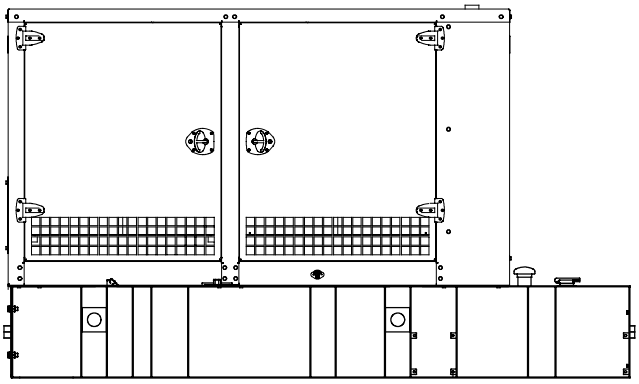
ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED

## Applicable to the following:

**20–60REOZJC**
**50/60REOZJD**
**80–275REOZJE**
**80–200REOZJF**
**125REOZJG**
**300REOZJ**



**Enclosure with Standard Subbase Fuel Tank**



**Enclosure with State Code Subbase Fuel Tank**

## Weather Enclosure Standard Features

- Internal-mounted critical silencer and flexible exhaust connector.
- Lift base or tank-mounted, steel construction with hinged doors.
- Fade-, scratch-, and corrosion-resistant Kohler® cream beige powder-baked finish.
- Lockable, flush-mounted door latches.
- Vertical air inlet and outlet discharge to redirect air and reduce noise.
- Certified to withstand 241 kph (150 mph) wind load rating. Available on all models, except 80–150REOZJE with steel enclosure and 125REOZJF with steel enclosure.

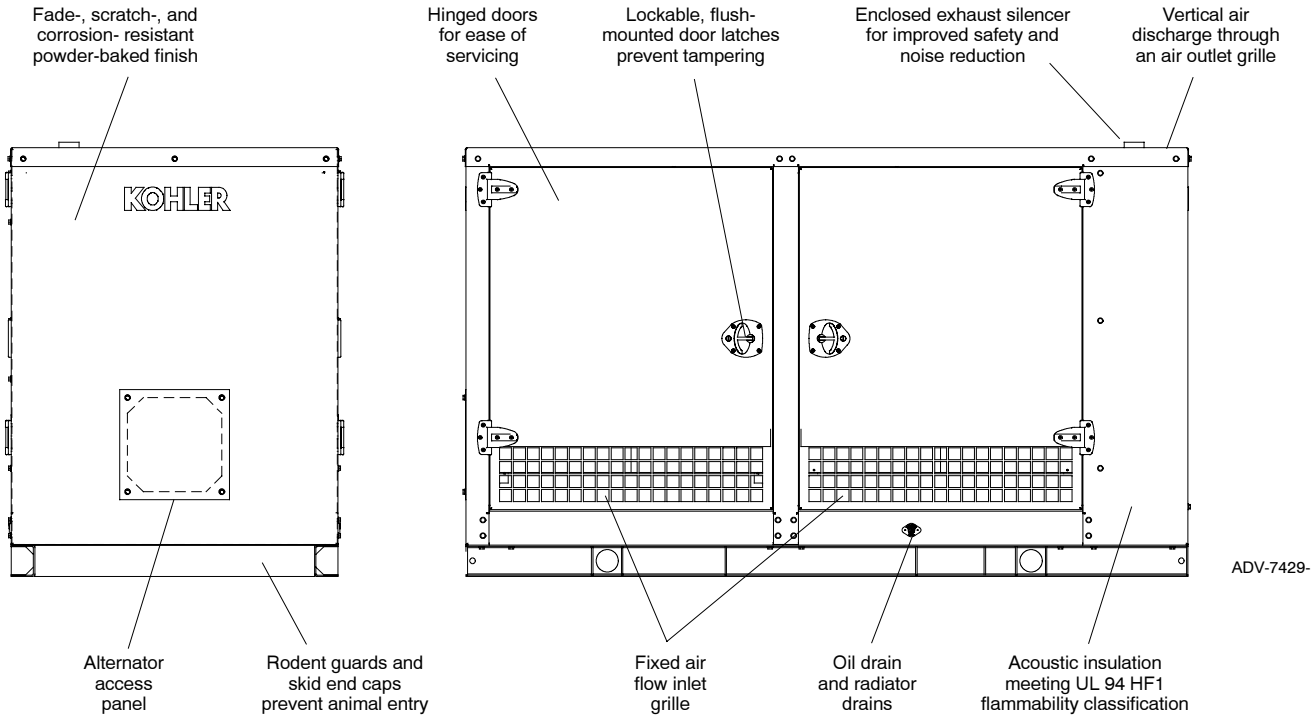
## Sound Enclosure Standard Features

- Includes all of the weather enclosure features with the addition of acoustic insulation material.
- Lift base or tank-mounted, steel or aluminum construction with hinged doors. Aluminum enclosures are recommended for high humidity and/or high salt/ coastal regions.
- Acoustic insulation that meets UL 94 HF1 flammability classification and repels moisture absorption.
- Sound attenuated enclosure that uses up to 51 mm (2 in.) of acoustic insulation.

## Subbase Fuel Tank Features

- The above-ground rectangular secondary containment tank mounts directly to the generator set, below the generator set skid (subbase).
- Both the inner and outer tanks have emergency relief vents.
- Flexible fuel lines are provided with subbase fuel tank selection.
- The secondary containment generator set base tank meets UL 142 tank requirements. The inner (primary) tank is sealed inside the outer (secondary) tank. The outer tank contains the fuel if the inner tank leaks or ruptures.

## Weather and Sound Enclosure




**Note:** 20–60REOZJC models shown, other models are similar. Refer to the respective ADV drawings for details.

## Enclosure Features

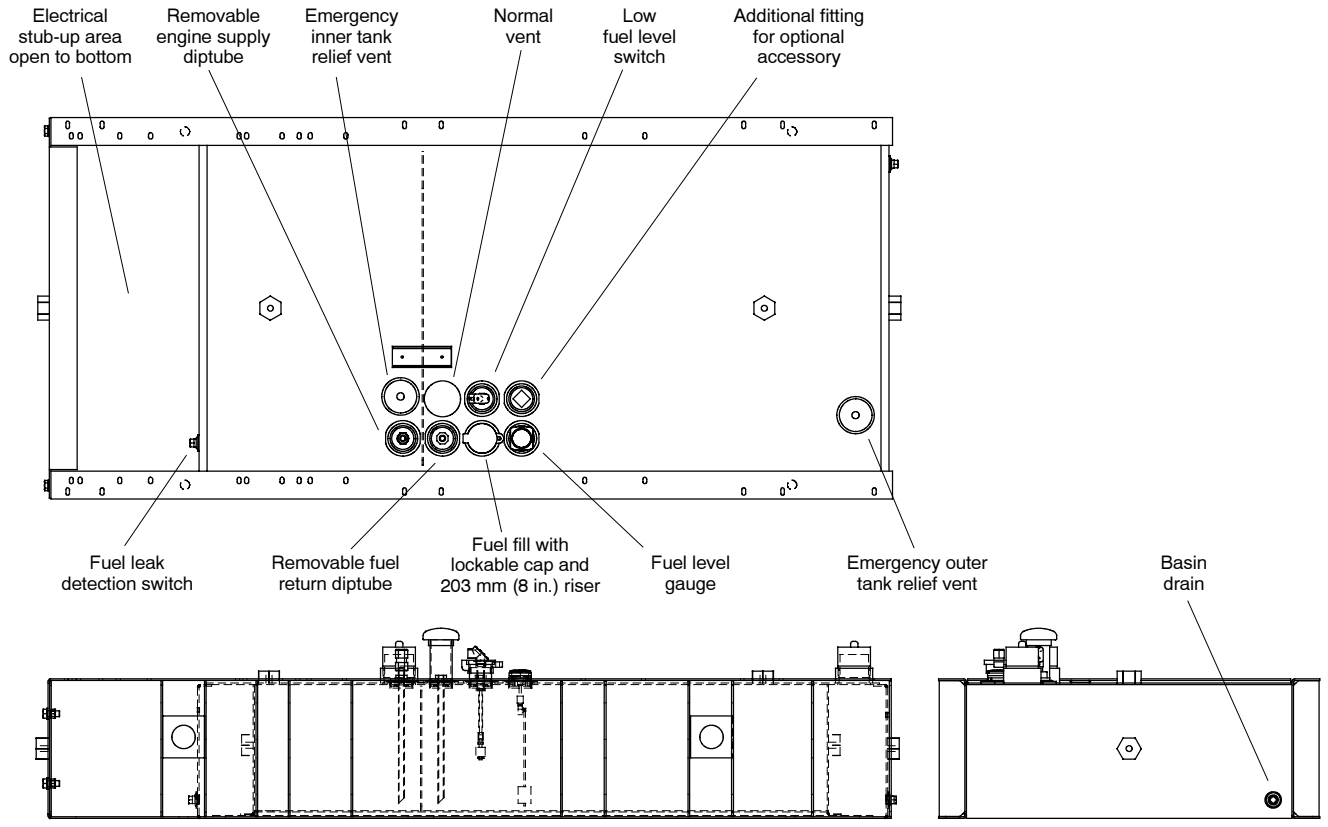
- Available in steel (14 gauge) formed panel, solid construction. Preassembled package offering corrosion resistant, dent resilient structure mounting directly to lift base or fuel tank.
- Powder-baked paint. Superior finish, durability, and appearance.
- Internal critical exhaust silencer offering maximum component life and operator safety.

  **NOTE:** To avoid exceeding the engine manufacturer's maximum allowable backpressure specification, enclosure tail pipe extensions or attachments are not recommended.
- Interchangeable modular panel construction. Allows complete serviceability or replacement without compromising enclosure design.
- Cooling/combustion air intake with a horizontal air inlet. Sized for maximum cooling airflow.
- Service access. Multi-personnel doors for easy access to generator set control and servicing of the fuel fill, fuel gauge, oil fill, and battery.
- Cooling air discharge. Weather protective design featuring a vertical air discharge outlet grille. Redirects cooling air up and above enclosure to reduce ambient noise.

## Additional Sound Enclosure Features

- Available in steel (14 gauge) or aluminum 3.2 mm (0.125 in.) formed panel, solid construction.
- Attenuated design. Acoustic insulation UL 94 HF1 listed for flame resistance offering up to 51 mm (2 in.) mechanically restrained acoustic insulation.
- Cooling air discharge. The sound enclosures include acoustic insulation with urethane film.

## Subbase Fuel Tank

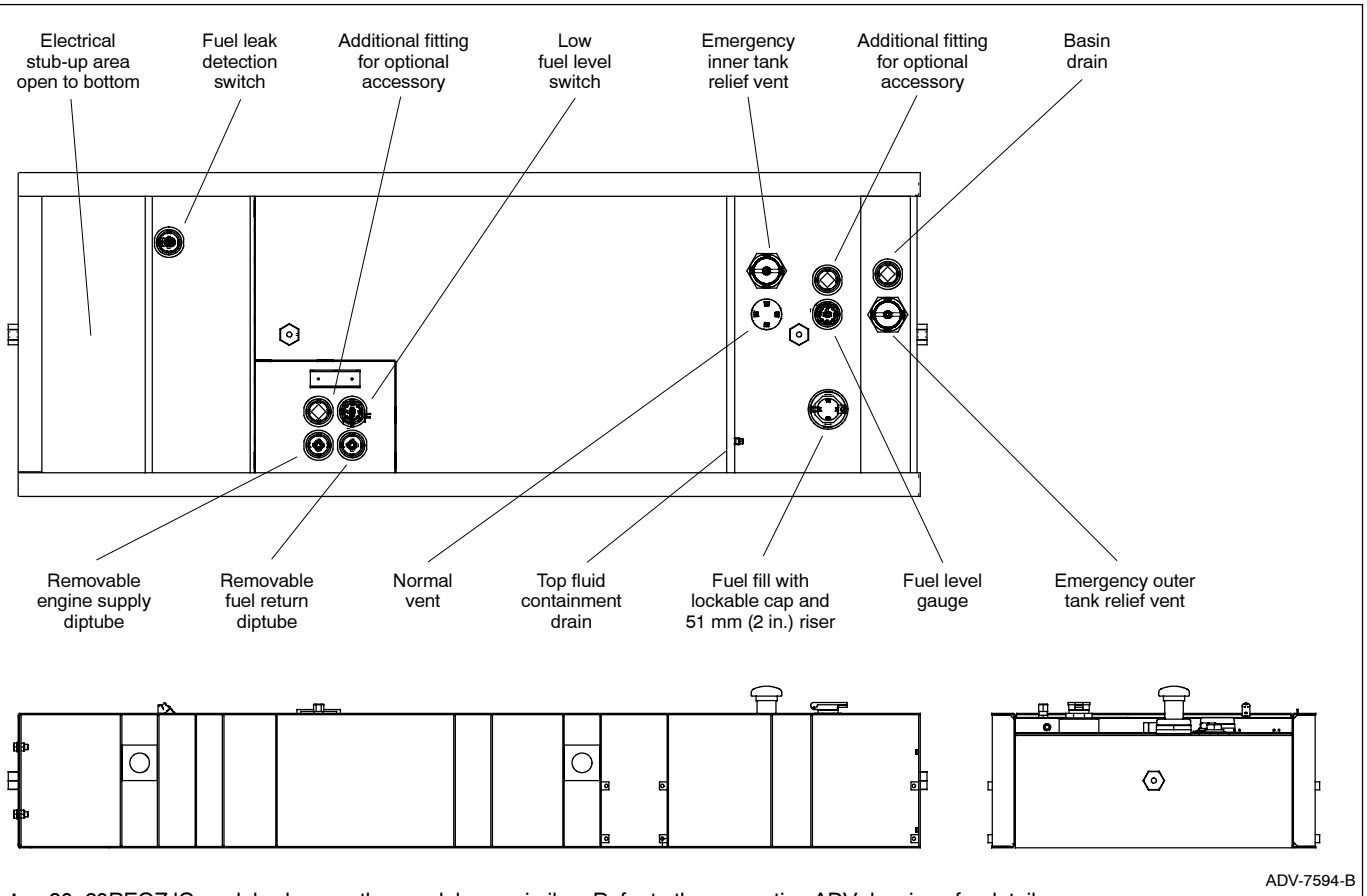



**Note:** 20–60REOZJC models shown, other models are similar. Refer to the respective ADV drawings for details.

## Standard Subbase Fuel Tank Features

- Extended operation. Usable tank capacity offers full load standby operation of up to 72 hours.
- UL listed. Secondary containment generator set base tank meeting UL 142 requirements.
- NFPA compliant. Designed to comply with the installation standards of NFPA 30 and NFPA 37.
- Integral external lift lugs. Enables crane with spreader-bar lifting of the complete package (empty tank, mounted generator set, and enclosure) to ensure safety.
- Emergency pressure relief vents. Vents ensure adequate venting of the inner and outer tank under extreme pressure and/or emergency conditions.
- Normal vent with cap. Vent is raised above lockable fuel fill.
- Low fuel level switch. Annunciates a 50% low fuel level condition at generator set control.
- Leak detection switch. Annunciates a contained primary tank fuel leak condition at generator set control.
- Electrical stub-up.
- State tank designed to comply with the installation standards of the Florida Dept. of Environmental Protection (FDEP) File No. EQ-634.

## State Code Subbase Fuel Tank




**Note:** 20–60REOZJC models shown, other models are similar. Refer to the respective ADV drawings for details.

## State Code Subbase Fuel Tank Options

**Bottom Clearance/Coating**

- ❑ I-beams, provides 106 mm (4.2 in.) of ground clearance
- ❑ Epoxy mastic coating

**Fuel in Basin Options**

- ❑ Fuel in basin switch, Florida Dept. of Environmental Protection (FDEP) File No. EQ-682 approved

**Fuel Fill Options**

- ❑ Fill pipe extension to within 152 mm (6 in.) of bottom of fuel tank.
- ❑ 18.9 L (5 gallon) spill containment with 95% shutoff
- ❑ 18.9 L (5 gallon) spill containment
- ❑ 18.9 L (5 gallon) spill containment fill to within 152 mm (6 in.) of bottom of fuel tank
- ❑ 26.5 L (7 gallon) spill containment, Florida Dept. of Environmental Protection (FDEP) File No. EQ-226 approved
- ❑ 26.5 L (7 gallon) spill containment with 95% shutoff, Florida Dept. of Environmental Protection (FDEP) File No. EQ–226 approved

**Fuel Supply Options**

- ❑ Fire safety valve (installed on fuel supply line)
- ❑ Ball valve (installed on fuel supply line)

**High Fuel Level Switch**

- ❑ High fuel level switch
- ❑ High fuel level switch, Florida Dept. of Environmental Protection (FDEP) File No. EQ-682 approved

**Normal Vent Options**

- ❑ 3.7 m (12 ft.) above grade (without spill containment)
- ❑ 3.7 m (12 ft.) above grade (with spill containment)

**Tank Marking Options**

- ❑ Decal, Combustible Liquids – Keep Fire Away (qty. 2)
- ❑ Decal, NFPA 704 identification (qty. 2)
- ❑ Decal, tank number and safe fuel fill height (qty. 2)
- ❑ Decal, tank number and safe fuel fill height, NFPA 704 identification

## Enclosure and Subbase Fuel Tank Specifications

| Fuel Tank Capacity, L (gal.) | Est. Fuel Supply Hours at 60 Hz w/Full Load Nominal/Actual | Enclosure and Subbase Fuel Tank | | | | | Fuel Tank Height, mm (in.) | Sound Enclosure, Sound Pressure at 7 m (23 ft.), dB(A) |
|---|---|---|---|---|---|---|---|---|
| | | Max. Dimensions, mm (in.) | | | Weight, kg (lb.) | | | |
| | | Length | Width | Height | With Steel Enclosure | With Aluminum Enclosure | | |
| **20REOZJC** | | | | | | | | |
| Lifting Base | 0 | 2320 (91.3) | 1077 (42.4) | 1384 (54.6) | 943 (2080) | 830 (1830) | 100 (4) | 68 |
| 294 (78) | 24/41 | | | 1671 (65.8) | 1272 (2806)* | 1159 (2556)* | 254 (10) | |
| 427 (113) | 36/60 | | | 1773 (69.8) | 1321 (2913)* | 1208 (2663)* | 358 (14) | |
| 626 (165) | 48/87 | | | 1925 (75.8) | 1393 (3073)* | 1280 (2823)* | 508 (20) | |
| **20REOZJC with State Code Fuel Tank†** | | | | | | | | |
| 442 (116) | 24/61 | 2896 (114) | 1040 (40.9) | 1671 (65.8) | 1362 (3003)* | 1249 (2753)* | 358 (14) | 68 |
| 558 (147) | 48/77 | | | 1849 (72.8) | 1459 (3217)* | 1346 (2967)* | 432 (17) | |
| 960 (253) | 72/133 | | | 2103 (82.8) | 1514 (3338)* | 1401 (3088)* | 686 (27) | |
| **30REOZJC** | | | | | | | | |
| Lifting Base | 0 | 2320 (91.3) | 1077 (42.4) | 1384 (54.6) | 1007 (2220) | 894 (1970) | 100 (4) | 68 |
| 294 (78) | 24/27 | | | 1671 (65.8) | 1336 (2946)* | 1223 (2696)* | 254 (10) | |
| 427 (113) | 36/40 | | | 1773 (69.8) | 1385 (3053)* | 1271 (2803)* | 358 (14) | |
| 626 (165) | 48/59 | | | 1925 (75.8) | 1457 (3213)* | 1344 (2963)* | 508 (20) | |
| **30REOZJC with State Code Fuel Tank†** | | | | | | | | |
| 442 (116) | 24/41 | 2896 (114) | 1040 (40.9) | 1671 (65.8) | 1424 (3139)* | 1311 (2889)* | 358 (14) | 68 |
| 558 (147) | 48/52 | | | 1849 (72.8) | 1521 (3353)* | 1408 (3103)* | 432 (17) | |
| 960 (253) | 72/90 | | | 2103 (82.8) | 1576 (3474)* | 1463 (3224)* | 686 (27) | |
| **40REOZJC** | | | | | | | | |
| Lifting Base | 0 | 2320 (91.3) | 1077 (42.4) | 1384 (54.6) | 966 (2130) | 853 (1880) | 100 (4) | 68 |
| 427 (113) | 24/33 | | | 1773 (69.8) | 1344 (2963)* | 1231 (2713)* | 358 (14) | |
| 626 (165) | 48/59 | | | 1925 (75.8) | 1416 (3123)* | 1303 (2873)* | 508 (20) | |
| 958 (253) | 72/90 | | | 2179 (85.8) | 1736 (3826)* | 1622 (3576)* | 762 (30) | |
| **40REOZJC with State Code Fuel Tank†** | | | | | | | | |
| 442 (116) | 24/34 | 2896 (114) | 1040 (40.9) | 1671 (65.8) | 1451 (3199)* | 1338 (2949)* | 358 (14) | 68 |
| 960 (253) | 48/74 | | | 2103 (82.8) | 1575 (3472)* | 1462 (3222)* | 686 (27) | |
| 1411 (372) | 72/109 | | | 2332 (91.8) | 1726 (3805)* | 1613 (3555)* | 914 (36) | |
| **50REOZJC and 50REOZJD** | | | | | | | | |
| Lifting Base | 0 | 2320 (91.3) | 1077 (42.4) | 1384 (54.6) | 1027 (2265) | 914 (2015) | 100 (4) | 68 |
| 427 (113) | 24/26 | | | 1773 (69.8) | 1405 (3098)* | 1292 (2848)* | 358 (14) | |
| 626 (165) | 36/38 | | | 1925 (75.8) | 1477 (3258)* | 1364 (3008)* | 508 (20) | |
| 958 (253) | 48/58 | | | 2179 (85.8) | 1736 (3826)* | 1622 (3576)* | 762 (30) | |
| **50REOZJC and 50REOZJD with State Code Fuel Tank†** | | | | | | | | |
| 442 (116) | 24/27 | 2896 (114) | 1040 (40.9) | 1824 (71.8) | 1529 (3371)* | 1416 (3121)* | 358 (14) | 68 |
| 960 (253) | 48/58 | | | 2103 (82.8) | 1653 (3644)* | 1540 (3394)* | 686 (27) | |
| 1411 (372) | 72/86 | | | 2332 (91.8) | 1804 (3977)* | 1691 (3727)* | 914 (36) | |
| **60REOZJC and 60REOZJD** | | | | | | | | |
| Lifting Base | 0 | 2320 (91.3) | 1077 (42.4) | 1384 (54.6) | 1164 (2566) | 1051 (2316) | 100 (4) | 68 |
| 493 (130) | 24/26 | | | 1773 (69.8) | 1566 (3452)* | 1452 (3202)* | 406 (16) | |
| 792 (210) | 36/42 | | | 2052 (80.8) | 1687 (3719)* | 1574 (3469)* | 635 (25) | |
| 958 (253) | 48/50 | | | 2179 (85.8) | 1736 (3826)* | 1622 (3576)* | 762 (30) | |
| **60REOZJC and 60REOZJD with State Code Fuel Tank†** | | | | | | | | |
| 558 (147) | 24/29 | 2895 (114) | 1040 (40.9) | 1849 (72.8) | 1616 (3563)* | 1503 (3313)* | 432 (17) | 68 |
| 960 (253) | 48/50 | | | 2103 (82.8) | 1767 (3896)* | 1654 (3646)* | 686 (27) | |
| 1411 (372) | 72/74 | | | 2332 (91.8) | 1918 (4228)* | 1805 (3978)* | 914 (36) | |

## Enclosure and Subbase Fuel Tank Specifications (continued)

| Fuel Tank Capacity, L (gal.) | Est. Fuel Supply Hours at 60 Hz w/Full Load Nominal/Actual | Enclosure and Subbase Fuel Tank | | | | | Fuel Tank Height, mm (in.) | Sound Enclosure, Sound Pressure at 7 m (23 ft.), dB(A) |
|---|---|---|---|---|---|---|---|---|
| | | Max. Dimensions, mm (in.) | | | Weight, kg (lb.) | | | |
| | | Length | Width | Height | With Steel Enclosure | With Aluminum Enclosure | | |
| **80REOZJE and 80REOZJF** | | | | | | | | |
| Lifting Base | 0 | 2821 (111.1) | 1156 (45.5) | 1525 (60) | 1483 (3269) | 1351 (2979) | 102 (4) | 68 |
| 757 (200) | 24/29 | | | 1880 (74) | 1851 (4080)* | 1719 (3790)* | 457 (18) | |
| 1314 (347) | 48/50 | | | 2185 (86) | 2108 (4647)* | 1976 (4357)* | 762 (30) | |
| **80REOZJE and 80REOZJF with State Code Fuel Tank†** | | | | | | | | |
| 815 (215) | 24/31 | 3400 (133.9) | 1156 (45.5) | 1855 (73) | 1996 (4400)* | 1864 (4110)* | 432 (17) | 68 |
| 1570 (415) | 48/60 | | | 2185 (86) | 2236 (4929)* | 2104 (4639)* | 762 (30) | |
| **100REOZJE and 100REOZJF** | | | | | | | | |
| Lifting Base | 0 | 2821 (111.1) | 1156 (45.5) | 1525 (60) | 1592 (3510) | 1461 (3220) | 102 (4) | 68 |
| 757 (200) | 24/24 | | | 1880 (74) | 1960 (4320)* | 1828 (4030)* | 457 (18) | |
| 1700 (449) | 48/55 | 3400 (133.9) | | 2185 (86) | 2345 (5170)* | 2214 (4880)* | 762 (30) | |
| **100REOZJE and 100REOZJF with State Code Fuel Tank†** | | | | | | | | |
| 815 (215) | 24/26 | 3400 (133.9) | 1156 (45.5) | 1855 (73) | 2105 (4641)* | 1974 (4351)* | 432 (17) | 68 |
| 1570 (415) | 48/50 | | | 2185 (86) | 2345 (5170)* | 2214 (4880)* | 762 (30) | |
| **125REOZJF and 125REOZJG** | | | | | | | | |
| Lifting Base | 0 | 3532 (139.0) | 1153 (45.4) | 1753 (69) | 1651 (3632) | 1515 (3333) | 0 (0) | 71 |
| 1131 (298) | 24/32 | | | 2236 (88) | 2400 (5280)* | 2264 (4981)* | 483 (19) | |
| 2207 (583) | 48/63 | | | 2667 (105) | 2751 (6052)* | 2615 (5753)* | 914 (36) | |
| **125REOZJF and 125REOZJG with State Code Fuel Tank†** | | | | | | | | |
| 1198 (316) | 24/34 | 4414 (173.8) | 1153 (45.4) | 2236 (88) | 2382 (5240)* | 2446 (4941)* | 483 (19) | 71 |
| 2255 (595) | 48/65 | | | 2591 (102) | 2654 (5839)* | 2518 (5540)* | 838 (33) | |
| **150REOZJE and 150REOZJF** | | | | | | | | |
| Lifting Base | 0 | 3532 (139.0) | 1153 (45.4) | 1753 (69) | 1860 (4101) | 1724 (3800) | 0 (0) | 73 |
| 1131 (298) | 24/25 | | | 2236 (88) | 2609 (5752)* | 2473 (5452)* | 483 (19) | |
| 2207 (583) | 48/50 | | | 2667 (105) | 2960 (6526)* | 2824 (6226)* | 914 (36) | |
| **150REOZJE and 150REOZJF with State Code Fuel Tank†** | | | | | | | | |
| 1198 (316) | 24/27 | 4414 (173.8) | 1153 (45.4) | 2236 (88) | 2591 (5712)* | 2455 (5412)* | 483 (19) | 73 |
| 2255 (595) | 48/51 | | | 2591 (102) | 2890 (6361)* | 2727 (6012)* | 838 (33) | |
| **180REOZJE and 180REOZJF** | | | | | | | | |
| Lifting Base | 0 | 4094 (161.2) | 1300 (51.2) | 2128 (84) | 1928 (4250) | 1780 (3925) | 0 (0) | 72 |
| 1514 (400) | 24/29 | | | 2611 (103) | 2861 (6307)* | 2713 (5981)* | 483 (19) | |
| 2871 (758) | 48/56 | | | 3017 (119) | 3255 (7176)* | 3107 (6850)* | 889 (35) | |
| **180REOZJE and 180REOZJF with State Code Fuel Tank†** | | | | | | | | |
| 1576 (416) | 24/31 | 5008 (197.2) | 1300 (51.2) | 2585 (102) | 3162 (6971)* | 3014 (6646)* | 457 (18) | 72 |
| 2896 (765) | 48/56 | | | 2890 (114) | 3488 (7690)* | 3340 (7363)* | 762 (30) | |
| **200REOZJE and 200REOZJF** | | | | | | | | |
| Lifting Base | 0 | 4094 (161.2) | 1300 (51.2) | 2128 (84) | 2309 (5090) | 2161 (4764) | 0 (0) | 73 |
| 1514 (400) | 24/26 | | | 2611 (103) | 3242 (7147)* | 3094 (6821)* | 483 (19) | |
| 2871 (758) | 48/50 | | | 3017 (119) | 3636 (8016)* | 3488 (7690)* | 889 (35) | |
| **200REOZJE and 200REOZJF with State Code Fuel Tank†** | | | | | | | | |
| 1576 (416) | 24/27 | 5008 (197.2) | 1300 (51.2) | 2585 (102) | 3543 (7811)* | 3395 (7485)* | 457 (18) | 73 |
| 2896 (765) | 48/50 | | | 2890 (114) | 4050 (8930)* | 3721 (8203)* | 762 (30) | |

## Enclosure and Subbase Fuel Tank Specifications (continued)

| Fuel Tank Capacity, L (gal.) | Est. Fuel Supply Hours at 60 Hz w/Full Load Nominal/Actual | Enclosure and Subbase Fuel Tank | | | | | Fuel Tank Height, mm (in.) | Sound Enclosure, Sound Pressure at 7 m (23 ft.), dB(A) |
|---|---|---|---|---|---|---|---|---|
| | | Max. Dimensions, mm (in.) | | | Weight, kg (lb.) | | | |
| | | Length | Width | Height | With Steel Enclosure | With Aluminum Enclosure | | |
| **230REOZJE** | | | | | | | | |
| Lifting Base | 0 | 4121 (162.3) | 1338 (52.7) | 2157 (84.9) | 2654 (5850) | 2540 (5600) | 0 (0) | 75 |
| 1787 (472) | 24/29 | | | 2659 (104.7) | 3561 (7850)* | 3447 (7600)* | 762 (30) | |
| **230REOZJE with State Code Fuel Tank†** | | | | | | | | |
| 2102 (555) | 24/34 | 5009 (197.2) | 1338 (52.7) | 2792 (109.9) | 3895 (8587)* | 3782 (8337)* | 635 (25) | 75 |
| 3573 (944) | 48/59 | 5325 (209.7) | | 3071 (120.9) | 4504 (9930)* | 4391 (9680)* | 914 (36) | |
| **250REOZJE** | | | | | | | | |
| Lifting Base | 0 | 4121 (162.3) | 1338 (52.7) | 2157 (84.9) | 2699 (5950) | 2585 (5700) | 0 (0) | 75 |
| 1787 (472) | 24/27 | | | 2659 (104.7) | 3606 (7950)* | 3493 (7700)* | 762 (30) | |
| **250REOZJE with State Code Fuel Tank†** | | | | | | | | |
| 2102 (555) | 24/32 | 5009 (197.2) | 1338 (52.7) | 2792 (109.9) | 3940 (8687)* | 3827 (8437)* | 635 (25) | 75 |
| 3573 (944) | 48/54 | 5325 (209.7) | | 3071 (120.9) | 4550 (10030)* | 4436 (9780)* | 914 (36) | |
| **275REOZJE** | | | | | | | | |
| Lifting Base | 0 | 4121 (162.3) | 1338 (52.7) | 2157 (84.9) | 2835 (6250) | 2722 (6000) | 0 (0) | 75 |
| 1787 (472) | 24/24 | | | 2659 (104.7) | 3742 (8250)* | 3629 (8000)* | 762 (30) | |
| **275REOZJE with State Code Fuel Tank†** | | | | | | | | |
| 2102 (555) | 24/28 | 5009 (197.2) | 1338 (52.7) | 2792 (109.9) | 4076 (8987)* | 3963 (8737)* | 635 (25) | 75 |
| 3573 (944) | 48/48 | 5325 (209.7) | | 3071 (120.9) | 4686 (10330)* | 4572 (10080)* | 914 (36) | |
| **300REOZJ** | | | | | | | | |
| Lifting Base | 0 | 4121 (162.3) | 1338 (52.7) | 2157 (84.9) | 2835 (6250) | 2722 (6000) | 0 (0) | 75 |
| 2070 (546) | 24/25 | | | 2735 (107.7) | 3770 (8311)* | 3656 (8061)* | 838 (33) | |
| **300REOZJ with State Code Fuel Tank†** | | | | | | | | |
| 2102 (555) | 24/25 | 5009 (197.2) | 1338 (52.7) | 2792 (109.9) | 4076 (8987)* | 3963 (8737)* | 635 (25) | 75 |
| 4066(1074) | 48/48 | 5588 (220.0) | | 3071 (120.9) | 4644 (10238)* | 4530 (9988)* | 914 (36) | |

**Note:** Refer to the respective ADV drawings for details.

***** Weight includes the generator set (wet), enclosure, silencer, and tank (no fuel).

† State code fuel tank specifications (height and weight) include I-beam option.

The generator set weight represents using the largest alternator option. The enclosure weight is with acoustic insulation added.

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