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**FAR-FIELD NOISE COMPLIANCE REPORT**

OPERATIONAL SOUND LEVEL STUDY FOR  
CONDITION OF CERTIFICATION NOISE-4  
SENTINEL ENERGY PROJECT, (07-AFC-3)  
RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR:

**Competitive Power Ventures**

URS PROJECT No. 29875266

**APRIL 17, 2013**

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CONDITION OF CERTIFICATION NOISE-4  
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April 17, 2013

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## List of Abbreviations

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ANSI	American National Standards Institute
CEC	California Energy Commission
COC	Condition of Certification
CPV	Competitive Power Ventures
CPM	Compliance Project Manager
CTG	Combustion Turbine Generator
dB	Decibel
dBA	A-weighted decibel
HP	Horsepower
HVAC	Heating, Ventilation, Air-Conditioning
Hz	Hertz
IL	Insertion loss
ISO	International Organization of Standardization
L <sub>10</sub>	Equivalent Sound Pressure Level, Exceeded 10% of the time
L <sub>50</sub>	Equivalent Sound Pressure Level, Exceeded 50% of the time
L <sub>90</sub>	Equivalent Sound Pressure Level, Exceeded 90% of the time
L <sub>eq</sub>	Equivalent Sound Pressure Level
L <sub>max</sub>	Maximum Sound Pressure Level
LLC	Limited Liability Company
LOS	Line-of-sight
ML	Measurement (or Monitoring) Location
MW	Megawatt
NR	Noise reduction
PWL	Sound Power Level
SCR	Selective Catalytic Reduction
SLM	Sound Level Meter
SN	Serial Number
SPL	Sound Pressure Level
URS	URS Corporation

**SECTION 1 EXECUTIVE SUMMARY**

**Background:** Operation of the Competitive Power Ventures Sentinel Energy Project (CPV Sentinel or the Project) must comply with California Energy Commission (CEC) Conditions of Certification (COC) that include NOISE-4 as indicated in the CEC Commission Decision (CEC-800-2010-016-CMF), December 2010 (Commission Decision). COC NOISE-4, reads as follows:

“The project design and implementation shall include appropriate noise mitigation measures adequate to ensure that operation of the project will not cause noise levels due solely to plant operation to exceed an average of 48 dBA  $L_{eq}$  measured at monitoring location LT-1, the residence referred to as Residence C on Noise and Vibration Figure 1 of Staff’s Final Staff Assessment (Exhibit 200, p. 4.6-1 et seq.). No new pure-tone components may be caused by the project. No single piece of equipment shall be allowed to stand out as a source of noise that draws legitimate complaints. The measurement of power plant noise for the purposes of demonstrating compliance with this condition of certification may alternatively be made at a location, acceptable to the CPM, closer to the plant (*e.g.*, 400 feet from the plant boundary) and this measured level then mathematically extrapolated to determine the plant noise contribution at the affected residence. The character of the plant noise shall be evaluated at the affected residential locations to determine the presence of pure tones or other dominant sources of plant noise.

- A. When each phase of the project first achieves a sustained output of 90 percent or greater of rated capacity, the project owner shall conduct a community noise survey at monitoring location LT-1 or at closer locations acceptable to the CPM. This survey shall be performed during power plant operation and shall also include measurement of one-third octave band sound pressure levels to determine whether new pure-tone noise components have been caused by the project.
- B. If the results from either noise survey indicate that the power plant average noise level ( $L_{eq}$ ) at LT-1 exceeds the above value, mitigation measures shall be implemented to reduce noise to a level of compliance with this limit.
- C. If the results from either noise survey indicate that pure tones are present, mitigation measures shall be implemented to eliminate the pure tones.

**Verification:** Each survey shall take place within 30 days of each phase of the project first achieving a sustained output of 90 percent or greater of rated capacity. Within 15 days after completing each survey, the project owner shall submit a summary report of the survey to the CPM. Included in each survey report will be a description of any additional mitigation measures necessary to achieve compliance with the above-listed noise limit and a schedule, subject to CPM approval, for implementing these measures. When these measures are in place, the project owner shall repeat the noise survey. Within 15 days of completion of the new survey, the project owner shall submit to the CPM a summary report of the new noise survey, performed as described above and showing compliance with this condition.”

The Commission Decision specifies that the community noise survey shall take place within 30 days of the project first achieving a sustained output of 90 percent or greater rated capacity and within 15 days after completing the survey, the project owner shall submit a summary report of the survey to the CPM for demonstration of compliance with NOISE-4. Included in each survey report will be a description of any additional mitigation measures necessary to achieve compliance with the above-listed noise limit and a schedule, subject to CPM approval, for implementing these measures.

URS conducted a post-commissioning community noise survey of ambient sound levels in the vicinity of CPV Sentinel on April 10, 2013. A review of  $L_{eq}$  (equivalent sound pressure level) measurement data from measurements conducted at LT-1 indicates that CPV Sentinel operational noise is not excessive and found to be compliant with the specified noise limit of 48 dBA  $L_{eq}$  at LT-1 as required by COC NOISE-4. A review of the measured third-octave spectral data at LT-1 indicates that, per industry-accepted definitions and on the basis of no reported receiver complaints to date, no new pure tones are being caused by the project.

At the time the Application For Certification was prepared, the nearest sensitive receiver was Residence C. CPV subsequently purchased Residence C. LT-1 is located at the western extent of the property line of Residence C. The Commission Decision was based on predicted noise levels at LT-1 and LT-1 is the criterion noise measurement location. The nearest residence is Residence D. As shown in the Application For Certification, Residence D is located approximately 300 feet east of Residence C and noise levels from CPV Sentinel at Residence D are less than the noise levels predicted for Residence C.

**Results:** **Table E1** below presents the CPV Sentinel  $L_{eq}$  sound levels measured at LT-1 during the quietest four consecutive hours (2:00 p.m. to 6:00 p.m.) of the 25-hour measurement period. As described in the Application For Certification, the area is highly developed for wind energy and is largely uninhabited. Ambient noise levels at this location are determined by prevailing wind conditions, including wind turbines, and not by other anthropogenic sources.

**Table E1** contains ambient noise level data obtained prior to facility construction and post-commissioning noise level data obtained during facility operation. These data provide a comparison of ambient noise levels prior to project construction and project operational noise levels. COC NOISE-4 specifies that noise levels be determined based on facility operation alone. These levels are calculated by logarithmically subtracting the ambient data obtained prior to facility construction from the noise levels obtained during plant operation.



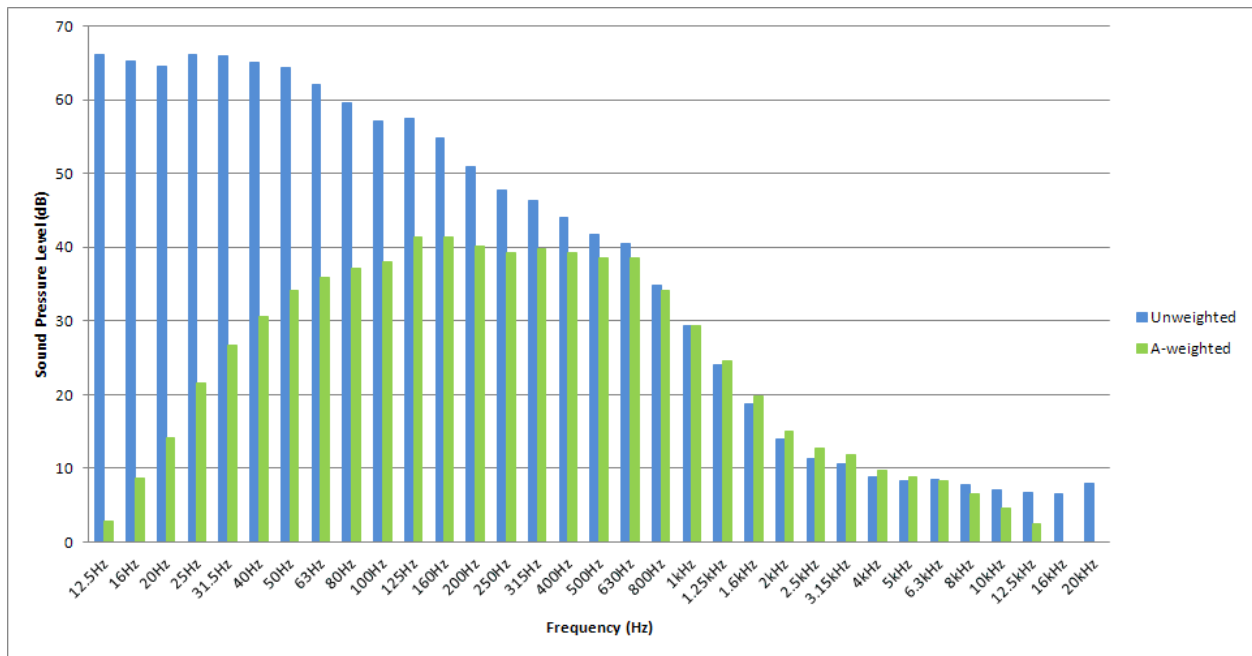
**Table E1**  
**CPV Sentinel Pre-construction and Operational Noise Levels at LT-1**

Receiver	Pre-construction Ambient Noise Level <sup>1</sup> (dBA L <sub>eq</sub> )	Measured Operational Noise Level <sup>2</sup> (dBA L <sub>eq</sub> )	CGS Noise Level <sup>3</sup> (dBA L <sub>eq</sub> )	COC NOISE-4 Limit (dBA L <sub>eq</sub> )	Complies With NOISE-4?
LT-1	49.0	51.6	48	48	Yes
1. Source: Commission Decision (CEC-800-2010-016-CMF, December, 2010) 2. URS Operational Noise Survey (April, 2013) 3. URS calculations (April, 2013)					

As shown in **Table E1**, the ambient noise level at LT-1 was determined to be 49 dBA based on measurement data obtained prior to construction of CPV Sentinel. The CPV Sentinel measured operational noise level at LT-1, based on data obtained during the recent community noise survey, is 48 dBA. Of note, CPV Sentinel operational noise levels at LT-1 are less than ambient noise levels. The measured operational noise level is within the operational noise limit specified by COC NOISE-4. Subjective observations by URS staff during the operational noise survey indicate that CPV Sentinel is slightly audible at LT-1 during quiet ambient conditions.

Short-term one-third octave measurements were conducted to verify the absence of pure-tones. These data are shown in **Figure E-1** in terms of unweighted and A-weighted decibels. The analysis of one-third octave spectra L<sub>eq</sub> indicates that no tones are produced as defined by ISO 1996-2:2007(E) Appendix D.

**Figure E1**  
**CPV Sentinel**  
**Far Field One-Third Octave Band Measurement Data**



Source URS Operational Noise Survey (April 2013).

Based on the data shown in **Figure E1** and the absence of formal or informal noise complaints during CPV Sentinel operations, it can be concluded that no pure tones are present.

The results of the operational noise survey indicate that CPV Sentinel operational noise levels satisfy the requirements of CEC COC NOISE-4.

**SECTION 2 INTRODUCTION**

The project site is located in an unincorporated area of Riverside County, CA. The site is designated “Public Facilities” pursuant to the Riverside County General Plan. The site (and nearby parcels) zoning is W-2 “Controlled Development Area”. A permitted use within the W-2 Zone is large-scale electric generating stations and associated corridors.

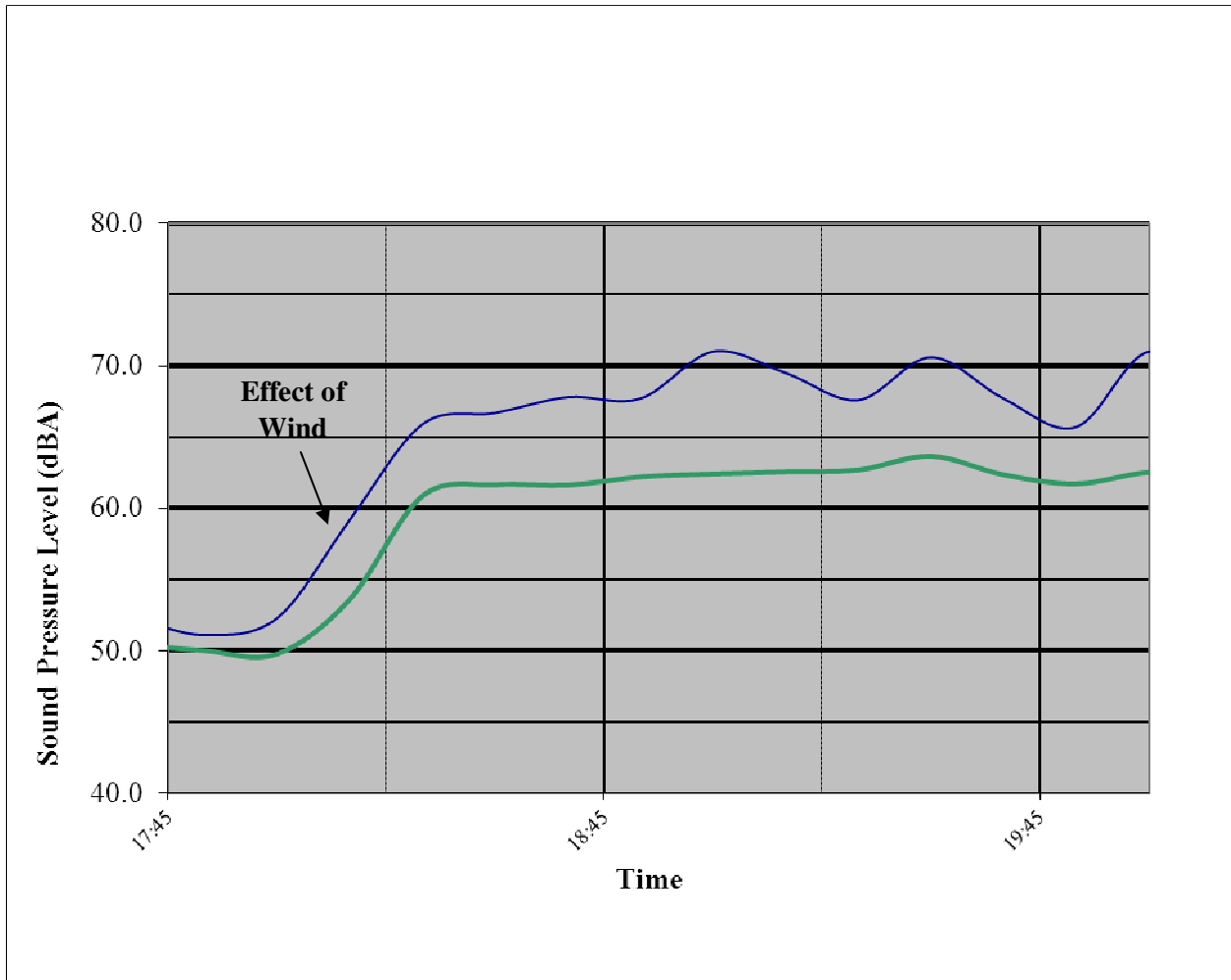
The area is extensively developed for the production of electricity by wind energy. Wind turbine generating units are located in nearly all directions around the proposed project site with the nearest located approximately 300 feet northeasterly of the proposed project site. The Devers electrical substation is located approximately 700 feet westerly of the site.

At the time the Application For Certification was prepared, the nearest sensitive receiver was Residence C. LT-1, a noise measurement location at the western extent of Residence C, was evaluated in the Application For Certification as representative of noise exposure at Residence C. The Commission Decision was based on predicted noise levels at LT-1 and LT-1 is the criterion noise measurement location.

CPV subsequently purchased Residence C. Currently, the nearest residence is Residence D. As shown in the Application For Certification, Residence D is located approximately 300 feet east of Residence C, more distant from CPV Sentinel and noise levels from CPV Sentinel at Residence D are less than the noise levels predicted for Residence C.

A noise survey was conducted at LT-1 May 9, 2007 and May 10, 2007 to quantify ambient noise levels. Meteorological conditions in the area are frequently characterized by wind conditions and ambient noise levels in the area are determined by wind velocity. The effects of wind velocity on noise levels are graphically shown in **Figure 1**. **Figure 1** depicts the  $L_{max}$  (blue) and  $L_{eq}$  (green) at LT-1 on April 10, 2013 between the hours of 5:45 p.m. PDT and 8:00 p.m. PDT. During this period, wind velocity increased from 7 miles per hour to twenty miles per hour. Due to the wind conditions, the ambient noise levels increased from approximately 50 dBA  $L_{eq}$  to approximately 62 dBA  $L_{eq}$ .

**Figure 1**  
**CPV Sentinel Energy Project Ambient Noise Survey LT-1**  
**5:45 p.m. PDT - 8:00 p.m. PDT, April 10, 2013**



Source URS Operational Noise Survey (April 2013).

**SECTION 3 MEASUREMENT METHODOLOGY AND DATA**

As specified in COC NOISE-4, noise measurement data were obtained at LT-1 by URS noise analysts on April 10, 2013. This section describes the measurement locations, techniques, instrumentation, and conditions under which measurements were conducted and data collected.

**3.1 NOISE MEASUREMENT CONDITIONS**

The survey began on the morning of April 10, 2013 and continued through the morning of April 11, 2013. Meteorological conditions were predominantly warm temperatures and clear skies. There was no precipitation. The measured air temperature readings ranged from 56 to 88 degrees Fahrenheit, with 10 to 20 percent relative humidity. Sustained winds varied from 2 miles per hour to 23 miles per hour with recorded wind gusts exceeding 30 miles per hour. These conditions are representative of typical meteorological conditions.

The predominant noise sources at LT-1 are noise associated with ambient wind. Wind noise sources include wind gusts, rustling vegetation, and aerodynamic and mechanical noise from the nearby wind turbines. During low wind conditions, operational noise from CPV Sentinel was evident.

**3.2 CPV SENTINEL OPERATING CONDITIONS**

CPV Sentinel is a nominally rated 850-megawatt (MW) electrical generating facility consisting of eight General Electric LMS 100 Combustion Turbine Generators in a simple-cycle configuration. Each unit consists of a MLO skid, auxiliary skid, inlet housing, intercooler, cooling tower, combustion turbine generator, SCR and exhaust stack. Zero Liquid Discharge equipment and fuel-gas compressors are also located at the facility.

As described, CPV Sentinel is comprised of a variety of noise-producing electrical and mechanical systems, and their associated components, that—when operating at a consistent capacity level—tend to function in a generally steady-state manner with only minor adjustments pertaining to environmental conditions and their impact on system performance. The aggregate noise from the facility essentially represents a relatively steady, continuous sound source. Brief increases of sound level may occur during load changes and other intermittent conditions; for instance, during startup or shutdown transients as the Variable Bypass Valves cycle during transitions to and from “steady-state” operation.

As shown in **Table 1**, CPV Sentinel electrical generation during the period of the measurement survey was steady at approximately 850 MW. This level is representative of “base load” conditions.

**Table 1**  
**CPV Sentinel Electrical Generation during the Noise Measurement Survey**

<b>Time</b>	<b>Output (mw)</b>
2:00:00 PM	843.340
3:00:00 PM	843.652
4:00:00 PM	842.800
5:00:00 PM	841.300
6:00:00 PM	842.200

**3.3 NOISE MEASUREMENT RESULTS**

The measurements were conducted with the following equipment:

- (1) Brüel & Kjær Model 2250 (serial number 2672701); and,
- (2) Larson Davis Model 820 (serial number 1597).

All sound level meters are certified American National Standards Institute (ANSI) Type 1 instruments. All instruments utilized microphones equipped with windscreens and mounted on a tripod or attached to a stationary object to simulate the average height of the human ear above grade (i.e., about 5’ elevation). Slow time-response and usage of the A-weighting scale was selected for the A-weighted overall level measurements, and fast time-response was the setting for un-weighted third-octave band center frequency analysis. The instruments were field calibrated before and after each measurement period with acoustic calibrators with instrument calibration traceable to the National Institute for Standards and Technology. Sound level measurements were conducted in accordance with appropriate portions of International Organization of Standardization (ISO) 1996-2:2007 and ANSI B133.8-1977 that are consistent with the stated NOISE-4 COC.

**Table 2** presents the statistical  $L_{eq}$  values, averaged from consecutive 1-second measurement intervals at the LT-1. These data were obtained from 2:00 p.m. to 6:00 p.m., April 10, 2013. Subsequent measurement data was invalid due to sustained high wind conditions.

**Table 2**  
**CPV Sentinel Pre-construction and Operational Noise Levels at LT-1**

<b>Receiver</b>	<b>Pre-construction Ambient Noise Level<sup>1</sup> (dBA <math>L_{eq}</math>)</b>	<b>Measured Operational Noise Level<sup>2</sup> (dBA <math>L_{eq}</math>)</b>	<b>CGS Noise Level<sup>3</sup> (dBA <math>L_{eq}</math>)</b>	<b>COC NOISE-4 Limit (dBA <math>L_{eq}</math>)</b>	<b>Complies With CoC NOISE-4?</b>
LT-1	49.0	51.6	48	48	Yes
4. Source: Commission Decision (CEC-800-2010-016-CMF, December, 2010) 5. URS Operational Noise Survey (April, 2013) 6. URS calculations (April, 2013)					

**SECTION 4 ANALYSIS AND DISCUSSION**

The measured operational noise data displayed in **Table 2** contains not only CPV Sentinel operation sound contribution but sound from the environment that includes intermittent sources. In order to accurately characterize CPV Sentinel operational noise and assess compliance with the applicable thresholds, facility noise must be reasonably isolated from non-plant noise sources. This was accomplished by logarithmically subtracting the pre-construction ambient noise levels from the measured operational noise levels.

As shown in **Table 2**, the ambient noise level at LT-1 was 49 dBA based on measurement data obtained prior to construction of CPV Sentinel. Measured operational noise levels at LT-1, based on data obtained during the recent community noise survey, is 51.6 dBA.

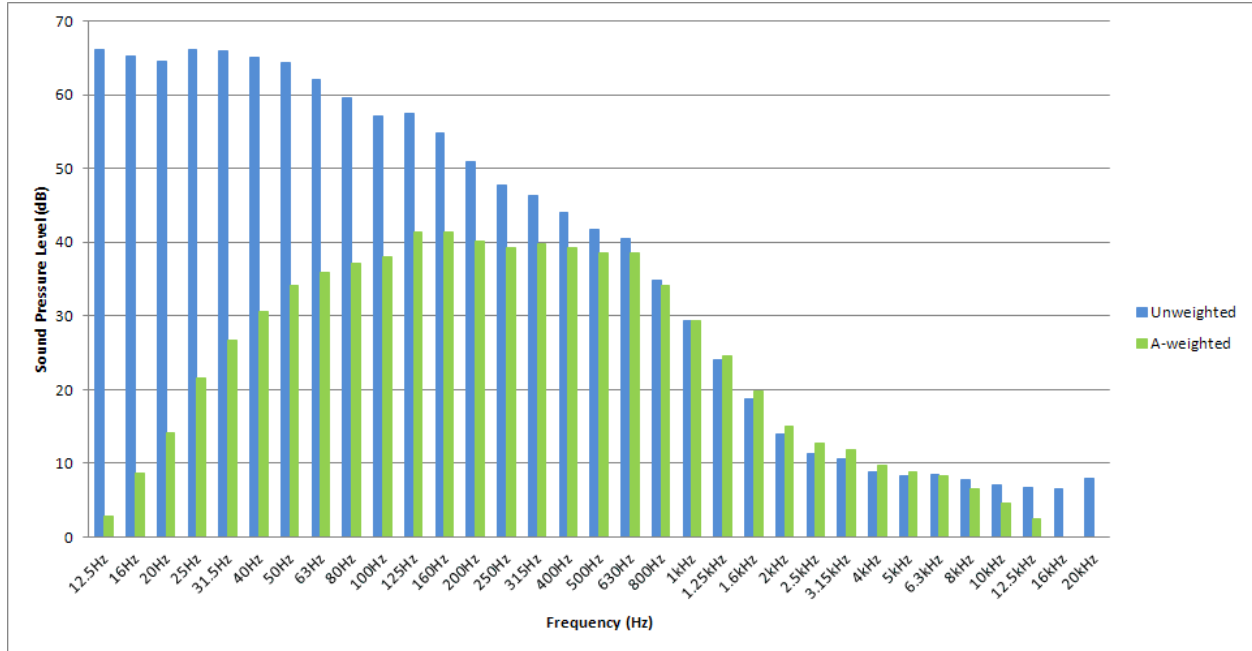
Data shown in **Table 2** indicate that noise level from CPV Sentinel operations at LT-1 is 48 dBA. This level is below the noise limit specified in Condition of Certification NOISE-4. Subjective observations of staff during the operational noise survey indicate that CPV Sentinel is slightly audible at LT-1. Noise levels from CPV Sentinel operations at the nearest residence, identified in the Application for Certification as Residence D, are less than the noise levels shown in **Table 2**.

**4.1 TONAL CHARACTERISTICS**

Per Condition of Certification NOISE-4, “This survey during power plant operation shall also include measurement of one-third octave band sound pressure levels to ensure that no new pure-tone noise components have been caused by the project.” The condition also requires that “the character of the plant noise shall be evaluated at the affected receptor locations to determine the presence of pure tones or other dominant sources of plant noise.”

**Figure 2** depicts the far field one-third octave spectral characteristics of CGS. The results of **Figure 2** are compatible with a determination of no discernable tones, as the level differences between adjacent third-octaves of the plots do not exceed the frequency-dependent values as defined by ISO 1996-2:2007(E) Appendix D. For instance, at high frequencies (500Hz through 10KHz), the level differences between a third-octave and its immediate third-octave neighbors (e.g., 800 Hz and 1250 Hz are adjacent to 1000 Hz) would each need to be greater than 5 dBA.

**Figure 2**  
**CPV Sentinel Far Field One-Third Octave Band Measurement Data**



Source URS Operational Noise Survey (April 2013).



**SECTION 5 CONCLUSION**

The results of the operational noise survey indicate that CPV Sentinel operational noise levels satisfy the criteria of CEC Condition of Certification NOISE-4.

**SECTION 6 REFERENCES**

Bies and Hansen, *Engineering Noise Control*, 3rd. ed., Spon Press, 2003.

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ISO 1996-2:2007(E), *Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of Environmental Noise Levels*, 2nd. ed., 2007-03-15, International Organization of Standardization, Geneva, 2007.

ISO 9613-2:1996(E), *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*, 1st. ed., 1996-12-15, International Organization of Standardization, Geneva, 1996.