D.12 System and Transportation Safety

This section describes the environmental and regulatory setting, significance criteria, and an evaluation of system safety/risk of upset (i.e., accident) impacts associated with the proposed San Onofre Nuclear Generating Station (SONGS) Steam Generator Replacement Project. The CEQA Guidelines recommend identifying hazards and risks to the public or environment caused by the project. However, the CEQA Guidelines do not provide any recommended significance criteria for radioactive hazards or risk of upset, and federal government control limits the ability of the CPUC to mitigate impacts in this area. It should be noted that the power plant is required to comply with NRC regulations for the possession, handling, storage, and transportation of radioactive materials in use at a nuclear power plant. These regulations address radioactive hazards, safety issues, and spent fuel handling and storage. The State of California, including the California Public Utilities Commission, and local jurisdictions such as San Diego County are preempted from imposing any regulatory requirements concerning radiation hazards and nuclear safety on nuclear power plant operators. The operation of nuclear generating facilities and the possession, handling, storage, and transportation of radioactive materials are therefore precluded from State regulation. The Applicant's operating licenses require them to comply with all NRC regulations that apply to the operations and activities, including the replacement of key facility components and disposal of contaminated material. These regulations are provided in Section D.12.2 of this EIR.

The CPUC has jurisdiction over limited activities that are not pre-empted by federal government control. This includes permitting transport and construction-related activities for the Proposed Project. Nuclear and radiological safety issues related to the proposed SONGS Steam Generator Replacement Project are solely under the NRC jurisdiction. This System and Transportation Safety section is included in this EIR to provide the reader with an understanding of the safety issues associated with the Proposed Project. The CPUC cannot use the information contained in this section of the EIR to regulate or condition the nuclear and radiological safety issues of the Proposed Project given the NRC's sole jurisdiction over safety issues associated with the permitting, construction and operation of SONGS, including the replacement of steam generators. However, this information is included to provide full disclosure of potential environmental safety impacts associated with the Proposed Project.

D.12.1 Environmental Setting for the Proposed Project

Baseline safety and risk of upset conditions at SONGS have been evaluated in several documents, including the Safety Analysis Report (SAR) and updates. There are three major systems that contribute to baseline safety conditions at SONGS, including:

- Units 2 and 3 reactors and systems,
- Spent fuel storage pools, and
- Dry cask spent fuel storage facility (an independent spent fuel storage installation [ISFSI]).

There are a wide variety of potential releases that could occur from the SONGS facilities. In response to potential radiation releases, SONGS has a comprehensive Emergency Response Plan (ERP) in place. The ERP identifies an Emergency Planning Zone (EPZ) for an area within a 10-mile radius of the facility as shown in Figure D.12-1. The EPZ encompasses all or portions of San Clemente, Dana Point, San Juan Capistrano, and Marine Corps Base Camp Pendleton (MCBCP). The 10-mile EPZ for SONGS calls for evacuation of this entire region if a worst case accident were to occur. There is also a 50-mile

Ingestion Pathway Zone for SONGS that calls for the monitoring of all food products and milk grown or produced within this 50-milc region in the event of a worst case accident at SONGS with a release of radiation.

Radiation Terminology and Background

This section of the EIR contains many terms associated with standard measures of nuclear radiation that the average reader may find unfamiliar. In defining exposure levels in subsequent sections of the EIR, most exposures are references by a dose or equivalent dose. Therefore, the following definitions have been provided.

Dose	The absorbed dose, given in rads, that represents the energy in ergs or Joules absorbed from the radiation per unit mass of tissue. Furthermore, the biologically effective dose or dose equivalent, given in rem or Sieverts, is a measure of the biological damage to living tissue from radiation exposure.
Nuclide	Any species of atom that exists for a measurable length of time. A nuclide can be distinguished by its atomic mass, atomic number, and energy state.
Curie	The original unit used to describe the intensity of radioactivity in a sample of material. One curie equals 37 billion disintegrations per second, or approximately the radioactivity of one gram of radium. This unit is no longer recognized as part of the International System of units. It has been replaced by the Becquerel.
Becquerel	An SI unit of radioactivity, defined as one disintegration per second. Replaces the Curie.
Sievert	A measure of dose (technically, dose equivalent) deposited in body tissue, averaged over the body. Such a dose would be caused by an exposure imparted by ionizing X radiation undergoing an energy loss of 1 joule per kilogram of body tissue (l gray). One Sievert is equivalent to 100 mrem or 0.1 rem.
Rem	An acronym for Roentgen Equivalent Man. A unit which measures radiation in terms of the energy involved (the same as RAD), weighted by a factor related to the type of radiation. For the types of radiation used in radiologic procedures this factor is equal to one, so the REM is equivalent to the RAD.
mrem	One millirem, or one thousandth of a rem.
RAD	An acronym for Radiation Absorbed Dose. A unit which measures radiation in terms of the absorbed dose. For radiological procedures it is equivalent to the rem, and the two units are used interchangeably. It represents the absorption of 100 ergs of nuclear (or ionizing) radiation per gram of absorbing material, such as body tissue.
erg	A metric unit of energy equal to work done by a force of 1 dyne (or 1 $g\text{-}cm/s^2$) acting over a distance of 1 cm. 10^7 (ten million) $erg\text{-}s^{-1}$ (ergs per second) = 1 watt. Also, 1 Calorie = 4.2×10^{10} (42 billion) ergs.

Figure D.12-1. SONGS Emergency Planning Zone Map

CLICK HERE TO VIEW

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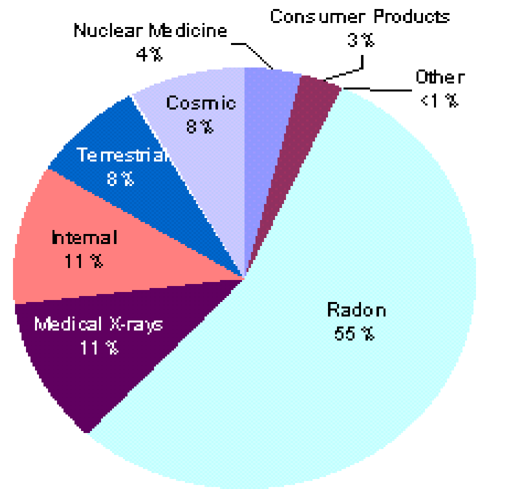
In the United States, human exposure to potentially harmful radiation is commonly measured in units called millirem (one one-thousandth of a rem). On average, each individual receives about 360 millirem of radiation each year. About 300 millirem, or 82 percent of the total, is natural background radiation (from radon and other natural sources). The remaining 18 percent of our radiation exposure is from manmade sources as shown in Figure D.12-2 (National Safety Council, 2002).

Figure D.12-2. Sources of Radiation Exposure



Source: National Safety Council, 2002.

Reactor Risk Baseline

Potential accidents associated with the operation of pressurized water reactor (PWR) nuclear power plants have been well documented. As noted above, SCE maintains a SAR to address all potential off-normal (i.e., events that are not considered normal operating conditions but do not result in an accident) and accident (conditions that could lead to or result in a release of radioactive material) scenarios for SONGS. Most off-normal and accident conditions would not result in any release of radioactive material, nor any impact to the surrounding environment.

The Reactor Safety Study (referred to as WASH-1400) was published in by the NRC in 1975. It was intended to estimate the probabilities of occurrences of accidents involving radioactivity release and to assess the risk of such accidents relative to other risks. The study involves (1) a list of potential accidents in nuclear reactors, (2) estimation of the likelihood of accidents resulting in radioactivity release, (3) estimation of health effects associated with each accident, and (4) comparison of nuclear accident risk with other accident risks. The findings of WASH-1400, which was published prior to the Three Mile Island accident, found that the risk of a nuclear accident was small and almost negligible compared with more common risks. Based on the number of U.S. reactors and the Three Mile Island accident, the calculated core damage frequency (CDF) is 1 in 2679 reactor-years or 3.7×10^{-4}/reactor-year (MIT, 2003), which translates to 1 in 1340 years or 7.5×10^{-4}/year for SONGS. Probabilistic Risk Assessment (PRA) experts estimate the CDF to be on the order of 1.0×10^{-4}/ reactor-year (MIT, 2003) or an equivalent of 2.0×10^{-4}/year at SONGS. In NUREG-0933,[1] the NRC estimates the CDF for pressurized water reactors such as the type at SONGS to be much lower at 1.236×10^{-5}/reactor-year (NRC, 2004a), which translates to 1 in 40,450 years or 2.472×10^{-5}/year for SONGS. This information consistently demonstrates that the probability of a core-damaging accident for a facility like SONGS is greater than ten in one million per year (1×10^{-5}/year), which is a widely accepted probability for defining significant risk.

In a study published by the U.S. House of Representatives in 1982, “Calculation of Reactor Accident Consequences (CRAC2) for U.S. Nuclear Power Plants (Health Effects and Costs) Conditional on an 'SST1' Release,” potential offsite consequences of a large meltdown release from either of the SONGS reactors were evaluated. The study, based on 1982 population and dollars, found the potential for approximately 27,000 peak early fatalities, 23,000 peak early injuries, 18,000 peak cancer deaths and property damage on the order of $182-186 billion. While the CRAC2 modeling was considered conservative and for a highly unlikely worst-case release, it is clear that the consequences associated worst-case nuclear power plant accidents would be substantial.

1 NRC document “A Prioritization of Generic Safety Issues” (NRC, 2004a)

At the present time, the combined frequency and potentially severe consequences of a core-damaging accident at SONGS represent a substantial public safety risk (as noted above, greater than ten in one million per year [1 x 10^{-5}/year]). While there are numerous events that can lead to an off-normal or accident condition at the SONGS reactors, the worst-case events would likely be associated with a Loss-of-Coolant Accident (LOCA) or reactor vessel failure (recent experience at the Davis-Besse reactor found a large cavity in the reactor vessel head that seriously jeopardized reactor vessel safety [MIT, 2003]). It should be noted that steam generator tube failures are a substantial contributor to overall facility risk and radioactive leak risk.

Spent Fuel Risk Baseline

In addition to reactor accidents, a high level of attention has been given to the issue of spent fuel handling and storage. Hazards associated with spent fuel pool fires and dry cask storage facilities have been evaluated by Sandia National Laboratory (1979), the NRC (2001), the Electric Power Research Institute (EPRI, 2002) and others (Alvarez et al., 2003). These issues, which are relevant to the existing spent fuel storage facilities at SONGS, were summarized by San Luis Obispo County in the Environmental Impact Report for the Diablo Canyon Independent Spent Fuel Storage Installation (SLO County, 2004). The Final Environmental Impact Report for the Diablo Canyon Power Plant Steam Generator Replacement Project (released by CPUC August 2005) also provides a discussion of baseline spent fuel risk and contains relevant information on the spent fuel baseline issue in the response to public comments.

The Proposed Project would occur as part of a regular refueling cycle for each unit, and all fuel would be removed from the reactors, which occurs during a normal refueling event. The SONGS nuclear reactors use enriched uranium oxide fuel pellets stacked end-to-end in 12-foot Zirconium alloy-based sealed rods to generate heat for conversion to electric power. These rods are arranged in groups known as fuel assemblies containing 264 fuel rods. Each reactor core has 193 fuel assemblies. Both units are currently operating on 18- to 21-month refueling cycles, and refueling outages normally last between 2 to 4 months.

During normal refueling operations, spent fuel is transferred into water-filled pools (wet racks) to allow for further cooling and radiation shielding. Each reactor has a dedicated fuel handling system and spent fuel storage pool. During the Proposed Project, all fuel from the reactor would be placed in the spent fuel pools. Temporarily relocating the fuel is considered part of the baseline because this normally occurs during refueling outages.

The spent fuel storage pools are located in the fuel handling building/auxiliary building, which is adjacent to the containment buildings. Spent fuel assemblies are normally removed from the reactor and transferred underwater to metal racks submerged in a pool of borated water. The pools have a cooling system to maintain the pool temperature below 140°F. The pool water cools the fuel rods and also serves as a shield against radiation. The pools are equipped with a redundant set of cooling pumps to serve as a backup in the event of loss of the main pumps.

When SONGS was originally built, the spent fuel pools were designed to hold a limited number of fuel assemblies, accommodating the fuel used by Units 2 and 3 through roughly 2007. At the time of the original design, it was expected that the spent fuel would be removed from the site for reprocessing for long-term storage at a federal site. Facilities for the commercial reprocessing of spent fuel or a long-term storage facility are currently not available.

The Applicant applied to the NRC and received approval to re-rack the spent fuel storage pools and increase the density of spent fuel storage in the pool. As part of this application a number of abnormal and accidental conditions were addressed. These included:

- A dropped fuel assembly accident,
- Abnormal location of a spent fuel assembly, and
- Lateral rack movement.

The analysis contained in the application and the NRC licensing review for re-racking showed that none of these postulated events would result in exceeding the design reactivity factor for the pools. The reader is referred to the Reracking Application and associated NRC licensing record for additional information on these accidental events.

SCE was required to identify and evaluate several normal and operational deviations and off-normal handling conditions associated with dry cask handling and operations in the SAR for its ISFSI. Potential radiation exposures would be managed in a manner that maintains personnel radiation doses "as low as reasonably achievable" (ALARA). The SONGS ALARA program complies with the requirements of 10 CFR 20[2] and 10 CFR 50.[3] The ALARA program is implemented through administrative procedures and working level procedures.

The Health Physics Program used for operating the SONGS dry cask storage facility would implement the requirements of 10 CFR 20, 10 CFR 72,[4] and the implementation of the ALARA philosophy for all site activities involving potential radiation exposure. The Radiation Protection Manager is responsible for administering, coordinating, planning, and scheduling all radiation protection activities involving the ISFSI. The primary objective of the Health Physics Program is to maintain radiation exposures to workers, visitors, and the general public below regulatory limits and otherwise ALARA.

"Off-normal" operations are events that deviate from normal operations, but are not considered accidents. Many of the off-normal events will likely occur over the life of the facility, but with minimal consequences. Off-normal operations include:

- Off-normal pressures
- Off-normal environmental temperatures
- Confinement boundary leakage
- Partial blockage of air inlets
- Cask drop less than allowable height
- Loss of electric power
- Cask transporter off-normal operation

None of these events are considered to represent a threat to public safety. As with off-normal operations, SCE has identified and thoroughly evaluated several accidental conditions associated with storage cask handling and operations. Many of these scenarios include "external events" that could occur which are beyond the control of SCE, such as natural disasters. The accident scenarios postulated include:

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2 Standards for Protection Against Radiation

3 Domestic Licensing of Production and Utilization Facilities [for nuclear facilities]

4 Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste.

- Earthquake
- Tornado
- Flood
- Tsunami
- Drops and tip-over
- Fire
- Explosion
- Leakage through confinement boundary
- Electrical accident
- Loading of an unauthorized fuel assembly
- Extreme environmental temperature
- Loss-of-neutron shielding
- Adiabatic heat-up
- Partial blockage of MPC vent holes
- 100% fuel rod rupture
- 100% blockage of air inlet ducts
- Transmission tower collapse
- Nonstructural failure of a lift jack

These spent fuel storage accident scenarios would not be expected to cause substantial public safety impacts.

Low-Level Radioactive Waste Baseline

Low-level radioactive waste (LLW or LLRW) from nuclear power plants ranges from trash suspected of being slightly contaminated to highly radioactive material such as activated structural components found within or in close proximity to the reactor. LLW includes reactor components, tools, spent demineralizer resins, evaporator concentrates, used filters, and miscellaneous contaminated wastes such as rags, mops, paper, and protective clothing.

All solid LLW at SONGS is handled according to SCE Solid Low-Level Radioactive Waste Management Procedures. The LLW that SONGS generates is disposed at the Envirocare of Utah facility.

The following discussion from the NRC summarizes the conditions for LLW onsite storage, which could occur as an alternative to SCE's Proposed Project (NRC, 1996):

> *LLW is normally stored on site on an interim basis before being shipped off site for permanent disposal. On-site storage facilities are designed to minimize personnel exposures. High-dose-rate LLW is isolated in a shielded storage area and is easily retrievable. The lower-dose-rate LLW is stacked or stored to maximize packing efficiencies. NRC requirements and guidelines ensure that LLW is stored in facilities that are designed and operated properly and that public health and safety and the environment are adequately protected (EPRI NP-7386). NRC requirements and guidelines include the following:*
>
> - *The amount of material allowed in a storage facility and the shielding used should be controlled by dose rate criteria for both the site boundary and any adjacent off-site areas. Direct radiation and effluent limits are restricted by 10 CFR Part 20 and 40 CFR Part 190. The exposure limits given in 10 CFR 20.1301 apply to unrestricted areas.*
> - *Containers and their waste forms should be compatible to prevent significant corrosion within the container. After a period of storage, the subsequent transportation and disposal should not cause a container breach.*
> - *Gases generated from organic materials in waste packages should be evaluated periodically with respect to container breach. After a period of storage, the subsequent transportation and disposal should not cause a container breach.*

- *Gases generated from organic materials in waste packages should be evaluated periodically with respect to container breach. High-activity resins should not be stored more than 1 year unless they are in containers with special vents.*
- *A program of at least quarterly visual inspection should be established.*
- *A liquid drainage collection and monitoring system should be in place. Routing of the drain should be to a radwaste processing system (EPRI NP-7386).*

NRC has historically discouraged the use of on-site storage as a substitute for permanent disposal. NRC Generic Letter 81-38 (NRC 1981) states that no facility should be built to store waste for longer than 5 years under a licensee's 10 CFR 50.59 evaluation. Specific NRC approval should be obtained. This limitation was based in part on safety considerations but was aimed at encouraging the development of permanent LLW disposal facilities. However, recognizing that the 5-year limit has not influenced the development of new waste disposal facilities and that the states continue to make slow progress, NRC has eliminated in its guidance any language that the 5-year term is a limit beyond which storage would not be allowed.

Regarding nuclear power reactors, the 5-year limit is associated with the need to obtain a separate Part 30 license to store LLW. Generic Letter 81-38 states that under certain conditions, Part 50 licensees should obtain a Part 30 materials license to store LLW. These conditions are that (1) there exists an unreviewed safety question with the proposed storage facility, (2) the existing license conditions or technical specifications prohibit increased storage, or (3) the planned storage time exceeds 5 years. Other than for the conditions noted, NRC regulations and procedures do not call for a separate Part 30 license for power reactors for LLW storage, because power reactor licensees are already authorized under Part 30 to possess by-product materials produced by the operation of the facility within the limits of their operating license.

Generic Letter 81-38 states that the application for a Part 30 license is for the administrative convenience of the Commission and is not intended to be substantively different from an application for amendment of the facility operating license (i.e., the Part 50 license). Because Part 50 licensees are already authorized under Part 30 to possess their LLW, NRC staff revised the guidance to state that these licensees should amend their Part 50 licenses when the storage of LLW is not within the limits of their current operating license. On February 1, 1994, the Commission, in responding to SECY-93-323, which recommended withdrawal of the on-site storage rulemaking, directed the staff to eliminate the requirement for power reactor licensees to obtain a separate Part 30 license (SECY-94-198). Agreement states are currently reviewing proposed changes to existing guidance.

Several events have increased the trend towards longer on-site storage. These events include the closure of the Beatty, Nevada, site in 1992; the restriction of the Richland, Washington, facility to Northwest Compact and Rocky Mountain Compact states and the restriction of the Barnwell, South Carolina, site to waste generated by Southeast Compact states. As of July 1994, 33 states were without access to licensed full-service disposal facilities. The status of state efforts to form compacts and identify new disposal sites is discussed in Section 6.4.3.3 [NUREG-1437 Vol. 1]. However, as of July 1, 1995, all states except North Carolina have access to the Barnwell site. The Envirocare site in Utah takes limited types of waste from certain generators.

The NRC (1996) also notes that there will likely be additional quantities of LLW generated associated with "extended power plant operations under renewed licenses" and the need for steam generator replacements in PWRs.

The NRC has entered into agreements with 33 states (including California), called Agreement States, to allow these states to regulate the management, storage and disposal of certain nuclear wastes. The NRC relinquishes to the Agreement States portions of its regulatory authority to license and regulate byproduct materials (radioisotopes); source materials (uranium and thorium); and certain quantities of special nuclear materials. Federal law, however, does not permit the NRC to delegate its responsibility for regulating nuclear power plants to Agreement States (Ohio State University, 2001a and 2001b). Nuclear power reactors in the United States must be licensed by the NRC and must comply with NRC regulations and conditions specified in the license in order to operate.

The Low Level Radioactive Waste Policy Amendments Act of 1985 gave the states responsibility for the disposal of their LLW. The Act encouraged the states to enter into compacts that would allow them to dispose of waste at a common disposal facility. Most states have entered into compacts; however, due to numerous political and technical issues, no new disposal facilities have been built since the Act was passed (NRC, 2005).

California became an Agreement State in 1962 and is a member of the Southwest Compact (including Arizona, North Dakota and South Dakota). The California Agreement State program is located in the Department of Health Services, Radiologic Health Branch. The Radiologic Health Branch administers the radioactive materials program. The California program regulates approximately 2,182 specific licenses authorizing radioactive materials (NRC, 2004b). The State of California does not have authority to regulate the management, storage, or disposal of LLW at nuclear power plants (California Department of Health Services, Radiologic Health Branch, 2005).

The Southwest Compact does not have a licensed disposal site, resulting in the need for facilities to utilize one of three nationwide disposal sites or store LLW onsite. California was originally slated to host the Southwest Compact disposal facility at the Ward Valley Low Level Radioactive Waste facility. However, potential contamination groundwater migration issues at the Ward Valley LLWL site were never satisfactorily resolved, and the facility was never permitted or constructed.

The three U.S. commercial land disposal facilities accept waste only from certain states or accept only limited types of LLW as discussed below. The remainder of the LLW is stored primarily at the site where it was produced, such as at nuclear power plants, hospitals, research facilities, and clinics (NRC, 2002b). Each of the three operating LLW disposal sites is located in and regulated by an Agreement State (i.e., South Carolina, Washington, and Utah). Each state has an oversight program that consists of periodic inspections of the facilities. The inspectors examine whether incoming shipments are properly documented and analyzed for their radioactive material content. They also ensure that licensees properly implement the radiation safety and waste disposal requirements.

The Barnwell, South Carolina disposal site is licensed by the State of South Carolina to receive wastes in Classes A through C.[5] The site accepts waste from all U.S. generators except those in Colorado, Nevada, and New Mexico (Rocky Mountain Compact states) and Idaho, Montana, Oregon, Utah, Washington, and

5 Based on the requirements of 10 CFR 61, LLW is classified as A, B, C or GTCC (greater than Class C) according to the half-lives and concentrations of key radionuclides. In general, requirements for waste form, stability, and disposal methods become more stringent when going from Class A to GTCC.

Wyoming (Northwest Compact states). Beginning in 2008, Barnwell will accept waste only from Connecticut, New Jersey, and South Carolina (Atlantic Compact states) (NRC, 2005).

The Hanford, Washington disposal site is licensed by the State of Washington to receive wastes in Classes A through C. The site accepts waste only from generators located in Colorado, Nevada, and New Mexico (Rocky Mountain Compact) and Idaho, Montana, Oregon, Utah, Washington, and Wyoming (Northwest Compact) (NRC, 2005).

The Envirocare disposal site located in Clive, Utah is licensed by the State of Utah for Class A waste only. This site accepts waste from all regions of the U.S. (NRC, 2005). If no new LLW disposal sites are licensed, after 2008, California-generated LLW will only be accepted by the Envirocare site. California's inability to construct and operate a LLW disposal site will result in there being no place to ship commercial Class B and C waste by 2008, and Envirocare of Utah will have a monopoly on disposal of Class A waste.

The steam generators replaced under the Proposed Project would be classified as a Class A waste. Many other nuclear power plant facilities undergoing similar steam generator replacements have opted to store steam generators onsite, including: Palo Verde in Arizona, Oconee in South Carolina, Calvert Cliffs in Maryland, and Sequoyah in Tennessee. Facilities will continue to store OSGs onsite until alternative disposal sites become available that allow for the cost-effective disposal of LLW.

Facility Security and Terrorism Issues

Subsequent to the events of September 11th, 2001, the NRC and commercial nuclear industry have implemented a variety of measures aimed at reducing the likelihood of a successful terrorist attack on nuclear facilities. Within hours of the September 11th attacks, the NRC issued a series of classified, security-related advisories to power reactor licensees which were above and beyond current regulatory requirements. These security enhancements were later formalized in an order issues on February 25, 2002. The order imposed Interim Compensatory Measures (ICMs) covering a wide variety of issues, which SCE implemented by August 31, 2002. Later, in April 2003, NRC issued a new design basis threat (DBT), which establishes the maximum terrorist threat that a facility must defend against, and required plants to develop and implement new security plans to address the new threat by October 2004. The NRC DBT and SCE security plans are not publicly available and are not discussed in this EIR.

SONGS has been designed and constructed to withstand potential hazards associated with natural external events, such as earthquakes, tornadoes, floods, and hurricanes. Terrorist attacks by fire or explosion would be analogous to external natural events and their implications for damage and release of radioactivity. The reactors are protected by a robust containment structure, which is typically protected by about four feet of reinforced concrete with a thick steel liner, and the reactor vessel, which is made of steel that is about six inches thick. Based on a peer-reviewed study prepared by EPRI, areas of the plant that house the reactor would withstand the impact of a widebody commercial aircraft (EPRI, 2002) and containment would not be breached. Therefore, it is unlikely that a terrorist attack on a nuclear reactor would result in a large-scale radioactivity release. However, nuclear power plant spent fuel facilities are not afforded the same level of protection as the reactors and could pose a potential risk of radioactivity releases in the event of a terrorist attack.

Potential terrorist threats to the SONGS spent fuel pools have not been publicly evaluated, but the pools are at risk to terrorist attack. It has been known for some time that loss of water in the spent fuel pools could result in spent fuel heating up relatively quickly to temperatures where the fuel cladding could catch fire resulting in the release of nuclear material to the environment (Sandia, 1979). The NRC has estimated the probability of this type of event to be less than one chance in 100,000 per pool-year (NRC, 2001), which is below the level at which the NRC would require mitigation. The NRC does not consider this to be a credible event given its very low likelihood of occurrence and the number of back-up systems in place that would prevent the loss of cooling.

The loss of cooling water in spent fuel pools could occur as a result of an accidental or malicious act. Water could be drained from the pool via existing valves or pipes, cooling water flow could be lost, or a terrorist act, such as a crash of a large jet into the pool, could occur. Draining the pools via an existing pipe or valve at SONGS is an extremely remote chance because the lowest pipe elevation is well above the spent fuel assemblies. In addition, the pipes are equipped with anti-siphon holes that would prevent siphoning of the pool inventory due to a leak at a lower elevation elsewhere in the system.

The biggest threat for a pool fire would be due to a malicious act such as an aircraft strike on the spent fuel pools. For SONGS, it is unlikely that a jet could be crashed into the spent fuel pools given their location, which is immediately adjacent to the main containment structures. However, in the event of such an incident, the pools and or spent fuel assemblies could be damaged, and a fire could occur from any spilled aviation fuel. Such a scenario could lead to the loss of cooling water flow. It could also make it difficult for any emergency response, particularly if any of the spent fuel assemblies were breached in the attack.

With loss of cooling water flow, the temperature of the water in the spent fuel pools would increase to the point where it could begin to boil off. The time it would take for the water in the spent fuels to boil down enough to expose the spent fuel road assemblies would depend on how much recently discharged spent fuel was in the pool. Boil down could take up to 10 days if the most recent fuel discharge was more than a year old (Alvarez et al., 2003). Given this amount of time and the fact SONGS has redundant cooling water pumps this scenario is highly unlikely to occur. Even if both sets of cooling pumps were lost, the time available would be great enough to repair or replace the required equipment to reestablish the cooling supply.

A recent Electric Power Research Institute (EPRI) study found that a Boeing 767-400 jet traveling at 350 miles per hour would not penetrate the wall of a spent fuel pool. The study found that the concrete around the pool would crack, but that the stainless steel walls would not be breached (EPRI, 2002). The detailed results of this study have not been released to the public for security reasons. As such, no independent verification of the analysis was possible.

Another concern with an aircraft impact would be fire. While the impact of the aircraft may not breach the spent fuel pool, it could result in the collapse of the building and a resultant fire from the jet fuel. The heat from the fire could be enough to evaporate some of the water in the pool. The crash of an aircraft similar to those used on September 11th could provide enough heat from the burning fuel to vaporize 500 tons of water (Alvarez et al., 2003). For SONGS, the location of the spent fuel pools and the fact that the pools are partially sheltered by terrain make it very unlikely that a large commercial aircraft could be flown into the pools.

A number of studies have been done to estimate the impacts associated with a spent fuel pool fire. Depending on the amount of nuclear material released, the areas impacted could be as high as 17 million acres (69,000 square kilometers) (Alvarez et al., 2003). An NRC study estimated that over 1.8 million acres (7,000 square kilometers) could be impacted as a result of a pool fire, which released nuclear material (NRC, 1997).

It should be noted that the NRC and Nuclear Energy Institute (NEI) have serious concerns related to the Alvarez article cited above (SLO County, 2004). The Alvarez article contains many assumptions, some of which would be considered conservative, but also provides a relevant overview of the benefits of dry storage of spent fuel. The EIR authors also recognize that one of the contributing authors to the Alvarez article was employed by a transport and dry storage equipment vendor while others are actively associated with groups that have viewpoints that are at odds with the nuclear industry. The NEI listed four areas of concern based on the NRC review of the article including:

1. Provides no justification for the postulated probabilities of worst-case spent fuel pool damage;
2. Overestimates radiation release;
3. Overestimates consequences and societal costs for the published severe event; and
4. Underestimates the costs of the author's main remediation.

While the NEI makes many valid points in its comments and the overall risk associated with a spent fuel pool fire, the overall risk is still considered substantial. Accelerated transfer of spent fuel from the spent fuel pools to the dry storage casks would minimize this risk.

D.12.2 Applicable Regulations, Plans, and Standards

Federal, State, and local agencies have established standards and regulations that affect the Proposed Project. A summary of the regulatory setting for system and transportation safety is provided below.

Federal and State Standards

The NRC and the Department of Transportation (DOT) regulate the use and transport of nuclear materials and protection of public safety. The roles of these agencies for the storage and transport of low-level radioactive waste are:

> NRC – Regulates users of radioactive material and the design, construction, use, and maintenance of onsite storage facilities and shipping containers used for larger quantities of radioactive material and fissile material (such as uranium). NRC regulations for transport are located in the Code of Federal Regulations, Title 10, "Energy," Part 71, "Packaging and Transportation of Radioactive Material." NUREV-0810 regulates the onsite storage of LLW. The NRC would provide oversight of all activities associated with the onsite storage of LLW, such as the OSGs.

> DOT – Regulates shippers and carriers of radioactive material and the conditions of transport (including routing, tiedowns, radiological controls, vehicle requirements, hazard communication, handling, storage, emergency response information, and employee training). DOT regulations are located in the Code of Federal Regulations, Title 49, "Transportation." The DOT would regulate all activities associated with the offsite transportation of the OSGs when they are removed from the SONGS site for disposal.

The following federal regulations apply to other operations at SONGS:

10 CFR – Energy	
Part 19	Notices, Instructions and Reports to Workers
Part 20	Standards for Protection Against Radiation
Part 61	Licensing Requirements for Land Disposal of Radioactive Waste
Part 71	Packaging and Transportation of Radioactive Material
49 CFR – Transportation (Subchapter C – Hazardous Materials Regulation)	
Part 171	General Information, Regulations and Definitions
Part 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information and Training Requirements
Part 173	Shippers – General Requirements for Shipments and Packaging
Part 174	Carriage by Rail
Part 176	Carriage by Vessel
Part 177	Carriage by Public Highway
Part 178	Specifications for Packaging
Part 180	Continuing Qualifications and Maintenance of Packaging
Part 390	Federal Motor Carrier Safety Regulations
Part 391	Qualifications for Drivers
Part 392	Driving of Commercial Motor Vehicles
Part 393	Parts and Accessories Necessary for Safe Operations
Part 395	Hours of Service of Drivers
Part 396	Inspection, Repair and Maintenance
Part 397	Transportation of Hazardous Materials; Driving and Parking Rules

The NRC NUREG-series publications establish requirements that are also applicable to the Proposed Project, including:

- NUREG-0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. Potential safety issues associated with the project, such as OSG removal and storage, RSG installation and all staging activities would be subject to NUREG-0800 review.
- NUREG-0810, Design Guidance for Temporary On-site Appendix 11.4-A Storage of Low Level Radioactive Waste. The design of the OSG storage facility (under a project alternative) would be subject to NUREG-0810 review.
- NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants. While SCE has not applied for a license renewal for SONGS 2 & 3, the Environmental Impact Statement in NUREG-1437 provides information on the NRC process of environmental evaluation for steam generator replacement activities related to license renewal.

OSG disposal as in the Proposed Project must meet the waste disposal requirements of 10 CFR 61 as follows. These requirements would also apply at the time of decommissioning of any onsite OSG storage facility, which would occur under a project alternative. NRC regulations in 10 CFR 61.55 divide low-level radioactive waste into Classes A, B and C. These classifications are based on the concentration of radionuclides, particularly long-lived radionuclides. Class A waste has the lowest concentration, and Class C has the highest. Class C waste must meet rigorous requirements on waste form to ensure stability, and requires additional measures at the disposal facility to protect against inadvertent intrusion. Waste that exceeds the requirements for Class C is considered Greater Than Class C (GTCC) and is generally considered unsuitable for near surface land disposal. The OSGs would be classified as a Class A waste. The 10 CFR 61 performance objectives address long-term safety of radioactive waste storage. The performance objectives addressed by 10 CFR 61 for land disposal of LLW are:

1. Long-term protection of the public health and safety (and the environment);
2. Protection of an inadvertent intruder;
3. Protection of workers and the public during operation of a LLW disposal facility; and
4. Long-term stability of the disposal site after closure.

Offsite transport of the Class A OSGs would be required to meet the requirements 10 CFR 71, radiation level limits for radioactive waste transportation. Those limits are:

1. 200 mrem/hour or less at the waste container surface.
2. 200 mrem/hour at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load, and on the lower external surface of the load.
3. 10 mrem/hour or less at any point two meters from the vertical planes projected from the outer edges of the vehicle.
4. 2 mrem/hour in normally occupied spaces.

Under 10 CFR 20, SONGS would be required to update their existing Radiation Protection Program to include issues associated with the proposed project. Specifically under 10 CFR 20.1101, SCE would be subject to the following requirements:

> *a) Each licensee shall develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with the provisions of this part. (See Section 20.2102 for recordkeeping requirements relating to these programs.)*
>
> *b) The licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).*
>
> *c) The licensee shall periodically (at least annually) review the radiation protection program content and implementation.*
>
> *d) To implement the ALARA requirements of Section 20.1101 (b), and notwithstanding the requirements in Section 20.1301 of this part, a constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, shall be established by licensees other than those subject to 10 CFR 50.34a, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in Section 20.2203 and promptly take appropriate corrective action to ensure against recurrence.*

As noted above, the NRC has sole jurisdiction over the regulation of nuclear power plants, including radioactive hazards, safety issues, and radioactive waste handing and storage. The State of California (and its local jurisdictions) is preempted from imposing any regulatory requirements concerning radiation hazards and nuclear safety on nuclear power plant operators. The possession, handling, storage, and transportation of radioactive materials similarly are precluded from State regulation.

Local Ordinances and Policies

The CPUC has jurisdiction over limited activities that are not pre-empted by federal government control. This includes permitting transport and construction-related activities for the Proposed Project. Nuclear and radiological safety issues related to the proposed SONGS Steam Generator Replacement Project are solely under the NRC jurisdiction.

D.12.3 Environmental Impacts and Mitigation Measures for the Proposed Project

D.12.3.1 Definition and Use of Significance Criteria

The scope of this analysis is to prepare a qualitative evaluation of Proposed Project system and transportation safety and risk of upset. However, some quantification, although well short of a quantitative risk analysis (QRA), is used to determine the significance of potential impacts.

The CEQA Guidelines recommend identifying hazards and risks to the public or environment caused by the project. However, the CEQA Guidelines do not provide any recommended significance criteria for radioactive hazards or risk of upset, and federal government control limits the ability of the CPUC to mitigate impacts in this area. Criteria from federal guidance are selected in order to facilitate full disclosure of potential impacts. NRC guidance offers many screening level approaches where either the probability of an event or exposure levels define the acceptability of an event.

Significance of Accident Probability. In order to evaluate the significance of potential impacts, it is necessary to consider the complete risk picture which includes the consequences of an accidental release, as well as the probability that an event can occur. In many cases, events with catastrophic consequences are considered insignificant because the probability that such an event can occur is so unlikely, or is preventable by many layers of protection, that it is highly speculative to assume that the event can ever occur.

Substantial guidance on acceptable accident probability is provided in the NUREG guidelines. Generally, when screening potential accident scenarios an event with a probability of less than one in one million per year (1×10^{-6}/year) is considered less than significant. Accident scenarios with a probability of less than ten in one million per year (1×10^{-5}/year) are considered acceptable and require no further mitigation.

Significance of Consequences. In evaluating potential impacts from this project, the radiation exposure that would be considered significant is set at a low level that would essentially represent a "no adverse effect" level. An adverse consequence under an accident scenario is defined in 10 CFR 72.106:

> *Any individual located on or beyond the nearest boundary of the controlled area may not receive from any design basis accident the more limiting of a total effective dose equivalent of 0.05 Sv (5 rem), or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue (other than the lens of the eye) of 0.5 Sv (50 rem). The lens dose equivalent may not exceed 0.15 Sv (15 rem) and the shallow dose equivalent to skin or any extremity may not exceed 0.5 Sv (50 rem).*

Acceptable exposure levels defined in 10 CFR 72.104 for normal and anticipated off-normal operations are substantially lower than those defined in 10 CFR 72.106 as follows:

During normal operations and anticipated occurrences, the annual dose equivalent to any real individual who is located beyond the controlled area must not exceed 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid and 0.25 mSv (25 mrem) to any other critical organ as a result of exposure to:

1. *Planned discharges of radioactive materials, radon and its decay products excepted, to the general environment,*
2. *Direct radiation from ISFSI or monitored retrievable storage (MRS) operations, and*
   a. *Any other radiation from uranium fuel cycle operations within the region.*
   b. *Operational restrictions must be established to meet as low as is reasonably achievable objectives for radioactive materials in effluents and direct radiation levels associated with ISFSI or MRS operations.*
   c. *Operational limits must be established for radioactive materials in effluents and direct radiation levels associated with ISFSI or MRS operations to meet the limits given in paragraph (a) of this section.*

While the alternative OSG Storage Facility would store low-level waste and not be directly regulated by 10 CFR 72.106, the exposure limits identified in this regulation can be used to characterize the maximum acceptable exposure during an accident.

The acceptable exposure amounts associated with radioactive materials are principally established by the NRC and the USEPA. Therefore, the provisions of USEPA radiation exposure limits under 40 CFR 190 apply to all SONGS operations, including Proposed Project activities and the activities under the OSG Onsite Storage Alternative, since the NRC is responsible for the implementation of this standard for licensed power reactors. Under Section 190.10(a), the annual dose equivalent must not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials, radon and its daughters excepted, to the general environment from uranium fuel cycle operations and to radiation from these operations.

In addition, the NRC also requires that doses be kept "as low as reasonably achievable" (ALARA). The limits are set as maxima which must not be exceeded, and the goal is to keep doses as far below these limits as practical. The NRC further defines acceptable exposures levels for various worker exposure scenarios and the public as shown in Table D.12-1.

Table D.12-1. Dose Limits per Year

Exposure Scenario	Dose
Radiation Workers:	
Total Effective Dose Equivalent (TEDE)	5 rem
Dose Equivalent to the Eye	15 rem
Shallow Dose Equivalent to skin, extremities	50 rem
TEDE to any other individual organ	50 rem
TEDE to embryo/fetus of declared pregnant woman	0.5 rem
Minors (aged under 18)	10% of worker limit

Source: 10 CFR 20.1201 and 20.1301.

The USEPA has also established an individual radiation protection limit from Department of Energy (DOE) facilities. The total radiation dose limit for individual members of the public as defined by 10 CFR 20.1301 is 1 mSv/year (100 mrem/year), not including the dose contribution from background radiation. Limits on emissions of radionuclides to the air from DOE facilities are set such that they will not result in a dose greater than 0.1 mSv/year (10 mrem/year) to any member of the public (40 CFR 61.92).

In the event of a major accident, 10 CFR 100.11 establishes exposure guidelines as a whole body dose of 25 rem which corresponds numerically to a once in a lifetime accidental or emergency dose for radiation workers. However, it is not intended to imply that 25 rem constitutes acceptable limits for emergency doses to the public under accident conditions. Rather, this 25 rem whole body value has been set forth as a reference value, which can be used in the evaluation of reactor sites with respect to potential reactor accidents of exceedingly low probability of occurrence, and low risk of public exposure to radiation. This exposure level is typically used to define zones of emergency response and exposure limits for emergency responders.

In evaluating the significance of potential exposures to the public, the more stringent applicable exposure levels as defined in 10 CFR 72.104, 40 CFR 190, 10 CFR 20.1301, 40 CFR 61.92, and 10 CFR 20.1101 (radiation protection programs), in combination with NUREG probability thresholds, were used to estimate significant exposures and potential impacts.

D.12.3.2 Replacement Steam Generator Transport

Impact S-1: RSG barges could create a marine traffic navigational hazard

Transport of the RSGs along the proposed Beach and Road Route would not pose any radiological hazard since they would be newly manufactured. The proposed delivery route would generally avoid interaction with the public for most of the route, remaining in the shipping lanes far offshore until the approach to the MCBCP Del Mar Boat Basin. As the RSG barge approaches and enters the breakwater area of Oceanside Harbor and the Del Mar Boat Basin, potential conflicts with existing marine traffic could pose a safety hazard. However, given the existing uses and design of the boat basin, potential impacts would be considered less than significant (Class III).

Impact S-2: RSG transport could impede emergency response vehicles

Equipment used during RSG transport could temporarily obstruct access on southbound Interstate Highway 5 (I-5) for emergency response vehicles, which could lead to adverse impacts to public services and traffic (see discussions in Section D.10, Public Services and Utilities, and Section D.13, Traffic and Circulation). Transport activities within the SONGS site could also limit the ability of emergency personnel to respond to incidents. By coordinating these activities with transportation agencies, which would be required by permits to access I-5, and coordinating with internal SONGS operations, potential safety impacts would be considered less than significant (Class III). Preserving adequate public services and avoiding the adverse effects of temporary road closures would also be accomplished through implementation of Mitigation Measures U-2a (Maintain adequate emergency vehicle access) and T-1a (Provide emergency vehicle access) identified in Sections D.10 and D.13, respectively.

D.12.3.3 Staging and Preparation

All Proposed Project staging and preparation activities including construction of the temporary RSG enclosures would occur well away from areas with public access. No radiological hazard would occur because staging and preparation activities would not involve handling nuclear fuel or radioactive waste. Therefore, these activities would not pose any appreciable safety hazard to the public.

D.12.3.4 Original Steam Generator Removal, Staging, and Disposal

Prepare for and Create Containment Opening

To perform steam generator replacement, a 28-foot-by-28-foot opening would be created in the containment dome. Prior to creating the dome opening, all fuel would be removed from the reactor and placed in the spent fuel pool, thus minimizing potential radiation exposure when the dome opening is created. The opening would require detensioning and removal of some tendons, removing concrete, cutting rebar, and cutting and removing a section of the steel liner. While the process of creating an opening in the containment dome may adversely affect structural integrity, no radioactive fuel would be present in the reactor core. Prior to a resumption to operations, the dome would be restored to its original configuration and structural integrity.

NRC oversight responsibilities include a review of major structural building modifications, which includes the containment structure with the opening in place and after its repair. Two NRC inspectors assigned full time to the SONGS site are expected to perform most of the NRC monitoring effort with support from other regional offices. All OSG removal activities including creating the containment opening would be inspected and monitored by the NRC to verify that activities are in accordance with applicable standards and regulations and that nuclear and radiological safety are maintained (NRC, 2000).

NRC Oversight of Containment Structure Modifications

The NRC recognizes that cutting the temporary opening and closing it would involve modifying the most important safety-related structure in the nuclear power plant; comprehensive NRC inspection and oversight would occur as described by NRC Inspection Procedure 50001, which provides guidance that quality assurance and quality control practices should be strictly followed (NRC, 2000). The three major phases of NRC inspections during the Proposed Project would be:

- Design and planning,
- Steam generator removal and replacement, and
- Post-installation verification and testing.

The NRC would develop a site-specific inspection plan to select and review the nuclear safety-related aspects of each of the above phases. This plan typically focuses on verification that the reactor coolant system, secondary systems, and containment system pressure boundaries are properly restored; ensuring that foreign materials are not introduced to safety systems; and that plant modifications do not introduce any plant risk during subsequent plant operation. Specific inspection subjects that could be monitored by the NRC are discussed in the following sections. These descriptions indicate the level of detail and breadth of the oversight provided by the NRC (PGEP, 2005).

Design and Planning Phase. The NRC inspector would conduct selected inspections to verify that changes made to systems, structures, and components as described in the Final Safety Analysis Report (FSAR) are reviewed in accordance with the requirements of 10 CFR 50.59. This requires that any changes must meet the criteria listed below. If these criteria are not met, then a facility license amendment must be obtained. These criteria are designed to ensure that replacement activity does not result in any substantial changes to the analysis or assumptions presented in the FSAR. The criteria that must be satisfied for compliance with 10 CFR 50.59 include the following:

- The Proposed Project would not result in more than a minimal increase in the frequency of occurrence of a previously analyzed accident.
- The Proposed Project would not result in more than a minimal increase in the previously evaluated likelihood of occurrence of a malfunction of a structure, system, or component important to safety.
- The Proposed Project would not result in more than a minimal increase in the consequences of a previously analyzed accident.
- The Proposed Project would not result in more than a minimal increase in the consequences of a structure, system, or component malfunction.
- The Proposed Project would not create the possibility for an accident of a different type than previously analyzed.
- The Proposed Project would not create the possibility of a different result than any previously evaluated from a malfunction of a structure, system, or component.
- The Proposed Project changes would not result in a design basis limit for a fission product barrier as described in the FSAR being exceeded or altered.
- The Proposed Project would not result in a departure from a method of evaluation described in the FSAR used in establishing the design basis or in the safety analysis.

The NRC would also review the engineering design, any equipment or procedure modifications, and analysis associated with steam generator lifting and rigging. This may include an assessment of crane and rigging equipment, safe load paths, load laydown areas and load drop analysis to assess the impact of these activities on reactor core or stored spent fuel, the associated cooling and plant support systems, and any systems that may be shared with other operating units at SONGS.

In addition to common system concerns related to steam generator lifting, an assessment may also be made of the administrative controls and plans in place to minimize any adverse impact on the operating unit. Other design issues to be reviewed may include security conditions pertaining to vital and protected area barriers, which could be affected by the Proposed Project activity, as well as ALARA planning, temporary shielding and other radiation protection program controls, planning, and preparation. The NRC may audit the SONGS outage radiation protection program to confirm that radiological concerns are properly included in planning for the Proposed Project. The NRC may also review planning associated with radioactive materials management due to the need to temporarily store reusable equipment and the potential to generate increased volumes of waste in the relatively short period of the outage.

Other topics that may be considered in the design and planning stage are the effect of changes in mass and center of gravity of the new steam generator on the seismic analysis for the containment structure, pipe stress analysis, and other safety systems and components. A related consideration is the effect of the steam generator and related design changes on transient and accident analyses, including tube rupture. This may not be a concern at SONGS because the Proposed Project would involve steam generator replacement in-kind; however, if the design of the steam generators changes, then these questions would have to be taken into account.

Steam Generator Removal and Replacement Phase. Selective inspections may be conducted by the NRC in important welding and non-destructive examination (NDE) activities. Included in this category would be review of special welding/NDE procedures, personnel training, radiography records and work packages for selected welds, pre-service weld requirements, and eddy current evaluation of new steam generator tubes.

SCE would provide a training facility to house a steam generator mock-up to train personnel in activities such as cutting, templating, machining, welding, and other specialized procedures applicable to OSG removal and RSG installation. The training and qualifications of SONGS and contractor quality control/assurance inspectors and NDE examiners may be reviewed by the NRC to ensure that these personnel meet all qualification requirements and are otherwise prepared for site-specific tasks. Inspection of status and activities pertaining to the establishment and maintenance of defined operating conditions, such as defueling, reactor cooling system (RCS) draindown, and system isolation and associated valve and system lockout/tagout, may also be included in the NRC inspector oversight activities.

If there are major structural modifications to cranes, buildings, and other necessary equipment needed to facilitate steam generator replacement, then review of these may be included in the NRC inspector oversight responsibilities. Modifications such as reinforcement of existing structures or floors, construction of new platforms or structures, and modifications to cranes and the impact of these modifications on ~~safety-related~~ equipment important to safety may be assessed against 10 CFR 50.59 criteria to ~~ensure that no unreviewed safety question has been created~~determine if prior NRC approval is required. NRC inspectors may also ensure that structural modifications and removal and restoration of component supports are properly documented.

Administrative controls and practices for ensuring the exclusion of foreign materials from the reactor cooling system openings and the steam generators may also be assessed, as well as the radiological safety plans for temporary storage and disposal of the replaced steam generator components.

Furthermore, implementation of procedures for contaminated tools and waste may be reviewed, which would include reviewing plans for disposal of concrete debris from the temporary opening. Although most of this material is not expected to be contaminated, some hard-to-detect isotopes such as H-3 and Fe-55 may be present.

Cutting and closing the temporary containment opening require close quality assurance attention and third party independent inspections. NRC inspectors would ensure that these activities are performed.

Post-Installation Verification and Testing Phase. Selective inspections would be performed in accordance with the established NRC inspection plan. Work pertaining to RCS and steam generator secondary side leakage testing may be covered in the inspection scope. The calibration and testing of instrumentation affected by the Proposed Project and review of procedures for equipment performance testing to confirm the design and establish baseline measurements may also be included. NRC inspectors may also include review of the OSG staging areas and disposal preparation activities to ensure access is properly controlled and that the dose rates at the perimeter are below applicable limits.

Part of NRC inspector duties associated with post installation verification and testing include verification that modifications are completed in accordance with the design and drawings; procedures and training have been updated; and that inspections are performed to ensure proper equipment restoration, equipment cleanliness, that pre-service baseline weld data has been obtained and that temporary services have been removed.

Summary of Potential Nuclear and Radiological Safety Impact

With NRC oversight described above, preparing for and creating the containment opening would cause no impact on public safety.

Original Steam Generator Disposal

OSG removal, staging, and disposal activities would result in worker and public exposure to residual OSG radiation; this impact is discussed below. Maneuvering OSGs from the SONGS reactors to the temporary enclosure facility would briefly block roads within the SONGS site, thus limiting the ability of emergency personnel to respond to incidents (similar to the effect under Impact S-2). However, by coordinating with internal SONGS operations, this potential safety impact would be considered less than significant (Class III).

Impact S-3: Residual contamination would be present on the OSGs with the potential for radiation exposure during removal, staging, and transport for disposal

Potential radiation exposures would be managed in a manner that maintains personnel radiation doses in accordance with the existing SONGS Radiation Protection Program. SONGS' ALARA program complies with the requirements of 10 CFR 20 (Radiation Protection Program, see section D.12.2) and 10 CFR 50 (Domestic Licensing of Production and Utilization Facilities [for nuclear facilities]). A detailed ALARA plan is maintained by SCE and periodically reviewed by the NRC, and it would be modified as necessary to address shielding and source removal, which would be included as part of the radiation work permit[6] used to control radiation exposure to OSG removal workers.

The existing SONGS Health Physics Program[7] would be used during Proposed Project activities and implement the ALARA requirements of 10 CFR 20. The Radiation Protection Manager is responsible for administering, coordinating, planning, and scheduling all radiation protection activities involving the Proposed Project. The primary objective of the Health Physics Program is to maintain radiation exposures to workers, visitors, and the general public below regulatory limits and otherwise ALARA.

The estimated contact radiation dose rates on the exterior of each OSG would be less than or equal to 20 mrem per hour. Because dose rates decline when one moves further away from the radiation source, workers moving the OSGs to the temporary enclosure facility would receive radiation exposure at 20 mrem per hour or less (SCE, 2004b), which would be substantially lower than the NRC worker exposure limit of 5 rem per year.

Contact dose rates on the exterior of the OSGs would be less than or equal to 20 mrem per hour. This assumes no system decontamination beyond shutdown chemistry control. Prior to removal to the temporary enclosure facility for packaging, the OSGs would be encapsulated in a protective coating to prevent the release of loose contamination. Steel covers would also be installed on piping openings to seal the internal portion of the OSG, effectively minimizing potential exposure to residual contamination (SCE, 2004b). Once within the temporary enclosure facility, the OSGs would be dissembled and packaged for disposal at a licensed LLW facility, most likely the Envirocare facility in Clive Utah.

At the time of OSG removal, the radionuclide mixture would be representative of a typical reactor coolant system cleanup filter. The spectrum of the expected radionuclide source during OSG removal is shown in Table D.12-2. This radionuclide spectrum is based on SCE estimates of activity to be about 2,000 Curies for the Unit 3 steam generators (SCE, 2004b) and the relative distribution of the steam generators at the Diablo Canyon Power Plant facility.

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6 A radiation work permit is issued by the SONGS Radiation Protection Manager (a SCE employee) prior to any activity that could result in radiation exposure.

7 The Health Physics Program covers all aspects of radiation exposure at SONGS and is designed to comply with applicable radiation exposure limits and minimize radiation exposure as low as reasonably achievable.

Based on the radiological spectrum of each unit OSG and activity of 2,000 Curies per steam generator, potential combined offsite project-related radiation exposure from the OSG removal process can be estimated. In order to address potential impacts associated OSG transport and radiation emissions, a dispersion modeling analysis was conducted to identify areas that would be vulnerable to elevated radiation dosage levels.

Radiological source terms were based on the activity levels provided by SCE (SCE, 2004b), as shown in Table D.12-2. The release fractions were adjusted according to the methodologies contained in DOE standards DOE-HDBK-3010-94, *Airborne Release Fractions/ Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, and DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23*, *Nuclear Safety Analysis Reports*.

Table D.12-2. OSG Radionuclide Inventory

Nuclide*	Curies/Unit	Nuclide	Curies/Unit
Fe-55	1.02E+03	Pu-241	2.99E+00
Zn-65	3.24E+02	Ni-59	1.28E+00
Co-60	2.96E+02	Cm-242	1.05E-01
Ni-63	1.24E+02	Sr-89	4.81E-02
Co-58	9.38E+01	Sr-90	3.09E-02
C-14	4.84E+01	Pu-238	1.88E-02
H-3	1.91E+01	Pu-239	1.60E-02
Nb-95	1.74E+01	Pu-240	1.95E-04
Mn-54	1.40E+01	Am-241	1.53E-02
Zr-95	8.71E+00	Cm-243	1.42E-02
Ru-106	6.59E+00	Cm-244	1.42E-02
Sb-125	5.55E+00	Tc-99	2.48E-04
Ce-144	5.55E+00	Pu-242	1.95E-04
Ag-110m	4.46E+00	Np-237	1.78E-05
Co-57	3.47E+00	I-129	5.80E-08
Sn-113	3.17E+00	**Total:**	**2.00E+03**

Source: Based on 2,000 Curies/Unit per SCE, 2004b.
* A general term applicable to all atomic forms of an element.

Dispersion parameters were based on a standard Gaussian plume model as described in the DOE's Handbook on Atmospheric Diffusion using daytime and nighttime stability and wind speed combinations (Stability Class D at 5 m/s and Stability Class F at 2 m/s, respectively). A modeling analysis was conducted utilizing the Hotspot model developed at University of California Lawrence Livermore National Laboratory (LLNL). The LLNL Hotspot model contains several dispersion models that are more appropriate than a standard Gaussian plume model, including models for explosions and fires.

Dose conversion factors were based on DOE/EH-0071, *Internal Dose Conversion Factors for Calculations of Dose to the Public*. Potential dosage was estimated using a standard breathing rate (3.5×10^{-4} m^3/sec) for the duration of the release.

Modeling results indicate that the potential for adverse offsite impact is minimal. Worst-case modeling indicated a Proposed Project–related total exposure of 0.05 mrem at the nearest public receptor. These worst-case exposure levels are well below the most stringent public exposure limit of 10 mrem/year. Worst-case exposure is also far below the DOT requirements (10 CFR 71) of 200 mrem/hour on the external surface of the transport container and 10 mrem/hour at any point two meters from the outer lateral surface of the vehicle. Therefore, potential safety impacts associated with OSG removal to the onsite enclosure and offsite transport to the disposal facility are considered less than significant (Class III).

D.12.3.5 Steam Generator Installation and Return to Service

Replacement of the SONGS steam generators would, at a minimum, allow the facility to operate through the end of its current license periods for each unit. The NRC SONGS Unit 2 and 3 operating licenses expire in February 2022 and November 2022, respectively. Therefore, the Proposed Project would extend the operating life of SONGS, and the environmental effects of current operations would continue as a result of CPUC approval of the project. However, the risk associated with SONGS operating to the end of the current license periods has been evaluated and, therefore, is part of the baseline.

The Applicant's stated position is that the continued operation of SONGS through the existing license period is part of the CEQA baseline (i.e., the conditions that existed at the time the NOP was issued). Other parties that provided comments in response to the Notice of Preparation (NOP) contend that approving the Proposed Project would extend the operational life of SONGS at least until the expiration date of the licenses, because SONGS would be more likely to shut down as a result of OSG deterioration if the CPUC denies Proposed Project cost recovery.

Since the NRC evaluated potential impacts associated with SONGS through the end of the current license periods and, more importantly, the NRC licenses were approved for operation through the end of these license periods, the Proposed Project does not extend the life of SONGS beyond that period for which potential environmental impacts have already been evaluated. SCE does not need CPUC approval to replace the steam generators, a process that has occurred at numerous other commercial reactors around the country, but only approval for project cost recovery. In addition, SCE expects that the NRC license would not need to be amended for the Proposed Project because all work would be conducted within the terms of the licenses. Therefore, given that both SONGS impacts have been evaluated through the end of the license periods and that SONGS received license approval to operate through the end of these license periods, the Proposed Project does not change the baseline risk of routine SONGS operations.

Should SCE seek to extend the current SONGS license periods, additional environmental review would be required that is beyond the scope of this EIR. See Section G of this EIR for additional information on the NRC license renewal process and SCE's position on license renewal at SONGS.

D.12.4 Environmental Impacts and Mitigation Measures for the Alternatives

D.12.4.1 Transportation Route Alternatives

Impacts associated with the transportation alternatives would be nearly identical to the proposed transportation options.

I-5/Old Highway 101 Route Alternative

Potential safety impacts associated with transport along the I-5/Old Highway 101 Route would be similar to those for the proposed Beach and Road Route (Impact S-2, Class III). Compared to the proposed Beach and Road Route, I-5 would be blocked for substantially longer periods. This would limit the ability of emergency service personnel to respond to incidents in the region. The possible disruption of fire protection or other emergency services could lead to adverse but mitigable public safety impacts that are discussed in Section D.10, Public Services and Utilities, and Section D.13, Traffic and Circulation. Mitigation Measures U-2a (Maintain adequate emergency vehicle access) and T-1a (Provide emergency vehicle access) identified in Sections D.10 and D.13, respectively, would reduce the potential impacts to public services and traffic.

MCBCP Inland Route Alternative

Potential safety impacts associated with this option would be similar to those for the Proposed Project and the I-5/Old Highway 101 Route Alternative (Impact S-2, Class III). Compared to the proposed Beach and Road Route, which would block only southbound I-5, all lanes of I-5 would be temporarily blocked for brief periods. This would limit the ability of emergency service personnel to respond to incidents in the region. The possible disruption of fire protection or other emergency services could lead to adverse but mitigable public safety impacts, as discussed in Section D.10 (Public Services and Utilities) and Section D.13 (Traffic and Circulation). Mitigation Measures U-2a (Maintain adequate emergency vehicle access) and T-1a (Provide emergency vehicle access) identified in Sections D.10 and D.13, respectively, would reduce the potential impacts to public services and traffic.

D.12.4.2 OSG Disposal Alternative

OSG Onsite Storage Alternative

Onsite storage of the OSGs would introduce new hazards related to the long-term presence of an OSG Storage Facility. The safety impacts of the OSG Onsite Storage Alternative include the potential for accidents at the storage facility or a terrorist attack, discussed below.

Impact S-4: An aircraft accident could result in damage to the OSG Storage Facility with a subsequent release of radioactive material

Onsite storage of the OSGs would occur in a facility designed to minimize the release of radioactive material. The most potentially damaging scenario of accident that could compromise the integrity of the OSG Storage Facility is presumed to unintentional impact by aircraft. (The risk of terrorism is addressed in Impact S-5 below.) Based on experience with other facilities in urban areas, including the relative proximity of surrounding airports, established flight paths, and the number of flights in nearby corridors, the probability of an inadvertent aircraft strike on the OSG Storage Facility would be less than the threshold of one in one million per year (1×10^{-6}/year). Although an inadvertent aircraft strike would be improbable, the potential consequences are summarized below.

The consequences of an inadvertent aircraft strike on the alternative OSG Storage Facility were evaluated using the dispersion modeling methodology discussed under Impact S-3, with the exception that more radiation would be released in any fire that would occur subsequent to aircraft impact, and the resulting plume would be thermally buoyant. Given the large thermal plume rise, worst-case concentrations would occur on the hillsides surrounding SONGS, with a maximum expected event dose of 3 mrem. This dosage conservatively assumes that individuals would remain in the area during the duration of a fire and would also be exposed to substantial amounts of smoke. Comparable normal exposure values would be 20 mrem for normal background radiation and 20 mrem for a chest X-ray. This worst-case exposure level is lower than acceptable exposure limits of 10 mrem per year for normal operations, and substantially lower than acceptable levels for one-time exposure accidents of 5 rem (5,000 mrem). Therefore, impacts associated with an inadvertent aircraft strike on the OSG Storage Facility and subsequent catastrophic loss of containment are less than significant (Class III).

Impact S-5: A terrorist attack could result in damage to the OSG storage facility with a subsequent release of radioactive material

Under the OSG Onsite Storage alternative, potential terrorist attacks on the OSG Storage Facility would be considered inconsequential, as demonstrated in the analysis for Impact S-4. The analysis for an accidental aircraft strike on the OSG Storage Facility assumed worst-case conditions with consequences similar to those of a willful terrorist attack on the OSG Storage Facility. Thus, although impacts associated with a potential terrorist attack on the OSG Storage Facility would be unfortunate to SCE and ratepayers, potential safety risks would be considered less than significant (Class III).

Impact S-6: Seismic activity could compromise the integrity of the OSG Storage Facility

Under the OSG Onsite Storage alternative, a long-term storage facility would be constructed and potentially exposed to ground shaking, fault rupture, and seismicity. Severe ground shaking (Impact G-6, as described in Section D.5, Geology, Soils, and Paleontology) could compromise the integrity of the OSG Storage Facility, if the facility design does not incorporate recent and relevant earthquake data. To address the effects of seismic activity on the OSG Storage Facility, the Safety Analysis Report for the SONGS facility would need to be updated. The risk of seismic activity compromising the integrity of the storage facility could be reduced to a less than significant level with implementation of the SAR update as recommended by Mitigation Measure G-6a (Class II).

Mitigation Measures for Impact S-6, Seismic activity could compromise the integrity of the OSG Storage Facility

Implement Mitigation Measure G-6a (Prepare an updated Safety Analysis Report to accommodate the OSG Storage Facility).

D.12.5 Environmental Impacts of the No Project Alternative

Development scenarios foreseeable under the No Project Alternative could result in new generation or transmission facilities being installed in southern California or Arizona to compensate for the lost generation of SONGS 2 & 3. One likely option would involve natural gas-fired combined-cycle power plants, based on the 60-hertz version of GE's most advanced gas turbine technology, the H System.

Potential safety impacts associated with natural gas-fired combined-cycle power plants have been well documented as part of the California Energy Commission (CEC) facility siting process. Depending on the exact location of a facility in relation to the public, potential safety impacts can be significant. However, safety impacts associated with any proposed power generation facility would be subjected to site-specific environmental review.

Typical natural gas-fired combined-cycle power plants would likely be equipped with selective catalytic reduction (SCR) emission control equipment to reduce emissions of criteria air pollutants. SCR utilizes ammonia, either anhydrous or aqueous solutions, as part of the SCR process. Hazards associated with the transportation, storage, and use of ammonia can result in significant public risk in the event of an accidental release near populated areas. Typical measures to avoid this impact would be identifying the route or method of delivery for ammonia (e.g., truck, rail, or pipeline) that would avoid populated areas or accident hazards or requiring the use of a urea-based system.

The siting of natural gas-fired combined-cycle power plants usually requires the construction of a large-capacity, high-pressure natural gas pipeline. Hazards associated with natural gas transmission pipelines can result in significant public risk in the event of an accidental release. However, power plants are generally sited in industrial areas which minimize potential public and sensitive receptor exposure to increased risk.

The description of the environmental setting above demonstrates that the probability of a core-damaging accident for a facility like SONGS is greater than ten in one million per year (1 x 10^{-5}/year). Should the Proposed Project not move forward, resulting in a cessation of SONGS operation before the end of the current licensing periods for both units, the baseline risk associated with routine SONGS operations would no longer be present. Under the No Project Alternative, SCE estimates that the SONGS Unit 2 and 3 reactors would need to be shut down as soon as 13 years before the end of their current license periods. Thus, SONGS would shut down and the risk of a reactor-related accident with severe consequences, including early fatalities, injuries, cancer deaths, and related property damage, would cease. Based on the decreased probability of a core-damaging accident associated with the decreased plant life that would occur under the No Project Alternative, this reduction in SONGS risk would be considered a beneficial impact (Class IV).

Baseline safety and risk conditions are characterized by potential releases from three main systems at SONGS, including:

- Units 2 and 3 reactors and systems,
- Spent fuel storage pools, and
- Dry cask spent fuel storage facility (ISFSI).

Potential hazards associated with spent fuel handling, both at the spent fuel pool and the ISFSI represent a significant risk. The probability of an accidental release associated with spent fuel also increases with time as more spent fuel is accumulated. Historically, the solution to increasing volumes of spent fuel has been the re-racking of the spent fuel pools to accommodate more waste, and increasing the probability of consequences of an accidental release. As the ISFSI is constructed in a phased approach, the likelihood of an accident increases as the number of operational casks increases. The No Project Alternative would result in over 1,000 less spent fuel assemblies being moved into storage during the 13 years leading up to NRC license expiration. Therefore, the No Project Alternative would reduce the risk associated with spent fuel handling, resulting in a beneficial impact (Class IV).

Equipment and infrastructure aging at SONGS is also an issue, reflected by the need to replace the steam generators. All equipment at SONGS has a limited useful service life, with reliability being a concern as equipment ages. All equipment failure rates are measured in units of time, such as failures per year or mean time between failures, thus implying that the probability of a failure increases as components age. The replacement of the SONGS steam generators would be in direct response to the long-term wear of these components and the concern for future failures. Metal fatigue, cracking and corrosion has limited the efficiency and reliability of these components. Nevertheless, continued operation of SONGS would result in an increased probability of component failure and an accidental release. However, it should be noted that replacement of the steam generators would actually reduce the probability an accidental release for those accidents related to steam generator tube failures.

The NRC (2004) has noted that the risk associated with steam generator tube ruptures is relatively low due to the effectiveness of NRC regulatory guidance and requirements, and represents only a small fraction of the facility risk. This is mainly due to the effectiveness of isolating defective tubes in the steam generators and minimizing the potential for a tube rupture. Therefore, replacement of the steam generators would not likely change long-term risk, and the core damage frequency for the SONGS pressurized water reactors would remain higher than 1.0 x 10^{-5}/reactor-year with or without the Proposed Project. Reducing the operational life of SONGS under the No Project Alternative would limit the number of years that SONGS would operate, along with the associated probability of an accident due to steam generator tube ruptures, and would be considered a beneficial impact (Class IV).

Terrorism is also an issue that has been raised. Prior to the events of September 11, 2001, the prospect of an airborne terrorist attack on SONGS would have been considered highly speculative under CEQA and dropped from further analysis. While it would be nearly impossible to estimate the probability of an aircraft-based terrorist attack on SONGS, much less the likelihood of a successful attack and containment breach, the possibility of such an attack cannot be totally discounted. The consequences associated with such an attack would be substantial, as described in the environmental setting above. The No Project Alternative would lead to a cessation of SONGS operations, which would reduce the consequences of a terrorist attack, resulting in a beneficial impact (Class IV). With or without the Proposed Project, the vulnerability of the spent fuel pools and ISFSI would remain.

D.12.6 Mitigation Monitoring, Compliance, and Reporting Table

Table D.12-3 shows the mitigation monitoring, compliance, and reporting program for System and Transportation Safety.

Table D.12-3. Mitigation Monitoring Program – System and Transportation Safety

IMPACT S-6	**Seismic activity could compromise the integrity of the OSG Storage Facility (Class II)**
MITIGATION MEASURE	**Implement Mitigation Measure G-6a: Prepare an updated Safety Analysis Report to accommodate the OSG Storage Facility**
Location	As in Mitigation Measure G-6a.
Monitoring / Reporting Action	As in Mitigation Measure G-6a.
Effectiveness Criteria	As in Mitigation Measure G-6a.
Responsible Agency	As in Mitigation Measure G-6a.
Timing	As in Mitigation Measure G-6a.

D.12.7 References

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