D.5 Geology, Soils, and Paleontology

D.5.1 Environmental Setting for the Proposed Project

This section presents a discussion of the regional topography, geology, seismicity, soils, and mineral and paleontological resources in the project area. Baseline geologic information was collected from published and unpublished geologic, seismic, and geotechnical literature covering the project area. The literature review was supplemented by a field reconnaissance of the proposed transportation routes and the proposed TSA and OSG Storage Facility sites. The literature review and field reconnaissance focused on the identification of specific geologic hazards and paleontologic resources.

The Proposed Project is located in the Santa Lucia Mountains in the west-central part of the Coast Ranges Geomorphic Province of Central California. The landscape in the project area is defined by elongated ranges and narrow valleys that trend slightly more northwest than does the coastline. The project area has a landscape of moderately high hills, the western side of which has been modified by erosion into a narrow, gently sloping plain. This more-or-less flat surface is an ancient, erosional marine terrace that has been uplifted by tectonic forces over the last 100,000 years or so. The Central Coast Ranges are a product of tectonic forces that continue to influence the geological and topographic development of the region. Folding, faulting, and uplift are all active agents that compete with erosion in shaping the mountains and coastline.

The geology and most geologic hazards have limited ability to affect most aspects of the Proposed Project because of the transitory nature of the activities. A primary aspect of the Proposed Project that is considered in this section is the proposed OSG Storage Facility because it would be a new structure designed to contain the low-level radioactive OSGs until the decommissioning of the entire plant — a time frame that could span many decades. Geologic issues relating to the transportation of the steam generators and the temporary placement of project-related facilities are also covered.

D.5.1.1 Topography

Topographic extremes at the power plant site range from 914 feet at the top of the hill (Hill 914) east of and above the plant to sea level. The plant itself lies on the marine terrace between 85 and 160 feet above mean sea level (msl). In the vicinity of the plant, the terrace is narrow and has been modified both by erosion and the presence of ancient topographic highs that protrude from the terrace surface as bedrock knobs or knolls. The moderately steep slope east of the plant (from the plant to the top of Hill 914; see Figure D.5-1) is measured on the map as 1:3 (vertical:horizontal), or 19 degrees. A steep seacliff has developed below the marine terrace at approximately the 80-foot elevation level (varies +/- 20 feet depending on location). Diablo Canyon extends eastward from the outlet at the shoreline just north of the plant. The sides of the canyon are fairly steep with the slope directly south of the substation at 1:2 (vertical:horizontal), or 25 degrees. Portions of the canyon have been modified by the construction of the switchyard, which has been constructed on fill material over a culverted section of Diablo Creek. The “man camp” area has also been modified by a cut into the hillside (the east side of Hill 914) and placement of fill on the creekside. This would be the area of the proposed OSG Storage Facility and various potential alternative OSG Storage Facility locations.

D.5.1.2 Geology

The geology of the project vicinity is described in the PEA (PG&E, 2004), and this section briefly summarizes the salient points. The Proposed Project is located on the flank of a down-folded section of Tertiary-age volcanic and sedimentary rocks that lies within a larger section of Mesozoic-age rocks. This sequence of rocks is associated with the subduction zone that marked the western margin of North America until approximately 25 million years and then was subsequently modified and moved along the west side of the San Andreas Fault System to its present location. Numerous faults have been observed in the rocks in the Diablo Canyon area, but they do not exhibit any of the features associated with active faults (faults with movement within the last 10,000 years), and thus are considered inactive (PG&E, 2004; CCC, 2004).

The western margin of North America is tectonically active, and the Proposed Project is located between zones of known active faults within this margin. The major active faults that could affect the site include the Hosgri Fault Zone (approximately three miles offshore); the Edna, Oso, and Oceanic faults (five, seven, and 13 miles to the east, respectively); and the San Andreas Fault (approximately 47 miles northeast at its closest point).

Geologic units at the project site, along the northern portion of the proposed transport routes, and in the vicinity of the proposed OSG Storage Facility are summarized in Table D.5-1 and shown on Figure D.5-2. This table lists each geologic formation, a description of the formation's general rock type or lithology, the slope stability, the location of the formation within the project boundaries, and age.

Table D.5-1. General Descriptions and Characteristics of the Geologic Formations

Formation Name	Lithologic Description	Slope Stability	Occurrence in Project Area	Age
Alluvial deposits	Cobble-pebble gravel, sand, silt, and clay	Generally stable on low slopes, unstable on moderate to steep slopes	Only in the bottom of Diablo Canyon	Quaternary
Landslide deposits	Lithology dependent on source material	Unstable on slopes, old slide deposits can reactivate	Along the access road near the base of Green Peak and in the entire area of the proposed OSG Storage Facility	Quaternary
Terrace deposits	Unconsolidated sand, silt, clay, and gravel. Marine and stream terrace deposits	Generally stable on low slopes, unstable at the edge of the sea cliff	Along the shoreline above the sea cliffs and below the base of the slopes below Green Peak and Hill 914	Quaternary
Pismo Formation, Squire Member	Massive white to tan calcareous arkosic sandstone; more calcareous and resistant near base. Contains marine fossils	Outcrop very small	As a small outcrop in the plant area	Pliocene
Monterey Formation	Siltstone or blocky dolomitic claystone and siliceous siltstone; tan to yellow-white; locally tuffaceous or interbedded with cherty shale	Generally stable on favorably oriented slopes; only one small landslide is mapped near project	Along the top of the ridgeline above the plant site from just below Hill 914 to Green Peak and eastward	Miocene
Obispo Formation	Contains variable deposits and intrusions of diabase (as dikes, sills and basalt flows), tuffaceous siltstone and claystone; and altered, resistant volcanic tuff	Moderately unstable on steep hillsides. Several large landslides mapped in this formation	Both sides of Diablo Canyon, the sea cliffs, the lower three-quarters of the north and south sides of Green Peak	Miocene

Source: Hall, 1973.

Figure D.5-1. View of Hill 914 and Green Peak
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Figure D.5-2. Geologic Formations and Mapped Landslide Areas
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The main rock types in the vicinity of the proposed OSG Storage Facility are volcanics of the Obispo Formation, which were mostly deposited in layers underwater. Some dikes and other intrusive bodies have been recognized, but in the project area, most of the exposures show a series of thin beds dipping in a northerly direction.

D.5.1.3 Soils

Soils are important to a project if agricultural soils are to be taken out of service or potential service, or if the soils pose particular engineering problems. According to a Soil Conservation Service Soil Survey of 1984, no soils suitable for agriculture are located in the areas of the Proposed Project activities. There are several issues regarding engineering properties of the soils; these include shrink-swell potential, risk of corrosion to built installations, erodibility, suitability for construction materials, and suitability for various types of development.

The Soil Conservation Service Soil Survey of San Luis Obispo County, California, Coastal Part (SCS, 1984) identifies the main soil types in the project area as Nacimiento Series soils. These are the soils that mantle the hillslopes. Soils developed within the lower part of Diablo Canyon are identified as Santa Lucia soils. Disturbed soils in the plant area are called Xererts. Because of the earthwork already done in the area, it is known that the soils near the proposed OSG Storage Facility are also called Xererts soils. Uphill from the proposed OSG Storage Facility site is Nacimiento soils. The Soil Survey mapping is generalized, and may not reflect the local and specific conditions at the site.

The following soil characteristics are provided by the Soil Survey (SCS, 1984). Shrink-swell is the potential for volume change resulting from change in moisture content. The shrink-swell potential is moderate for Nacimiento soils, and low for Santa Lucia soils in the project area. Soils with high sulfate and/or salt content can corrode sub-grade constructed works. In the project area, Nacimiento soils have a high risk of corroding uncoated steel and a low risk of corroding concrete. However, the Santa Lucia soils deeper in the canyon have a high corrosion risk for both uncoated steel and concrete. Soil types present in the vicinity of the plant and proposed OSG Storage Facility have severe limitations for development of all types of buildings and associated development because of steep slopes. None of the project area soils are considered suitable for construction materials (roadfill, sand, or gravel) because of excess fines in crushed material. Because of the steep slopes and thin soils developed over bedrock, most of the soil in the project vicinity is considered erodible.

D.5.1.4 Seismic Hazards

Seismic hazards in the vicinity of the Proposed Project include ground shaking, surface rupture, liquefaction, slope instability, and tsunami runup. Of all the potential hazards, ground shaking associated with an earthquake on one of the nearby faults is the most likely to affect the Proposed Project. Ground shaking could trigger landslides; landslides are discussed in the next section. No known active faults immediately underlie the areas of Proposed Project activities, therefore the potential for fault surface rupture at the DCPP site is low. Surface rupture, liquefaction and tsunami runup have all been shown by the Applicant and others to not pose a hazard to the areas of Proposed Project activities (PG&E, 2004; CCC, 2004). Port San Luis, the proposed offloading location, could be affected by a tsunami. However, the Pacific Tsunami Warning Center (operated by NOAA) would likely be able to provide advance notice, thereby providing time for project-related activities to prepare.

The effects of ground shaking during an earthquake could include cracks in the road, slumping of the road, and rockfall (see Figures D.5-3 and D.5-4 for examples of rocks shaken loose from a road cut following the magnitude 6.5 San Simeon earthquake of December 22, 2003). In addition, if an earthquake occurs while construction activities or heavy lifting are underway, the ground shaking could cause equipment, scaffolds, cranes, and trailer loads to temporarily become unstable.

D.5.1.5 Geologic Hazards

General geologic hazards potentially affecting the project area include landslides and debris flows. Steep slopes occur above the proposed RSG transport route (from Port San Luis to DCPP) and above the area of the proposed OSG Storage Facility. In a heavy rainstorm, accumulations of colluvium (loose, weathered bedrock, soil and organic material) could become unstable and wash down the straight gullies as a debris flow. Gullies most likely to be affected are present on the south-facing slope that is south and east of the plant site and above the Access Road. Small and large landslides are mapped above and across the Access Road in several places, and a large landslide is mapped in the "man camp" area where the proposed OSG Storage Facility and alternative storage locations would occur (Hall, 1973). See Figure D.5-2 for a detailed map of previous landslide areas.

Hill 914 rises south of the "man camp" area. The lower two-thirds of the slope are underlain by Obispo volcaniclastics as thin beds that mainly dip north but also show local folding with dips in other directions. Thin clay beds, observed within the strata on this slope by PG&E geologists, reduce the stability of the slope. The Independent Spent Fuel Storage Installation (ISFSI) recently approved by San Luis Obispo County, would be located at the base of a steep cut slope in this area. Possible strategies to protect built structures from landslide hazards in this area involve the use of rock bolts and tie backs to help stabilize the cut slope above the DCPP facilities (CCC, 2004).

D.5.1.6 Mineral Resources

Mineral rights in the DCPP lands are owned by PG&E. According to the 1989 California Division of Mines and Geology Mineral Resources survey of southwestern San Luis Obispo County, the Diablo Canyon Power Plant lands are classified as Mineral Resources Zone – 1 (MRZ-1) (DMG, 1989). MRZ-1 is applied to areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence. This designation is assigned when well-developed lines of reasoning, based on economic and geologic principles, and adequate data have demonstrated that the likelihood for occurrence of significant mineral deposits is nil or slight.

D.5.1.7 Paleontology

Paleontologic resources are considered significant if they include the fossilized remains of terrestrial or marine animals, especially vertebrate animals, or plants. There are no geologic formations at the site that are known to contain such fossils — most of the geologic formations are marine deposits or are volcanic in origin. While some volcanic ash deposits are known to preserve terrestrial fossils, no such fossils have been recognized at or in the vicinity of the project area.

Figure D.5-3. Example of Rockfall near Atascadero

Figure D.5-4. Example of Rockfall near Santa Rita

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D.5.2 Applicable Regulations, Plans, and Standards

Geologic resources and geotechnical hazards are normally governed by local jurisdictions. The conservation elements and seismic safety elements of city and county general plans contain policies for the protection of geologic features and avoidance of hazards. Local building codes and ordinances normally implement these policies. The Applicant must also comply with several additional federal, State, and local applicable statutes, regulations, and policies. Relevant and potentially relevant statutes, regulations, and policies are discussed below.

Federal and State Standards

The NRC has sole jurisdiction over the regulation of nuclear power plants and the associated safety issues. NRC regulations in 10 CFR 61 specify criteria for low-level radioactive waste disposal facilities, and 10 CFR 72.102 and 103 specify the geological and seismological characteristics for facilities storing high-level radioactive waste. NRC Regulatory Guide 1.29, Seismic Design Classification, includes seismicity-related building criteria. The NRC is required by 10 CFR 100 to consider the geology and seismic setting for any nuclear power plant site and to require adequate compensating engineering safeguards to minimize the risk of accidents or an inadvertent release of radioactive materials. Please see Section B.3.3.3 for more information regarding NRC regulations and guidelines for construction of storage facilities.

NRC regulations (10 CFR 50.59) allow a licensed power plant to make modifications to the original design and equipment without seeking re-certification only if the modification will allow the plant to function within the parameters specified by the Final Safety Analysis Report (FSAR) or updated FSAR. PG&E updates the FSAR every two years (PG&E, 2004). At the current time, PG&E has stated that the Proposed Project would not require an amendment to its NRC licenses for DCPP [1].

These regulations require that nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunamis, and seiches without the loss of their safety functions and capabilities. The Reactor Site Criteria (10 CFR 100, including Appendix A) describe the nature of the investigations required to obtain the geologic and seismic data necessary to determine site suitability and provide reasonable assurance that a nuclear power plant can be constructed and operated at a proposed site without undue risk to the health and safety of the public. More specifically, these criteria describe procedures for determining the quantitative vibratory ground motion design basis at a site due to earthquakes, as well as provide information needed to determine whether and to what extent a nuclear power plant needs to be designed to withstand the effects of surface faulting. Other geologic and seismic factors required to be taken into account in the siting and design of nuclear power plants are also identified.

With respect to frequency of faulting, the NRC uses a more conservative approach than that of State-level Alquist-Priolo regulations (see below). The NRC classifies a "capable" fault as a fault that has exhibited one or more of the following characteristics:

- Movement at or near the ground surface at least once within the past 35,000 years or movement of a recurring nature within the past 500,000 years;

[1] PG&E has stated that "the steam generator replacement outages will not create any non-normal refueling situations and will not require any updates or changes to the NRC License" (PG&E, 2004g) and "it will not be necessary to file for a license amendment with the NRC to install the replacement steam generators." (PG&E, 2004d)

- Macro-seismicity as determined instrumentally with records of sufficient precision to demonstrate a direct relationship with the fault; or
- A structural relationship to a capable fault, according to the two characteristics listed above, such that movement on one could be reasonably expected to be accompanied by movement on the other.

In response to these requirements, earthquake potential of the significant seismic sources in the region has previously been characterized in the Long Term Seismic Program (LTSP) for DCPP (PG&E, 1988). The 1988 LTSP included an assessment of potential seismic sources, earthquake probability, and estimated levels of deterministic and probabilistic ground motions for the site. Numerous additional published documents, and data on earthquake activity in the area over the past 20 years, are also available.

State Statutes

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (formerly the Special Studies Zoning Act) regulates development and construction of buildings intended for human occupancy to avoid the hazard of surface fault rupture. While the Act does not specifically regulate power plant projects, it does help define areas where fault rupture is most likely to occur. The Act groups faults into categories of active, potentially active, and inactive. Historic and Holocene age faults are considered active, Late Quaternary and Quaternary age faults are considered potentially active, and pre-Quaternary age faults are considered inactive. These classifications are qualified by the conditions that a fault must be shown to be "sufficiently active" and "well defined" by detailed site-specific geologic explorations in order to determine whether building setbacks should be established. Only a short fault segment in the San Luis Obispo Quadrangle is included in the Alquist-Priolo maps. There are no Alquist-Priolo faults in the vicinity of the proposed RSG transport route or near the proposed OSG Storage Facility.

California Coastal Act

Expansion of existing power plants in the Coastal Zone is governed by California Coastal Act policy and regulations (Sec. 30001.2 of Coastal Act). The Coastal Act also discusses hazards in the coastal environment, including coastal bluff erosion (Section 30253; see also Chapter 11 of the County of San Luis Obispo Local Coastal Program [LCP]).

Policy 2 in Chapter 11 of the LCP, which implements at the local level the general policies of the California Coastal Act, states that new development within the Coastal Zone shall ensure structural stability while not creating or contributing to erosion or geologic instability.

Policy 6 in Chapter 11 of the LCP discusses coastal bluff setbacks for new development or expansion of existing uses. The policy requires that the sites be designed and set back adequately to assure stability and structural integrity and to withstand bluff erosion and wave action for a period of 75 years without construction of shoreline protection structures which would require substantial alterations to the natural landforms along bluffs and cliffs. This policy may affect siting of the proposed staging and preparation activities, but it would not affect the proposed OSG Storage Facility.[2]

[2] PG&E has filed a Conditional Use Permit (CUP) Application with the County of San Luis Obispo for the OSG Storage Facility and a CDP for the Temporary Staging Areas and Containment Access Facilities. Both Applications were submitted to the County on February 2, 2005. The County of San Luis Obispo has not yet made a decision on the CUP and CDP applications filed by PG&E.

Policy 7 in Chapter 11 of the LCP specifies that coastal bluffs and cliffs greater than 10 feet in vertical relief are to be included in the Geologic Study Area (GSA) combining designation. The proposed transport route and entire DCPP site are identified on the county maps as within a GSA for liquefaction and landslide hazards (see http://landarch.larc.calpoly.edu/slocounty/rural.htm, select Map 1 of 2 of the Rural Combining Designation Map). The requirements of Policy 7 include a geologic report on the hazards of the area unless the County Engineer determines previous reports are adequate to characterize the project area.

Local Ordinances and Policies

The General Plan Safety Elements for San Luis Obispo County contain guidelines and recommendations for the avoidance of geologic hazards. County and local grading ordinances establish detailed procedures for excavation and grading required for underground construction.

County Local Coastal Program

The coastal zone management program required by the California Coastal Act (see *California Coastal Act* section above) is administered by the California Coastal Commission and local governments. Local governments develop Local Coastal Programs (LCPs) that include specific policies to govern coastal resources within their jurisdictions. The San Luis Obispo County Local Coastal Program generally defines the Coastal Zone as inland 1,000 yards from the shoreline, with additional extensions inland for important habitat, recreational, or agricultural resources. See Section D.8.2 for additional information on San Luis Obispo County's LCP. The California Coastal Act section above describes the LCP provisions applicable to geological resources, and the specific components of the Proposed Project, which include:

- Section 23.04.118, which dictates setbacks required of new development or expansion of existing uses located adjacent to a beach or coastal bluff;
- Section 23.07.080, which requires that geologic study area designation is applied to areas where geologic and soil conditions could create potential hazards to life and property due to new development; and
- Section 23.07.086, which states that all uses within a geologic study area are to be established and maintained according to specific grading, seismic, and erosion requirements.

D.5.3 Environmental Impacts and Mitigation Measures for the Proposed Project

The literature review and field check of the geologic conditions in the project area revealed that slope stability issues along certain portions of the Access Road, as well as adjacent to the proposed location of the OSG Storage Facility, and seismic ground shaking hazards are the most likely hazards to adversely affect the Proposed Project. These issues are addressed in the following discussion of impacts.

D.5.3.1 Definition and Use of Significance Criteria

These criteria address geologic and soil conditions and paleontological resources with respect to the impacts the Proposed Project may have on the local setting, and the impact specific geologic hazards and conditions may have upon the project. The criteria are established based on CEQA statutes, guidelines and appendices; thresholds of significance developed by local agencies; government codes and ordinances; and requirements stipulated by California Alquist-Priolo statutes.

Impacts of the Proposed Project on the geologic environment would be considered significant if:

- Unique geologic features or geologic features of unusual scientific value (including significant fossils) for study or interpretation would be disturbed or otherwise adversely affected.
- Known mineral and/or energy resources would be rendered inaccessible.
- Agricultural soils would be converted to non-agricultural uses.
- Geologic processes, such as landslides or erosion, could be triggered or accelerated by construction or disturbance of landforms.
- Substantial alteration of topography would be required or could occur beyond that which would result from natural erosion and deposition.

Impacts of geologic hazards on the project would also be considered significant if the following conditions existed:

- High potential for earthquake-induced ground shaking to cause liquefaction, settlement, lateral spreading and/or surface cracking in the vicinity of the proposed OSG Storage Facility or along the RSG transport route.
- Potential for failure of construction excavations or underground foundations of the OSG Storage Facility due to the presence of loose saturated sand or soft clay.
- Presence of corrosive soils, which could damage the underground portions of the OSG Storage Facility.
- Potential for tsunamis or seiches to cause damage to the OSG Storage Facility or to equipment during transportation or construction of facilities.

The information in the setting, Section D.5.1 above, demonstrates that the Proposed Project would not impact agricultural soils, mineral resources, or paleontological resources.

D.5.3.2 Replacement Steam Generator Transport

Replacement steam generator offloading and transport activities would have a transient effect on the landscape and as such would not impact geological, soils, or paleontological resources. However, the route from Port San Luis to DCPP would cross over areas of potentially unstable earth materials.

Impact G-1: Extremely heavy loads could mobilize unstable ground along transport route

The extremely heavy transport loads and equipment would add an unusual load to the offloading area and the roads along the RSG transport route. PG&E has stated that the Access Road is currently in good condition and that it was designed and built to accommodate heavy loads. The condition of paved

areas in the Port San Luis Harbor District is unknown. In certain places, it is possible that replacement steam generator transport could exceed the capacity of the road to support the vehicles. The locations most likely to be at risk are those areas that cross above landslides, such as Patton Cove, but with implementation of Mitigation Measure G-1a this impact would be less than significant (Class II).

Mitigation Measure for Impact G-1, Extremely heavy loads could mobilize unstable ground along transport route

G-1a **Prevent overloading of unstable ground along transport route.** Existing geotechnical reports shall be reviewed by PG&E/CPUC not less than one year prior to the scheduled transport of the RSGs. PG&E/CPUC shall determine if the existing reports provide sufficient information to establish that the load-bearing capacity of soils and geologic features at the offloading area or along the transport route would support the loads, or if additional studies are necessary. If new studies are necessary, they shall be completed not less than ten months prior to commencement of the Proposed Project.

Either the existing geological reports or new studies shall meet the following performance criteria not less than six months before the scheduled start of transport activities:

- Report clearly identifies any and all unstable portions of the transport route.
- PG&E or its consultant shall develop plans for any necessary road improvements, which shall be reviewed by the CPUC or its consultant to ensure that proposed improvements would both (1) ensure ground stability of all roads to be used during transport and (2) remain within the footprint of the proposed route (as defined in the Proposed Project or the Replacement Steam Generator Offloading Alternative) so as to ensure that there would be no additional environmental impacts.

Any and all necessary road improvements shall be completed at least 60 days prior to the scheduled start of transport activities. The CPUC or its environmental monitor shall ensure construction activities remain within the defined road footprint. In addition, the CPUC or its consultant shall survey the transport route after the completion of construction (prior to the start of transport activities) to ensure that all necessary ~~completed~~ improvements have been implemented on ~~successfully stabilized appropriate portions of~~ all roads to be used during transport.

Impact G-2: Temporary effects of earthquake shaking could endanger worker safety

In the unlikely, but not impossible, event that a major earthquake occurs in the region during the Proposed Project, the effects of ground shaking could endanger workers. This is especially a concern during offloading and transport activities, when large loads would be lifted and handled by cranes and transporters/movers. Seismic ground shaking could create sudden breaks in road surfaces, loosen rocks and boulders from road cuts and slopes, trigger landslides, cause equipment in the offloading areas to topple, and possibly destabilize the transport tractors or the load. Workers could be injured or killed if they are in the path of falling rocks or toppling equipment. With the implementation of Mitigation Measures G-1a, G-2a, and G-2b, the impact would be less than significant (Class II).

Mitigation Measures for Impact G-2, Temporary effects of earthquake shaking could endanger worker safety

G-2a **Protect workers from temporary effects of earthquake shaking.** The Applicant shall produce a safety plan that specifically includes measures that will be taken to ensure worker safety during earthquake-caused ground shaking. This plan shall be reviewed internally by PG&E and submitted

to CPUC for its review at least 60 days prior to the scheduled commencement of the Proposed Project. Elements of the plan should include, but not be limited to the following: (a) a protocol for workers to follow in the event an earthquake occurs; (b) protocols for set-up and management of equipment during the loading, transport, offloading, staging, and installation phases that address the potential effects of ground shaking; and (c) training for workers so they will know what to do in the event of an earthquake. CPUC shall review the safety plan for consistency with California Occupational Safety and Health Standards and approve the safety plan prior to commencement of any Proposed Project activities.

G-2b **Prevent casualties caused by falling rocks.** Rocks and boulders that are precariously situated above portions of the transport route shall be identified, and evaluated by PG&E and/or the transportation contractor to determine if they should be removed or stabilized prior to project commencement.

D.5.3.3 Replacement Steam Generator Staging and Preparation

Staging and preparation would involve development of a temporary staging area (TSA). The proposed TSA would be located at the southern end of the DCPP site, on a previously developed flat terrace area (see Figure B-2). The RSGs would be stored in a temporary structure built over paved parking areas. Potential impacts of geology on the Proposed Project include seismic shaking in the event of an earthquake on one of the nearby faults. There would be no impact to geological, soils, or paleontological resources from this phase of the Proposed Project.

Similar to RSG offloading and transport (Impact G-2), ground shaking during a major earthquake could endanger workers during RSG staging and preparation. Seismic ground shaking could create breaks in the developed TSA area, loosen rocks and boulders from slopes, trigger landslides, and cause equipment in the staging area to topple. Because workers could be injured or killed if they are in the path of falling rock or toppling equipment, mitigation would be necessary to ensure their safety. Implementation of Mitigation Measures G-2a and G-2b would be necessary to reduce this impact to less than significant levels (Class II).

D.5.3.4 Original Steam Generator Removal, Transport, and Storage

The OSGs would be moved from the reactors to a temporary containment facility where they would be dismantled, encapsulated, and prepared for transport by transporters to the proposed OSG Storage Facility. The low-level radioactive OSGs would then remain onsite until the Diablo Canyon Power Plant is ready for decommissioning. During the OSG removal and transport stages, the Proposed Project would involve transport of heavy loads along the route to the OSG Storage Facility (Impact G-1), and the site could be impacted by an earthquake, which could jeopardize worker safety (Impact G-2). Implementation of Mitigation Measure G-1a would ensure that potentially unstable transport routes to the OSG Storage Facility are not overloaded, which would reduce Impact G-1 to less than significant levels (Class II). Protecting workers from potentially falling rock or toppling equipment, as specified in Mitigation Measures G-2a and G-2b, would reduce Impact G-2 to less than significant levels (Class II).

It is unlikely that landslides or debris flows would affect short-term transport activities, but the large mapped landslide on the south side of Diablo Canyon in the "man camp" area could pose a hazard for the OSG Storage Facility. These long-term slope stability issues and earthquake-induced ground shaking could adversely impact the storage site.

Impact G-3: Ground shaking could compromise integrity of the OSG Storage Facility

The anticipated ground motions at the DCPP site as determined in the 1988 LTSP form the present design basis for the proposed OSG Storage Facility. Severe ground shaking could compromise the integrity of the OSG Storage Facility if the materials and design of the structure are not based on all relevant earthquake data, including recent data on earthquake activity near the DCPP site. Ground shaking could cause damage to the OSG Storage Facility if the facility is not designed according to relevant recent earthquake data. Implementing Mitigation Measure G-3a would ensure the 1988 LTSP is updated and that this impact is reduced to less than significant levels (Class II).

Mitigation Measure for Impact G-3, Ground shaking could compromise integrity of the OSG Storage Facility

G-3a **Long Term Seismic Program Update.** The analyses completed for the Long Term Seismic Program (PG&E, 1988) shall be refined to incorporate new earthquake data that have been derived since publication of the LTSP. This update should be reviewed by the Diablo Canyon Independent Safety Committee, the NRC, and the CPUC at least 60 days prior to final approval of the OSG Storage Facility design. Based on the updated information, a new Design Earthquake (the seismicity characteristics that a structure is designed to withstand) shall ~~would~~ be developed for the proposed OSG Storage Facility by PG&E~~and incorporated into the structural design of the facility~~. PG&E shall also confirm that the updated information has been submitted to the NRC for consideration in the OSG Storage Facility design plan.

Impact G-4: Slope instability could affect design, construction, and functioning of the OSG Storage Facility

The proposed OSG Storage Facility would be located at the base of a steep slope comprised of Obispo Volcanics. A large, old landslide is mapped on this slope and in the "man camp" area (Hall, 1974). Maps provided by PG&E did not indicate the amount of cut and fill modifications to the old landslide in the "man camp" area, so it is not possible to completely assess the suitability of this site for a long-term storage facility for radioactive material, albeit low-level waste. The proposed OSG Storage Facility would be on a modified landslide area above Diablo Creek. Settling, shifting, or sliding in this area could eventually compromise the OSG Storage Facility. A detailed geotechnical evaluation to identify any necessary methods to stabilize slopes in the vicinity of the proposed OSG Storage Facility, or specification of a bunker-type construction style including solid, reinforced cement walls that are bound together for the storage facility would minimize the impact of this geologic hazard to less than significant levels (Class II).

Mitigation Measure for Impact G-4, Slope instability could affect design, construction and functioning of the OSG Storage Facility

G-4a **Evaluate slope stability in the vicinity of the OSG Storage Facility site.** A geotechnical evaluation ~~similar to that done for the ISFSI~~ shall be undertaken by PG&E and/or the construction contractor to assess the stability of the north-facing slopes in the area of the proposed OSG Storage Facility, both above and below the level of the current "man camp." This report should be reviewed and approved by PG&E and CPUC at least 60 days prior to final approval of the OSG Storage Facility design. Such an evaluation shall include exploratory borings and surface mapping of the north-facing slope. Slope stability evaluation shall include analysis of the dip of layered rock, identification of clay beds, and presence and orientation of small faults and fractures with orientations parallel or subparallel to the slope. Static and dynamic stability analysis shall be performed

in accordance with all applicable building codes, considering the information developed under Mitigation Measure G-3a~~using the most recent seismic acceleration values as derived since the 2003 San Simeon earthquake~~.

If the report indicates either the upper or lower portion of the slope could become unstable, remedial measures (e.g., construction of engineered retaining wall; improved slope drainage; remove excess colluvium; engineering design of the structure to withstand postulated landslide loads) shall be developed or a different location (already analyzed in this EIR) for the OSG Storage Facility shall be selected.

D.5.3.5 Replacement Steam Generator Installation

There would be only transient impacts from the possibility of seismic ground shaking during the work of steam generator installation. As identified for other phases of work, an earthquake during this phase could jeopardize worker safety (Impact G-2). Protecting workers from potentially falling rock or toppling equipment, as specified in Mitigation Measures G-2a and G-2b, would reduce Impact G-2 to less than significant levels (Class II). There would be no impacts to geological, soils, or paleontological resources with this phase of the project.

D.5.4 Environmental Impacts and Mitigation Measures for the Alternatives

D.5.4.1 Replacement Steam Generator Offloading Alternative

The narrow transport route between the Intake Cove and the rest of the DCPP facility would be subjected to extremely heavy loads during transport of the RSGs under this alternative (Impact G-1). The Applicant notes that the path from the Intake Cove was used in 1995 to bring massive transformers to DCPP. Implementation of Mitigation Measure G-1a would ensure that any potentially unstable ~~transport~~ portions of the route~~s~~ between the Intake Cove and the TSA are not overloaded, which would reduce Impact G-1 to less than significant levels (Class II). Close quarters and nearby cliffs above the road to Intake Cove could be dangerous in an earthquake. Ground shaking could loosen boulders from the top or sides of the cliff; as with the Proposed Project, the offloading could jeopardize worker safety (Impact G-2), which would warrant implementation of Mitigation Measures G-2a and G-2b (Class II) to ensure less than significant impacts.

D.5.4.2 Temporary Staging Area Alternatives

All of the temporary staging locations would occupy paved and previously modified surfaces. There would be no geologic impact for any of these sites other than the issues associated with ground shaking (Impact G-2), which could be mitigated to less than significant levels with Mitigation Measures G-2a and G-2b (Class II).

D.5.4.3 Original Steam Generator Storage Facility Location Alternatives

Each of the alternative OSG Storage Facility locations, as well as the Proposed Project, would be exposed to approximately similar seismic hazards from ground shaking (Impact G-3), and they would be located on either "made ground" at the switching station or the modified landslide area above Diablo Creek, which would be exposed to the hazard of slope instability (Impact G-4). Because each of the locations

either lie above a steep slope of ancient landslide material (at the base of the slope is Diablo Creek) or at the base of the north-facing slope in the "man camp" area (just east of the switchyard), the long-term stability of the slopes must be considered. Implementing Mitigation Measure G-3a would address the seismic ground shaking hazard, and Mitigation Measure G-4a would reduce the impact of the slope instability hazard to less than significant levels (Class II). The Proposed Project and OSG Storage Facility Location Alternatives A and B would have a greater likelihood of being affected by potential instabilities of the bluff over Diablo Creek.

D.5.4.4 Original Steam Generator Offsite Disposal Alternative

Offsite disposal of the OSGs would eliminate the need for construction of the OSG Storage Facility and thus, would not require the same geotechnical and construction preparation as onsite storage. Therefore, there would be less potential impacts at the DCPP facility than the Proposed Project and the OSG Storage Facility Location Alternatives, and potential environmental impacts, if any, would occur at the alternative offsite disposal location instead.

D.5.5 Environmental Impacts of the No Project Alternative

The No Project Alternative would probably cause the power plant to shut down in approximately 2013 or 2014. This would decrease the potential for infrastructure damage or worker injury due to earthquakes or landslides. The No Project Alternative would probably also result in the construction of replacement power plants and replacement transmission lines or the expansion of existing power plants elsewhere in central California. New power plants based on either fossil fuels or renewable energy sources may have local geological impacts or be impacted by geological hazards. Facility siting requirements, normally addressed through CEQA compliance, would likely ensure that the replacement facilities are designed and built to minimize geological impacts or exposure to geological hazards.

D.5.6 Mitigation Monitoring, Compliance, and Reporting Table

Table D.5-2 shows the mitigation monitoring, compliance, and reporting program for Geology, Soils, and Paleontology.

Table D.5-2. Mitigation Monitoring Program – Geology, Soils, and Paleontology

IMPACT G-1	**Extremely heavy loads could mobilize unstable ground along transport route (Class II)**
MITIGATION MEASURE	**G-1a: Prevent overloading of unstable ground along transport route.** Existing geotechnical reports shall be reviewed by PG&E/CPUC not less than one year prior to the scheduled transport of the RSGs. PG&E/CPUC shall determine if the existing reports provide sufficient information to establish that the load-bearing capacity of soils and geologic features at the offloading area or along the transport route would support the loads, or if additional studies are necessary. If new studies are necessary, they shall be completed not less than ten months prior to commencement of the Proposed Project. Either the existing geological reports or new studies shall meet the following performance criteria not less than six months before the scheduled start of transport activities: • Report clearly identifies any and all unstable portions of the transport route. • PG&E or its consultant shall develop plans for any necessary road improvements, which shall be reviewed by the CPUC or its consultant to ensure that proposed improvements would both (1) ensure ground stability of all roads to be used during transport, and (2) remain within the footprint of the proposed route (as defined in the Proposed Project or the Replacement Steam Generator Offloading Alternative) so as to ensure that there would be no additional environmental impacts. Any and all necessary road improvements shall be completed at least 60 days prior to the scheduled start of transport activities. The CPUC or its environmental monitor shall ensure construction activities remain within the defined road footprint. In addition, the CPUC or its consultant shall survey the transport route after the completion of construction but before the start of transport activities to ensure that all necessary ~~completed~~ improvements have been implemented on ~~successfully stabilized appropriate portions of~~ all roads to be used during transport.
Location	Entire transport route
Monitoring / Reporting Action	Letter report providing summary of geotechnical reports reviewed; new reports if necessary; CPUC to review and approve any road improvements; CPUC to verify stability of road(s) after completion of all reports and construction but before transport
Effectiveness Criteria	Route not damaged during project; roadway capable of supporting heavy loads; no additional environmental impacts from stabilization of transport route
Responsible Agency	CPUC, County of San Luis Obispo, Port San Luis Harbor District
Timing	Prior to start of project (see text of measure for exact time limits)
IMPACT G-2	**Temporary effects of earthquake shaking could endanger worker safety (Class II)**
MITIGATION MEASURE	**G-2a: Protect workers from temporary effects of earthquake shaking.** The Applicant shall produce a safety plan that specifically includes measures that will be taken to ensure worker safety during earthquake-caused ground shaking. Elements of the plan should include, but not be limited to the following: (a) a protocol for workers to follow in the event an earthquake occurs; (b) protocols for set-up and management of equipment during the loading, transport, offloading, staging, and installation phases of the project that address the potential effects of ground shaking; (c) training for workers so they will know what to do in the event of an earthquake. CPUC ~~to~~ shall review the safety plan for consistency with California Occupational Safety and Health Standards and approve the safety plan prior to commencement of any Proposed Project activities.
Location	Entire transport route

Table D.5-2. Mitigation Monitoring Program – Geology, Soils, and Paleontology

Monitoring / Reporting Action	Provide copy of Safety Plan.
Effectiveness Criteria	No workers injured by effects of seismic shaking during project
Responsible Agency	CPUC, local planning agencies
Timing	Prior to start of Proposed Project~~transportation of the RSGs~~
MITIGATION MEASURE	**G-2b: Prevent casualties caused by falling rocks.** Rocks and boulders that are precariously situated above portions of the transport route shall be identified and evaluated to determine if they should be removed or stabilized prior to project commencement.
Location	Entire transport route
Monitoring / Reporting Action	Provide letter report stating that the precarious rock survey has taken place and what action has been or will be taken.
Effectiveness Criteria	No workers injured by falling rock during project
Responsible Agency	CPUC, County of San Luis Obispo
Timing	Prior to transport of RSGs along route
IMPACT G-3	**Ground shaking could compromise integrity of the OSG Storage Facility (Class II)**
MITIGATION MEASURE	**G-3a: Long Term Seismic Program Update.** The analyses completed for the Long Term Seismic Program shall be refined to incorporate new earthquake data that have been derived since publication of the LTSP. This update should be reviewed by the Diablo Canyon Independent Safety Committee, the NRC, and the CPUC at least 60 days prior to final approval of the OSG Storage Facility design. Based on the updated information, a new Design Earthquake (the seismicity characteristics that structure is designed to withstand) ~~would~~ shall be developed for the proposed OSG Storage Facility by PG&E~~and incorporated into the structural design of the facility~~. PG&E shall also confirm that the updated information has been submitted to the NRC for consideration in the OSG Storage Facility design plan.
Location	Vicinity of all OSF Storage Facility potential locations
Monitoring / Reporting Action	Submit updated ~~plan~~ information to Diablo Canyon Independent Safety Committee, the NRC, and the CPUC at least 60 days prior to final approval of the OSG Storage Facility design.
Effectiveness Criteria	Updated information on seismic hazards
Responsible Agency	CPUC, County of San Luis Obispo, NRC, Diablo Canyon Independent Safety Committee
Timing	Prior to start of Proposed Project and at least 60 days prior to final approval of the OSG Storage Facility design
IMPACT G-4	**Slope instability could affect design, construction, and functioning of the OSG Storage Facility (Class II)**
MITIGATION MEASURE	**G-4a: Evaluate slope stability in the vicinity of the OSG Storage Facility site.** A geotechnical evaluation ~~similar to that done for the ISFSI~~ shall be undertaken by PG&E and/or the construction contractor to assess the stability of the north-facing slopes in the area of the proposed OSG Storage Facility, both above and below the level of the current "man camp." This report should be reviewed and approved by PG&E and the CPUC at least 60 days prior to final approval of the OSG Storage Facility design. Such an evaluation shall include exploratory borings and surface mapping of the north-facing slope. Slope stability evaluation shall include analysis of the dip of layered rock, identification of clay beds, and presence and orientation of small faults and fractures with orientations parallel or subparallel to the slope. Static and dynamic stability analysis shall be performed in accordance with all applicable building codes, considering the information developed under Mitigation Measure G-3a~~using the most recent seismic acceleration values as derived since the 2003 San Simeon earthquake~~. If the report indicates either the upper or lower portion of the slope could become unstable, remedial measures (e.g., construction of engineered retaining wall; improved slope drainage; remove excess colluvium; engineering design of the structure to withstand postulated landslide loads) shall be developed or a different location (already analyzed in this EIR) for the OSG Storage Facility shall be selected.

Table D.5-2. Mitigation Monitoring Program – Geology, Soils, and Paleontology

Location	Vicinity of the OSF Storage Facility potential locations
Monitoring / Reporting Action	Geotechnical report to CPUC at least 60 days prior to final approval of the OSG Storage Facility design
Effectiveness Criteria	Engineering design to stabilize slope and protect improvements during construction and long-term operation
Responsible Agency	CPUC, County of San Luis Obispo, NRC, Diablo Canyon Independent Safety Committee
Timing	Prior to start of Proposed Project and at least 60 days prior to final approval of the OSG Storage Facility design

D.5.7 References

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