Chapter 12

Noise and Vibration

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Chapter 12
Noise and Vibration

This chapter identifies and evaluates noise concerns in the action area, and analyzes the proposed action's potential impacts related to noise and groundborne vibration. Key sources of information used in the preparation of this chapter include the following.

- The *Guidelines for the Preparation and Content of the Noise Element of the General Plan* prepared by the California Governor's Office of Planning and Research (2003).
- Standard noise analysis and reduction methodologies developed by the U.S. Forest Service (USDA Forest Service 1980), the Federal Transit Administration (1995), Nelson (1987), Hoover and Keith (1996), and others.

Background

Sound, Acoustics, and Noise

Sound travels through the air as pressure waves caused by some type of vibration. In general, sound waves travel away from a noise source at ground level in a hemispherical pattern. The energy contained in a sound wave is spread over an increasing area as it travels away from the source, so loudness decreases at greater distances from the noise source. *Noise* is defined as unwanted, intrusive, or unpleasant sound.

Sound level meters measure the air pressure fluctuations caused by sound waves, with separate measurements made for different sound frequency ranges. The decibel (dB) scale for describing sound uses a logarithmic scale to account for the large range of audible sound intensities. Most sounds consist of a broad range of sound frequencies, and several frequency-weighting schemes have been used to develop composite dB scales that approximate the way the human ear responds to noise levels. The A-weighted dB scale (dBA) is the most widely used for environmental noise assessments. Typical A-weighted noise levels for various types of sound sources are summarized in Table 12-1.

Table 12-1. Typical A-Weighted Sound Levels

Sound Source	Sound Level (dBA)	Typical Response
Carrier deck jet operation	140	Painfully loud
Limit of amplified speech	130	
Jet takeoff (200 feet) Auto horn (3 feet)	120	Threshold of feeling and pain
Riveting machine Jet takeoff (2,000 feet)	110	Very annoying
Shout (0.5 foot) New York subway station	100	
Heavy truck (50 feet) Pneumatic drill (50 feet)	90	Hearing damage (8-hour exposure)
Passenger train (100 feet) Helicopter (in flight, 500 feet) Freight train (50 feet)	80	Annoying
Freeway traffic (50 feet)	70	Intrusive
Air conditioning unit (20 feet) Light auto traffic (50 feet)	60	
Normal speech (15 feet)	50	Quiet
Living room Bedroom Library	40	
Soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	
	10	Just audible
	0	Threshold of hearing

Noise levels that vary with time are often quantified by two descriptors: the equivalent sound level (L_{eq}) and the "percentile-exceeded" sound level. L_{eq} represents the *equivalent steady-state sound level*, or the steady-state level of sound that would contain the same acoustic energy as the actual time-varying sound level measured during a given time period. The *percentile-exceeded noise level* is the noise level that is exceeded for the indicated percentage of the specified period. For example, L_{10} is the relatively loud noise level exceeded only 10% of the time during the measurement period, while L_{90} is the relatively quiet noise level exceeded 90% of the time. An additional descriptor for time varying sound levels is the *day-night level (L_{dn})*, defined as the energy average of the A-weighted sound levels occurring during a 24-hour period, with a 10-dBA "penalty" added to sound levels occurring between 10:00 p.m. and 7:00 a.m.

The nature of dB scales is such that individual dB ratings for different noise sources cannot be added directly to give the sound level for the combined noise source. Instead, the combined noise level produced by multiple noise sources is calculated using logarithmic summation. For example, if one bulldozer produces a noise level of 80 dBA, then two bulldozers operating side by side would generate a combined noise level of 83 dBA, or 3 dBA louder than the single bulldozer.

People generally perceive a 10-dB increase in a noise source as a doubling of loudness. Most people cannot detect differences of 1–2 dB between noise levels of a similar nature (for example, a 1-dB increase in traffic noise compared to existing traffic noise). However, under ideal listening conditions, some people can detect differences of 2 or 3 dB, and most people under normal listening conditions would probably perceive a 5-dB change in sounds of a similar nature. When a new, intruding sound is of a different nature than the background sound (for example, a car alarm compared to quiet residential sounds), most people can detect changes as small as 1 dBA.

When distance is the only factor considered, sound levels from isolated point sources of noise typically decrease by about 6 dB for every doubling of distance from the noise source. When the noise source is a continuous line, such as vehicle traffic on a highway, sound levels decrease by about 3 dB for every doubling of distance. Noise levels can also be affected by several factors other than the distance from the noise source. Topographic features and structural barriers that absorb, reflect, or scatter sound waves can affect the reduction of noise levels. Atmospheric conditions (wind speed and direction, humidity levels, and temperatures) and the presence of dense vegetation can also affect the degree of sound attenuation.

Groundborne Vibration

In addition to generating noise, heavy construction equipment can generate groundborne vibration. Pile driving and similar activities, because they result in blows or impacts on the ground surface, produce vibrational waves that radiate along the surface of the earth and downward into the earth, potentially resulting in effects that range from annoyance to structural damage. As vibrations travel outward from the source, they excite the particles of rock and soil through which they pass and cause them to oscillate by a few ten-thousandths to a few thousandths of an inch. Differences in subsurface geologic conditions and distance from the source of vibration will result in different vibration levels characterized by different frequencies and intensities. In all cases, vibration amplitudes will decrease with increasing distance. The maximum rate or velocity of particle movement is the commonly accepted descriptor of the vibration "strength." This is referred to as the *peak particle velocity* (ppv) and is typically measured in inches per second.

Human response to vibration is difficult to quantify. Vibration can be felt or heard well below the levels that produce any damage to structures. The duration

of the event has an effect on human response, as does frequency. Generally, as the duration and vibration frequency increase, the potential for adverse human response increases.

Table 12-2 summarizes the average human response to vibration that may be anticipated when a person is at rest in quiet surroundings. If the person is engaged in any type of physical activity, vibration tolerance increases considerably.

It is important to understand that Table 12-2 describes the responses of average individuals. Individual responses can fall anywhere within the full range of the human response spectrum. At one extreme are those people who receive some tangible benefit from the pile driving operation (for example) and probably would not be disturbed by any level of vibration, as long as it does not damage their property. At the opposite extreme are people who would be disturbed by even barely detectable vibration. Individuals at either of these two extremes are not represented in the summary of average human response presented in Table 12-2 or in the impact analyses presented later in this chapter; both focus on average or typical responses.

Table 12-2. Human Response to Ground Vibration

Response	Ground Vibration (ppv, inches/second)
Barely to distinctly perceptible	0.02–0.10
Distinctly perceptible to strongly perceptible	0.10–0.50
Strongly perceptible to mildly unpleasant	0.50–1.00
Mildly unpleasant to distinctly unpleasant	1.00–2.00
Distinctly unpleasant to intolerable	2.00–10.00

Source: Bender 1996.

Affected Environment

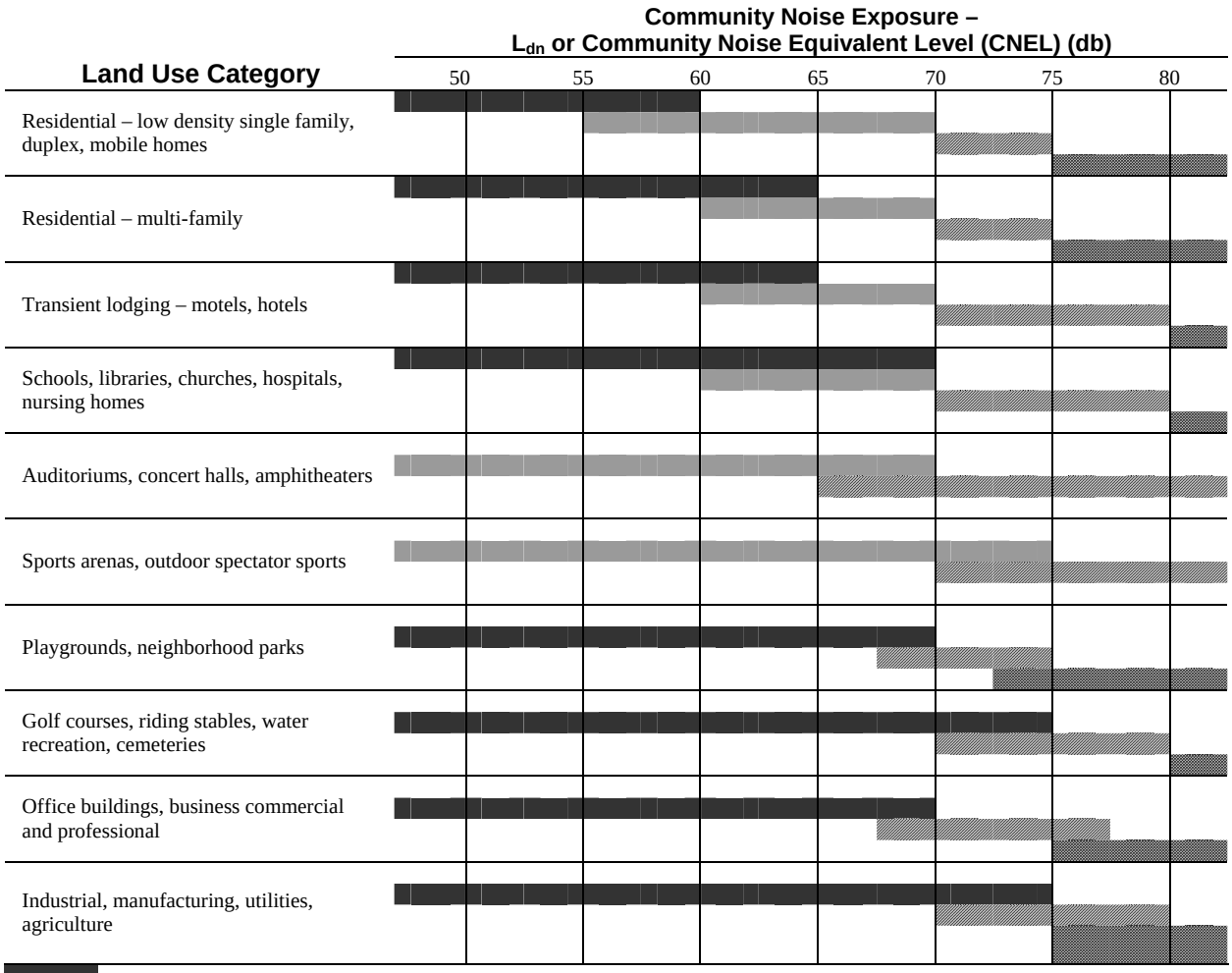
Regulatory Framework

Noise Regulations

Noise is regulated at the state and local level.

The State of California requires each local government entity to include a noise element as part of its general plan. To support appropriate land use planning at the local level, Title 4 of the California Administrative Code presents guidelines that identify the noise levels that are compatible with various types of land uses. The state land use compatibility guidelines are shown in Table 12-3.

Table 12-3. State Land Use Compatibility Standards for Community Noise Environment



Normally Acceptable	Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.
Conditionally Acceptable	New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features are included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.
Normally Unacceptable	New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.
Clearly Unacceptable	New construction or development generally should not be undertaken.

Source: California Governor's Office of Planning and Research 2003.

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Consistent with the Title 4 guidance summarized in Table 12-3, each city and county in California develops planning guidelines that are implemented through its general plan. More specifically, the noise element of the general plan contains goals and policies to support land use planning that will allow the jurisdiction to ensure that the Title 4 standards are met for various land uses.

Many local jurisdictions also have noise ordinances and/or municipal code statutes that are intended to protect citizens from exposure to noise levels that could result in disturbance or adverse effects. Such ordinances and codes permit noise limitations to be enforced through legal mechanisms as well as land use planning. City and county noise ordinances and municipal codes are used primarily to limit noise from stationary sources. In many cases, they also regulate noise generated by construction. To assist local jurisdictions in developing noise ordinances, the State of California has developed a Model Noise Ordinance that serves as a template.

The requirement that PG&E comply with local noise ordinances is preempted by the exclusive jurisdiction of the CPUC. However, CPUC requires that PG&E consult with local agencies and jurisdictions regarding land use matters, and make every feasible effort to meet local noise standards. If for some reason, PG&E cannot meet local standards, its project managers and construction leads are responsible for implementing a variety of BMPs, depending on the nature of the activity (see *PG&E's Existing Environmental Programs and Practices* in Chapter 2).

Groundborne Vibration Regulations

There are no widely adopted standards for acceptable levels of ground vibration generated by construction activities. However, the U.S. Department of Transportation has identified a "vibration damage threshold" of 0.20 inch per second (0.51 centimeter per second) for fragile buildings and 0.12 inch per second (0.31 centimeter per second) for extremely fragile historic buildings (Federal Transit Administration 1995). In addition, the Transportation Research Board suggests maximum allowable peak particle velocities from pile driving for various structure types and conditions (Transportation Research Board 1997), as summarized in Table 12-4 on the following page.

Table 12-4. Transportation Research Board Building Maximum Structure Vibration Criteria

Structure and Condition	Limiting Peak Particle Velocity	
	Inches per Second	Centimeters per Second
Historic buildings; certain other old buildings	0.5	~1.3
Residential structures	0.5	~1.3
New residential structures	1.0	~2.5
Industrial buildings	2.0	~5.1
Bridges	2.0	~5.1

Source: Transportation Research Board 1997.

Some jurisdictions elect to adopt vibration standards, which may be based on the guidelines summarized in Table 12-4.

As identified above for noise, the requirement that PG&E comply with local vibration ordinances is preempted by the exclusive jurisdiction of the CPUC, although CPUC requires compliance to the extent feasible. To that end, PG&E's standard BMPs include measures that address some common sources of vibration.

Existing Conditions

Ambient Noise Environment

The action area is located within portions of San Joaquin, Stanislaus, Merced, Mariposa, Madera, Fresno, Kings, Tulare, and Kern Counties, and includes a diversity of land uses ranging from urban to agricultural and rural, as discussed in Chapter 3 (*Land Use and Planning*). Based on experience with similar settings, it is assumed that existing noise levels in the action area's rural and agricultural regions are in the range of 40–50 dB L_{dn}. In developed areas, ambient noise levels could be as high as 65 dB L_{dn}. Table 12-5 summarizes typical ambient noise levels based on population density.

Table 12-5. Population Density and Ambient Noise Levels

Population Density	dBA L_{dn}
Rural	40–50
Suburban	
Quiet suburban residential or small town	45–50
Normal suburban residential	50–55

Population Density	dBA L_{dn}
Urban	
Normal urban residential	60
Noisy urban residential	65
Very noisy urban residential	70
Downtown, major metropolis	75–80
Under flight path at major airport, 0.5–1 mile from runway	78–85
Adjoining freeway or near a major airport	80–90

Sources: Cowan 1984, Hoover and Keith 1996.

Noise-Sensitive Land Uses

Noise-sensitive land uses are generally defined as locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Noise-sensitive land uses typically include residences, hospitals, schools, guest lodging, libraries, and certain types of recreational uses. Noise-sensitive receptors are found throughout the action area. Receptors such as residential areas, schools, and hospitals are typically most concentrated in developed areas, but residences and other sensitive uses also occur in sparser distribution in rural/agricultural areas.

Environmental Consequences and Mitigation Strategies

Methodology for Impact Analysis

Analysis focused on generation of noise during O&M and minor construction activities, and assumed a continuing commitment on PG&E's part to satisfy the CPUC requirement to conform to local standards where feasible, while still meeting the company's legal responsibility to provide safe, reliable electricity and natural gas service. Because O&M and minor construction activities—as well as CPUC requirements for noise control—would be the same under the proposed action and all alternatives, analysis assumed that noise generation would be similar for all alternatives. Actual noise generation would vary depending on site-specific constraints, so potential noise impacts are of necessity discussed qualitatively, at a program level of detail.

The proposed action and alternatives would each result in a slightly different balance of impact avoidance versus compensation for unavoidable impacts, so there could be some in-practice difference in long-term noise generation related to increases/decreases in the extent of compensation lands, and the noise-generating activities (notably, earthwork) needed to manage them. However, it is impossible to predict the extent and type of management- or restoration-related

earthwork needed under each alternative, because the location and condition of compensation lands cannot be identified at this time. Consequently, although differences in noise generation among the proposed action and alternatives are expected to be minor, detailed analysis of potential differences would be speculative at this time, and this topic is not addressed further in this EIS/EIR.

Significance Criteria

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would result in any of the following.

- Exposure of persons to or generation of noise levels in excess of standards established in a local general plan or noise ordinance or applicable standards of other agencies.
- Exposure persons to or generation of excessive groundborne vibration or groundborne noise levels.
- Substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
- Substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

Impacts and Mitigation Measures—All Alternatives

Impact N1—Potential for temporary or permanent exposure of noise-sensitive land uses to elevated noise levels. As discussed above, PG&E's ongoing O&M and minor construction activities are expected to be the only substantial source of noise associated with the proposed action, and they would be similar across all alternatives. Noise associated with O&M and minor construction would be generated primarily by the following sources.

- Vehicles (e.g., trucks, helicopters and fixed-wing light aircraft, and ATVs) used for inspection patrols and employee access trips.
- Heavy machinery (e.g., cranes, excavators, and scrapers) used for maintenance and construction of PG&E facilities and infrastructure.
- Smaller equipment (e.g., chainsaws and generators) used for a variety of O&M activities.

Table 12-6 presents typical noise levels generated by equipment that may be used in O&M and/or minor construction activities.

Table 12-6. Typical Noise Generation for Commonly Used Construction Equipment

Equipment	Typical Noise Level (dBA) 50 Feet from Source	Equipment	Typical Noise Level (dBA) 50 Feet from Source
Air Compressor	81	Jackhammer	88
Backhoe	80	Loader	85
Bulldozer	85	Paver	89
Chainsaw	86	Pile driver (impact)	101
Compactor	82	Pile driver (sonic)	96
Concrete mixer	85	Pneumatic tool	85
Concrete pump	82	Pump	76
Concrete vibrator	76	Rock drill	98
Crane, derrick	88	Roller, sheep's foot	74
Crane, mobile	83	Saw	76
Excavator/ shovel	82	Scraper	89
Generator	81	Truck	88
Grader	85	Wood chipper	89
Helicopter (single rotor)	79[1]		

[1] At 500 feet under level flight conditions.

Source: Cowan 1984, Federal Transit Administration 1995, Nelson 1987, USDA Forest Service 1980.

The noise impacts associated with a specific activity would depend on the type of activity, the types and number of pieces of equipment in use, the noise level generated by the various pieces of equipment, the duration of the activity, the distance between the activity and any noise-sensitive receivers, and possible shielding effects that might result from local topography, vegetation, or buildings. Because the proposed project is a 30-year operating conservation program, information regarding the range of covered activities is known, but site-specific information is not. For individual O&M and minor construction activities that may occur during the 30-year permit term, the specific types and number of vehicles and equipment at a given site, and their duration and frequency of use, are not available. The same is true for activity-specific noise levels. Noise levels for these activities are expected to be similar, however, to levels for existing O&M and minor construction currently implemented by

PG&E. In most instances, existing O&M activities are temporary and sporadic; although some, such as patrols, are regularly scheduled, others, such as emergency maintenance, occur on an "as-needed" basis. With the exception of larger maintenance activities and minor construction projects, O&M and construction noise generation would thus be intermittent and very short-term in nature. In addition, PG&E would continue to employ its current slate of BMPs under all alternatives. As discussed in Chapter 2, typical measures include

- conducting work during daytime hours;
- using standard equipment with noise control devices (e.g., mufflers) that meet manufacturers' specifications;
- using "quiet" equipment (i.e., equipment designed with noise control elements);
- installing portable barriers to shield compressors and other small stationary equipment where necessary;
- installing sound barriers for pile-driving activity, where practicable, by using an acoustic curtain or blanket around the point of impact;
- directing equipment exhaust stacks and vents away from buildings, when feasible;
- routing truck traffic away from noise-sensitive areas, where feasible;
- following a common-sense approach to vehicle use; and encouraging workers to shut off vehicle engines whenever possible;
- limiting pick-up trucks and other small equipment to an idling time of five minutes;
- identifying "sensitive receptors" who might be disturbed by construction noise and notifying them in advance of upcoming work; and
- responding immediately to complaints raised by adjacent residents.

In light of the CPUC requirement to conform to local standards where feasible, and with PG&E's existing noise BMPs in place, most activities enabled under the proposed action are not expected to substantially expose persons to or generate noise levels in excess of standards established in a local general plan or noise ordinance or applicable standards; result in a substantial permanent increase in ambient noise levels in the work vicinity; or result in a substantial temporary or periodic increase in ambient noise levels in the work vicinity. Thus, **in the majority of cases, impacts of O&M and minor construction noise are expected to be less than significant.**

Some O&M and minor construction activities (in particular, those that require multiple pieces of heavy equipment; and those that occur in close proximity to sensitive residential, school, hospital, or recreational land uses) would have the potential to generate noise in excess of local general plan or noise ordinance standards. For example, a bulldozer (85 dB at 50 feet) and grader (85 dB at 50 feet) operating concurrently would result in a combined noise level of 88 dB at 50 feet, exceeding the noise standards of many jurisdictions. This is a potentially

significant impact. The significance of that impact would be reduced through implementation of PG&E's standard business practices and BMPs, which will be incorporated in all O&M and minor construction activities enabled under the proposed action. Typical practices include consulting and coordinating with local jurisdictions to minimize and lessen noise effects; implementing a range of noise reduction BMPs, as appropriate; and responding quickly to public complaints or concerns about noise effects. The business practices and BMPs PG&E brings forward as part of the proposed action reflect PG&E's obligations under CPUC regulations. PG&E's obligations under the CPUC, including its commitment to implement regular business practices and the BMPs described in Chapter 2, would substantially lessen the potential for significant intermittent occurrences of higher levels of construction noise. **Related noise impacts are expected to be less than significant as a result.**

Once constructed, new minor facilities would generate noise related to the operation of power transformers, switchyards, and other equipment. Additional fairly minor noise would be generated by vehicles used for inspection and maintenance visits to new facilities. In most instances, the types of facilities that would be constructed under the proposed action operate well within local standards. Likewise, in designing, constructing, and operating new minor facilities, PG&E carries forward its obligations under the CPUC, including its regular business practices and BMPs. Typical practices include consulting and coordinating with local jurisdictions to minimize and lessen noise effects; implementing a range of noise reduction BMPs, as appropriate; and responding quickly to public complaints or concerns about noise effects. **Noise impacts related to operation of new facilities are expected to be less than significant as a result.**

Mitigation Measure—No mitigation is required.

Impact N2—Potential for temporary or permanent exposure of noise-sensitive land uses to elevated vibration levels. O&M activities may generate minor groundborne vibration. Vibration from typical construction and earthmoving activity is generally below the threshold of perception at distances of more than about 50 feet; adverse effects related to vibration are most often associated with "high impact" activities such as pile driving. Most O&M activities are thus unlikely to expose persons to or generate excessive groundborne vibration or groundborne noise levels even at nearby sensitive land uses, so **in the majority of cases, impacts are expected to be less than significant.**

There may be some instances where "high impact" activities would occur in close proximity to sensitive land uses, potentially resulting in temporarily elevated vibration levels. In rare cases, vibration levels could temporarily exceed applicable standards, representing a potentially significant impact. However, the significance of any impact would be reduced through implementation of PG&E's standard business practices and BMPs, which will be incorporated in all O&M and minor construction activities enabled under the proposed action, as discussed above. As described in Chapter 2, typical practices include consulting and coordinating with local jurisdictions to minimize and lessen effects on nearby

land uses, including effects of construction-generated vibration; implementing vibration reduction BMPs, as appropriate; and responding quickly to public complaints or concerns about vibration. The business practices and BMPs PG&E brings forward as part of the proposed action reflect PG&E's obligations under CPUC regulations. PG&E's obligations under the CPUC, including its commitment to implement regular business practices and the BMPs described in Chapter 2, would substantially lessen the potential for significant intermittent occurrences of higher levels of construction vibration. **Related vibration impacts are expected to be less than significant as a result.**

Vibration levels associated with operation of new facilities would typically be very low, and **no significant long-term impact is anticipated.**

Mitigation Measure— No mitigation is required.

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