Application for Certification 00-AFC-14

EL SEGUNDO POWER REDEVELOPMENT PROJECT

NOISE ANALYSIS

Prepared by:

El Segundo Power II LLC
Symphony Towers
750 B Street, Suite 2740
San Diego, CA 92101-8129

With technical assistance from:

URS

130 Robin Hill Road, Suite 100
Santa Barbara, California 93117

and

2020 East First Street, Suite 400
Santa Ana, California 97205

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El Segundo Power II (ESPII) proposes to construct and operate the El Segundo Power Redevelopment Project (ESPR) at the existing El Segundo Generating Station (ESGS). ESPII filed ESPR Application for Certification (00-AFC-14) on December 18, 2000. During preparation of the AFC, and during the subsequent proceedings, ESPII conducted a series of noise investigations to answer the following questions:

- How will ESPR operations (project) effect the neighboring noise-sensitive receivers?
- What is the best way of determining the project’s effect?
- How do changes in the ambient noise level determine our ability to measure the project’s effect?
- What mitigation measures are appropriate for ESPR?

This report details the evolution of the noise analysis, and summarizes the answers to these questions.

With regard to noise, the major functional feature of the project (the replacement of Units 1 and 2 at the northern boundary of the ESGS with a modern combined cycle plant – Units 5, 6, and 7) has become secondary relative to the issue of the noise effects resulting from removal of two large fuel oil tanks near the southern project boundary. Residences that are currently visually and acoustically shielded from the ESGS are concerned that removal of the tanks could significantly increase noise levels from both the existing and new plant components. If it were possible to crank down the tanks like a car window and then crank them back up, the analysis of the project’s effects would be simple. Unfortunately, this is not possible; the estimation of the tank removal effects on nearby residents is complicated by the relatively high ambient noise levels in the area and site logistics.

Based upon the work conducted, the ESPR is predicted to have a less-than-significant impact upon the neighboring noise-sensitive receivers, as defined by noise standards established by the California Energy Commission (CEC), the City of El Segundo (COES) and the City of Manhattan Beach (COMB).

A reliable method is needed to verify the actual future operations-phase noise impacts on nearby residences. Verification measurements taken at the nearest residential receivers would be unreliable because of the unique features of this project such as the planned removal of two large fuel oil tanks and its location and setting. These features make it difficult to a) predict the project’s impact, b) verify the project’s impact, and c) verify the effectiveness of mitigation measures if implemented. Thus, a portion of this report explains why the CEC and COMB’s proposed verification method is problematic, and then proposes alternative verification and remedy methods.

The following “frequently asked questions” address the relevant concepts of community noise impact analysis.

What is Sound?

Sound is the mechanical vibration of a gaseous, liquid, or solid elastic medium through which energy is transferred away from the source by progressive sound waves. The technical term corresponding to the layman’s “loudness” of sound is sound pressure level (SPL).

What is Noise?

Noise is unwanted sound. The human response to environmental noise is subjective and varies considerably from individual to individual. The effects of noise can range from interference with sleep, concentration, and communication, to the causation of physiological and psychological stress, and at the highest levels, hearing loss.

How is Sound Described?

Sound is technically described in terms of amplitude (loudness) and frequency (pitch). The standard unit of sound amplitude measurement is the decibel (dB). Because the human ear is not equally sensitive to sound at all frequencies, a special frequency-dependent rating scale has been devised to relate noise to human sensitivity. The decibel scale adjusted for A-weighting (dBA) provides this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear. Over the audible range of pitch, the human ear is less sensitive to low frequencies and is more sensitive to mid-level and high-pitched sound. Figure 1 lists noise levels in dBA for various noise sources in the environment and industry.

L_{eq}, the equivalent energy noise level, is the average acoustic energy content of noise, usually measured over one hour. Thus, the L_{eq} of a time-varying noise and that of a steady noise are the same if they deliver the same acoustic energy to the ear during exposure. Other noise measures give information on the range of instantaneous noise levels experienced over time. Examples include L_{50}, the noise level that was exceeded 50 percent of the time during a measurement period (e.g., 30 minutes in a one-hour measurement period).

What Difference in Noise Level is Measurable?

The tolerance for Type 1 (precision-grade) sound level meters, generally the most accurate instrument type used for community noise analyses, is plus or minus 1 dB.

What Difference in Noise Level is Audible?

Based upon independent studies of human perceptions to noise, a change of 3 dBA is just perceptible, while a 5 dBA change is considered clearly perceptible. Outside of carefully controlled conditions, a change of 1 dB is generally not perceptible. A change of 10 dBA would be perceived by the typical listener as a doubling of loudness.

How does Noise Behave? Is Noise Additive ?

Noise levels from a source diminish as the distance from the receptor increases. Other factors such as the weather and reflecting or shielding also help intensify or reduce noise levels at any given location. For a “point” source of noise such as a piece of stationary equipment (or a power plant if the distances are large), the noise is reduced by approximately 6 dBA for each doubling of distance. Noise levels may also be reduced by intervening structures; generally, a solid structure that just breaks the line-of-sight between the receptor and the noise source reduces the noise level by approximately 5 dBA.

Because noise levels are typically described using the (logarithmic) decibel scale, noise calculations involving the combining of two or more levels are performed in the logarithmic domain. Thus, two identical noise sources, each having a sound pressure level of 60 dBA at a given reference distance, combine to produce a sound pressure level of 63 dBA, not 120 dBA as one might believe. To increase the noise levels by another 3 dBA, it would be necessary to “switch on” two more 60 dBA sound sources. In other words, for each (just perceptible) increase in the sound pressure level of 3 decibels, a doubling of the sound power is required.

What are Human Responses to Changes in Noise Levels?

Human responses to changes in the noise environment have been categorized in a variety of ways. Furthermore, individual responses can vary widely depending upon hearing acuity as well as psycho-acoustic factors. One reference[1] uses the following scale (shown in Table 1) to describe community responses to noise level changes.

TABLE 1
NOISE AND COMMUNITY RESPONSE

Amount in dB(A) by which the rating sound level exceeds the noise criterion	Estimated Community Response	
	Category	Description
0	None	No observed reaction
5	Little	Sporadic complaints
10	Medium	Widespread complaints
15	Strong	Threats of community action
20	Very Strong	Vigorous community action

[1] Acoustic Noise Measurements, Hassall and Zavari.

How Does Noise Science Ensure That Changes In Noise Will Not Disturb People?

Noise science is based upon typical human response to noise. The current basis of what is "typical" has primarily been developed over the past four to five decades by social scientists and psycho-acousticians, using social surveys. Thus, noise science cannot ensure that any one individual will not be annoyed by a change in the noise environment. Within any large group of individuals, there will be a small percentage who are highly sensitive to very small changes in noise, a small percentage who are quite insensitive to changes in noise, and a middle group (constituting the majority) that are moderately sensitive to changes in noise. However, noise science can be used to minimize annoyance to the vast majority of the community, often referred to as "persons of normal sensibility," in the establishment of planning guidelines and noise ordinances.

Does Time of Day or Location of Noise Matter?

Human response to noise is dependent upon time of day. During the nighttime hours (typically defined as being from 10 p.m. to 7 a.m.), humans are generally more sensitive to noise, and thus tend to be more easily annoyed by noise. Location or context of the noise is also important. Noises that are known or familiar generally will not elicit a response as readily as "strange" noises.

What is Masking?

Masking is the process by which the threshold of audibility for one sound is raised by the presence of another sound. Masking is most effective when the masking sound includes a wide range of frequencies[2], and is of a sufficient sound power (loudness) to compete with or overshadow the sound of concern. Both surf noise and modern turbine aircraft noise contain a wide range of frequencies, and have a great deal of sound power (directly related to the energy involved with both the surf and the takeoff of large commercial aircraft).

What Does Ambient Noise Level Mean?

Ambient noise is the all-encompassing noise associated with a given environment at a specified time, being composed of sound from many sources at many directions, near and far[3]. For ESPR, the meaning of the term "ambient noise level" is very important because the noise standards against which the project is assessed are based upon the ambient noise level.

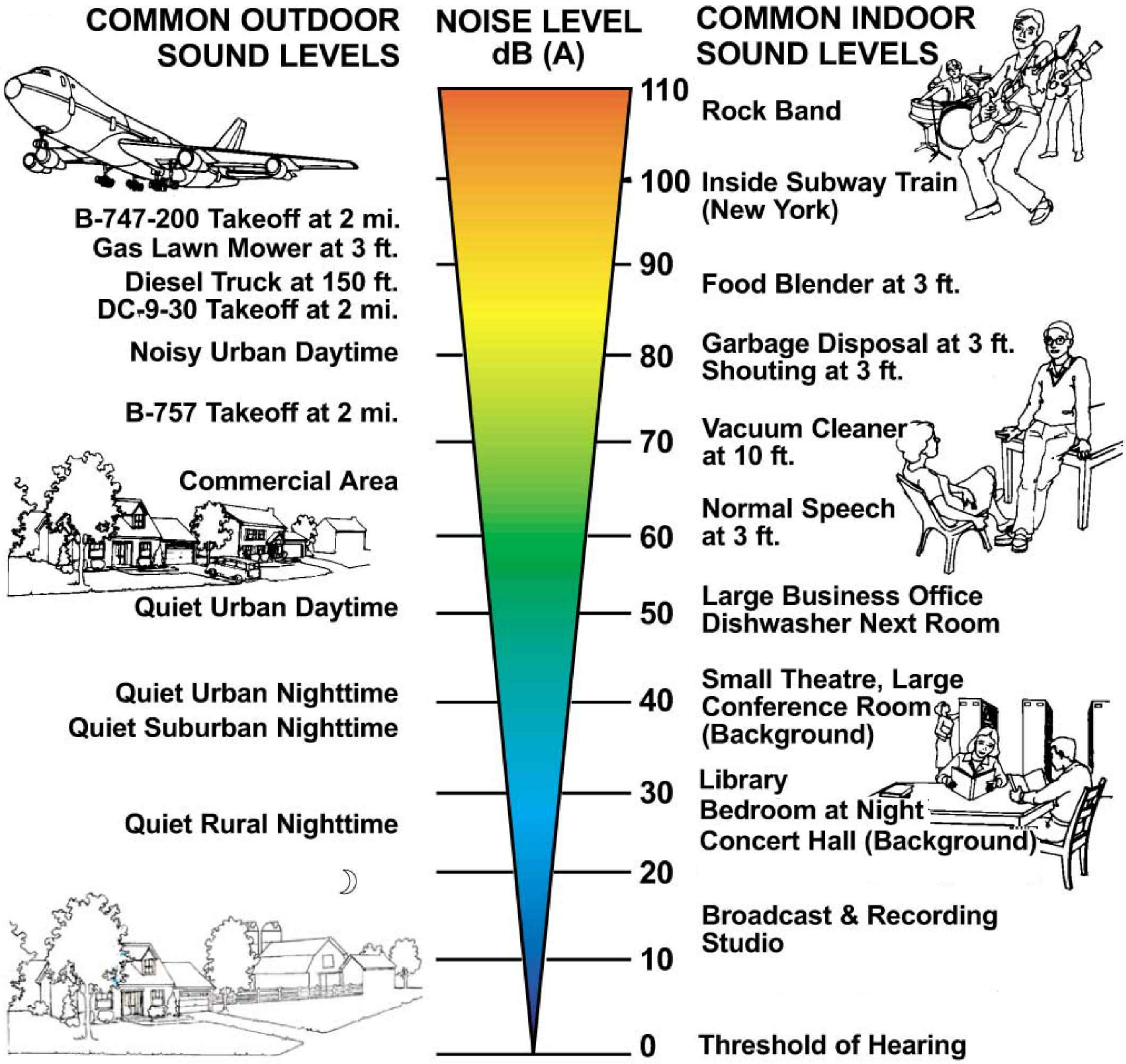
Implicit in noise assessments involving the collection of ambient noise data is the assumption that the ambient conditions being measured are *typical* of that place. CEC siting criteria

[2] Handbook of Noise Measurement, Ninth Addition. Arnold P.G. Peterson
[3] Handbook of Acoustical Measurements and Noise Control, Third Edition. Cyril M. Harris, ed.

(CEC Siting Regulations, Section 4[B]) specify that in presenting a "representative characterization of the ambient noise levels in the project vicinity," the applicant use "a minimum of 25 consecutive hours at a minimum of one site. Other sites may be monitored for a duration at the applicant's discretion during the same 25-hour period." The clear direction is that the chosen 25-hour period should be typical of a normal cycle – neither the quietest nor the loudest day of the year, month, or week.

The California Department of Transportation (Caltrans), in their Technical Noise Supplement (October, 1998), gives the following guidance for those conducting highway noise measurements: "…if the purpose of the noise measurements is to determine a future noise impact by comparing predicted noise with measured, the measurements must reflect the highest existing hourly noise level that occurs regularly." Caltrans and the Federal Highway Administration will not fund a soundwall project for a noise impact that only occurs once or twice a year. Generally, Caltrans recommends that noise measurements be conducted during midweek days only (Tuesdays, Wednesdays, and Thursdays) and not during a holiday week or other unusual major events, to avoid the possibility that conditions are other than typical.

Similarly, airport noise studies generally use one or more years' worth of aircraft flyover data to generate the noise contours that define noise-impacted areas. The very loudest aircraft events, while most certainly an important (and annoying) component of the airport's operations, do not accurately characterize the typical conditions. To accurately characterize the typical conditions, all of the airport's typical operations must be factored in, not just the quietest or just the loudest.



SOURCE:
Draft EIS/EIR LAX Proposed Master Plan Improvements, Los Angeles, CA
U.S. Dept. of Transportation, FAA
January 2001

NOISE SCALE: COMMON SOUND LEVELS

Project No.: 6600000030.03	Date: NOVEMBER 2001	Project: EL SEGUNDO POWER REDEVELOPMENT	Figure 1

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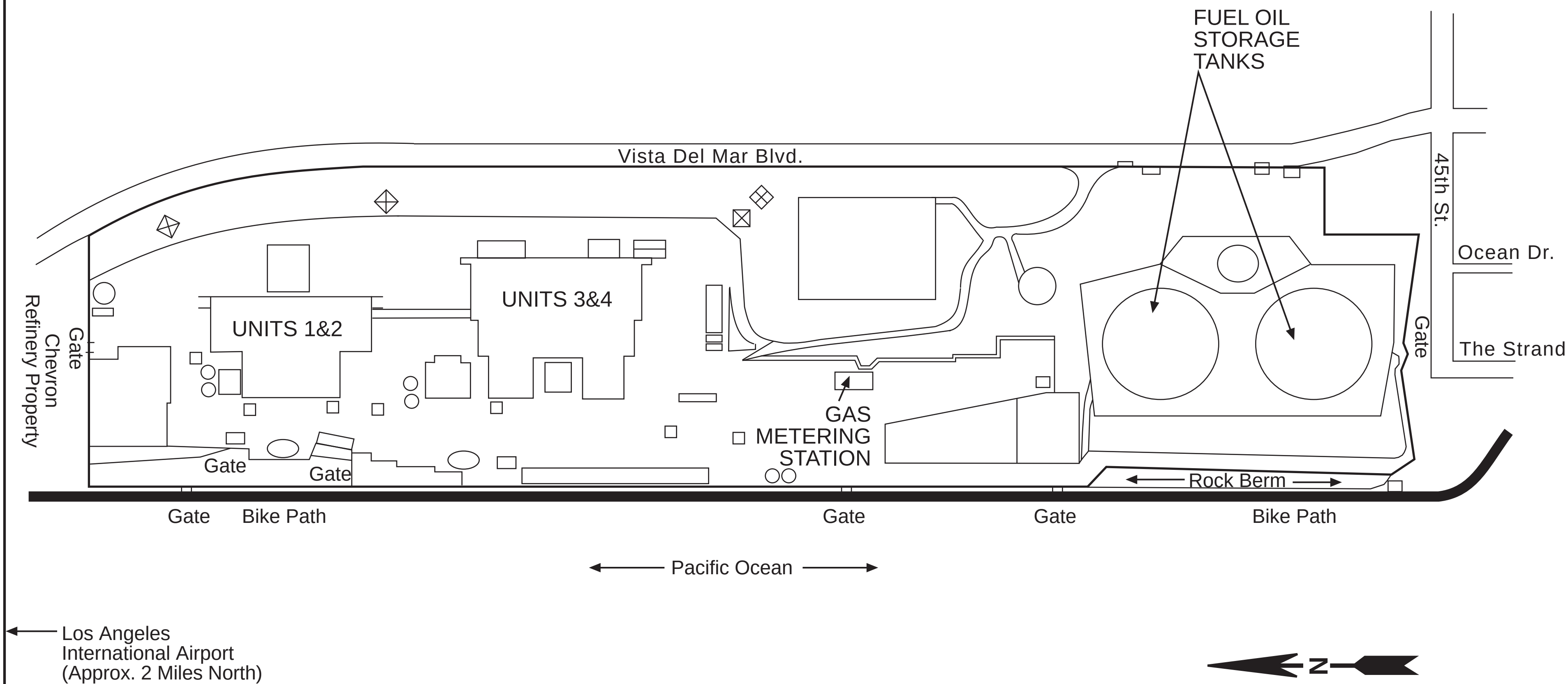
Figure 2 shows the locations of major ESGS noise sources. Units 1 and 2 are located approximately 2,200 feet away from the nearest residences along 45th Street, while Units 3 and 4 are located approximately 1,750 feet away. The gas metering station is located approximately 1,200 feet from the nearest residences. Three fuel oil storage tanks occupy a seven-acre property at the southern end of the ESGS. The two large tanks and their associated berms are located immediately north of 45th Street. These structures provide varying degrees of shielding between the residences and the ESGS.

Based upon the noise measurements and critical listening conducted for the project, sound sources at 45th Street residences include the surf from the Pacific Ocean, aircraft departing and (at night) arriving at Los Angeles International Airport (LAX), helicopters and other aircraft flying overhead and low parallel to the beach, and traffic along Highland Avenue/Vista Del Mar and local streets. At locations closer to the west end of 45th Street, the surf sounds are more dominant, while near Highland Avenue/Vista Del Mar, traffic noise becomes more of a factor (during morning, daytime, and early evening hours). At locations along the east end of 45th Street, noises from the adjacent Chevron Refinery can sometimes be heard. Based upon the observations during the noise measurements, noise from the existing ESGS is not a primary contributor to the noise environment at residences near 45th Street.

El Segundo Generating Station



EXISTING ESGS SOUND AND NOISE ENVIRONMENT

Project No.: 6600000030.03	Date: NOVEMBER 2001	Project: EL SEGUNDO POWER REDEVELOPMENT	Figure 2

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ESPR includes several components with the potential or perceived potential to permanently effect the noise environment of adjacent residences. Figure 3 shows the changes in the site that will result from the project.

4.1 FUEL OIL STORAGE TANK REMOVAL

The two large fuel oil storage tanks will be removed during ESPR construction. In the earlier planning stages of the project, the tank removal was to have been accomplished prior to the commencement of the project, and the cleared area was to be used for construction staging and storage. Consequently, the initial noise analysis (docketed 12/18/00) did not consider the direct effects of the removal of the fuel oil tanks. In response to community concern relating to construction noise, the current plan is to use the empty fuel oil tanks as both a temporary noise barrier and a warehouse for construction staging and storage. Large access doors would be cut into the tanks in the sides that face away from the El Porto Community. Tank removal will occur in two stages: the north tank will be removed at the completion of Units 1 and 2 demolition; the south tank will be removed at the completion of Units 5, 6, and 7 construction.

The fuel oil tanks (each is 219 feet in diameter and 48 feet in height) presently block much or all of the direct view from the west end of the 45th Street area to the ESGS power units. Removal of the two fuel oil tanks would result in changes in the view experienced by residents and visitors of the El Porto community, particularly along 45th Street and The Strand. By removing the tanks, observers would have a less obstructed view of the ESGS power units, although intervening terrain and structures would still shield varying portions of the facility from observers, depending upon the observation point.

4.2 REPLACEMENT OF UNITS 1 AND 2 WITH UNITS 5, 6, AND 7

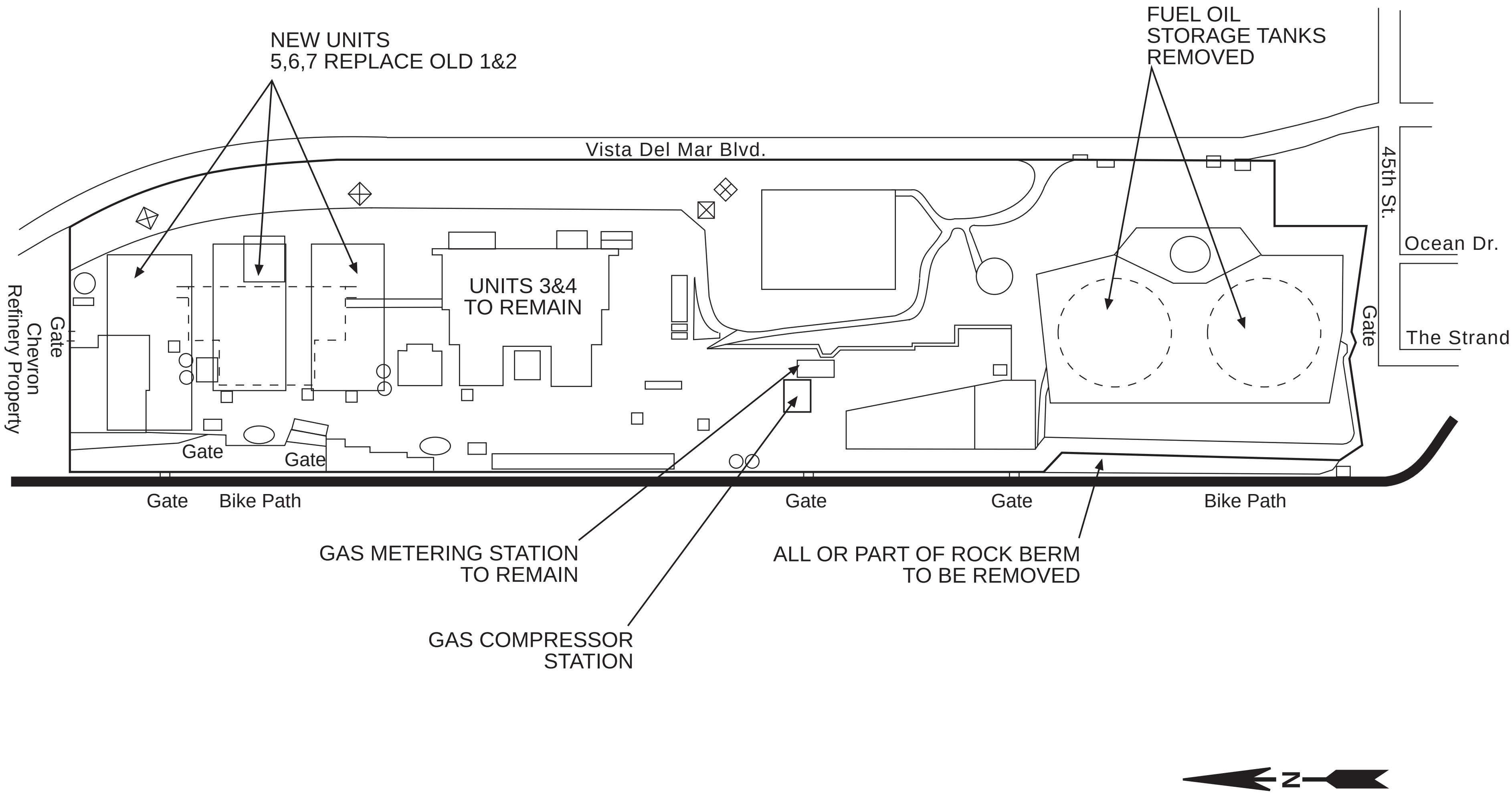
The primary objective of ESPR is the replacement of the two oldest existing power units (Units 1 and 2, which are steam-powered turbines) with a newer, more efficient plant (Units 5, 6, and 7, consisting of two combustion turbines and one steam turbine). The noise produced by Units 5, 6, and 7 and the associated equipment was analyzed in the initial noise assessment for the project (Docketed 12/18/00). Units 5, 6, and 7 would incorporate noise reduction features to ensure compliance with CEC and local noise standards (i.e., would not contribute to a 5 dBA increase above existing conditions at the property line).

4.3 GAS COMPRESSOR STATION

As part of the project, a new gas compressor station (GCS) would be installed approximately 300 feet south of Unit 4 and approximately 1,250 feet north of the nearest residences. The noise produced from the new gas compressor station was analyzed, along with the other equipment associated with construction of Units 5, 6, and 7, in the initial noise assessment for the project.

The GCS will include noise reduction features to ensure compliance with CEC and local noise standards (i.e., would not contribute to a 5 dBA increase above existing conditions at the property line).

El Segundo Generating Station



SITE MODIFICATIONS WITH PROJECT

Project No.: 6600000030.03	Date: NOVEMBER 2001	Project: EL SEGUNDO POWER REDEVELOPMENT	Figure 3

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Table 2 lists the noise data relevant to the 45th Street community noise analyses. Prior AFC filings, Data Response submittals, and internal analyses used a different numbering system for some of the referenced data; thus, the previous symbol or number is provided for reference.

TABLE 2
NOISE MONITORING DATA RELEVANT TO 45TH STREET ANALYSES

	Location	Date(s)	Type of Monitoring/Duration	Previous Measurement Number
1	At south side of ESGS, across street from 45th Street Community	7/20/00 - 7/21/00 8/31/00 – 9/01/00	Long-term (25-hr) Long-term (25-hr)	LT-2 LT-2A
2	In front of 120 45th Street	7/20/00	Short-Term	ST-4
3	Approx. 120 feet south of Unit 4 stack	11/13/00	Short-term, broadband and octave band spectral measurements	ST-17
4	North of north fuel oil tank	4/01/01 – 4/02/01 (11 p.m. – 1 a.m.)	Short-term, simultaneous with Location 5A and 5B measurements to try to determine noise reduction from tanks	ST-19
5A	On balcony of 4420 The Strand, overlooking Pacific Ocean	4/01/01 – 4/02/01 (11 p.m. – 12 a.m.)	Short-term (1 minute duration, multiple times to screen for aircraft and other sources)	ST-18A
5B	Inside 4420 The Strand, microphone next to an open 2nd floor window facing north	4/01/01 – 4/02/01 (12 a.m. – 1 a.m.)	Short-term (1 minute duration, multiple times to screen for aircraft and other sources)	ST-18B
6	Adjacent to bike path at boundary between ESGS and The Strand	4/02/01 (1:30 a.m.)	Short-term, reference measurement of surf noise	ST-20
7	85 feet south of gas metering valve	4/02/01	Short-term, reference measurement of gas metering valve	ST-21
8	Approx. 360 feet south of Unit 4 stack centerline	4/2/01	Short-term, reference measurement of Unit 4	ST-22
9	Atop west side of fuel oil tank containment berm, west of south fuel oil tank, overlooking the surf	6/20/01 – 6/23/01 7/31/01 – 8/03/01 8/06/01 – 8/09/01	Long-term, surf noise measurements Long-term, surf noise measurements Long-term, surf noise measurements	SNM SNM SNM
10	Approx. 90 feet southeast of Unit 4 Forced Draft Fan	8/10/01 – 8/13/01 8/16/01 – 8/19/01	Long-term, reference measurement of Unit 4 and rest of plant before, during and after shutdown Long-term, reference measurement of Unit 4 and rest of plant before, during and after re-start	Ref.1 Ref.1
11	Approx. 1,000 feet south of Unit 4, approx. 600 feet north of 45th Street residences	8/10/01 – 8/13/01 8/16/01 – 8/19/01	Long-term, reference measurement of Unit 4 and rest of plant before, during and after shutdown Long-term, reference measurement of Unit 4 and rest of plant before, during and after re-start	Ref.2 Ref.2
12	Approx. 1,600 feet south of Unit 4, approx. 100 feet north of 45th Street residences, atop security monitor pole	8/10/01 – 8/13/01 8/16/01 – 8/19/01	Long-term, reference measurement of Unit 4 and rest of plant before, during and after shutdown Long-term, reference measurement of Unit 4 and rest of plant before, during and after re-start	Ref.3 Ref.3

Following is a summary of the analysis methods and results, in the chronological order that they took place.

6.1 ORIGINAL AFC ANALYSIS

As explained previously, the original AFC analysis focused on the installation of Units 5, 6, and 7 and related new equipment. The change in noise levels from the removal of the fuel oil storage tanks was not specifically addressed. However, the analysis did not take credit for shielding from any structures or topography, including Units 3 and 4 or the fuel oil tanks, and was thus highly conservative. The results of that analysis indicated that the operation of Units 5, 6, and 7 and related equipment would result in an increase of less than one decibel in the overall noise level at the 45th Street community.

6.2 INITIAL ESTIMATE OF FUEL OIL TANK REMOVAL EFFECTS

Using data collected during noise measurements on July 20 – 21, 2000, August 31 – September 1, 2000 and November 13, 2000, the effect of the fuel oil storage tanks' removal was estimated analytically. The noise measurement data collected near the existing ESGS (Location 3 as shown in Figure 4), where the dominant noise source was the power plant, was adjusted for the extra distance to the nearest residences and compared with the measurement data collected near those residences (i.e., Locations 1 and 2). The results indicated that the tank removal would result in an increase of approximately 3 to 4 dBA (A-weighted decibels) at the worst-case receivers. This preliminary analysis conservatively neglected effects from air absorption or shielding from terrain or structures that would remain.

6.3 DATA REQUEST ANALYSIS

6.3.1 Simultaneous Measurements North of Fuel Oil Tanks and Inside and Outside 4420 The Strand

At the request of the CEC, simultaneous noise measurements were conducted on the north side of the north fuel oil tank (Location 4) and at one of the residences currently receiving the most acoustical shielding from the tanks, located at 4420 The Strand (Location 5A/5B). Adjusting the data to account for the extra distance and the noise influences of the surf and a gas metering valve, it was estimated that the post-tank-removal noise levels at the worst-case location would be 4 to 5 dBA higher than the pre-tank-removal noise levels during the quietest periods. During typical daytime ambient conditions, it was estimated that noise from the ESGS (including ESPR) would not be audible. Noise level effects at other locations would diminish in direct proportion to the degree of shielding currently provided by the fuel oil storage tanks. At locations that currently do not receive any visual shielding from the tanks, removal of the tanks would have no noise effect with regard to noise from ESPR. Although attempts were made to physically and analytically separate the influences of surf noise and valve noise from the plant noise near the north fuel oil tank, the results of this study were less conclusive than any of the parties had hoped.

6.4 SURF NOISE MEASUREMENTS

To better understand the influence of the ocean surf on the ambient noise conditions in the 45th Street community, long-term surf noise measurements were conducted.

Why Surf Noise Measurements?

Figure 5 represents the two sets of 25-hour noise measurement data collected thus far at the southern boundary of the El Porto community, at Location 1 (the southern ESGS property line, approximately midway between the eastern and western boundaries). Location 1 is shown on Figure 4. The first set of noise data was collected from July 20, 2000 to July 21, 2000 while all four existing power units (Units 1, 2, 3, and 4) were operating. The measured hourly noise levels ranged from 52 – 58 dBA L_{50} (50 – 56 dBA L_{90}). During the second measurement, conducted from August 31, 2000 to September 1, 2000, only Unit 3 was operating. The measured hourly noise levels ranged from 56 – 58 L_{50} (53 – 57 dBA L_{90}). The fact that the lowest hourly noise levels were lower with all four power units running than with only one unit running suggests that ESGS operations have a negligible effect on the noise levels at the southern boundary of the ESGS. The differences between LT-2 and LT-2A (up to four decibels) in the lowest hourly noise levels are attributable to local ambient factors, especially surf noise. The surf noise generally *masks* operations noise from the plant. This masking effect has also been evident from critical listening conducted during numerous site visits in and around the 45th Street community.

Surf Noise Measurement Methodology

A total of nine days of surf noise measurements (made up of three sets of continuous three-day sessions) were conducted. All three sessions were conducted during the 2001 summer season. According to residents (and verified by our research), the summertime generally has the lowest and therefore quietest surf of the year. The surf noise data is included as Appendix A.

As shown in Figure 4, the noise monitor (Location 9) used for the measurements was located along the west side of the containment berm for the fuel oil storage tanks, approximately 250 feet north of the southern ESGS property line. The noise measurement location was selected in order to have surf noise as the main noise source, with minimal influence from other sources. The noise monitor was mounted on a wooden railing near the top of the containment berm. The monitor's microphone had an unobstructed view of the surf, which (depending upon tide and surf conditions) varied from approximately 150 to 400 feet away. During installation and removal of the instrument, the surf noise was observed to be the dominant noise source, with periodic aircraft "events" (flights from LAX and helicopters along the coastline) and distant beachgoers (during daytime hours) as secondary noise sources. The ESGS was inaudible at the surf noise measurement location, and thus not an influence on the measurements.

Surf, Meteorology, and Plant Operations Data

In addition to the noise data, information on the surf height, tide levels, and wind were collected for the three measurement periods. Based upon a historical data search, the surf and meteorology were consistent with typical summer conditions for the area. Operational data from the plant was also obtained for the measurement periods.

Conclusions of Surf Noise Measurements

A multivariate analysis of the surf noise, tide levels, wind data, and plant operation was conducted and is attached as Appendix D. The multivariate analysis concludes that environmental factors were highly statistically significant as an influence on the surf noise, with wave height being the most statistically significant factor. This analysis also concludes that plant operations were not a major contributor to the noise levels measured.

6.5 NOISE MODEL RESULTS – CADNA/A®

Cadna/A® is a computer software program for prediction and assessment of noise levels in the vicinity of industrial facilities and other noise sources. Cadna/A® uses internationally recognized algorithms (ISO 9613-2) for the propagation of outdoor sound to calculate the noise impacts, and presents the resultant noise levels in an easy to understand, graphically-oriented format. The program allows for input of all pertinent features (such as terrain or structures) that affect noise, resulting in a highly accurate estimate of existing and future noise levels.

Cadna/A® was used to create a model of the existing facility and the 45th Street residential area to the south. Digital Elevation Modeling was used to account for elevation and terrain features, and aerial photographs were used to model the existing structures. Noise emission levels were input using octave band levels (measured near the source of interest), to accurately estimate noise propagation and attenuation effects. To ensure that the model was providing accurate results, the model was tested using previously measured and modeled noise data, and was found to be consistent with both practice and theory.

Noise from Unit 4, the gas metering valve south of Unit 4, and the surf were modeled. Noise from other noise sources, such as aircraft from LAX and local traffic, were not included in the model in order to provide a more conservative analysis, and because these other sources, while generally present, decrease in level during the late night and early morning hours.

Figures 6 and 7 present the results of the Cadna/A® noise analysis. Figure 6 shows the existing noise environment in and around the ESGS, with the fuel oil tanks in place. Figure 7 shows the same noise sources with the tanks removed.

Low Average Ocean Noise Level

In order to provide a conservative assessment, the surf noise levels used in the analysis represent "low average" conditions. For each of the nine days of surf noise measurements (conducted in June, July, and August, 2001), the lowest four-hour period was determined and then averaged. The nine four-hour periods were then averaged, to arrive at the "low average" surf noise level.

Unit 4 and Gas Metering Valve Noise Levels

The noise levels from measurements of Unit 4 and the gas metering valve conducted on 4/2/01 were used to calibrate the Cadna/A® model. Units 1, 2, and 4 were operating during the time of the measurements. The model was calibrated by increasing or reducing the overall level of each noise source until the resultant modeled sound pressure level matched the measured sound pressure level at a reference point dominated by the source being adjusted.

Predicted Changes Using Cadna/A®

As can be seen by comparison of Figures 6 and 7 (and review of Table 3), noise levels at residential receivers are predicted to increase by 0.5 to 1.9 dBA depending upon proximity to the ocean and the degree to which the tanks shield the receiver. Model Receiver Location C-1 (on the corner of 45th Street and The Strand, labeled in Table 3 and shown in Figures 6 and 7) is the residence receiving the most amount of tank shielding from the ESGS. Cadna/A® predicts that removal of the tanks would result in an overall increase in noise levels of 1.7 dBA at this location. The remainder of Model Receiver Locations (C2 through C6) are located east of Location C-1. At these locations, the tanks do not shield residences from the ESGS as well as at Location C-1. At these locations, Cadna/A® predicts an overall increase in noise levels ranging from 0.5 dBA (Location C-6) to 1.9 dBA (Location C-3). These increases are attributable to an increase in exposure to surf noise, not plant noise. Tank removal would increase the view (and thus the noise level) of the surf at these locations.

TABLE 3
CADNA/A® RESULTS (IN A-WEIGHTED DECIBELS, dBA)

Model Receptor Number	With fuel oil tanks in place (existing condition); Unit 4 & gas metering valve noise levels from test conditions; "low-ambient" surf noise levels (A)	With fuel oil tanks removed; Unit 4 & gas metering valve noise levels from test conditions; "low-ambient" surf noise levels (B)	Noise level difference (B-A)
C-1	52.5	54.2	1.7
C-2	50.1	51.5	1.4
C-3	48	49.9	1.9
C-4	47.8	49.3	1.5
C-5	48.3	49	0.7
C-6	48.1	48.6	0.5

In summary, Cadna/A® analysis indicates that at the residential locations currently receiving the most acoustical benefit from tank shielding with respect to Unit 4, the effect of tank removal would be an increase in noise levels of less than 2 dBA during conditions of "low average" surf. During conditions of average and above-average surf, the increase in noise levels attributable to tank removal would be further reduced.

6.6 UNIT 4 SHUTDOWN AND RESTART

Unit 4 was shutdown for scheduled maintenance on midnight of August 11, 2001. Long-term noise monitors were installed prior to the shutdown and programmed to record the noise levels before, during, and after Unit 4 shutdown. Noise monitors were installed in three locations onsite: Location 10 immediately south of Unit 4; Location 11 approximately 1,000 feet south of Unit 4; and Location 12 approximately 1,500 feet south of Unit 4, adjacent to the southern ESGS property boundary. Locations 10, 11, and 12 are shown in Figure 4. These locations were carefully selected in an effort to isolate – to the extent possible – noise emanating from Unit 4:

- Location 10 is in the immediate proximity of Unit 4 (approximately 160 feet southeast of the forced draft fan);

- Location 11 is as far south as possible while still maintaining a line-of-sight to Unit 4 (particularly the forced draft fan and the west side of Unit 4, including the stack);

- Location 12 (at the top of the ESGS security monitoring pole) is designed to represent exposure of Unit 4 (particularly the upper levels and stack) to 45th Street residences seaward of Highland Avenue.

Shutdown

The noise monitors recorded three days of continuous data for the shutdown period (from 12 p.m. on August 10, 2001 to 12 p.m. on August 13, 2001). Figure 8 shows the shutdown period, focussing on the first 24 hours for the sake of clarity. Shown in the figure are the noise levels at the three measurement locations, as well as the power output in percent of Unit 4, and the Unit 4 Forced-Draft (FD) fans setting. The FD fans are very large fans located at the base of the Unit 4 stack. The shutdown process of a large steam turbine is not immediate; in order to safely shut the equipment down, the FD fans are used to cool the turbines and related machinery. Thus, as Figure 8 shows, upon taking Unit 4 offline at approximately midnight on August 11, the FD fans were turned up 100 percent, until approximately 8 a.m. the next morning. The resultant increase in noise from the FD fans can be seen in the curve labeled L_{50} Location 10. The noise level at Location 10 increased from approximately 76 to 79 dBA in the “before shutdown” mode to approximately 83 to 85 dBA in the “during shutdown” mode. After 8 a.m., in the “after shutdown” mode, the noise levels at Location 10 decreased to approximately 66 to 67 dBA. However, Figure 8 also shows that the simultaneous noise levels at Locations 11 and 12 were not affected by the changes in plant noise. The noise levels at these two locations prior to Unit 4 shutdown were very similar to the levels during and after shutdown.

Restart

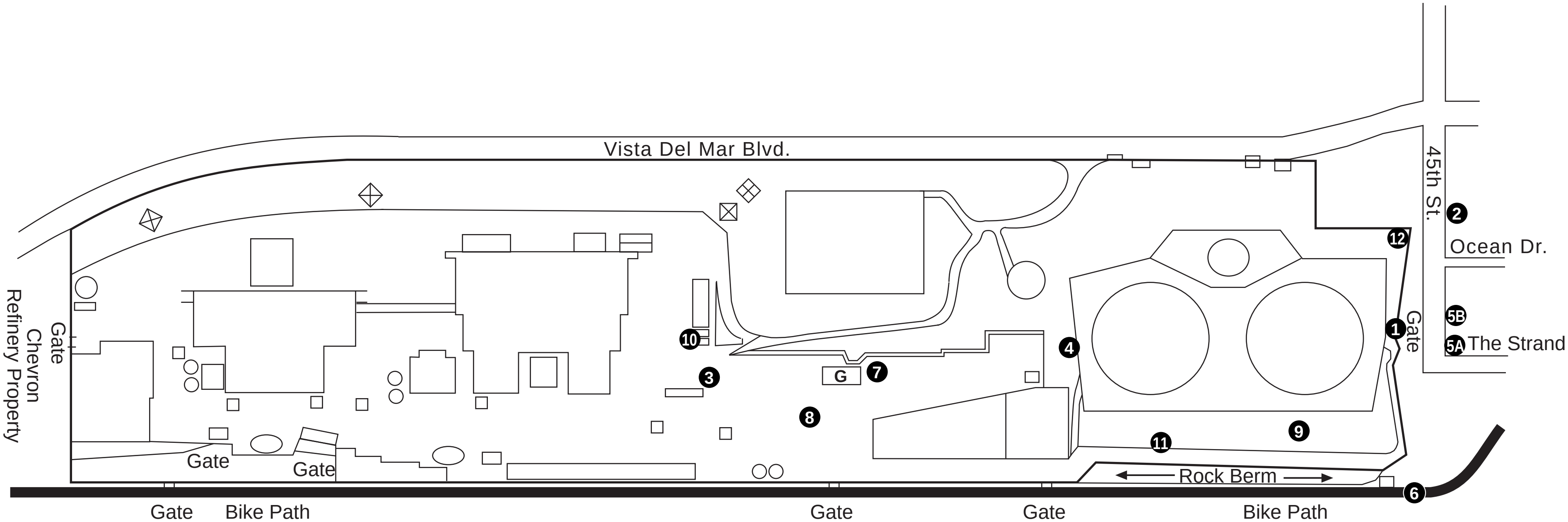
Unit 4 was restarted at approximately 8 p.m. on August 16, 2001. Prior to the restart, the noise monitors were reprogrammed to record the noise levels before, during, and after the restart. The noise monitors again recorded three days of continuous data (from 12 p.m. on August 16, 2001 to 12 p.m. on August 19, 2001). Figure 9 shows the first 48 hours of that data, again for the sake of eliminating some of the superfluous data. Similarly to Figure 8, the restart data shows that the noise levels at the two noise measurement locations not in immediate proximity to Unit 4 are not affected by onsite activities. Rather, they seem to be tracking other activities – namely, the ambient environment around the ESGS as discussed previously.

Multivariate Analysis of Unit 4 Startup and Shutdown

The six days of noise data were analyzed using multivariate techniques to determine the extent to which the operations at ESGS influenced the noise levels at Location 11. The text of the multivariate analysis contained in Appendix D refers to Location 11 as Ref 2. Location 11 was chosen as a key site for the analysis because its view of Unit 4 is not blocked by the fuel oil tanks, and because it is approximately 600 feet closer to the ESGS than the nearest noise-sensitive receivers. The multivariate analysis concluded that there was no statistically significant difference between the noise levels at Location 11 with Unit 4 on versus with Unit 4 off. The statistical analysis is included as Appendix D.

Despite its close proximity to the surf, Location 11 is actually more shielded from surf noise than either Location 12 (located on the security monitor tower near the southeast corner of the ESGS) or the 45th Street residences. Noise measurements conducted for this purpose have determined that the 8 to 10 foot high rock berm that shields Location 11 from the surf noise provides 12 to 13 decibels of noise reduction. The additional shielding explains why the noise levels at Location 11 were consistently lower (generally by approximately 7 decibels) than those at Location 12.

El Segundo Generating Station



LEGEND

❶ Noise Measurement Location

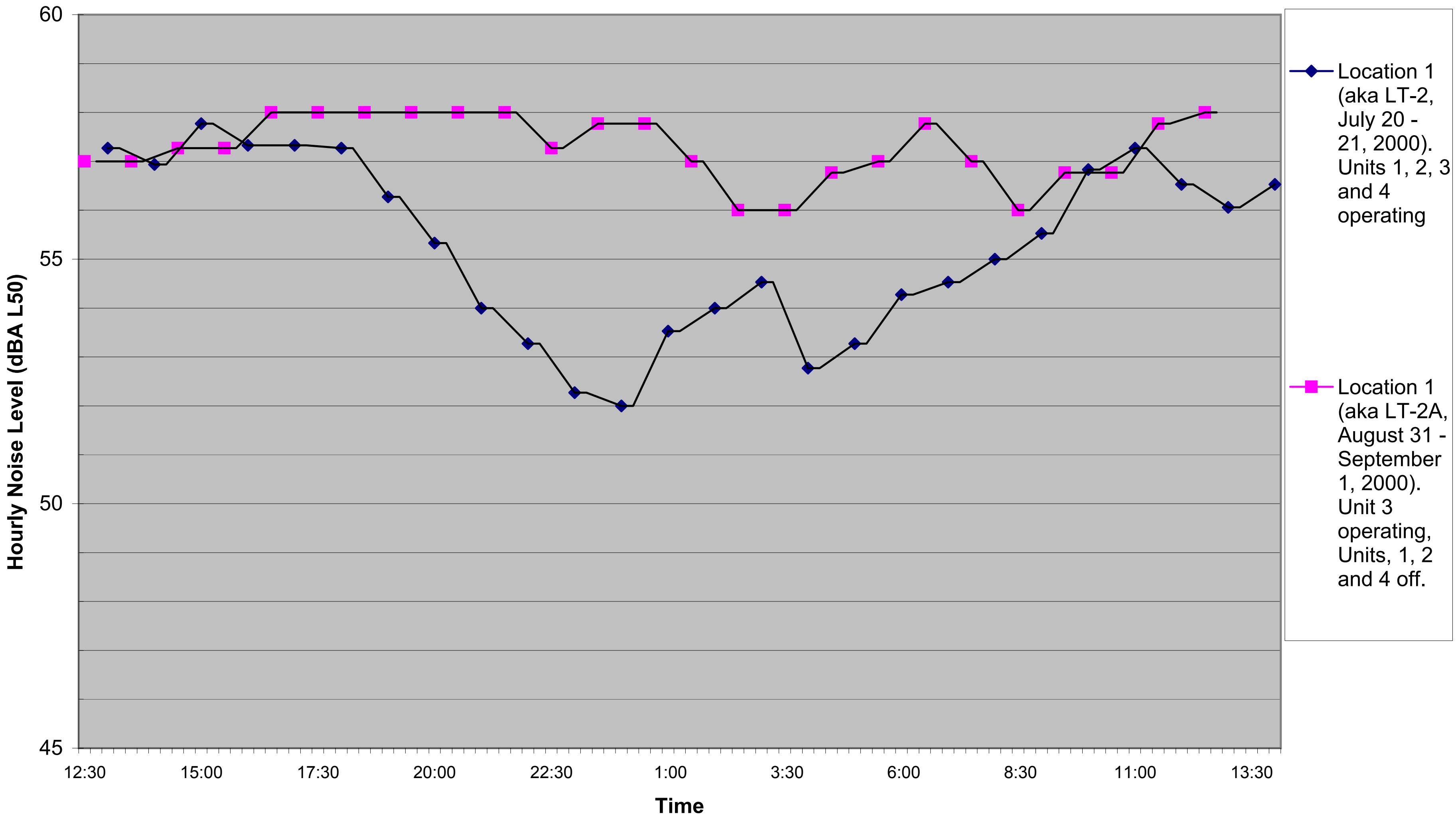
NOISE MEASUREMENT LOCATIONS

Project No.: 6600000030.03	Date: NOVEMBER 2001	Project: EL SEGUNDO POWER REDEVELOPMENT	Figure 4

URS

L:/nrg/property fig 4.fh9 11/01

Figure 5: Hourly Noise Levels at Location 1 (ESGS Southern Boundary / 45 th Street) with All Units Operating versus with One Unit Operating



CADNA/A NOISE RESULTS: EXISTING SOUND ENVIRONMENT, EL SEGUNDO GENERATING STATION

November 2001	El Segundo Power Redevelopment	Figure 6

CADNA/A NOISE RESULTS: SOUND ENVIRONMENT WITH FUEL OIL TANKS REMOVED, EL SEGUNDO GENERATING STATION

November 2001	El Segundo Power Redevelopment	Figure 7

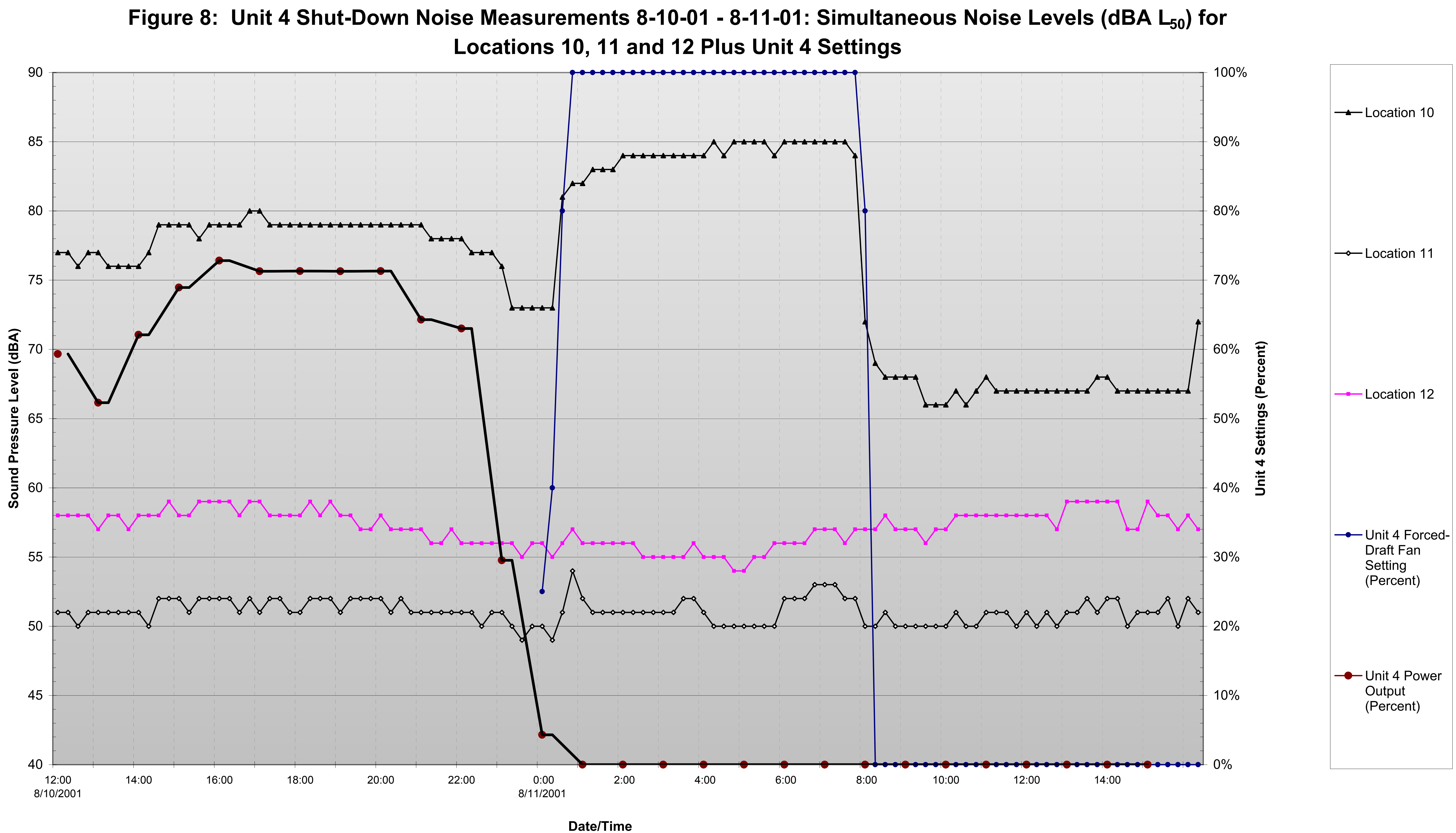
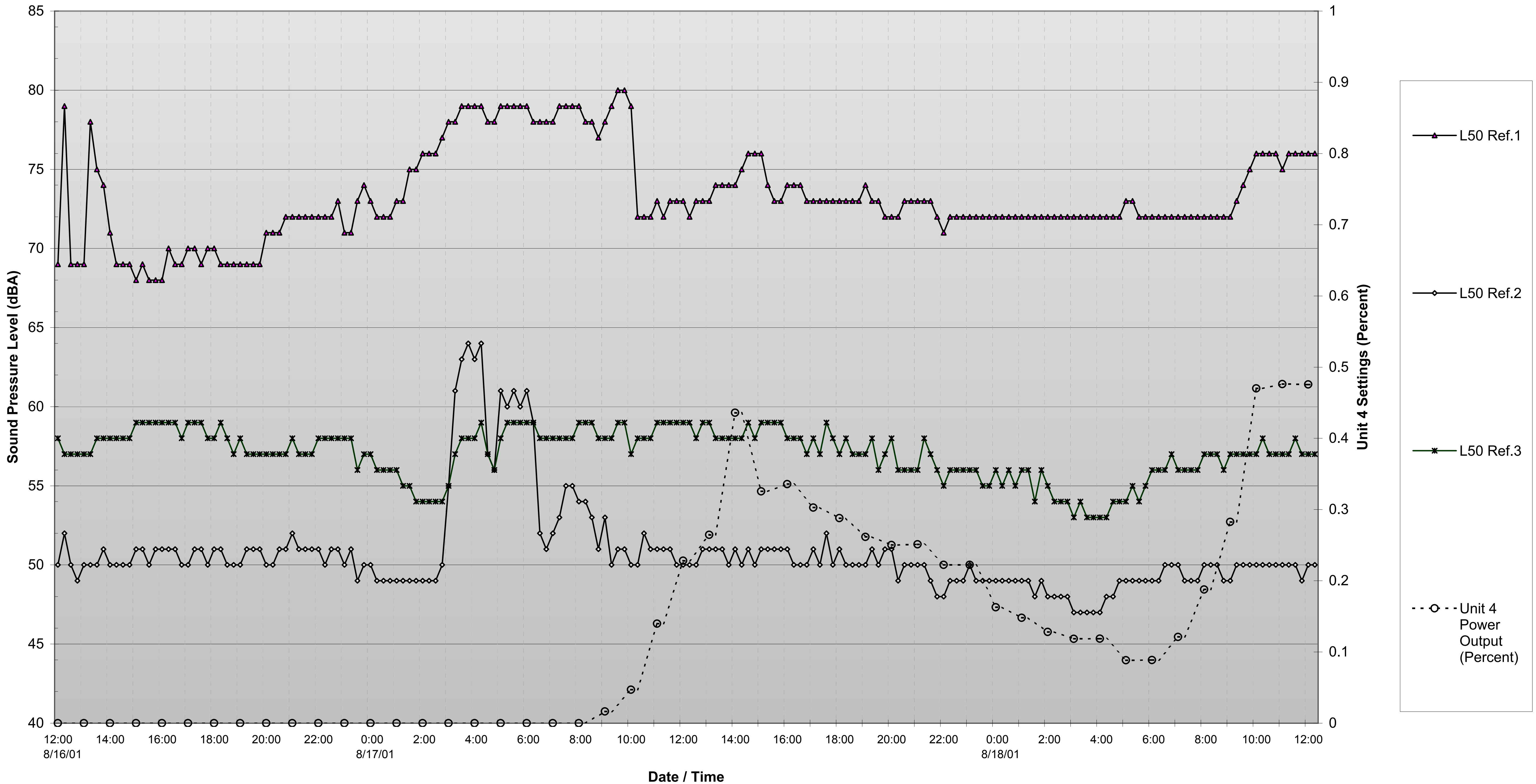


Figure 8: Unit 4 Shut-Down Noise Measurements 8-10-01 - 8-11-01: Simultaneous Noise Levels (dBA L50) for Locations 10, 11 and 12 Plus Unit 4 Settings
Sound Pressure Level (dBA)
Unit 4 Settings (Percent)
Date/Time
12:00
8/10/2001
14:00
16:00
18:00
20:00
22:00
0:00
8/11/2001
2:00
4:00
6:00
8:00
10:00
12:00
14:00
90
85
80
75
70
65
60
55
50
45
40
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Location 10
Location 11
Location 12
Unit 4 Forced-Draft Fan Setting (Percent)
Unit 4 Power Output (Percent)

Figure 9: Unit 4 Restart Noise Measurements 8-16-01 - 8-18-01: Simultaneous Noise Levels (dBA L_{50}) for Locations 10, 11 and 12, plus Unit 4 Settings



7.1 SUMMARY OF NOISE SURVEY RESULTS AND METHODS

Table 4 summarizes the results from the various analyses conducted for this project.

TABLE 4
NOISE IMPACTS SUMMARY

Analysis Method	Estimated Noise Level Increase from Fuel Oil Tank Removal	Comments (Method, Limitations)
1	Approximately 4 dBA	Using short-term measurement data near ESGS, adjusted for distance to nearest residence. This analysis conservatively neglected shielding effects from terrain or remaining structures, as well as effects from air absorption.
2	4.8 dBA	Simultaneous noise measurements conducted north of the fuel oil tanks and at residence receiving maximum tank shielding from the ESGS. Difficult to physically "exclude" and analytically separate the effects of gas metering valve noise, plant noise and ocean noise from one another.
3	Less than 2 dBA	Cadna/A® computer model; accounts for topography, multiple sources and levels input as octave band (frequency-specific). Utilized "low-average" (i.e., quiet summertime surf) ambient conditions.
4	Not measurable (1 dBA or less)	Simultaneous, long-term measurements at multiple locations while Unit 4 was shut down and then restarted. Conservative because reference measurement location unobstructed by the tanks (Location 11) was approximately 600 feet closer to Unit 4 than the nearest residences.

Rationale for Selection of Different Analysis Methods Used for the ESPR Project

Noise analyses are conducted to try to estimate or predict the results of something that is not readily measurable. It is understood that the available calculation methods are not perfect; assumptions and approximations must be made. Because of this, in conducting noise analyses as in any type of engineering study, it is standard practice to err on the side of caution. This is often referred to as conducting a "worst-case" analysis, or using "conservative engineering judgement." For ESPR, the noise analysis has consistently followed this conservative practice. For example, the initial analysis of the noise effects from Units 5, 6, and 7 did not take any credit for noise shielding from existing and remaining structures or terrain features. Thus the analysis of noise levels from Units 5, 6, and 7 at residences to the south ignores any noise-shielding that would be provided by Units 3 and 4, or any other objects.

The corollary to the standard engineering practice of erring on the side of caution is that the more sophisticated the analysis approach taken, the less conservative the assumptions need to be. An analysis that takes into account more of the factors involved is by definition more accurate, and therefore comes closer to the actual outcome of what would occur from the project.

Prior to using the Cadna/A® noise modeling software, different approaches were used to address the effect of the fuel oil tank removal. The basic methodologies used and results of each were summarized in Section 6. Each of the prior analyses had one or more limitations that resulted in conservative estimates of noise impacts. For example, the initial attempt at calculating the tank removal effects (as outlined in Section 6.2 and summarized as Method 1 in Table 4) neglected air absorption effects or shielding from remaining terrain or structures. In the next study (described in Section 6.3.1 and summarized as Method 2 in Table 4), an attempt to directly measure the differences between the "with tank" and "without tank" noise environments was hampered by contamination from multiple noise sources.

Cadna/A® (described in Section 6.5 and summarized as Method 3 in Table 4) was utilized because the prior analytical efforts, which used historically accepted sampling methodologies to analyze existing and future conditions, did not simultaneously account for the complex conditions involved with this project (i.e., intervening terrain and structures between the plant and residences; and the varying effects of surf and wind conditions on the ambient environment). The decision to use Cadna/A®, a sophisticated (and costly) verified modeling tool, was selected because it provides a means to address the complex conditions unique to this project. Cadna/A® represents the state-of-the-art in noise modeling tools. The analysis incorporated complex terrain features and accounted for the effects of surf noise. Whereas the previous analyses did not account for both of these factors simultaneously, the Cadna/A® analysis is considered superior to those earlier analyses. Therefore, the results produced by Cadna/A®, indicating that the effect of the fuel oil tank removal will be an increase of less than 2 dBA above ambient noise levels, represent the most accurate estimation to date.

The Unit 4 shutdown and startup data (described in Section 6.6 and summarized as Method 4 in Table 4) was collected in an effort to further validate the Cadna/A® results based on additional field measurements. The results of this analysis confirm that removal of the tanks will not result in perceptible changes to the noise environment in the 45th Street community under typical conditions.

7.2 CHANGES TO THE NOISE ENVIRONMENT

In terms of changes to the existing noise environment at 45th Street, removal of the fuel oil storage tanks is estimated to result in an increase of less than 2 dBA during "low-average" ambient noise conditions. Such a change would not be audible to persons of normal sensibility. As shown by the analysis of Unit 4 shutdown and startup (see Section 6.6 and Figures 8 and 9), removal of the fuel oil tanks would be even lower than 2 dBA during typical, summertime conditions.

7.3 IMPACTS AND LORS COMPLIANCE

CEC, COES, and COMB noise standards will not be exceeded at nearby residences; therefore, ESPR, including removal of the fuel oil tanks, will, by definition, not have a significant noise impact on this area.

ESPR will have no significant noise impact, as defined by the California Environmental Quality Act (CEQA), and will be LORS-compliant under the terms of the Warren-Alquist Act.

Following is a brief summary of the project's compliance with applicable laws, ordinances, regulations and standards (LORS).

8.1 WARREN-ALQUIST ACTIVITIES

Pursuant to the Warren-Alquist Act, the CEC is required to establish reasonable impact assessment criteria. To this end, CEC siting criteria (Section 4[A]) uses a 5-dBA increase as the basis for determining impacts in community noise analysis. ESPR will meet this 5-dBA criteria.

8.2 CALIFORNIA ENVIRONMENTAL QUALITY ACTIVITIES

CEQA requires an analysis of noise impacts using industry standards and practices, and requires mitigation if significant impacts are identified. If a determination of no significant impacts is made, mitigation is not required. Based on the analyses, ESPR will not cause significant noise impacts.

8.3 CITY OF MANHATTAN BEACH NOISE ORDINANCE

ESPII believes that COMB's noise standards are compatible with and essentially equivalent to the CEC and COES criterion of ambient noise level plus 5 dBA.

Section 5.48.160 is the portion of the COMB Noise Ordinance dealing with exterior noise standards. Table 1 of Section 5.48.160 lists exterior noise standards that may not be exceeded for a cumulative period of more than 30 minutes in any hour. Because the project is a power plant, emitting a (nearly) continuous noise level, Section 5.48.160 is the applicable noise standard. The residential noise standard is 50 dBA from 7 a.m. to 10 p.m., and 45 dBA from 10 p.m. to 7 a.m. The commercial noise standard is 65 dBA from 7 a.m. to 10 p.m., and the industrial noise standard is 70 dBA. Table 1 also includes the statement that if the 30-minute per hour ambient level (L_{50}) exceeds the applicable level, then the ambient L_{50} becomes the exterior noise standard which may not be exceeded for a cumulative period of more than 30 minutes in any hour. Subsection F of Section 5.48.160 states in part: "If the measurement location is on a boundary between two (2) different land use classifications, the noise level limit applicable to the more restrictive land use classification plus five (5) dB, shall apply" (Ord. 1957am eff 12/5/96).

The ESPR Project property (an industrial land use) is located immediately to the north of 45th Street. The El Porto Community (a residential land use) is located immediately to the south of 45th Street. Therefore, ESPII believes that subsection F of Section 5.48.160 is applicable. Pursuant to subsection 5.48.160 (F), the noise level limit would be the ambient noise level plus 5 dBA, which is consistent with the analysis presented in the Application for Certification (AFC).

Contrary to the above interpretation, the City asserts that a 2-dBA increase is the applicable impact threshold. Based upon the Cadna/A® and the Unit 4 shutdown analyses, ESPR will meet this 2-dBA threshold criteria.

8.4 CITY OF EL SEGUNDO NOISE ORDINANCE

The COES Noise Ordinance sets permissible project-related increases above ambient noise levels by land use; 5 dBA above the ambient noise level is the limit for residential, while 8 dBA above the ambient noise level is the limit for commercial and industrial. ESPR will meet these threshold criteria.

Based on the results presented herein, the following measures are recommended to ensure that operational noise from implementation of the ESPR Project will not adversely impact residents of the El Porto community:

1. Modify ESPR Condition of Certification NOISE-6 to reflect standard noise impact measurement (i.e., 25-hour continuous survey at the start of operations) which are designed to verify the pre-construction noise estimates and quantify the actual operational noise conditions. This would entail post-construction ambient noise measurements in the proximity of Unit 4, and extrapolation of those measurements to the nearest receptors. Pure tone analysis would be conducted in the immediate vicinity of the nearest residential receptors.

2. Contingent on the acceptance of Recommendation 1, provide acoustical treatment of the south side of Unit 4, as an enhancement to the project.

These recommendations are discussed below.

9.1 PROPOSED CONDITION OF CERTIFICATION NOISE-6

ESPII recommends the following proposed noise Condition of Certification be implemented.

NOISE-6. Upon the project first achieving an output of 80 percent or greater of rated capacity, the project owner shall conduct a 25-hour community noise survey, utilizing the same monitoring sites employed in the pre-project ambient noise survey as a minimum. The survey shall also include the octave band pressure levels to ensure that no new pure-tone noise components have been introduced. No single piece of equipment shall be allowed to stand out as a dominant source of noise that draws complaints. Steam relief valves shall be adequately muffled to preclude noise that draws complaints. The noise contributed by the ESPR operations at the nearest residence shall not exceed the ambient noise level by 5 dBA L_{50} under normal operating conditions. If the results from the survey indicate that power plant noise levels are in excess of 5 dBA L_{50} above the ambient at the nearest residence, additional mitigation measures shall be implemented to reduce noise to a level of compliance with this limit. The mitigation measures (to be employed as required) include, but are not limited to:

1. Standard outdoor/weather enclosures for the combustion turbine generator packages;
2. Air inlet silencers for the combustion turbines;
3. Standard outdoor/weather enclosure for the steam turbine;
4. Generator packages; and
5. Silencers for the heat recovery steam generator exhaust stacks.

Protocol

The measurement of power plant noise for purposes of demonstrating compliance with this Condition may be made at an acceptable location close to the plant (e.g., 400 to 1,000 feet from the power generating units), and this measured level may then be mathematically extrapolated to determine the plant noise contribution at the nearest sensitive receptor.

Notwithstanding the use of this alternative method for determining the noise level, the character of plant noise shall be evaluated at the nearest sensitive receptor to determine the presence of pure tones or other dominant sources of plant noise.

Within thirty (30) days after first achieving an output of 80 percent or greater of rated output, the project owner shall conduct the above described noise survey. Within thirty (30) days after completing the survey, the project owner shall submit a summary report of the survey to the Cities of El Segundo and Manhattan Beach, and to the CPM. Included in the report will be a description of any additional mitigation measures necessary to achieve compliance with the above listed noise limits, and a schedule, subject to CPM approval, for implementing these measures. Within thirty (30) days of completion of installation of these measures, the project owner shall submit to the CPM a summary report of a new noise survey, performed as described above and showing compliance with this Condition.

9.2 POSSIBLE NOISE REDUCTION TREATMENT OF UNIT 4 SOUTH SIDE

Contingent on acceptance of the proposed Noise-6 condition, acoustical treatment of the south side of Unit 4 could be implemented as an enhancement to the project. The acoustical treatment would be designed to achieve a minimum reduction of Unit 4 noise of 2 decibels.

Noise reduction of Unit 4 would have a negligible beneficial effect on the community during all but the very quietest times of the year for short periods of time and is not required pursuant to the California Environmental Quality Act (CEQA) or the Warren-Alquist Act. This is because the potentially affected receptors – the residents and visitors around the El Porto Community – are typically the recipients of sounds and noises from a variety of sources other than the power plant. Surf noise, aircraft noise from LAX, and roadway noise are all major contributors to the noise environment in the area.

California Department of Transportation. 1998. Technical Noise Supplement to the Traffic Noise Analysis Protocol (in reference to ambient noise and determination of noise impacts)

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Harris, Cyril M., ed. 1991. Handbook of Acoustical Measurements and Noise Control. Third Edition. McGraw-Hill, Inc. New York, NY.

International Organization for Standardization (ISO). 1996. *ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors* (as used by Cadna/A® noise modeling program.

Peterson, A.P.G. and E. Gross, Jr. 1972. Handbook of Noise Measurement. Seventh Edition. General Radio Company. Concord, MA.

City of El Segundo. El Segundo Municipal Code, Title 9 – Peace, Safety, and Morals, Chapter 9.06, Noise and Vibration Regulations.

City of Manhattan Beach. 1996. City of Manhattan Beach Municipal Code, Chapter 5.48 Noise Regulations-General Provisions.