APPENDIX D

Appendices Related to Radiological Hazards

- **D1: MANAGEMENT, STORAGE, TRANSPORTATION, AND DISPOSAL OF SPENT NUCLEAR FUEL AND HIGH-LEVEL WASTE AT SAN ONOFRE NUCLEAR GENERATING STATION**
- **D2: RADIOLOGICAL SCOPING AND CHARACTERIZATION DATA**
- **D3: SPENT NUCLEAR FUEL TRANSPORTATION EXPERIENCE AND RISK ASSESSMENTS**
- **D4: NUCLEAR REGULATORY COMMISSION ENVIRONMENTAL IMPACT EVALUATION**
- **D5: RADIATION BASICS**
- **D6: POST-SHUTDOWN DECOMMISSIONING ACTIVITIES REPORT**

The Following References <u>used in these Appendices</u> are Considered Confidential – Not For Public Review

- San Onofre Nuclear Generating Station Site Characterization Report, doc no. 51-9239894-000 (AREVA, 2015)
- Hazardous Materials and Wastes Inventory Matrix Report and Site Map
- San Onofre Nuclear Generating Station Units 2 & 3, Updated Final Safety Analysis Report (UFSAR), Revision 36, May 2013

APPENDIX D1
MANAGEMENT, STORAGE, TRANSPORTATION, AND DISPOSAL OF SPENT NUCLEAR FUEL AND HIGH-LEVEL WASTE AT SAN ONOFRE NUCLEAR GENERATING STATION[1]

INTRODUCTION

As discussed in Section 1.0, *Introduction*, the federal government has exclusive jurisdiction over the radiological aspects of decommissioning. As also discussed in Section 1.0, activities related to the existing Approved Independent Spent Fuel Storage Installation (ISFSI) and the transportation and off-site storage of spent nuclear fuel (SNF) are subject to the Settlement Agreement that resolved a legal challenge[2] to Coastal Commission approvals related to on-site storage of SNF. Under this Settlement Agreement, Southern California Edison (SCE) will develop, with input from a team of expert consultants, a Transportation Plan and Strategic Plan for transportation and off-site storage of SNF.

At the time of preparation of this EIR, these plans are not yet available. Moreover, the operation and maintenance of the ISFSI and the transportation and off-site storage of SNF and high-level radioactive waste (HLW) are not part of the Proposed Project. Nonetheless, to maximize disclosure to the public, the EIR includes this appendix containing background information on management, storage, transportation, and disposal of SNF and HLW.

This report summarizes the standards and assumptions that SCE has made in its existing planning documents for the management of spent nuclear fuel (SNF) and HLW associated with the decommissioning of the San Onofre Nuclear Generation Station (SONGS), including on-site storage and off-site transportation and disposal. This report describes the regulatory requirements and contractual agreements relevant to the storage and disposal of SNF and HLW. An additional purpose of this report is to provide further information on the logistical, legal, contractual, and financial uncertainties that illustrate why detailed evaluation of transportation and final removal of SNF and HLW to an off-site facility is currently too speculative to be evaluated in detail in the EIR. This report also identifies and discusses several potentially feasible alternatives to continued on-site storage that have been proposed by stakeholders or members of the public.

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[1] This document has been prepared for the California State Lands Commission by Aspen Environmental under Contract No. C2015046.

[2] Citizens Oversight, Inc., et al. v. California Coastal Commission, Southern California Edison Company, et al., *Superior Court for County of San Diego Case No. 37-2015-00037137-CU-WM-CTL*.

DESCRIPTION OF THE CURRENT PLAN AND SCHEDULE

The Post Shutdown Decommissioning Activities Report (PSDAR) (SCE 2014a), the Irradiated Fuel Management Plan (IFMP) (SCE 2014b), the Site-Specific Decommissioning Cost Estimate (DCE) (SCE 2014c) for SONGS Units 2 and 3, and the Testimony on SONGS 1 DCE (SCE 2016) describe the assumptions and schedule for decommissioning of the SONGS site (Units 2 and 3, and the remaining activities necessary to complete the decommissioning of Unit 1). The planning documents include the on-site storage and eventual off-site shipment of SNF and HLW. SONGS Unit 1 was shut down in 1992, and the associated on-shore facilities were largely dismantled between 1999 and 2008 (SCE 2016).

The key elements of the IFMP for decommissioning include:

- Wet storage of SNF in spent fuel pools until it can be transferred to dry storage;
- Dry storage of SNF and HLW from decommissioning activities in an expanded interim spent fuel storage facility (ISFSI); and
- Transportation of SNF and HLW to a geologic repository for disposal by the U.S. Department of Energy (DOE).

This report is focused primarily on the fuel and waste stored on-site at SONGS, which currently includes both dry storage in an ISFSI and wet storage in the spent fuel pools for SONGS Units 2 and 3. An additional 270 fuel assemblies from SONGS Unit 1 are in spent fuel pool storage at the General Electric Hitachi Facility at Morris, Illinois, where it would remain until it is shipped to the DOE for disposal between 2050 and 2051.

Transfer of SNF and HLW to On-site Dry Storage

During the decommissioning of SONGS Unit 1, the Nuclear Regulatory Commission (NRC) licensed an ISFSI, which was constructed on a portion of the site previously occupied by Unit 1 facilities. This ISFSI uses Transnuclear's Standardized Advanced NUHOMS® System, which consists of transportable Dry Shielded Canisters (DSCs), reinforced concrete Horizontal Storage Modules (HSMs), and a transfer cask. Storage was initiated in 2003 and expanded in 2007 to include 63 HSMs, in which 51 DSCs have been installed to date. Fifty DSCs contain irradiated fuel and one contains Greater-Than-Class-C (GTCC) waste. Eighteen of the storage modules are derived from the decommissioning of Unit 1 (17 DSCs with SNF and one with GTCC waste), and the remaining 33 DSCs contain SNF from Units 2 and 3. The most recent loading campaign was conducted in 2012. All the fuel in the ISFSI is stored in Transnuclear NUHOMS Model Number 24PT1 or 24PT4 DSCs. The remaining SNF at the site is currently contained in spent fuel pools at Units 2 and 3 or is being transferred to dry storage in the expanded ISFSI.

An expanded ISFSI (licensed by NRC and approved in 2015 by the California Coastal Commission) was constructed adjacent to the existing ISFSI site. Holtec International constructed a HI-STORM UMAX underground storage facility to store 2,668 used fuel assemblies in MPC-37 multi-purpose canisters, where each canister can store up to 37 used fuel assemblies. To ensure a long service life in the site's marine air environment, SCE has specified corrosion resistant stainless steel for the confinement boundary, and all external surfaces of the storage ~~cavity~~ canister in contact with ambient air will use stainless steel to minimize in-service maintenance requirements.

Spent fuel is currently being transferred into the dry storage multi-purpose canisters from the pools, which should be completed in 2019. According to Maheras et al. (2015), the Unit 2 and 3 SNF in the pools would require 73 MPC-37 casks if all the SNF is stored in the ISFSI. A total of 123 SNF canisters (50 existing and 73~~5~~ new canisters) ~~are currently~~will be located within the ISFSI (SCE-AM 2018).

Transfer of SNF and HLW for Off-Site Disposal

The current schedule for shipments of SNF and HLW from SONGS to the DOE for disposal at a repository is predicated on the agreements detailed in the Standard Contracts (10 CFR Part 961, 2016) between the DOE and individual utilities (SCE 2014b). The Standard Contracts for acceptance and disposal of SNF and HLW contain the basis for the initial ranking of industry-wide spent fuel acceptance obligations based upon the date of permanent removal of the SNF from service ("oldest fuel first" allocation). These schedules do not represent a contractual commitment by the DOE or the utilities and are used only as a planning basis (DOE 2004). The sequence in which the DOE would ship and receive waste from various power plants is known in the industry as the "queue." The Standard Contracts contain provisions allowing for "exchanges" of acceptance obligations, and priority for retired units such as SONGS, so it is possible that SCE could negotiate an alternative schedule, if a facility is available.

Given the DOE's lack of performance to date (the DOE was originally obligated to accept waste in 1998), SCE's assumption (for purposes of the IFMP) has been to base acceptance projections upon application of the "oldest fuel first" allocation scheme to a projected start date for repository operations. The 2014 IFMP was based upon a 2024 start date for DOE acceptance of SNF from the industry and the SONGS Units 2 and 3 positions in the queue. In 2016, that assumption was modified to specify that the DOE would begin to accept shipments in 2028 (SCE 2016). Therefore, the IFMP projects that all fuel will be removed from the SONGS site as of 2049. Based on this assumption, the ISFSI will be subsequently decommissioned by the 2051 final license termination date.

However, as part of the lawsuit settlement in *Citizens Oversight, Inc., et al. v. California Coastal Commission, Southern California Edison Company, et al.*, Superior Court for County of San Diego Case No. 37-2015-00037137-CU-WM-CTL, SCE entered into a

Settlement Agreement that requires SCE to use "commercially reasonable efforts" to relocate SONGS SNF to an off-site storage facility. Implementation of the Settlement Agreement could result in the transfer of the SNF to a federally or privately-owned consolidated interim storage (CIS) facility prior to the establishment of a federal repository. Until a viable site is identified, the ultimate storage site for SONGS SNF and the associated timeline for off-site relocation of the SNF are unknown.

As noted in the IFMP and DCE for SONGS 2 and 3 and SONGS 1, the DOE is responsible for the cost of transportation and disposal of SNF, so the nuclear decommissioning trusts do not contain any funds for transportation or future off-site storage.

EXISTING REGULATORY FRAMEWORK AND FEDERAL PROGRAM PLANS

This section describes the current status of the federal (DOE) efforts to develop facilities for the storage and disposal of SNF in the U.S., as well as recent activities in Congress to restart the waste management program. These programs represent a range of potential opportunities to provide for the transport of SNF from the SONGS site, but none are currently progressing.

THE NUCLEAR WASTE POLICY ACT AND THE REPOSITORY PROGRAM

The Nuclear Waste Policy Act (NWPA) of 1982, as amended in 1987, established the federal program, requirements, and process applicable to the management, storage, and disposal of SNF and HLW. The primary goal of the NWPA was "to provide for the development of repositories for the disposal of high-level radioactive waste and spent nuclear fuel." The NWPA created the Office of Civilian Radioactive Waste Management (OCRWM) within the DOE to implement federal government responsibilities specified by the Act, and also established the Nuclear Waste Fund (Section 302), which imposed a fee of 0.1 cents per kilowatt-hour (approximately $750 million per year) on electricity generated by civilian nuclear power reactors. As of the end of 2014 (the date of the most recent audit), the Nuclear Waste Fund had a balance of about $39.8 billion (DOE 2014). In exchange for the payment of this fee, utilities were authorized to enter into contracts with the Secretary of Energy for the acceptance of title, transportation, and long-term storage and disposal of SNF and HLW. SCE, acting on its own behalf as well as agent for the SONGS co-owners, entered into a single Standard Contract on June 10, 1983, covering the three SONGS units. The Act further specified that the Secretary "shall take title to the high-level radioactive waste or spent nuclear fuel involved as expeditiously as practicable, upon the request of the generator or owner, … beginning not later than January 31, 1998."

The NWPA defined a process for the identification and selection of candidate repository sites, and the characterization and analysis of these sites, to determine whether they were suitable for the development of a repository. In 1986, the DOE published a Final Environmental Assessment that documented the selection of three sites for further characterization (i.e., Yucca Mountain, Nevada; a site in basalt at the Hanford Site in Washington; and a site in bedded salt deposits in Deaf Smith County, Texas). However, in the 1987 Amendment to the Act, Congress directed the DOE to characterize only the Yucca Mountain site in Nevada and to develop the repository there, if it was found to be suitable.

Following the process prescribed in the amended NWPA, the Secretary recommended to the President in February 2002, and the President recommended to Congress, that Yucca Mountain be developed as the nation's first geologic repository (DOE 2002). In accordance with the NWPA, the governor of Nevada exercised his right to veto the President's recommendation, a veto which could only be overturned by majority votes in both houses of Congress. The House passed a resolution on April 25, 2002, approving Yucca Mountain by a margin of 306 to117, and the Senate voted (by voice vote) on July 9, 2002, to override the governor's veto.

Although the selection of Yucca Mountain was confirmed by the congressional resolutions, the site recommendation was not the final step in the regulatory approval process, because the NWPA further required that the DOE must demonstrate that the proposed repository meets the radiological health and safety standards established and regulated by the NRC. That process is not complete, and is described below.

Status of the License Application for Yucca Mountain

The DOE submitted an application to the NRC on June 3, 2008, for a license to construct the repository at Yucca Mountain (DOE 2008). The NRC's role is to assess whether the proposed facility meets NRC's regulatory requirements. The NRC staff's technical review, documented in its Safety Evaluation Report (SER), is one part of the licensing process. The process also includes hearings before the NRC's Atomic Safety and Licensing Board (ASLB), which will adjudicate challenges by a number of parties to the technical and legal aspects of the DOE application, and the Commission's review of contested and uncontested issues. On March 3, 2010, the DOE filed a motion with the Board asking to withdraw its application. The Board denied that request on June 29, 2010, finding that "… the [NWPA] does not permit the Secretary [of the DOE] to withdraw the Application that the NWPA mandates the Secretary file. Specifically, the NWPA does not give the Secretary the discretion to substitute his policy for the one established by Congress in the NWPA that, at this point, mandates progress towards a merits decision by the [NRC] on the construction permit" (NRC 2010). On appeal, the Commission found itself evenly divided on whether to overturn or uphold the Board's decision. During this time period, Congress had reduced funding for the NRC's review of the application, with no funds appropriated for fiscal year 2012 (and none in subsequent years). Recognizing the budgetary limitations, the Commission directed the Board to complete case management activities by the end of September 2011, and the Board suspended the adjudicatory proceeding on September 30. At the same time, the NRC staff also completed orderly closure of its Yucca Mountain technical review activities.

The Obama Administration had decided to terminate the Yucca Mountain Project during fiscal year (FY) 2009, claiming that it was "unworkable." In February 2010, the President issued the FY 2011 Budget Request with a zero budget request for OCRWM. Despite the ASLB ruling denying the DOE's motion to withdraw its license application, the Administration directed the DOE to dissolve OCRWM. Cases were filed in the U.S. Court of Appeals by the states of Washington and South Carolina, and several other parties, challenging the termination of the Yucca Mountain repository proceedings. Nevertheless, on October 1, 2010, the DOE shifted OCRWM program responsibilities to various DOE Offices, and, as of September 30, 2010, OCRWM employed no staff (DOE 2010).

In August 2013, the D.C. Circuit Court of Appeals ordered the NRC to resume its review using existing funds from previous appropriations. The NRC staff completed and published the five-volume SER in January 2015. In the SER, the NRC staff found that the DOE's license application met the regulatory requirements for the proposed repository, with two exceptions: the DOE had not obtained certain land withdrawal and water rights necessary for construction and operation of the repository. Therefore, the NRC staff recommended that the Commission not authorize construction of the repository until, among other things, these regulations were met and a supplement to the DOE's Environmental Impact Statement was completed. After the DOE declined to complete the supplement and deferred to the NRC, the Commission directed the NRC staff to develop the supplement, which was completed in early 2016.

Although the program has not been funded since 2010 and the OCRWM has been dismantled, the NWPA remains the legislation applicable to nuclear waste management in the U.S., and the license application to the NRC remains active. The adjudicatory process undertaken by the ASLB remains suspended. According to the NWPA, the ASLB hearings were required to be completed within 18 months (NRC may request a 12-month schedule extension if necessary). Additional funding from Congress for both the NRC and DOE would be required to support resumption of the License Application hearings.

At the time that the DOE attempted to withdraw the License Application in 2010, the DOE's schedule for the licensing and construction of the repository showed Construction Authorization by NRC in 2012, initial receipt of waste in 2017, and full operation of the facility in 2020 (DOE 2008). Therefore, the schedule projected that a fully-funded program would require on the order of 7 to 10 years to reach operational readiness, not counting the time associated with re-starting the program. Start-up costs and schedules would need to include the re-establishment of OCRWM or an alternative management organization (within or independent from the DOE) that would take its place.

Nuclear Waste Fund Suspension

After termination of the Yucca Mountain Project, the Nuclear Energy Institute (NEI) and the National Association of Regulatory Utility Commissioners filed a lawsuit challenging the DOE's continued collection of the surcharge to pay for used nuclear fuel management. In a unanimous decision, the U.S. Court of Appeals for the D.C. Circuit found that, "Because the Secretary is apparently unable to conduct a legally adequate fee assessment, the Secretary is ordered to submit to Congress a proposal to change the [nuclear waste] fee to zero until such time as either the Secretary chooses to comply with the [Nuclear Waste Policy] Act as currently written, or until Congress enacts an alternative waste management plan."

"Today's decision confirms that the federal government cannot continue to defy Congress' explicit direction to implement a viable program to manage reactor fuel from America's nuclear power plants. The court's ruling reinforces the fundamental principle that the federal government's obligation is to carry out the law, whether or not the responsible agency or even the president agrees with the underlying policy … unless and until the Energy Department's repository program is restarted or another waste disposal program is developed, it is appropriate that the Nuclear Waste Fund fee be suspended" (U.S. Court of Appeals 2013).

As noted previously, the Nuclear Waste Fund balance as of the end of 2014 was approximately $39.8 billion. Although the courts have barred the DOE from continuing to collect fees, investment income continues to accrue at about $1.4 billion per year in 2013 and 2014 (DOE 2014).

DOE Interim Storage Activities

Although the primary focus of the NWPA was on developing a solution for the permanent final disposal of SNF and HLW (i.e., the repository), the Act does contain provisions that guide the development of facilities for interim storage. Section 111(a)(5) specified that the generators and owners of SNF and HLW have the primary responsibility to provide for, and to pay the costs of, interim storage until such waste and spent fuel is accepted by the Secretary of Energy. Subtitle B of the NWPA (Sections 131 through 137) authorizes interim storage of spent fuel until a geologic repository is ready, and it encourages the development of expanded at-reactor interim storage facilities. If any operator of civilian nuclear power reactor cannot reasonably provide adequate spent nuclear fuel storage capacity, Subtitle B authorizes the DOE to develop a federally owned and operated interim storage system with not more than 1,900 metric tons of capacity to prevent disruptions to the orderly operation of the plant.

The NWPA also authorized the siting and construction of a large-scale federally operated Monitored Retrievable Storage (MRS) Facility that could store large volumes (up to 15,000 metric tons) of SNF and HLW (Subtitle C, Sections 141 through 149). However, the implementation of the MRS program was subject to several conditions designed to ensure that the MRS did not become a de facto repository. Most significantly, construction of such a facility may not begin until the Commission has issued a license for the construction of a repository (Section 148(d)(1)).

A Congressionally chartered MRS Commission (authorized by the 1987 Amendment to the NWPA) in 1989 recommended a 2,000-ton Federal Emergency Storage facility and a 5,000-ton User-Funded Interim Storage Facility. The MRS Commission's recommendations were not pursued, and no effort to develop a federally-operated interim storage facility was ever authorized when the Yucca Mountain Repository program was active.

Lawsuits Resulting from DOE's Failure to Receive Waste

As a result of the DOE's failure to begin receiving waste in 1998, every nuclear utility, including SCE, has sued the DOE to recover the costs associated with the DOE's breach of contract (i.e., the costs incurred by the requirement to store SNF and HLW for a longer period of time than originally anticipated). SCE filed suit (Case No. 04-109C) on February 13, 2009, with the U.S. Court of Federal Claims, seeking damages in the amount of $146,349,316 to cover costs incurred through December 31, 2005. The major categories of costs included construction of the ISFSI for Unit 1, as well as the expansion of the ISFSI for Units 2 and 3 (expanded ISFSI).

SCE has also incurred significant costs for off-site storage of SNF. SONGS had originally planned to reprocess their nuclear fuel and shipped 99 fuel assemblies in 1974 and 1976 to the General Electric Hitachi Facility in Morris, Illinois to be reprocessed. The Hitachi Facility never became operational, and in 1977, President Carter indefinitely deferred the spent fuel reprocessing program. Because of space limitations in the Unit 1 spent fuel pool, SCE shipped an additional 171 assemblies to Morris in 1980 for indefinite storage, for a total of 270 fuel assemblies.

In addition, SONGS costs included funds expended in an attempt to develop an independent fuel storage facility known as Private Fuel Storage, LLC (PFS). SCE joined the PFS project in 1994 as part of an effort to investigate economically competitive, interim spent fuel storage alternatives. The PFS consortium was formed by eight electric utility companies for the purpose of developing an interim SNF storage facility. PFS partnered with the Skull Valley Band of Goshute Indians in Utah to build and operate the facility. SCE participated in PFS because of uncertainties related to siting an ISFSI at SONGS due to the compact nature of the SONGS site, and the absence of other viable spent fuel storage options. When it became apparent that SONGS would be able to develop an ISFSI onsite, SCE stopped making payments to PFS but remained a participant (inactive). PFS eventually received an NRC license to operate, but never opened due to opposition from the state of Utah, and the refusal by the U.S. Department of Interior to approve the lease and a right-of-way needed to access the site (PFS 2012).

The trial court awarded SCE $142,394,294 for expenses undertaken because of the DOE's breach. The DOE appealed a portion of the award regarding the allocation of costs, but the court's finding was upheld by the Court of Appeals. SCE will continue to file claims in the future (and be reimbursed) for costs incurred after 2005 for the continued storage resulting from the DOE's breach, including construction of the new expanded ISFSI. These reimbursements are made from the federal Judgment Fund administered by the U.S. Department of the Treasury, which is paid for by taxpayers, and is used to pay awards and settlements from claims against the U.S. The Nuclear Waste Fund can only be used for the purposes defined in the NWPA; therefore, it cannot be used to pay for the judgments related to the DOE's breach of contract. Over the past 15 years, more than $5 billion has been paid, and estimates of future liability range from over $27 billion, assuming that the DOE begins accepting waste within the next 10 years, to as much as $100 billion, depending on when the DOE begins to accept SNF at a Federal facility (DOE 2014).

Blue Ribbon Commission and Recent DOE Activities

Following termination of the Yucca Mountain Project, the DOE chartered the Blue Ribbon Commission on America's Nuclear Future to recommend a new strategy for managing the back end of the nuclear fuel cycle. For nearly 2 years, the Blue Ribbon Commission conducted numerous public meetings and hearings, and developed a series of recommendations. The strategy they recommended in their final report in 2012 has eight key elements:

(1) A consent-based approach to siting future nuclear facilities
(2) A new organization dedicated solely to implementing the waste management program
(3) Access to the funds nuclear utility ratepayers are providing for nuclear waste management
(4) Prompt efforts to develop one or more geologic disposal facilities
(5) Prompt efforts to develop one or more consolidated storage facilities
(6) Prompt efforts to prepare for large-scale transport of SNF and HLW
(7) Support for continued U.S. innovation in nuclear technology
(8) Active U.S. leadership in international efforts

After the release of the Blue Ribbon Commission Report in 2012, the DOE (2013) published a document describing a proposed revised schedule and strategy to site and construct facilities for the storage and disposal of SNF and HLW. Because the proposed strategy is not consistent with the NWPA, the implementation of the revised strategy is contingent on the passage by Congress of new legislation and funding that would allow the implementation of the DOE's revised strategy (referred to here as the DOE 2013

Strategy). The revised strategy proposed to implement a program over the next 10 years that would:

- Site, design, license, construct, and begin operations of a federally operated pilot interim storage facility by 2021, with an initial focus on accepting used nuclear fuel from shut-down reactor sites;
- Advance toward the siting and licensing of a larger interim storage facility to be available by 2025 that would have sufficient capacity to provide flexibility in the waste management system and allow for the acceptance of enough used nuclear fuel to reduce expected government liabilities; and
- Make demonstrable progress on the siting and characterization of repository sites to facilitate the availability of a geologic repository by 2048.

In the 5 years since the publication of the revised strategy, Congress has not authorized any funding for its implementation, or made the changes to the NWPA that would be required to allow it. The DOE has not developed or submitted proposed legislation to Congress. The schedules proposed in the revised strategy assumed that funding and modifications to the NWPA would be made expeditiously, so it is reasonable to assume that the 3-year delay in implementation of the program would result in at least a 3-year delay in the target dates identified (i.e., 2024 for a pilot project, 2028 for a larger interim facility).

Recent Congressional Efforts to Address Interim Storage

In response to the lack of progress since the dissolution of OCRWM, and termination of the Yucca Mountain Project, several members of Congress have proposed legislative initiatives to accelerate the establishment of interim storage alternatives, and to restart or reinvigorate the repository program. In the Senate, Senator Bingamon proposed a new Nuclear Waste Administration Act in 2012, and Senators Alexander, Murkowski, Feinstein, and Cantwell proposed the Nuclear Waste Administration Act of 2013, and a revised version in 2015. Their proposal would implement some, but not all, of the recommendations of the Blue Ribbon Committee, and the DOE's 2013 Strategy. The Nuclear Waste Administration Act of 2015 would:

- Establish an independent agency to manage the country's nuclear waste program in place of the DOE
- Define a consent-based process for the development of consolidated storage facilities and a repository
- Establish a new working capital fund in the U.S. Department of the Treasury, into which the fees collected from the utilities would be deposited
- Authorize the Secretary of Energy to revisit the decision to commingle defense waste with commercial spent fuel

In July 2016, Rep. Robert Dold of Illinois introduced the Stranded Nuclear Waste Accountability Act (H.R. 5632), which would direct the Secretary of Energy to implement a program to provide compensation to communities that are hosts to closed nuclear power plants that must continue to store spent nuclear fuel onsite because of the government's failure to establish a geologic repository.

On June 26, 2017, Rep. John Shimkus (R-IL) introduced the Nuclear Waste Policy Amendments Act of 2017 (H.R. 3053). The bill would amend the Nuclear Waste Policy Act of 1982 (NWPA) to improve the DOE's nuclear waste management program to store and dispose of SNF and HLW.

- Title I of the bill directs DOE to initiate a program to consolidate and temporarily store commercial SNF during the development, construction, and initial operation of a repository, with preference for the DOE to take ownership of SNF from facilities that have ceased commercial operation. This title also authorizes DOE to enter into an agreement with a non-federal entity for the purposes of storing SNF to which the DOE holds title.
- Title II addresses federal "land withdrawal" (describing legal uses of the federal land) and related management issues associated with the licensing and construction of a permanent geologic repository at the Yucca Mountain, Nevada site, including the permanent withdrawal of specific federal land for repository use by DOE. Title II also removes potential impediments to the NRC licensing process and conditions for the repository; and limits activities relating to a separate repository for HLW generated by atomic energy defense activities.
- Title III provides DOE with consolidated storage options to help fulfill the federal government's obligations to take title to SNF. Provisions amend the NWPA to authorize DOE to modify contracts to allow the transfer of commercial SNF to DOE for monitored retrievable storage in addition to DOE's existing legal obligations to ensure the permanent disposal of commercial SNF.
- Title IV provides benefits to the repository host state and units of local governments. The provisions update the NWPA to requalify the State of Nevada to enter into an agreement with DOE to help mitigate potential impacts that may result from hosting the repository. The title also allows qualified covered units of local government to enter into separate benefits agreements with DOE.
- Title V amends the method by which DOE funds its nuclear waste management activities through the collection and usage of the Nuclear Waste Fund (Fund). The bill also makes specific portions of previously collected funding available to the DOE without further appropriation throughout the multi-decade life cycle of the repository program.
- Title VI makes miscellaneous changes to the NWPA, including updating the generic (non-Yucca Mountain specific) standards for a repository, setting a fixed-

term appointment for the OCRWM Director, and expanding the qualified usage of DOE financial assistance to state and local organizations to support SNF transportation activities.

The House of Representatives held several hearings on H.R. 3053 and passed the bill on May 10, 2018. H.R. 3053 is not expected to be brought to a vote in the Senate until very late 2018 or 2019 at the earliest.

In addition to the efforts of both the House and Senate to authorize an interim storage program, the House of Representatives has, each year since the termination of the Yucca Mountain Project, included funding for both the DOE and NRC in their budget for the restart of the licensing of the Yucca Mountain Repository. In the 2016 and 2017 House Budgets, $150 million was requested. However, neither the Yucca Mountain funding, nor funding for a revised program to implement the Administration's 2013 Strategy, has been authorized in any year since 2010.

The new administration included $120 million in its proposed 2018 budget to restart the licensing of Yucca Mountain, but the final version of the budget did not include funding for either Yucca Mountain or development of interim storage. At present, it remains uncertain whether the Senate will support the restart of the repository program and whether Congress will authorize funding for the repository program or interim storage in future budgeting.

Proposed Private Fuel Storage Facilities

There is no regulatory prohibition on the development of a private facility to provide interim storage of SNF. Three private entities that have attempted to establish interim storage programs are discussed below.

Private Fuel Storage, LLC (PFS)

The PFS facility in Utah was licensed by the NRC but never opened due to the refusal of the U.S. Department of the Interior (regarding right-of-way for rail access to the site) and the Bureau of Indian Affairs (regarding uncertainties over land trust issues) to grant needed approvals, which precluded the facility from becoming operational (PFS 2012). PFS notified the NRC in 2012 that they intended to terminate their license unless they were granted an Exemption from Part 171 Annual Fees as long as the facility is not operational. After review, the NRC granted the exemption, so the license remains in effect, but the access issues remain unresolved. More recently, two other private initiatives, discussed below, have emerged that could provide an interim storage solution for SNF and HLW.

Waste Control Specialists, LLC (WCS)

Waste Control Specialists, LLC (WCS) in Andrews County, Texas, prepared and submitted a license application for a Consolidated Interim Storage Facility (CISF) for approval by the NRC, in accordance with the requirements of 10 CFR Part 72. The CISF would be constructed and operated on an approximately 100-acre initial footprint within a 320-acre parcel, where security would be maintained, within the currently controlled WCS property of 14,000 acres. WCS is requesting initial authorization to store up to 5,000 metric tons of uranium (MTU) in Phase 1, but has analyzed the environmental impacts of storing up to 40,000 MTU at the CISF (WCS 2015).

WCS submitted a letter to the NRC on April 18, 2017, requesting that the NRC temporarily suspend all safety and environmental review activities as well as public participation activities associated with the CISF Application. WCS indicated that it faced financial burdens that currently make pursuit of licensing unsupportable (NRC 2017).

Subsequent to the request to suspend the review of the License Application, parent company (Valhi, Inc.) sold WCS to J.F. Lehman & Company in January 2018. In addition, WCS and Orano CIS LLC (a subsidiary of Orano USA) formed a joint venture, Interim Storage Partners LLC (ISP), whose purpose is to undertake the licensing, construction, and operation of the WCS CISF. On June 8, 2018, ISP submitted a request to the NRC to restart its review of the application for approval of the WCS CIS Facility.

Eddy Lea Energy Alliance, LLC (ELEA)

A second private venture for a Centralized Interim Storage Facility has been proposed by the Eddy Lea Energy Alliance, LLC (ELEA), a partnership of Holtec International and the Cities of Carlsbad & Hobbs and the Counties of Eddy & Lea in New Mexico (Alliance). The Alliance has purchased 1,000 acres of land approximately halfway between Carlsbad and Hobbs, New Mexico for potential use, and has proposed using Holtec's existing designs for below-grade SNF storage (HISTORM UMAX). Holtec constructed the new expanded ISFSI at SONGS for the storage of the remaining Unit 2 and 3 spent fuel.

Holtec submitted a license application for the facility on March 31, 2017. Their application includes a Final Safety Analysis Report and Technical Specifications for a HI-STORM UMAX canister storage system (Holtec 2016). The Alliance has proposed a development schedule similar to that proposed by WCS, with licensing completed before 2020 and construction and initial operation possible by 2021.

Potential Constraints to the Use of Private Fuel Storage Facilities

Although in theory there are no regulatory barriers to the construction and operation of private fuel storage facilities, there are significant legal and contractual constraints that would have to be overcome for SCE to contemplate shipment of fuel to a private facility.

These relate to both the costs and potential liabilities that would be associated with the transfer of the fuel to a third party.

Cost Issues: The question of who would pay for SCE to move and store SNF and HLW from SONGS to an off-site facility is not simple to answer. As noted above, the NWPA specifies that owners and generators of SNF and HLW are responsible for interim storage until the DOE accepts it for transportation and disposal. As a result, SONGS (and other utilities) plans and trust funds for decommissioning activities do not include any money for transportation or storage at off-site facilities, because those costs are solely the responsibility of the DOE. The Decommissioning Trust Funds are funded by charges to utility ratepayers and overseen by the California Public Utilities Commission, and it seems unlikely they would approve the use of the Trust Funds for costs that are the responsibility of the federal government.

Similarly, the breach of contract lawsuit settlements do not currently anticipate costs that would be incurred for off-site transportation and temporary storage, and include only costs incurred by the utilities (e.g., SCE) resulting from the DOE's breach. It is not clear whether the administrators of the Judgment Fund would approve the reimbursement of third party vendors for transportation or storage above and beyond the costs already incurred for on-site storage. Currently, utilities such as SCE are reimbursed for their costs, but may not collect a fee or profit. Private vendors could not be expected to participate if they could not earn a profit.

Despite the breach of contract, the DOE is not currently paying anything for the continued storage of SNF and HLW at SONGS or any other reactor, and does not have access to the Nuclear Waste Fund. For the DOE to contribute in any way, Congress would have to authorize funding, either through access to the Fund, or through another source of new appropriations. As noted previously, the primary focus of the program historically (and the primary purpose of the fund) was the development of a repository for permanent disposal. Given the lack of progress on the direction of the U.S. nuclear waste management policy and program over the last 6 years, it seems unlikely that Congress would authorize the use of the Waste Fund for interim storage.

As discussed above, the most recent Senate proposals for reform of the nuclear waste management program include a proposal for a new "working capital" fund (separate from the Nuclear Waste Fund) that could in theory be used to support interim storage, but how or if such funding will materialize is unknown.

Contractual (Liability) Issues: The issue of responsibility or liability for SNF and HLW is similar in many ways to the cost issue. Under the NWPA, utilities hold title to and responsibility for managing SNF and HLW until the DOE accepts it (and title) for transportation and disposal. The NWPA did not contemplate the addition of third parties to the waste management equation, and therefore does not explicitly address it. If SCE decided to transport and store waste at an off-site facility, it would presumably want to be released from future liability, in the unlikely event of any accidents or other incidents.

A third party that was storing waste temporarily would likely not be willing to accept long-term liability for SNF or HLW, particularly in the absence of a permanent disposal option such as a repository. As a result, the proposals by WCS and ELEA assume that DOE will be willing to negotiate a contract that would take legal title and pay them for interim storage until a repository is available for permanent disposal. Therefore, a modification of the NWPA by Congress would likely be required to implement private storage. Since OCRWM was disbanded in 2010, there is no single organization within the government that is currently responsible for the management of nuclear waste, although many of the legal functions of OCRWM were assigned to other departments or offices within the DOE.

As noted above, the proposed H.R. 3053 does include provisions that would enable DOE to accept title, and pay a third party to store SNF at an interim storage facility, such as the proposed facilities at WCS and ELEA. H.R 3053 specifically expresses a preference for the temporary storage of stranded SNF from shutdown reactors such as SONGS.

MOVING SONGS SNF AND HLW TO ANOTHER EXISTING ISFSI

As is the case for potential storage of SNF at a private facility, there is no regulatory prohibition on the possible use of an existing ISFSI for interim storage, and SONGS already has 270 fuel assemblies that have been stored at the GE Hitachi Facility in Morris, Illinois for over 35 years. However, there are no operating ISFSI's in the U.S. that currently accept SNF or HLW from outside parties. During the scoping process for the SONGS Decommissioning EIR, there have been suggestions that SCE could negotiate an agreement with Palo Verde Nuclear Generating Station to expand the ISFSI at Palo Verde to also store SONGS SNF and HLW (SCE is a 15.8% owner of Palo Verde). Others have suggested that the ISFSI at the closed Rancho Seco Nuclear Generating Station near Sacramento could be expanded to store SONGS SNF and HLW.

Although another ISFSI could theoretically be expanded to accommodate SONGS waste, many of the same cost and liability issues that would apply to a private facility would also apply to an existing ISFSI. Neither SCE nor any of the existing nuclear generating stations has access to funds to pay for transportation or off-site storage (the Judgment Fund only pays the costs of on-site storage). The DOE or a new Nuclear Waste Administration Act could be authorized and funded to pay the costs of and assume liability for off-site storage of SNF from SONGS through the passage of legislation similar to the proposed Senate Nuclear Waste Administration Act of 2015 (Section 3.7). It is unknown whether DOE or a new organization would consider the possibility of using an existing facility or what the other requirements new legislation might impose.

Expanding the capacity of an existing ISFSI would also require amendment of the NRC license for the facility, and would presumably trigger additional review by state regulatory agencies (e.g., the California Public Utilities Commission), as well as other state and federal agencies responsible for land use. Estimating the likelihood of success of such efforts, or the time that would be required, would be speculative.

SUMMARY

The plan and schedule for the management of SNF and HLW during SONGS decommissioning are based on assumptions consistent with existing law (the Nuclear Waste Policy Act) and contracts (the Standard Contracts) that provide a defensible basis for projections of the activities and time required to complete decommissioning. Current nuclear waste management policy in the U.S. encourages on-site ("at reactor") storage of SNF and HLW until it can be shipped to the DOE for permanent disposal in a geologic repository. The schedule for the transportation of waste from SONGS to the repository is constrained by the rate at which the DOE can receive shipments from all the operating and closed commercial nuclear power plants, as well as DOE sites shipping HLW and SNF. Based on the assumption that the DOE will be ready to begin accepting fuel in 2028 (at a repository if the Yucca Mountain Project is restarted, or at an interim storage facility if one becomes available), the IFMP projection that all the SONGS SNF and HLW will be shipped by 2049 is reasonable and would support the projected completion of SONGS decommissioning activities in 2051.

There are certain scenarios (e.g., involving interim storage facilities) that could potentially support a faster transfer of SNF and HLW to off-site facilities, but there is presently no basis for defining them in more detail or analyzing them. Such scenarios would require modifications of current regulations and other policy changes that cannot currently be reliably predicted.

In any event, the broad sequence of waste management events required to complete SONGS decommissioning appear to be set: (1) transfer of SNF from the Spent Fuel Pools to the on-site ISFSI; (2) extended storage in the ISFSI; and (3) transportation of SNF and HLW off-site to a repository or interim storage facility.

At the same time, numerous uncertainties surround the location and timing of transportation and final removal of SNF and HLW to an off-site facility. These include the ongoing lack of federal funding since 2010 for the licensing or development of a federal geologic repository; the lack of new federal legislation or funding to allow implementation, of the revised DOE 2013 Strategy; and the legal and contractual constraints facing development of private storage facilities and the movement of SNF and HLW between existing ISFSIs. These uncertainties render detailed evaluation of transportation and final removal of SONGS SNF and HLW to an off-site facility too speculative to be evaluated in detail in the EIR.

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APPENDIX D2
RADIOLOGICAL SCOPING AND CHARACTERIZATION DATA[1]

This appendix provides an overview of the results of the radiological scoping survey of the offshore discharge conduits and the characterization results of Unit 2 and 3 onshore areas and system components.

DISCHARGE CONDUITS SCOPING SURVEY

Table D2-1 identifies the number of samples collected at the discharge conduits by sample location and type of media for both Unit 2 and Unit 3 discharge conduits following the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)[2] scoping survey approach (CB&I 2017).

Table D2-1. Type and Quantity of Radiological Scoping Survey Samples

Sample Locations/Type of Media	Unit 2 Discharge Conduit (# of samples)	Unit 3 Discharge Conduit (# of samples)
Internal – Scrapings	10	10
Internal – Sediment	10	10
External – Ocean Bottom Sediment	6	6
External – Conduit Displacements	2	2

Source: CB&I 2017.

Internal samples were collected every 50 feet, starting 50 feet out from the stop gates located at the individual plant exits before each discharge conduit. External samples were taken approximately 12 feet to the north and south of each identified sample location. Additional samples were taken at the conduit displacement areas located where the Unit 2 and Unit 3 discharge conduits connect to the box culvert (shoreward end of the conduits). Minor cracking of the grout band seal developed at this location due to minor differential settling of the conduit; therefore, these areas were included by CB&I as sampling locations. Sampling locations are mapped in the CB&I report (CB&I 2017).

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[1] This document has been prepared for the California State Lands Commission by Aspen Environmental under Contract No. C2015046.

[2] The MARSSIM provides detailed guidance on how to demonstrate that a site is in compliance with a radiation dose- or risk-based regulation. The MARSSIM focuses on the demonstration of compliance during the final status survey following scoping, characterization and any necessary remedial actions. MARSSIM, Revision 1 (NRC 2000), with June 2001 update, is available in print or electronic format at: https://www.epa.gov/radiation/download-marssim-manual-and-resources. The Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual (MARSAME), a supplement to the MARSSIM that is also discussed in this EIR, provides technical information on survey approaches to determine proper disposition of materials and equipment (see https://www.epa.gov/radiation/marsame-manual-and-resources). The difference between the manuals is:

- MARSSIM is for **SITE** surveys and is applicable to real property (buildings and land)
- MARSAME is for **Materials and Equipment** (M&E) surveys and applies to non-real materials and equipment.

Table D2-2 presents the results of the samples by type showing the nuclide identified, range of results, and the average radioactive content.

Table D2-2. Results of 2016 Conduit Radiological Scoping Survey

Location/Type	Nuclide	# Positive Results	Range (pCi/gram)	Average (pCi/gram)
Unit 2 Sediment	Co-60	10	0.16 – 2.2	0.97
	Cs-137	1	0.14	0.14
Unit 2 Scrapings	Co-60	4	0.061 – 0.79	0.067
Unit 3 Sediment	Co-60	1	0.66	0.66
	Cs-137	2	0.11 – 0.12	0.12
Unit 3 Scrapings	Co-60	1	0.049	0.049
Ocean Bottom (including conduit displacement areas)	Co-60	3	0.059 – 0.092	0.072

Source: CB&I 2017.
Acronyms: Co = cobalt; Cs = cesium pCi = picocuries.

The CB&I report noted that for sediment, NUREG-1301, Table 4.12-1 “Lower Limits of Detection (LLD)” lists only Cs-134 and Cs-137 for gamma spectral analysis and their respective LLD (CB&I 2017). NUREG-1301 also requires analyses and reporting of all nuclides (other peaks) that are identifiable (NRC 1991, p. 66).

The CB&I report (CB&I 2017) positively identified Co-60, as required by NUREG-1301. However, very few (5 of 56) of the Cs-134 measurements met the LLD requirement of 0.15 pCi/g. Perhaps the *a priori* LLD was determined to be 0.15 pCi/g, but the observed LLD was not confirmed based upon post analysis review. Even so, the reported results were low, with a maximum of less than 0.1 pCi/g. The short radioactive half-life of Cs-134 will cause the concentration levels, if any exist, to be reduced significantly through radioactive decay. Decommissioning Plan activities are expected to continue until 2035; as a result, Cs-134 concentrations would be about 0.002 times what they were at the end of 2016. The NRC will ultimately determine if any resampling or analysis may be required.

No sampling was performed to identify natural radioactive background concentrations; in particular, for the plant-related radionuclide Cs-137. These types of samples are normally collected outside and away from impacted areas. If natural background radioactivity were determined and subtracted from the reported results, the actual concentrations of plant-related radioactivity would be less than those reported. Positive results for several other naturally occurring radionuclides (thalium-208, thorium-234, lead-212, actinium-228, bismuth-212 and -214, and potassium-40) were reported in the CB&I report (Table 7.2). These radionuclides do not appear to be associated with power plant activities, but the report does not include a corresponding narrative.

The extent and depth of ocean bottom contamination was not evaluated. However, this was not a goal of the scoping survey and consideration of the very low results should be included in any future risk analysis. As this was a scoping survey, the NRC may determine that additional sampling is appropriate for the FSS.

For comparison, the following table shows the maximum results for Co-60 and Cs-137, the highest LLD for Cs-134, along with the NRC Screening release levels for soil from NUREG-1757. All the results are below NRC screening levels.

Table D2-3. Plant-Related Nuclide Data, Survey Results, and Screening Level

Radionuclide	Half Life (years)	Maximum[1] Sample Result (pCi/g)	NRC Screening Level[2] (pCi/g)
Co-60	5.3	2.2	3.8
Cs-134	2.1	0.33	5.7
Cs-137	30	0.14	11

Source: Argonne National Laboratory (ANL) 2007; CB&I 2017; NRC 2006, Table H.2.
Acronyms: NRC = Nuclear Reglatory Commission; pCi/g = picocuries per gram.
Notes:
1 For Cs-134, the maximum result is the Lower Limits of Detection.
2 A look-up table for common radionuclides for soil surface residual radioactivity equivalent to 25 millirem per year for a resident farmer.

SONGS RADIOLOGICAL CHARACTERIZATION

Table D2-4 shows the measurement and sample types performed and/or conducted for radiological characterization of the SONGS site and installed features (SCE 2016; AREVA 2015).

Table D2-4. Radiological Characterization Survey Measurements and Quantity

Measurement or Sample Type	Measurement Data	Report Units	Quantity Collected
Direct Alpha	Total alpha surface activity	dpm/100cm^2	138
Direct Beta	Total beta or beta-gamma surface activity	dpm/100cm^2	1,191
Contact Gamma	Total gamma activity	cpm	2,404
Exposure Rate	Gamma exposure rate	mR/hr	296
Removable Alpha	Removable alpha surface activity	dpm/100cm^2	1,157
Removable Beta	Removable beta surface activity	dpm/100cm^2	1,157
Gamma Spectral	Gamma radionuclide analysis	pCi/g - for solid samples or pCii/ml for liquid	1,061
Off-site Laboratory	Alpha, beta, and gamma radionuclide analysis	pCi/g - for solid samples or pCii/ml for liquid	83

Source: AREVA 2015, Table 4-3.
Acronyms: cpm = counts per minute; dpm/100cm^2 = disintegrations per minute per 100 square centimeters; mR/hr = milliroentgens per hour; pCi/g = picocuries per gram; pCii/ml = picocuries per milliliter

Areas that have no reasonable potential for residual contamination are classified as "non-impacted areas." These areas have no radiological impact from site operations and are typically identified early in decommissioning. Areas with reasonable potential for residual contamination are classified as "impacted areas." MARSSIM provides for three classifications of areas with residual contamination (NRC 2000):

- **Class 1 Areas:** Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation surveys) above the DCGLw.[3] Examples of Class 1 areas include: (1) site areas previously subjected to remedial actions, (2) locations where leaks or spills are known to have occurred, (3) former burial or disposal sites, (4) waste storage sites, and (5) areas with contaminants in discrete solid pieces of material and high specific activity.
- **Class 2 Areas:** Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGLw. To justify changing the classification from Class 1 to Class 2, there should be measurement data that provide a high degree of confidence that no individual measurement would exceed the DCGLw. Other justifications for reclassifying an area as Class 2 may be appropriate, based on site-specific considerations. Examples of areas that might be classified as Class 2 include: (1) locations where radioactive materials were present in an unsealed form, (2) potentially contaminated transport routes, (3) areas downwind from stack release points, (4) upper walls and ceilings of buildings or rooms subjected to airborne radioactivity, (5) areas handling low concentrations of radioactive materials, and (6) areas on the perimeter of former contamination control areas.
- **Class 3 Areas:** Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGLw, based on site operating history and previous radiation surveys. Examples of areas that might be classified as Class 3 include buffer zones around Class 1 or Class 2 areas, and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

[3] MARSSIM defines two potential derived concentration guideline levels (DCGLs) based on the area of contamination. If the residual radioactivity is evenly distributed over a large area (e.g., survey unit), MARSSIM looks at the average activity over the entire area. This DCGL is called the DCGLW and it is derived based on an average concentration over a large area. It is the DCGL used in the statistical tests. Conversely, if the residual radioactivity appears as relatively small areas of elevated activity (i.e., hot spots) within a larger area, MARSSIM considers the results of individual (judgmental) measurements. This DCGL is called the DCGLEMC and it is defined as the DCGL used for the elevated measurement comparison (EMC); it is derived separately for hot spots.

The MARSSIM suggested limits on the size of survey units are summarized in Table D2-5. For the NRC to approve the FSS for license termination (the end state), each survey unit must pass the release criterion.

Table D2-5. MARSSIM Suggested Sizes of Survey Units

Classification	Survey Unit Areas	
	Structures	Land
Class 1	Up to 100 m^2	Up to 2,000 m^2
Class 2	100 to 1,000 m^2	2,000 to 10,000 m^2
Class 3	No limit	No limit

Source: NRC 2000, MARSSIM Roadmap Table 1.
Acronym: m^2 = meters squared.

The Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual (MARSAME) is a supplement to MARSSIM which provides information on planning, conducting, evaluating, and documenting radiological disposition surveys for the assessment of materials and equipment. SCE plans to conduct disposition surveys per the guidance in MARSAME, and has divided the impacted systems into the following classifications (NRC 2009):

- Class 1 Systems are expected to have levels of licensed radioactive material requiring disposal as Class A waste or greater.
- Class 2 Systems have the potential for cross-contamination from Class 1 systems.
- Class 3 Systems are not expected to be contaminated, but are suspect by virtue of their association with Class 2 systems and being located in a MARSSIM-impacted area.

Release criteria for subsurface soils are also determined with the NRC on a site-specific basis; neither surface nor subsurface DCGLs are yet established. The MARSSIM does not provide recommendations for survey unit sizes or sampling efforts below the top 6 inches of soil. The two main media of interest in MARSSIM are contaminated surface soil and building surfaces. The MARSSIM also does not cover other media, including construction materials, equipment, subsurface soil, surface or subsurface water, biota, air, sewers, sediments, or volumetric contamination. The MARSAME does provide guidance on the survey of materials and equipment (NRC 2000; NRC 2009).

Table D2-6 provides a list of survey areas and characterization survey conclusions. Table D2-7 presents the SONGS plant systems and their respective components. The MARSAME classification is provided as well as an indicator on certain Class 2 and 3 systems that may be suitable for release.

Table D2-6. List of Survey Areas and Characterization Survey Conclusion

Major Components	Characterization Survey Conclusion
South Yard Facility Area (SYFA)	
Structures: Multi-Purpose Handling Facility (MPHF) Hazmat Pad: Pad and Roof (underside) Radioactive Equipment and Materials Storage (REMS) Staging Pad **Environmental:** MPHF Yard Area South Yard Facility: Hot Side, Cold Side, and Canopy Area Lot 1	For the investigation survey of the REMS Awning Area, the gamma spectral analysis confirmed Cs-137 contamination of the concrete at the location of highest gamma and beta activity, exceeding the NRC screening value for Cs-137 in soil. Walkover gamma scans indicated elevated readings that were investigated by static gamma and direct beta measurements followed by a core bore at the highest location. Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the above grade paved area within the South Yard Facility Open Paved Area (East) contains one localized hot spot and several other point-source contaminants found during Station radiation protection (RP) release surveys. After future remediation of those locations, and considering no other significant levels of residual licensed radioactive contamination are detected, the remaining material in the area could be dispositioned using MARSAME release practices or other low-cost options.
Make Up Demineralizer Area (MUDA)	
Structures: MUDA structures (fenced area - includes tanks and support structures) **Systems:** Make-Up Demineralizer **Environmental:** Upper Lot 2 & Lower Lot 2 Make-Up Demineralizer (fenced area) South Road K-Zone Building K40/K50/K60	Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the MUDA survey units may qualify for disposition using MARSAME material release practices or other low-cost disposal options.
South Protected Area Yard (SPAY)Make Up Demineralizer Area (MUDA)	
Structures: Diesel Generator Building Building K-10 Building K-20 Building K-30 **Systems:** Auxiliary Transformer Main Transformer **Environmental:** Open Paved Areas/Environs	The concrete slab surface outside the Unit 3 equipment hatch contains low-level licensed radioactive contamination. After remediation and confirmatory survey results showing successful cleanup, the slab materials may qualify for disposition using MARSAME material release practices or other low-cost options. For other surfaces, excluding the Unit 3 equipment hatch slab, radiological measurements were of sufficient quantity and sensitivity to provide a basis to conclude that the SPAY survey units do not contain other locations with licensed radioactive material contamination and may qualify for disposition using MARSAME material release practices or other low-cost options.
East Road Area (ERA	
Environmental: Open Paved Area/Environs Hazardous Material Area	Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the above grade paved area within the ERA Truck Bay/Fuel Handling Bay Paved Area do not

Table D2-6. List of Survey Areas and Characterization Survey Conclusion

Major Components	Characterization Survey Conclusion
	contain substantial levels of residual licensed radioactive contamination, and may qualify for disposition using MARSAME material release practices or other low-cost options. Note that SONGS radiation protection staff conducted detailed surveys to support the unconditional release of this area to install plant support equipment and found three roughly square foot asphalt locations contaminated with very low levels of fixed contamination. Those locations were identified, marked, and determined to not require radiological control or warning signs.
Unit 2 Area (U2A)	
Structures: Containment Building Fuel Handling Building Penetration Building Tank Building Safety Equipment Building	***Unit 2 Containment Building –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 2 Containment Building radiological systems components will likely qualify for disposition as Class A low-level radioactive waste. All concrete structures in the containment building are likely contaminated with low levels of tritium and carbon-14. This excludes the reactor vessel and internals whose characterization was not within the scope of this work due to the higher radiation levels. After removal of the most significantly contaminated bare concrete beta wall, the concrete and steel structures are likely suitable for low-cost disposal options. Low-cost disposal options or decontamination with MARSAME material release practices could be conservatively applied for removal of the reactor head and the three tri-sodium phosphate baskets and the one emergency containment sump. ***Unit 2 Fuel Handling Building –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 2 Fuel Handling Building radiological systems components will likely qualify for disposition as Class A low-level radioactive waste. The concrete and steel structures and some of the components are likely suitable for low-cost disposal options. Low-cost disposal options or decontamination with MARSAME material release practices may be conservatively applied during removal of the components on the electrical penetration on the 45-foot and 63-foot elevations. ***Unit 2 Penetration Building –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 2 Penetration Building radiological systems components will likely qualify for disposition as Class A low-level radioactive waste. After removal of the most significantly contaminated bare concrete beta wall, the concrete and steel structures are likely suitable for low-cost disposal options. Plant continuous exhaust and containment exhaust ducts and valves have low levels of licensed radioactive material. Some components in electric penetration rooms can be released using MARSAME release practices.

Table D2-6. List of Survey Areas and Characterization Survey Conclusion

Major Components	Characterization Survey Conclusion
	Unit 2 Tank Enclosure Building – Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 2 Tank Enclosure Building radiological systems tanks & associated components will likely qualify for disposition as Class A low-level radioactive waste. For the non-radiological tanks and associated components, and the electrical tunnel components and structure, MARSAME material release practices may be conservatively applied during removal. Of the 1,665 square meter footprint for the Tank Enclosure Building, this elevation contains only one square meter of contaminated area (bermed area around the spent fuel pool makeup pump and the Auxiliary Feedwater (AFW) Pump Room sump). ***Unit 2 Safety Equipment Building –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 2 Safety Equipment Building upper elevation components and structures including 30 feet and above are likely suitable for low-cost disposal option. Much of the 8-foot elevation may be suitable for low-cost disposal. The -15-foot elevation will likely qualify for disposition as Class A low-level radioactive waste.
Systems: Tank Building	***Unit 2 MSIV and Tendon Gallery Area –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 2 MSIV Area structures and components may qualify for disposition using MARSAME material release practices or other low-cost options.
Environmental: Main Steam Isolation Valve (MSIV) Area Open Paved Areas/Environs	***Unit 2 MSIV Open Area 30' –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 2 MSIV Open Environmental Area structures and components may qualify for disposition using MARSAME material release practices or other low-cost disposal options.
Unit 3 Area (U3A)	
Structures: Containment Building Fuel Handling Building Penetration Building Tank Building Safety Equipment Building **Systems:** Tank Building **Environmental:** MSIV Area Open Paved Areas/Environs	***Unit 3 MSIV Open Area 30' –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 3 MSIV Open Environmental Area structures and components may qualify for disposition using MARSAME material release practices or other low-cost disposal options. ***Unit 3 Containment Building –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 3 Containment Building radiological systems components except for the reactor vessel will likely qualify for disposition as Class A low-level radioactive waste. All concrete structures in the containment building are likely contaminated with low levels of tritium and C-14. After removal of the most significantly contaminated bare concrete beta wall, the concrete and steel structures are likely suitable for low-cost disposal options. ***Unit 3 Fuel Handling Building –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude

Table D2-6. List of Survey Areas and Characterization Survey Conclusion

Major Components	Characterization Survey Conclusion
	that the Unit 3 Fuel Handling Building radiological systems components will likely qualify for disposition as Class A low-level radioactive waste. The concrete and steel structures and some of the components are likely suitable for low-cost disposal options. Low-cost disposal options or decontamination with MARSAME material release practices may be conservatively applied to roof surface. ***Unit 3 Penetration Building –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 3 Penetration Building radiological systems components will likely qualify for disposition as Class A low-level radioactive waste. After removal of the most significantly contaminated bare concrete beta wall and some floor scabbling, the concrete and steel structures are likely suitable for low-cost disposal options. Plant continuous exhaust and containment exhaust ducts and valves have low levels of licensed radioactive material. Components in electric penetration rooms can be released using MARSAME release practices. ***Unit 3 Tank Enclosure Building (TEB) –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 3 Tank Enclosure Building radiological systems tanks & associated components will likely qualify for disposition as Class A low-level radioactive waste. For the non-radiological tanks & associated components, and the electrical tunnel components and structure, MARSAME material release practices may be conservatively applied during removal. The lower elevations of the U3A AFW Tunnels are posted contaminated areas, encompassing no more than about 20 square meters of the 1283 square meter footprint for the 30’ TEB. The 30’ elevation has a 1 square meter contaminated area: a bermed area around the spent fuel pool makeup pump and the AFW Pump Room sump. Several square meters of contaminated areas are present in the T005 cubicle floor. ***Unit 3 Safety Equipment Building –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 3 Safety Equipment Building upper elevations components and structures including elevations 30’ and above are likely suitable for low-cost disposal options. Much of the 8’ elevation may be suitable for low-cost disposal. The -15’ elevation will likely qualify for disposition as Class A low-level radioactive waste. ***Unit 3 MSIV and Tendon Gallery Area –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Unit 3 MSIV and Tendon Gallery Area structures and components may qualify for disposition using MARSAME material release practices or other low-cost disposal options.

Table D2-6. List of Survey Areas and Characterization Survey Conclusion

Major Components	Characterization Survey Conclusion
Auxiliary Building Area (ABA)	
Structures: Auxiliary Radwaste Building Auxiliary Control Building	***ABA Radwaste Building –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Radwaste Building radiological systems components will likely qualify for disposition as Class A low-level radioactive waste. The concrete and steel structures and some of the components are likely suitable for low-cost disposal options. Low-cost disposal options or decontamination with MARSAME material release practices may be conservatively applied to some Control Element Drive Mechanism (CEDM) Control Room and related components. ***ABA Control Building –*** Radiological surveys of the Control Building show the area to be free of radioactive contamination with a single exception. The Historical Site Assessment describes an April 2010 event in which water was observed seeping through the east wall onto the floor of Room 111B, 9‘elevation of the Control Building. The source of the water was from an over-fill condition of tank T-066 in Radwaste Primary Tank Room 111B located on the opposite side of the wall from Room 111B of the Radwaste Building. The estimated three gallons of water that seeped through to the control building floor were mopped up and towel dried leaving the area free of detectable removable contamination but with detectable levels of fixed contamination. The affected area was subsequently epoxy coated to prevent leaching of activity. Surveys in Control Building Room 111B showed no removable contamination but fixed activity indicated by direct gamma and beta readings that exceeded both the Reference Material Background (RMB) and Survey Area (SA) critical levels. Cs-137 at a concentration of 17 pCi/g was revealed by gamma spectral analysis in the surface wafer of the core bore sample taken at this location. The subsequent wafer at a depth of ½” showed no detectable radioactive material. Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the Control Building portion of the ABA does not contain significant licensed radioactive material and following minimal remediation may qualify for disposition using MARSAME material release practices or other low-cost options.
Turbine Building Area (TBA)	
Structures: Unit 2 Turbine Generator Building Unit 3 Turbine Generator Building Unit 2 FFCPD Building Unit 3 FFCPD Building Turbine Deck Office	***Unit 2 -*** Sumps: The Unit 2 TB East sump sediment sample was 181 pCi/gram Cs-137; the West sump and the Blowdown Processing Sump (BPS) sump sediment samples showed no Radionuclides of Concern (ROCs) detected above a minimum detectable concentration (MDC) of less than 0.1 pCi/gram for Co-60 or for Cs-137. Building surfaces: no indications of fixed or loose surface contamination. One BPS Filter Cubical epoxy painted concrete

Table D2-6. List of Survey Areas and Characterization Survey Conclusion

Major Components	Characterization Survey Conclusion
	floor near a floor drain exhibited fixed beta contamination. Internally contaminated systems include: • turbine and condenser system, • liquid radioactive waste discharge lines, • Steam Jet Air Ejector systems and • associated discharge monitoring skids. Once internally contaminated systems are removed, sumps and remediated the remainder of the TBA would be suitable for low-cost disposal options or MARSAME material release practices. Remediation practices and materials dispositioning processes should be conservatively applied during removal of the equipment with special attention to the BPS filtration and ion exchanger systems and demolition of the associated concrete and steel structure and floor drain and imbedded piping. ***Unit 3 -*** Sumps: East and West sumps have Co-60 and Cs-137 in sludge; the East sump also has Cs-134. The BPS sump sediment samples showed no ROCs detected above an MDC less than 0.1 pCi/gram for Co-60 or for Cs-137. Building surfaces: no indications of fixed or loose surface contamination. One BPS Filter Cubical epoxy painted concrete floor near the drain has fixed beta contamination. Internally contaminated systems include: • turbine and condenser system, • liquid radioactive waste discharge lines, • Steam Jet Air Ejector systems and • associated discharge monitoring skids. Once internally contaminated systems are removed and sumps remediated, the remainder of the TBA would be suitable for low-cost disposal options or MARSAME material release practices. Remediation practices and materials dispositioning processes should be conservatively applied during removal of the equipment with special attention to the BPS filtration and ion exchanger systems and demolition of the associated concrete and steel structure and floor drain and embedded piping. ***Unit 2 & Unit 3 - FFCPD Building –*** Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the non-end state Class 2 FFCPD survey area did not contain licensed radioactive material on structural floors or walls. Low-cost disposal options or MARSAME material release practices should be conservatively applied during removal of equipment and demolition of the concrete and steel structure.
Intake Structure Area (ISA)	
Structures: Unit 2 Intake Structure Unit 3 Intake Structure Sub-Surface structures underlying the West Road	Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the above and below ground level areas and equipment surfaces within the ISA (excluding the radwaste discharge system) do not contain detectable levels of residual licensed radioactive contamination, and may

Table D2-6. List of Survey Areas and Characterization Survey Conclusion

Major Components	Characterization Survey Conclusion
Systems: Unit 2 Intake Related Systems Unit 3 Intake Related Systems Sub-Surface systems underlying the West Road	qualify for disposition using MARSAME material release practices or other low-cost options.
West Road Area (WRA)	
Structures: Building B-49/B-50 Building B-42 Building B-43/B-44 Chemical Storage Building	Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the structures, environmental and systems equipment of the WRA do not contain detectable levels of residual licensed radioactive contamination, and may qualify for disposition using MARSAME material release practices or other low-cost options.
Systems: Secondary Water Hold Up Tanks Clean/Dirty Oil Tank Chemical Tank Various Pumps Unit 3 Radwaste Line/Pump	
Environmental: Secondary Water Hold Up Tanks Clean/Dirty Oil Tank Area Chemical Tank Area Scaffold Yard Open Paved Areas/Environs	
North Protected Area Yard (NPAY)	
Structures: Unit 2 Hold Down Building B-64/B-65 Unit 2 Diesel Generator Building	Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the structures, environmental and systems equipment of the NPAY do not contain detectable levels of residual licensed radioactive contamination, and may qualify for disposition using MARSAME material release practices or other low-cost options.
Systems: Oily Waste Separator Fire Water Tanks Diesel Fuel Pump/Tank Secondary Water Hold Up Tank	
Environmental: Open Paved Areas/Environs	
North Industrial Area (NIA)	
Systems: Sewage Treatment Plant	Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the structures and environmental areas of the NIA, with exception of the ISFSI, do not contain detectable levels of residual licensed radioactive contamination, and may qualify for disposition using MARSAME material release practices or other low-cost options.
Environmental: Open Paved Areas/Environs	

Table D2-6. List of Survey Areas and Characterization Survey Conclusion

Major Components	Characterization Survey Conclusion
North Owner Controlled Area (NCOA)	
Structures: AWS Building Security Building Administrative Building Helicopter pad area **Environmental:** Lot 3 Lot 4 Paved Roadway	Cs-137 was revealed in two sediment samples: Two Survey Units contained sediment samples with 0.18pCi/g and 0.19 pCi/g, respectively. Those concentrations are less than 2% of the NRC Screening Values of 11 pCi/gram in surface soil and consistent with other on-site sediment sample results. All other measurements indicated the area and its surveyed structures to be free of licensed radioactive material. Gamma spectrometric analysis showed the elevated survey location identified in another Survey Unit was due entirely to the presence of Natural Occurring Radioactive Material (NORM). Radiological measurements were of sufficient quantity and sensitivity to provide a basis to conclude that the above grade soil covered areas, asphalt and concrete paved areas, and surveyed structures within the North Owner Controlled Area do not contain licensed radioactive material and may qualify for disposition using MARSAME material release practices or other low-cost alternative.
Switchyard Area (SYA)	
Structures: Mechanical, Electrical Equipment Room Structures **Systems:** Multiple Substations **Environmental:** Gravel Base Area	Radiological surveys show the SYA to be free of radioactive contamination with the exception of the sediment samples collected from the storm runoff gutters. Ten of the 14 sediment samples collected in the storm drain gutters showed Cs-137 ranging from just above the minimum detectable activity (MDA) level of 0.1 pCi/g to 1.06 pCi/g and one sample from the lower storm gutter showed Co-60 at 0.14 pCi/g in addition to Cs-137 at 0.52 pCi/g (sum of fraction evaluation result less than10% of NRC screening levels.) Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the SYA does not contain licensed radioactive material in excess of 10% of NRC screening levels.
Storm/Yard Drain Network (SYDS)	
Systems: Drain Lines **Environmental:** Catch Basins	Radiological measurements of sufficient quantity and sensitivity provide a basis to conclude that the storm and yard drain system does not contain significant licensed radioactive material and may qualify for disposition using MARSAME material release practices or other low-cost options. During decommissioning any remaining sediment in the basins should be appropriately dispositioned and attention must be given to joints between drain pipe sections to determine if radioactive material may have migrated into surrounding soil.

Source: AREVA 2015.

Table D2-7. Status and MARSAME Classification of SONGS Plant Systems

System[1]	Components
Class 1 Reactor Coolant System (RCS)	Reactor Vessel & Internals
	New Steam Generators
	Unit 3 Reactor Head
	Pressurizer & Heaters
	Loop Piping
	Reactor Coolant Pumps
Class 1 Chemical & Volume Control System (CVCS)	Letdown Heat Exchanger
	Volume Control Tank
	CVCS Ion Exchangers
	Regenerative Heat Exchanger
	Charging Pumps
Class 1 Fuel Handling System	Transfer Canal
	Fuel Pool Heat Exchangers & Filters
Class 1 Coolant Radwaste Systems	Reactor Coolant Drain Tanks
	Radwaste Primary & Secondary Ion Exchangers
	Radwaste Primary and Secondary Tanks
	Condensate Return Tank
Class 1 Miscellaneous Liquid Radwaste & Resin Storage	Chemical Waste Tank
	Miscellaneous Waste Tank
	Miscellaneous Waste Evaporator Condensate Monitoring Tanks
	Crud Tank & Backflushable Filters
	Spent Resin Tank
Class 1 Safety Injection & Shutdown Cooling	Reactor Water Storage Tank
	Safety Injection System
	Shutdown Cooling Heat Exchanger
Class 1 Auxiliary Feedwater Systems	Auxiliary Feedwater Pumps & Valves
Class 1 Building Sumps	Containment Building
	Radwaste Building
	Safety Equipment Building
	Penetration Building
	Fuel Handling Building
	Control Building (Class 3) [2]
Class 1 Continuous & Containment Ventilation Systems	Radwaste Area Ventilation System
	Safety Equipment Building & Penetration Building Ventilation System
	Exhaust Plenum & Discharge Ducts
	Airborne Radiation Monitor Skids
	Control Building Ventilation System (Class 3) [2]
Class 1 Gaseous Radwaste System	Waste Gas Decay Strippers & Tanks
	Waste Gas Discharge Ventilation Duct

Table D2-7. Status and MARSAME Classification of SONGS Plant Systems

System[1]	Components
Class 2 Component Cooling Water (CCW) System	CCW Heat Exchanger [2]
	CCW Surge Tanks [2]
	CCW Pumps & Valves [2]
Class 2 Turbine Plant	BPS Filters & Ion Exchangers
	Condenser Hotwell [2]
	Main Steam Isolation Valves & Air Ejector [2]
	Turbine Gland & Valve Seal [2]
	Moisture Separator Reheaters [2]
	Condensate Polishers Filters & Ion Exchangers [2]
	Holdup Tank
Class 3 Turbine Plant Cooling Water (TPCW) System	TPCW Heat Exchanger [2]
	TPCW Surge Tanks [2]
	TPCW Pumps & Valves [2]
Class 3 Saltwater Cooling Water (SWC) System	SWC Heat Exchanger [2]
	SWC Surge Tanks [2]
	SWC Pumps & Valves [2]
Class 3 Chilled Water System	Normal & Emergency Chiller Units [2]
	Compressors & Condensers [2]
	Storage Tanks [2]
Class 3 Circulating Water System	Intake Structure [2]
	Circulating Water Pumps [2]
	Main Condenser [2]
	Discharge Structure [2]

Source: AREVA 2015, Table 4-6.
Notes:
[1] Class 1 Systems are expected to have levels of licensed radioactive material requiring disposal as Class A waste or greater; Class 2 Systems have the potential for cross-contamination from Class 1 Systems; and Class 3 Systems are not expected to be contaminated, but are suspect by virtue of their association with Class 2 Systems and being located in a MARSSIM-impacted area.
[2] No Detectable Activity; suitable for release.

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APPENDIX D3
SPENT NUCLEAR FUEL TRANSPORTATION EXPERIENCE AND RISK ASSESSMENTS[1]

INTRODUCTION

As discussed in Section 1.0, *Introduction*, the federal government has exclusive jurisdiction over the radiological aspects of decommissioning. As also discussed in Section 1.0, activities related to the existing Approved Independent Spent Fuel Storage Installation (ISFSI) and the transportation and off-site storage of spent nuclear fuel (SNF) are subject to the Settlement Agreement that resolved a legal challenge[2] to California Coastal Commission approvals related to on-site storage of SNF. Under this Settlement Agreement, Southern California Edison (SCE) will develop, with input from a team of expert consultants, a Transportation Plan and Strategic Plan for transportation and off-site storage of SNF.

At the time of preparation of this EIR, these plans are not yet available. Moreover, the operation and maintenance of the ISFSI and the transportation and off-site storage of SNF and high-level radioactive waste (HLW) are Future Activities that are not part of the Proposed Project and instead are facility operations that will be performed in parallel with the Proposed Project's Decontamination and Dismantlement (D&D) activities over the next 30 years or more. Nonetheless, in an effort to maximize disclosure to the public, the EIR includes this appendix containing background information on transportation of SNF, HLW, and radioactive materials generally.

This appendix provides an overview of the transportation of radioactive materials both nationally and internationally. The appendix also describes infrastructure and past experience related to the transportation of radioactive materials from the San Onofre Nuclear Generating Station (SONGS) to disposal or storage off-site. The information below includes a discussion of some of the issues and constraints associated with the handling, packaging, and preparation of SNF and HLW for transport off-site, including regulatory permits and certifications that are required. Lastly, this report summarizes several aspects of the transportation of SNF and HLW, including the respective roles and responsibilities of federal, state, and local agencies (in regulation, security, and accident/emergency response), evaluation of the risks associated with transportation, assessment of the impacts associated with transportation of SNF and HLW to the geologic repository, and discussion of the physical protection and safeguards regulations require which are designed to protect against sabotage, terrorism, or acts of malice.

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[1] This document has been prepared for the California State Lands Commission by Aspen Environmental under Contract No. C2015046

[2] Citizens Oversight, Inc., et al. v. California Coastal Commission, Southern California Edison Company, et al.*, Superior Court for County of San Diego Case No. 37-2015-00037137-CU-WM-CTL.*

U.S. and International Experience

The U.S. and many other countries have successfully managed, stored, and transported SNF and HLW since the advent of commercial nuclear power over 40 years ago. Internationally, over that time, there have been approximately 20,000 shipments of over 80,000 tons of used nuclear fuel covering a total distance of over 30 million kilometers (Stahmer 2009). In the U.S. alone, there have been more than 3,000 used nuclear fuel shipments covering a total distance of over 1.55 million miles (2.5 million kilometers [km]). Only nine transportation accidents have been reported to the U.S. Atomic Energy Commission and the U.S. Department of Energy (DOE) (Nuclear Energy Institute [NEI] 2016) in over 40 years of used nuclear fuel transport. Four of these involved empty casks (Holt 1997). In the most severe accident, a tractor-trailer carrying a 25-ton used nuclear fuel cask swerved to avoid a head-on collision and overturned. The cask separated from the trailer and came to rest in a ditch. The cask was slightly damaged, but did not release any radioactive materials. No accident involving SNF or HLW has resulted in a release of radioactive materials causing damage to the environment, workers, or the public.

In addition to SNF and HLW, the DOE has also managed the transportation and disposal of transuranic waste to the Waste Isolation Pilot Plant (WIPP) in New Mexico for nearly 20 years, using transportation practices and methods that are similar to those that would be used for SNF. During that time, WIPP has received approximately 12,000 shipments that traveled over 14 million miles without a radiological release.

International experience has been similarly successful. France has 59 commercial nuclear reactors that provide approximately 63,000 megawatts of electricity or 78 percent of all electricity consumed. Of the 1,200 tonnes (metric tons) (1,322 tons) of used nuclear fuel produced each year, 850 tonnes (937 tons) are transported to the French reprocessing plant in La Hague on the Normandy coast (World Nuclear Association 2017). HLW in France is predominantly shipped by rail. About 300 fresh fuel, 250 used nuclear fuel, 30 MOX fuel, and 60 plutonium oxide powder shipments are made annually in France (Stahmer 2009).

The United Kingdom, Canada, Germany, Sweden, Japan, and other countries are currently safely and successfully managing the storage and transportation of SNF and HLW. According to Stahmer (2009), in over 45 years of used nuclear fuel transport, not a single incident or accident has resulted in a significant radiological impact on people or the environment.

Transportation Packaging and Casks

All the fuel in the previously constructed ISFSI is currently stored in Transnuclear NUHOMS Model Number-24PT1 or 24PT4 DSCs. The Standardized Advanced NUHOMS System consists of transportable DSCs, reinforced concrete horizontal storage modules, and a transfer cask. The Model 24PT1 and 24PT4 DSCs each hold up to 24 pressurized water reactor used fuel assemblies.

For the new (2017) ISFSI expansion, SCE selected the Holtec HI-STORM UMAX System for future dry storage. The Holtec system consists of transportable multipurpose canisters (MPC-37), which contain the fuel; underground vertical ventilated modules, which contain the multipurpose canisters during storage; and a transfer cask (HI-TRAC VW), which contains the multipurpose canister during loading, unloading, and transfer operations. The multipurpose canisters can store up to 37 pressurized water reactor used nuclear fuel assemblies.

For the Transnuclear Standardized Advanced NUHOMS System, the MP187 transportation cask is certified to ship used nuclear fuel in the 24PT1 canister, and the MP197HB transportation cask is certified to ship used nuclear fuel in the 24PT4 canister. The MP187 transportation cask is not currently certified for the transport of GTCC low-level radioactive waste. Per the *Preliminary Evaluation of Removing Used Nuclear Fuel from Shutdown Sites* (Maheras et al. 2015) it could require one to three years to obtain NRC approval of the cask for GTCC transport. However, it notes that it may be possible to transport the GTCC waste using the MP197HB transportation cask.

Revision 7 of the certificate of compliance for the MP197HB transportation cask also authorizes the transport of high burnup fuel in the 24PT4 canister; therefore, the eight high burnup fuel assemblies stored in 24PT4 canisters are transportable. If the unused 32PTH2 canisters at the existing ISFSI are used, the certificate of compliance for the MP197HB transportation cask would also have to be revised before used nuclear fuel or GTCC radioactive waste could be transported.

Holtec's HI-STAR 190 transportation cask would be used to transport the MPC-37 multipurpose canisters from the ISFSI. The ~~transportation cask is not yet certified for the MPC-37 canister, but an application for a certificate of compliance has been submitted to the NRC (Manzione 2015). The additional 1,115 high burnup fuel assemblies from the Units 2 and 3 spent fuel pools would be transportable, if they are included in the list of approved contents in the certificate of compliance.~~ HI-STAR 190 transportation cask has been approved to transport MPC-37 multipurpose canisters from the ISFSI, including high burnup fuel assemblies.

SONGS INFRASTRUCTURE AND EXPERIENCE SHIPPING RADIOACTIVE MATERIALS

The SONGS site is served by the Pacific Sun Railroad and has an on-site rail spur that is about 0.8-mile long and was originally built in the 1960s to support construction of Unit 1, and was subsequently used to support construction of Units 2 and 3 in the 1970s. The rail spur connects with the Pacific Sun Railroad mainline about 0.6-mile northwest of the site. The rail spur was reactivated in 2000 to support the decommissioning of Unit 1

(Gilson 2005; Gilson and Blythe 2005). SONGS staff members have indicated that use of the onsite rail spur would require removal or modification of the vehicle barrier and maintenance of the rail.

The rail spur has been used to ship several large components during Unit 1 decommissioning, such as turbine shells, turbine rotors, three steam generators, and a pressurizer. The steam generators were the largest: each weighed approximately 209 tons, were cylindrical with spherical ends, measured approximately 11 feet, 4.5 inches in diameter at the upper dome, and were approximately 45 feet long. Low-level radioactive waste was also shipped by rail using gondola cars and intermodal containers loaded onto rail cars.

Truck shipments of 270 used nuclear fuel assemblies were also made from SONGS Unit 1 to Morris, Illinois from 1972 through 1980 (Science Applications International Corporation [SAIC] 1991): 95 shipments using the IF-100 truck transportation cask and 175 shipments using the NAC-1 truck transportation cask (SAIC 1991). Heavy haul truck transport was also used to ship the four old steam generators 830 miles from San Onofre to Clive, Utah for disposal. Each steam generator weighed 760,335 pounds and was 15.5 feet wide, 15.5 feet tall, and 43 feet long. The gross vehicle weight of each shipment was 1,561,050 pounds and each shipment required 14 days of travel time (Morgan 2015).

The mainline track in the vicinity of the San Onofre site is designated as track class 5 and is built with 115-pound rail and the on-site spur is built with 90-pound rail. The mainline is owned by the North County Transit District. Amtrak Pacific Surfliner and Metrolink commuter rail service operate over the same track between Orange County and Oceanside, California, which limits freight service to 12:00 a.m. to 5:00 a.m. The North County Transit District also provides Coaster and Sprinter commuter rail service between Oceanside and San Diego, and Oceanside and Escondido, California. The Pacific Sun Railroad interchanges with the Burlington Northern Santa Fe or BNSF Railroad at the Stuart Mesa rail yard, which is located about 13 miles south of the San Onofre site.

The SONGS site has no on-site barge facilities. Construction of an on-site barge facility was attempted during construction of Unit 1, but the effort was unsuccessful because of currents and wave activity. However, a combination of ship, barge, platform trailer, tracked vehicle, and heavy haul truck transport has been used to haul very heavy equipment to the site and could conceivably be used to move equipment or materials away. This method was used to transport four replacement steam generators weighing approximately 650 tons each from Mitsubishi Heavy Industries in Kobe, Japan to the SONGS site in 2008 and 2010. They were transported by heavy lift cargo ship to the Port of Long Beach or Port of Los Angeles, then transloaded to an ocean-going barge and transported to the Del Mar Boat Basin at Marine Corps Base Camp Pendleton. From there, the generators were transferred to a Goldhofer heavy haul trailer, and towed to the SONGS site.

REGULATION OF TRANSPORTATION OF SNF AND RADIOACTIVE MATERIALS

The NRC and the U.S. Department of Transportation (DOT) jointly oversee the transportation of radioactive materials (NRC 2016).

The DOT's role is to:

- Regulate shippers of hazardous materials, including radioactive material
- Oversee vehicle safety, routing, shipping papers, emergency response, and shipper training
- The role of the NRC is to:
- Regulate users of radioactive material in 13 states (37 states, including California, regulate users within their borders)
- Approve the design, fabrication, use, and maintenance of shipping containers for the most hazardous radioactive materials, including SNF
- Regulate the physical protection of commercial SNF in transit against malicious acts

The NRC requires radioactive materials shipments to comply with the DOT's safety regulations for transporting hazardous materials. Millions of packages of radioactive material are shipped throughout the U.S. each year by rail, air, sea, and road. They contain small amounts of radioactive material that are used in industry and medicine. Examples include smoke detectors, watch dials, nuclear material to diagnose and treat illnesses, and slightly contaminated equipment such as syringes used for radioactive medicines. These packages provide a safe and economical means of transporting small quantities of radioactive material.

The greater the potential risk posed by the contents, the more stringent the DOT's packaging requirements are. The DOT regulations limit how much radioactivity can be transported in each package. That way, the dose from any accident will not pose a serious health risk.

NRC regulations for the safety of transport packages for large quantities of radioactive materials, including SNF, can be found in 10 CFR Part 71. The NRC requires shipping packages for SNF, under both normal and accident conditions of transport, to:

- Prevent the loss of radioactive contents
- Provide shielding and heat dissipation
- Prevent nuclear criticality (a self-sustaining nuclear chain reaction)

Normal conditions that a SNF transport package must be able to withstand include hot and cold environments, changes in pressure, vibration, water spray, impact, puncture, and compression. To show that it can withstand accident conditions, a package must pass stringent impact, puncture, fire, and water immersion tests. Transportation packages must survive these tests in sequence, including a 30-foot drop onto a rigid surface followed by a fully engulfing fire of 1,475 degrees Fahrenheit (°F) for 30 minutes. These very severe tests equate to the package hitting a concrete highway overpass at high speed and being involved in a severe and long-lasting fire. The test sequence encompasses more than 99 percent of vehicle accidents.

The NRC reviews each package design to confirm that it meets the required conditions. Before a package can be used to transport SNF, the NRC must issue an approval certificate.

The NRC's regulatory controls apply to every U.S. shipment of SNF from commercial reactors. For more than 40 years, this oversight has resulted in an outstanding record of safety and security. Thousands of domestic SNF shipments have been completed safely. After the September 11, 2001, terrorist attacks, the NRC further expanded this system.

NRC regulations reflect the International Atomic Energy Agency transportation safety standards and also supplement DOT regulations. The NRC looks at its transportation regulations every few years and proposes changes, if needed, to address new requirements, policies, or technical improvements.

To ensure that large quantities of radioactive materials are transported safely, the NRC:

- Reviews and certifies transport package designs
- Requires designers to follow strict quality assurance programs for package design, fabrication, use, and maintenance
- Inspects package designers and fabricators to ensure that packages conform to NRC-approved designs and quality assurance programs and
- Inspects some shipments
- Many additional requirements help to ensure these shipments are safe:
- DOT regulations require shipper and carrier training.
- The DOT and the Federal Emergency Management Agency oversee emergency response coordination, training, and communication.
- The DOT carries out its own transportation inspection and enforcement programs.

There is no way to completely eliminate risk. Still, the NRC has found both the likelihood of an accident that releases nuclear material and the risk to the public to be small. The NRC regulates the transportation of radioactive waste as an essential part of its mission.

Transportation Risks (NRC Risk Assessments and Safety Studies)

The NRC has carefully studied and evaluated the risks associated with the transportation of SNF and other radiological materials for over 40 years. Over time, these analyses have incorporated increasingly complex methods, technology, and more comprehensive datasets. As computer modeling programs have become more sophisticated, simulations have addressed and incorporated more data and scenarios taken from actual SNF transportation experience, including the simulation of numerous actual and postulated severe accidents.

In 1977, the NRC published the *Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes* (NUREG-0170) (NRC 1977), which showed that the NRC's transportation regulations adequately protect public health and safety. Additional studies by the NRC and their contractors (e.g., Fischer et al. 1987; Sprung et al. 2000) found the risks were even smaller than the 1977 study predicted. The 2000 study used improved risk assessment techniques to analyze the ability of containers to withstand an accident.

In 2014, the NRC published a comprehensive *Spent Fuel Transportation Risk Assessment* (NRC 2014). This study modeled the radiation doses people might receive if SNF is shipped from reactors to a central facility. The results indicate that NRC regulations for SNF transport are adequate to ensure safety of the public and the environment. The study found:

- Doses from routine transport would be less than 1/1000 the amount of radiation people receive from background sources each year.
- There is less than a 1 in 1 billion chance that radioactive material would be released in an accident.
- If an accident did release radioactive material, the dose to the most affected individual would not cause immediate harm.

The NRC also studies major transportation accidents across the country to understand the actual accident conditions. These studies allow NRC to determine whether its regulations would protect the public if large quantities of radioactive materials were involved. These studies, coupled with the risk assessments, give the NRC added confidence in the safety of SNF shipments.

Transportation Security

The NRC and the DOE jointly operate a system to track domestic and foreign nuclear materials shipments. The NRC also requires those involved in SNF shipments to:

- Follow only approved routes.

- Provide armed escorts through heavily populated areas.
- Provide monitoring and redundant communications.
- Coordinate with law enforcement agencies before shipments.
- Notify, in advance, the NRC, local tribes, and states through which the shipments will pass.
- After the terrorist attacks on September 11, 2001, the NRC enhanced security requirements for transporting SNF and large quantities of radioactive materials. Through advisories and orders to licensees, the NRC required:
- More pre-planning and coordination with affected states
- Additional advance notification of shipments
- Enhanced control and monitoring
- Trustworthiness checks for individuals with access to or information about the shipment
- Stronger security controls over shipment routes and schedules

These newer requirements and other enhancements were formally added to the NRC's transport regulations through a rulemaking, finalized in May 2013.

Accident Response Assistance

State and local governments have primary responsibility to oversee the response to any accident involving a nuclear materials shipment. They would ensure the carrier and others take the actions required to protect public health and safety.

Any event involving NRC-licensed material that could threaten public health and safety or the environment would trigger special NRC procedures. The NRC may activate its Headquarters Operations Center. It also may activate one of its four Regional Incident Response Centers (Region I-King of Prussia, Pennsylvania.; Region II-Atlanta, Georgia.; Region III-Lisle, Illinois.; and Region IV-Arlington, Texas).

The NRC's highest priority in any accident is to provide expert consultation, support, and assistance to state and local responders. Teams of NRC specialists evaluate information, assess the potential impact on the public and environment, and evaluate possible recovery strategies. Other experts consider the effectiveness of different protective actions, including sheltering in place or evacuation.

Transportation Impacts (Yucca Mountain)

The DOE studied the effects associated with the transportation of SNF and HLW in detail as part of the Environmental Impact Statement (EIS) for the proposed Yucca Mountain

Repository. If the repository is opened, 72 commercial and five DOE sites would begin loading and shipping waste. Most shipments would be on legal-weight trucks and trains travelling on the nation's highways and railroads. Barges and heavy-haul trucks could be used for the short-distance transport of SNF from some commercial sites to nearby railroads. Shipments of SNF and HLW arriving in Nevada would travel to the Yucca Mountain site by legal-weight truck, rail, or heavy-haul truck. Legal-weight truck shipments would use existing highways in accordance with DOT regulations. The EIS identified nationwide routes and alternatives for legal-weight highway and rail shipping. Within the State of Nevada, DOE also identified and analyzed alternative rail corridor and intermodal transfer station locations, and associated heavy-haul truck routes, respectively.

The DOE then analyzed the impacts of transporting SNF and HLW to the repository under the mostly legal-weight truck and mostly rail scenarios. Under the mostly legal-weight truck scenario, most of the SNF and HLW would be shipped to Nevada by legal-weight truck, while naval fuel would be shipped by rail. Under the mostly rail scenario, commercial SNF from most sites (including SONGS) and DOE and naval SNF and HLW would arrive in Nevada by rail. However, commercial fuel from a few commercial sites would initially be shipped by legal-weight truck because those sites do not currently have the capability to load a rail cask.

The EIS evaluated the impacts of the two alternative scenarios for transporting SNF and HLW to the Yucca Mountain site. Much of the difference in the impacts between the mostly legal-weight truck and mostly rail scenarios is a result of the differing number of shipments over the 24-year transportation period and differences in the characteristics of the truck and rail modes of transport. The mostly legal-weight truck scenario would involve about 53,000 shipments (2,200 annually), and the mostly rail scenario would involve approximately 10,700 shipments (450 annually). Because of the larger number of shipments, the mostly legal-weight truck scenario would have somewhat greater radiological impacts during routine operations, even though each individual truck shipment would carry less radioactive material than a rail shipment.

The EIS analysis also considered potential accidents based on various accident cases presented in NUREG-6672, Reexamination of Spent Fuel Shipment Risk Estimates. The analysis estimated impacts of postulated releases from accidents in three population zones: urban, suburban, and rural, under a set of meteorological (weather) conditions that represent the national average meteorology. The analysis used state-specific accident data, the lengths of routes in the population zones in states through which the shipments would pass, and the number of shipments that would use the routes to determine accident probabilities.

In addition to the risk due to accidents involving a release of radioactive material, the analysis examined the impacts of loss-of-shielding accidents. The loss-of-shielding scenarios range from an accident with no loss of shielding to a low-probability severe accident involving both a loss of shielding (and any increased direct exposure) and a release of some of the contents of the cask.

The EIS analysis also estimated impacts from an unlikely but severe accident called a maximum reasonably foreseeable accident to provide perspective about the consequences for a population that might live nearby. For maximum reasonably foreseeable accidents, the consequences were estimated for each of the accidents and for both truck and rail casks from the spectrum of accidents presented in NUREG-6672. For each accident, the possible combinations of weather conditions, population zones, and transportation modes were considered. The accidents were then ranked according to those that would have a likelihood greater than 1 in 10 million per year and that would have the greatest consequences.

Although every potential accident that could occur cannot feasibly be analyzed, the EIS analyzed several types of accidents that represent groups of initiating events and conditions having similar characteristics. For example, the EIS analyzed the impacts of a collection of collision accidents in which a cask would be exposed to impact velocities in the range of 60 to 90 miles (97 to 145 km) per hour. The EIS also analyzes a maximum reasonably foreseeable accident in which a collision would not occur, but where the temperature of a rail cask containing SNF would rise to between 1,400°F and 1,800°F (between 750°C and 1,000°C). The conditions of the maximum reasonably foreseeable accident analyzed in the EIS envelop conditions reported for the Baltimore Tunnel fire (a train derailment and fire that occurred in July 2001 in a tunnel in Baltimore, Maryland). Temperatures in that fire were reported to be as high as 1,500°F (820°C), and the fire was reported to have burned for up to 5 days.

The estimated radiological accident risk of a single latent cancer fatality for the entire population within 80 kilometers (50 miles) of the rail and truck transportation routes would be about 0.0025 (1 chance in 400) during as many as 50 years of shipments to the repository. Because this risk is for the entire population of individuals along the transportation routes, the risk for any single individual would be small (DOE 2008).

The maximum reasonably foreseeable transportation accident analyzed in this Repository EIS is estimated to occur with a frequency of about 8×10^{-6} per year (DOE 2008). If the accident occurred in an urban area, DOE estimated that there would be 9 cancer fatalities in the exposed population. If the accident occurred in a rural area, DOE estimated that the probability of a single latent cancer fatality in the exposed population would be 0.012 (1 chance in 80) in the exposed population.

DOE also evaluated the potential consequences of an accidental crash of a large jet aircraft into a truck cask or rail cask. The analysis determined that penetration of the cask would not occur; however, potential seal failure could result in releases of radiological materials. The consequences associated with this event would be very low (less than 1 latent cancer fatality in an urban population).

The consequences of the maximum reasonably foreseeable transportation accident would be higher under the mostly rail scenario than under the mostly legal-weight truck scenario, principally because the amount of material in a rail shipment would be larger than that in a legal weight truck shipment.

Protection from Intentional Acts of Malice

The NRC has developed a set of rules specifically aimed at protecting the public from harm that could result from sabotage of SNF casks. Known as physical protection and safeguards regulations (10 CFR 73.37), these security rules are distinguished from other regulations that deal with issues of safety affecting the environment and public health. The objectives of the regulations are to:

- Minimize the possibility of sabotage
- Facilitate recovery of SNF shipments that could come under control of unauthorized persons

The same cask safety features that provide containment, shielding, and thermal protection also provide protection against sabotage. The casks are massive, and the SNF in a cask would typically be only about 10 percent of the gross weight; the remaining 90 percent would be shielding and structure.

It is not possible to predict with any certainty whether sabotage events would occur and, if they did, the nature of such events. Nevertheless, DOE examined various accidents, including an intentional aircraft crash into a transportation cask. The analysis (DOE 2002, 2008) evaluated the ability of large aircraft parts to penetrate shipping casks and found that that neither the engines nor shafts would penetrate a cask and cause a release of radiological materials if an aircraft were to crash into a spent nuclear fuel cask.

DOE also evaluated the potential consequences of a sabotage event in which a high-energy density device penetrates a rail or truck cask. The results of this analysis (DOE 2008) indicate that the risk of the maximally exposed individual incurring a fatal cancer would increase when compared to the current risk of incurring a fatal cancer from all other causes. DOE estimated that there would be 28 latent cancer fatalities in the exposed population if the sabotage event occurred in an urban area. If the sabotage event took place in a rural area, DOE estimated that the probability of a single latent cancer fatality in the exposed population would be 0.055 (1 chance in 20).

CONCLUSION

This review described the existing conditions related to temporary on-site storage at the existing, newly expanded ISFSI, the presence of a usable rail spur at the site, and SONGS plans for eventual shipment and disposal of SNF and HLW. U.S. and international experience in the storage and transportation of SNF and HLW (as well as lower levels of radioactive and hazardous waste) were also described briefly, and the risks associated with transportation summarized. No barriers or impediments to the successful operation of the ISFSI, and the on-site storage and off-site transportation of SNF and HLW have been identified, although a few conditions were noted that could cause delays, such as the lack of certified transportation casks for certain containers.

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APPENDIX D4
NUCLEAR REGULATORY COMMISSION
ENVIRONMENTAL IMPACT EVALUATION[1]

As discussed in Section 1.0, *Introduction*, the U.S. Nuclear Regulatory Commission (NRC) has exclusive jurisdiction over the radiological aspects of decommissioning and has prepared National Environmental Policy Act (NEPA) documents relating to the decommissioning of nuclear facilities. (See Section 1.1.1.1 for additional discussion.) This appendix provides an overview of how these NEPA documents evaluate environmental impacts.

As also discussed in Section 1.0, *Introduction*, activities related to the existing Approved ISFSI and the transportation and off-site storage of spent nuclear fuel (SNF) are subject to the Settlement Agreement that resolved a legal challenge to Coastal Commission approvals related to on-site storage of SNF. Under this Settlement Agreement, Southern California Edison (SCE) will develop, with input from a team of expert consultants, a Transportation Plan and Strategic Plan for transportation and off-site storage of SNF.

At the time of preparation of this EIR, these Plans are not yet available. Moreover, the operation and maintenance of the ISFSI and the transportation and off-site storage of SNF and high-level radioactive waste (HLW) are not part of the Proposed Project. Nonetheless, to maximize disclosure to the public, the EIR includes this appendix containing background information on federal environmental review of the decommissioning of nuclear facilities.

The NRC uses terms from National Environmental Policy Act documents, such as those for license renewal or new reactors, to define the standard of significance for assessing environmental issues (NRC 2014), as shown below.

- SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
- MODERATE: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
- LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

SCE had the potential environmental impacts from the SONGS Decommissioning Plan activities assessed for each resource area using evaluations in NUREG-0586, Supplement 1 *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities,* (issued in 2002) as a guide (ENERCON 2014). Like the evaluations in NUREG-

[1] This document has been prepared for the California State Lands Commission by Aspen Environmental under Contract No. C2015046

0586, the analysis assumed that operational mitigation measures are continued and would not rely on the implementation of new mitigation measures unless specified. Environmental releases, waste volumes, and other environmental interfaces were estimated. These data were assessed against the potential for impact and the existing environmental conditions at SONGS to identify impacts. A significance level of SMALL was determined (ENERCON 2014).

The NRC reviewed the potential environmental impacts of stored SNF in NUREG-2157, *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel* (GEIS), published in September 2014 (NRC 2014). The NUREG-2157 generically determines the environmental impacts of continued storage, including those impacts identified in the remand by the Court of Appeals in the *New York v. NRC* decision, and provides a regulatory basis for a revision to 10 CFR 51.23 that addresses the environmental impacts of continued storage for use in future NRC environmental reviews. In this context, "the environmental impacts of continued storage" means those impacts that could occur as a result of the storage of SNF at "at-reactor" and "away-from-reactor" sites after a reactor's licensed life for operation and until a permanent repository becomes available. The GEIS evaluates potential environmental impacts to a broad range of resources. Cumulative impacts are also analyzed (NRC 2014).

Because the timing of repository availability is uncertain, the GEIS analyzes potential environmental impacts over three possible timeframes (NRC 2014):

- The *short-term storage timeframe* (60 years of continued storage after the end of the reactor's licensed life) includes routine maintenance and monitoring of the spent fuel pool and ISFSI, and transferring SNF from pools to dry cask storage. Because decommissioning is required to be completed within 60 years after a reactor shuts down (unless additional time is necessary to protect public health and safety), the NRC assumes that all SNF would be moved from spent fuel pools to dry cask storage by the end of the short-term storage timeframe.
- The *long-term storage timeframe* (100 years beyond the initial 60-year [short-term] storage timeframe) includes activities such as continued facility maintenance, construction and operation of a Dry Transfer System (DTS), and replacement of ISFSI and DTS facilities, including casks.
- The *indefinite storage timeframe*, which addresses the possibility that a repository never becomes available, assumes that the activities associated with long-term storage continue indefinitely, with ISFSI and DTS facilities being replaced at least once every 100 years.

All potential impacts in each resource area are analyzed for each continued storage timeframe. The GEIS also contains several appendices that discuss specific topics, including the technical feasibility of continued storage and repository availability as well as the two technical issues involved in the remand of *New York v. NRC* — spent fuel pool leaks and spent fuel pool fires.

The SNF storage facility is part of the fuel handling building and is a Seismic Category I structure.[2] SNF assemblies are stored under water in SNF storage racks in the spent fuel pool. A separate fuel-handling building is provided for each reactor unit. The SNF storage racks and spent fuel pool provide for storage of fuel assemblies in the spent fuel pool, while maintaining spacing between assemblies for adequate cooling water flow. This prevents nuclear criticality, and protects the fuel assemblies from excess mechanical or overheating. Without these preventative actions, overheating could lead to loss of water through boiling and then potential fires, nuclear criticality, and meltdown. The design basis of the spent fuel pool must meet the requirements of 10 CFR 50.68 (ENERCON 2014).

The NRC also looked at ongoing regulatory activities that could affect the continued storage of SNF, including regulatory changes resulting from lessons learned from the September 11, 2001, terrorist attacks and the March 11, 2011, earthquake and tsunami that damaged the Fukushima Dai-ichi plant in Japan.

NUREG-2157 summarizes the NRC's conclusions related to the evaluation of the following topics, which are detailed below (NRC 2014):

- Environmental Impacts of Postulated Accidents
- Potential Acts of Sabotage or Terrorism
- Natural Phenomena Hazards
- Spent Fuel or ISFSI Leakage
- Spent Fuel Pool Fire

ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS

Because the accident risks for spent fuel pool storage only apply during the short-term timeframe and the accident risks for dry cask storage are substantially the same across the three timeframes, the GEIS does not present the various accident types by timeframe, but rather by accident type (i.e., design basis and severe) and storage facility type (i.e., spent fuel pool and dry cask storage system).

- **Design Basis Accidents in SNF Pools.** Impacts would be SMALL. The postulated design basis accidents considered in this GEIS for spent fuel pools include hazards from natural phenomena, such as earthquakes, floods, tornadoes, and hurricanes; hazards from activities in the nearby facilities; and fuel handling related accidents. In addition, potential effects of climate change are also considered. Based on the NRC's assessment, the environmental impacts of these postulated accidents involving continued storage of SNF in pools are SMALL

[2] Seismic Category I – SSCs that are designed and built to withstand the maximum potential earthquake stresses for the particular region where a nuclear plant is built.

because all important safety SSCs involved with the SNF storage are designed to withstand these design basis accidents without compromising the safety functions.

- **Design Basis Accidents in Dry Cask Storage Systems and Dry Transfer Systems**. Impacts would be SMALL. All NRC-licensed dry cask storage systems are designed to withstand all postulated design basis accidents without any loss of safety functions. A DTS or a facility with equivalent capabilities may be needed to enable retrieval of SNF for inspection or repackaging. Licensees of DTS facilities are required to design the facilities so that all safety-related SSCs can withstand the design basis accidents without compromising any safety functions. Based on the GEIS assessment, the environmental impact of the design basis accidents is SMALL because safety-related SSCs are designed to function in case of these accidents.
- **Severe Accidents in Spent Fuel Pools.** Probability-weighted impacts would be SMALL. A spent fuel pool may encounter severe events, such as loss of off-site power or beyond design basis earthquakes. Although it is theoretically possible that these events may lead to loss of spent fuel pool cooling function resulting in a spent fuel pool fire, the likelihood of such events is extremely small. Although some handling accidents, such as a postulated drop of a canister, could exceed NRC's public dose standards, the likelihood of the event is very low. Therefore, the environmental impact of severe accidents in a dry storage facility is SMALL.
- **Severe Accidents in Dry Cask Storage Systems.** Probability-weighted impacts would be SMALL. Although some handling accidents such as a postulated drop of a canister could exceed NRC's public dose standards, the likelihood of the event is very low. Therefore, the environmental impact of severe accidents in a dry storage facility is SMALL.

POTENTIAL ACTS OF SABOTAGE OR TERRORISM

The GEIS finds that even though the environmental consequences of a successful attack on a spent fuel pool beyond the licensed life for operation of a reactor are large, the very low probability of a successful attack ensures that the environmental risk is SMALL. Similarly, for an operational ISFSI or DTS during continued storage, the NRC finds that the environmental risk of a successful radiological sabotage attack is SMALL (NRC 2014).

The potential for theft or diversion of light water reactor SNF from the ISFSI with the intent of using the contained special nuclear material for nuclear explosives is not considered credible because of (1) the inherent protection afforded by the massive reinforced concrete storage module and the steel storage canister; (2) the unattractive form of the contained special nuclear material, which is not readily separable from the radioactive fission products; and (3) the immediate hazard posed by the high radiation levels of the SNF to persons not provided radiation protection (NRC 2014).

Although a successful act of sabotage or terrorism by an armed attack is low in probability, the consequences of such an act could be severe. A discussion of a postulated spent fuel pool fire resulting from loss of pool water resulting from a successful attack was assessed in the GEIS. The conditional consequences described include downwind collective radiation doses above one million person-rem, up to 191 early fatalities, and economic damages exceeding $50 billion. However, given the very low probability of a successful attack with these consequences, the NRC determined that the risk of successful attack is SMALL (NRC 2014).

NATURAL PHENOMENA HAZARDS

The postulated design basis accidents considered in the GEIS for spent fuel pools include hazards from natural phenomena, such as earthquakes, flood, tornadoes, and hurricanes; hazards from activities in the nearby facilities; and fuel-handling-related accidents. In addition, the potential effects of climate change are also considered. Based on the GEIS analysis, the environmental risk of these postulated accidents involving continued storage of SNF in pools is SMALL. The SSCs involved with the fuel storage are designed to withstand these design basis accidents without compromising the safety functions. If climate change influences on natural phenomena create conditions adverse to safety, the NRC has sufficient time to require corrective actions to ensure SNF storage continues with minimal impacts (NRC 2014).

SPENT FUEL OR ISFSI LEAKAGE

Continued storage of SNF could result in non-radiological and radiological impacts to groundwater quality. In the unlikely event a spent fuel pool leak remained undetected for a long period of time, contamination of a groundwater source above a regulatory limit could occur (e.g., a Maximum Contaminant Level for one or more radionuclides). The GEIS analysis concludes that (1) there is a low probability of a leak of sufficient quantity and duration to affect off-site locations; and (2) physical processes associated with radionuclide transport, site hydrologic characteristics, and environmental monitoring programs, ensure that impacts from spent fuel pool leaks would be unlikely. Impacts to groundwater from continued storage in ISFSIs would be minimal because ISFSI storage requires minimal water and produces minimal, localized, and easy-to-remediate liquid effluents on or near ground surface.

The GEIS estimated an annual discharge rate for leakage from the spent fuel pool of 100 gallons per day with contaminants at certain concentrations assumed to be present at the start of short-term storage. The GEIS compared these concentrations to annual effluent ranges for reactors. Even in the unlikely event that spent fuel pool leakage flowed continuously (24 hours per day, 365 days per year) undetected to local surface waters, the quantities of radioactive material discharged to nearby surface waters would be comparable to values associated with permitted, treated effluent discharges from operating nuclear power plants. Based on these considerations, the NRC concluded that the impact of spent fuel pool leaks on surface water would be SMALL (NRC 2014).

SPENT FUEL POOL FIRE

A spent fuel pool accident could develop into a spent fuel pool fire in a number of ways. Spent fuel pool accidents can arise from either the loss of spent fuel pool cooling, drainage of the spent fuel pool, or the dropping of heavy items into the spent fuel pool. Additionally, the NRC has assessed various accident sequences including spent fuel pool failure due to wind-driven missiles, aircraft crashes, heavy-load drop, seal failure, inadvertent draining, loss of cooling, and seismic events (NRC 2014). The GEIS describes the NRC's finding that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, and societal and economic impacts of spent fuel pool fires are SMALL (NRC 2014).

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APPENDIX D5
RADIATION BASICS[1]

As discussed in Section 1.0, *Introduction*, the federal government has exclusive jurisdiction over the radiological aspects of decommissioning. As also discussed in Section 1.0, activities related to the storage and transportation of spent nuclear fuel (SNF) are subject to the Settlement Agreement that resolved a legal challenge[2] to California Coastal Commission approvals related to on-site storage of SNF. Under this Settlement Agreement, Southern California Edison (SCE) will develop, with input from a team of expert consultants, a Transportation Plan and Strategic Plan for transportation and off-site storage of SNF.

At the time of preparation of this EIR, these plans are not yet available. Nonetheless, to maximize public disclosure and understanding, the EIR includes this appendix containing background information on basic radiation concepts.

Appendix D5 provides an overview of the various types of radiation and introduces the concepts of human health impacts as a result of exposure to radiation and potentially toxic materials.

RADIATION

Radiation is the emission and propagation of energy through space or through a material in the form of waves or bundles of energy called photons, or in the form of high-energy subatomic particles. Radiation generally results from atomic or subatomic processes that occur naturally.

The most common kind of radiation is **electromagnetic radiation**, which is transmitted as photons. Electromagnetic radiation is emitted over a range of wavelengths and energies. Visible light is the most familiar form of electromagnetic radiation. Radiation of longer wavelengths and lower energy includes infrared radiation, which transmits heat and radio waves. Electromagnetic radiation of shorter wavelengths and higher energy, which is more penetrating, includes ultraviolet radiation (the cause of sunburn), x-rays, and gamma radiation. Figure D4-1 illustrates the types of radiation that compose the electromagnetic spectrum. As shown in Figure D4-1, electromagnetic energy increases from left to right as the frequency increases. An increase in energy and frequency corresponds with a decrease in wavelength.

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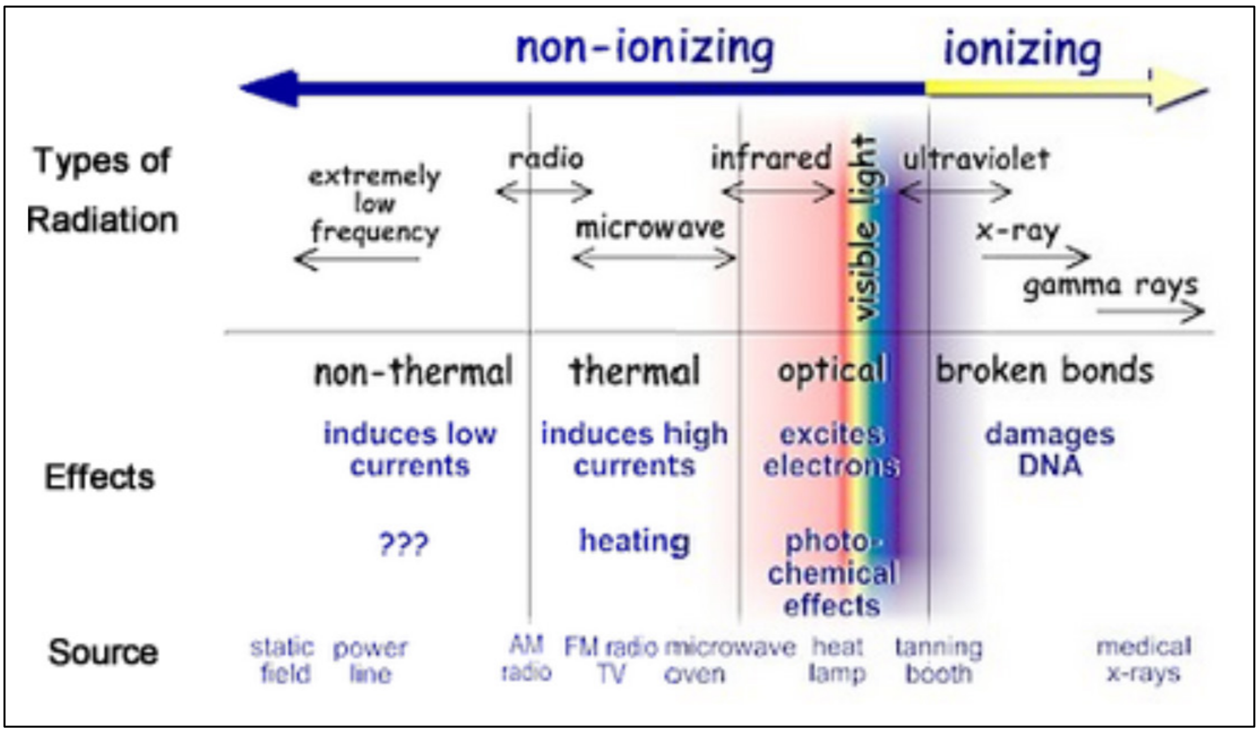
[1] This document has been prepared for the California State Lands Commission by Aspen Environmental Group under Contract No. C2015046.

[2] Citizens Oversight, Inc., et al. v. California Coastal Commission, Southern California Edison Company, et al., *Superior Court for County of San Diego Case No. 37-2015-00037137-CU-WM-CTL.*

RADIATION

Radiation occurs on Earth in many forms, either naturally or as the result of human activities. Natural forms include light, heat from the sun, and the decay of unstable radioactive elements in the Earth and the environment. Some elements that exist naturally in the human body and in the environment are radioactive and emit ionizing radiation. For example, one of the naturally occurring isotopes of potassium (essential for health) is radioactive. In addition, isotopes of the naturally occurring uranium and thorium decay series are widespread in the human environment. Human activities have also led to sources of ionizing radiation for various uses, such as diagnostic and therapeutic medicine and nondestructive testing of pipes and welds. Nuclear power generation produces ionizing radiation as well as radioactive materials, which undergo radioactive decay and can continue to emit ionizing radiation for long periods of time.

Figure D4-1. Types of Radiation in the Electromagnetic Spectrum



Source: U.S. Environmental Protection Agency (USEPA) 2017.

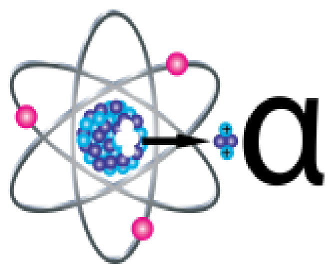
Ionizing radiation is radiation that has sufficient energy to displace electrons from atoms or molecules to create ions. Some forms of ionizing radiation are electromagnetic (for example, X-rays or gamma radiation), while other forms of ionizing radiation are subatomic particles (for example, alpha and beta radiation). The ions formed by ionizing radiation have the ability to interact with other atoms or molecules. In biological systems, this interaction can cause damage in the tissue or organism.

Radioactive Decay and Fission

Radioactivity is the property or characteristic of an unstable atom to undergo spontaneous transformation (to *disintegrate* or *decay*) with the emission of energy as radiation. Usually the emitted radiation is ionizing radiation. The result of the process, called **radioactive decay**, is the transformation of an unstable atom (a *radionuclide*) into a different atom, accompanied by the release of energy (as radiation) as the atom reaches a more stable, lower energy configuration.

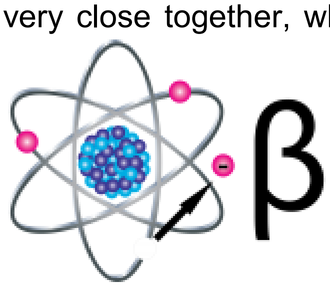
Radioactive decay produces three main types of ionizing radiation: (1) alpha particles, (2) beta particles, and (3) gamma or X-rays. These types of ionizing radiation, which are described below, have different characteristics and levels of energy, as well as varying abilities to penetrate and interact with atoms in the human body.

Alpha Particles



Alpha particles (α) are positively charged and made up of two protons and two neutrons from the atom's nucleus. Alpha particles come from the decay of the heaviest radioactive elements, such as uranium, radium, and polonium. Even though alpha particles are very energetic, they are so heavy that they use up their energy over short distances and are unable to travel very far from the atom.

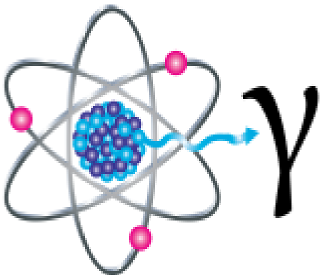
The health risk from exposure to alpha particles depends greatly on how a person is exposed. Alpha particles lack the energy to penetrate even the outer layer of skin, so exposure to the outside of the body is not a major concern. Alpha particles can be stopped by a thin layer of material such as a single sheet of paper. Inside the body, however, these particles can be very harmful. If alpha-emitters or radioactive atoms (called radionuclides) are inhaled, swallowed, or get into the body through a cut, the alpha particles can damage sensitive living tissue. The ionizations caused by alpha-emitters are very close together, which results in more severe damage to cells and DNA. For this reason, alpha particles are more dangerous than other types of radiation (USEPA 2017).



Beta Particles

Beta particles (β) are small, fast-moving particles with a negative electrical charge that are emitted from an atom's nucleus during radioactive decay. These particles are emitted by certain unstable atoms such as hydrogen-3 (tritium), carbon-14, and strontium-90.

Beta particles are more penetrating than alpha particles, but are less damaging to living tissue and DNA because the ionizations they produce are more widely spaced. They travel farther in air than alpha particles, but can be stopped by a layer of clothing, several reams of paper, several inches of wood or water, or by a thin layer of a substance such as aluminum. Some beta particles are capable of penetrating skin and causing damage such as skin burns. As with alpha-emitters, beta-emitters are most hazardous when inhaled or swallowed (USEPA 2017).



Gamma Rays

Gamma rays (γ) are packets of energy called photons. Gamma rays are similar to visible light, but have higher energy. Unlike alpha and beta particles, which have both energy and mass, gamma rays are pure energy. Gamma rays are often emitted along with alpha or beta particles during radioactive decay.

Gamma rays are a radiation hazard for the entire body. They can easily penetrate barriers that can stop alpha and beta particles, such as skin and clothing. Gamma rays have substantial penetrating power and require a dense material to be stopped, such as several inches to several feet of heavy material (for example, concrete or lead). The energy associated with gamma radiation is dispersed across the body in contrast to the local energy deposition caused by alpha particles. In fact, some gamma rays can pass completely through the human body; as they pass through, they can cause ionizations that damage tissue and DNA (USEPA 2017).

X-Rays

Because of their use in medicine, x-rays are a familiar type of radiation. X-rays are similar to gamma rays in that they are photons of pure energy. X-rays and gamma rays have the same basic properties, but come from different parts of the atom. X-rays are emitted from processes outside the nucleus, while gamma rays originate inside the nucleus. X-rays are also generally lower in energy and therefore less penetrating than gamma rays. X-rays can be produced naturally or by machines using electricity.

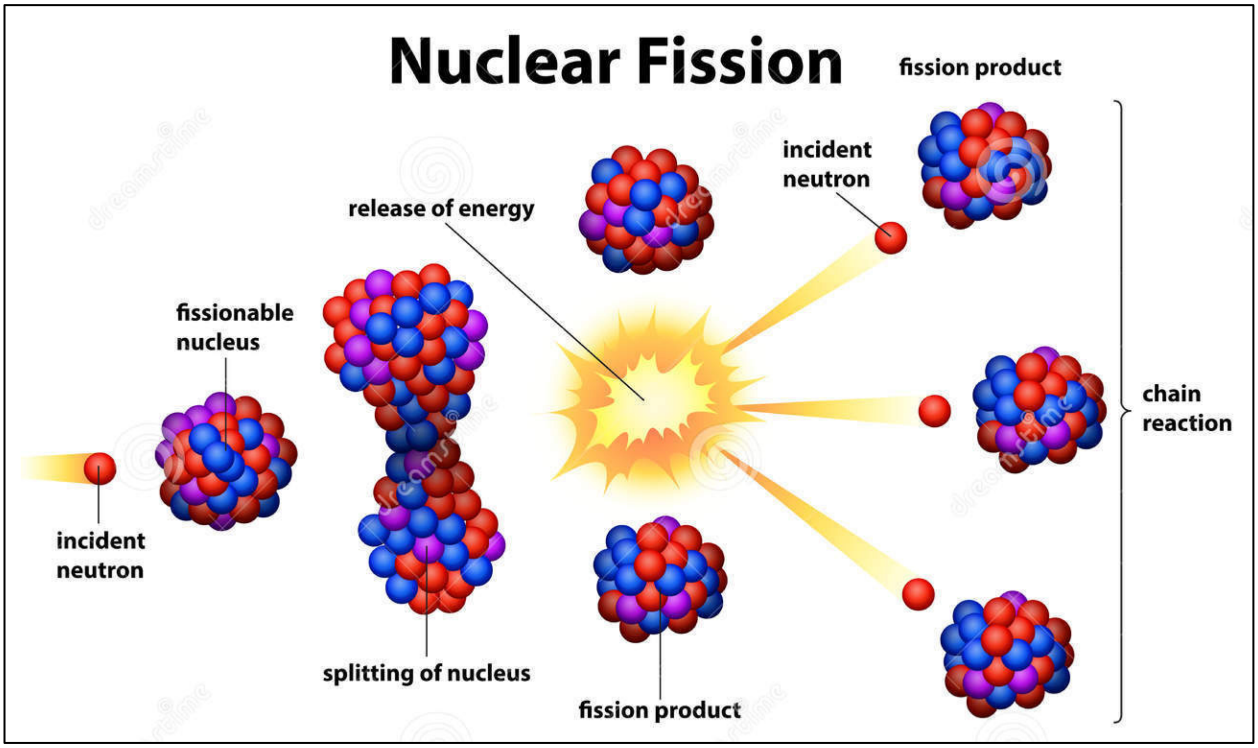
FISSION

In a nuclear reactor, heavy atoms such as uranium and plutonium undergo a process called fission after the absorption of a subatomic particle (usually a neutron). In fission, a heavy atom splits into two lighter atoms and releases energy in the form of radiation and the kinetic energy of the two new lighter atoms (see Figure D4-2). The new lighter atoms are called fission products. The fission products are often unstable and undergo further radioactive decay to reach a more stable state.

FISSION

Fission is the process whereby a large nucleus (for example, uranium-235) absorbs a neutron, becomes unstable, and splits into two fragments, resulting in the release of large amounts of energy per unit of mass. Each fission releases an average of two or three neutrons that can go on to produce fissions in nearby nuclei. If one or more of the released neutrons on the average causes additional fissions, the process keeps repeating. The result is a self-sustaining chain reaction and a condition called criticality. When the energy released in fission is controlled (as in a nuclear reactor), it can be used for various benefits such as to propel submarines or to provide electricity that can light and heat homes.

Figure D4-2. Nuclear Fission Chain Reaction



Source: ExtremeTech 2017.

Some heavy atoms do not immediately undergo fission after absorbing a subatomic particle. Rather, a new nucleus is formed that tends to be unstable (like fission products) and undergoes radioactive decay.

The radioactive decay of fission products and unstable heavy atoms is the source of radiation from spent nuclear fuel and high-level radioactive waste, which makes these materials hazardous in terms of risk to human health.

EXPOSURE TO RADIATION AND RADIATION DOSE

Radiation that originates outside an individual's body is called external or direct radiation. Such radiation can come from an x-ray machine or from radioactive materials (materials or substances that contain radionuclides), such as radioactive waste or radionuclides in soil. Internal radiation originates inside a person's body following intake of radioactive material or radionuclides through ingestion or inhalation. Once in the body, the fate of a radioactive material is determined by its chemical behavior and how it is metabolized. If the material is soluble, it might be dissolved in bodily fluids and deposited in various body organs; if insoluble, it might move rapidly through the gastrointestinal tract or be deposited in the lungs. Whether it emits alpha or beta particles, gamma rays, x-rays, or neutrons, a quantity of radioactive material is expressed in terms of its radioactivity, which refers to the amount of ionizing radiation released by a material (i.e., how many atoms in the material decay in a given time period). The units of measurement for radioactivity are the curie (Ci, U.S. unit) and becquerel (Bq, the international unit). One becquerel represents the amount of a radioactive material that will undergo one transformation per second. Becquerels are not used to measure radiation dose or radiation exposure.

Exposure describes the amount of radiation traveling through the air. Many types of radiation monitors measure exposure. The units for exposure are the roentgen (R, U.S. unit) and coulomb/kilogram (C/kg, international unit).

Absorbed dose describes the amount of radiation absorbed by an object or person. The unit for absorbed radiation dose is the rad (U.S. unit) or the gray (Gy, international unit). One gray is equal to 100 rads.

Effective dose describes the amount of radiation absorbed by a person, adjusted to account for the type of radiation received and the effect on particular organs. The unit used for effective dose is rem (U.S. unit) or sievert (Sv, international unit). More commonly, dose is measured in much smaller units defined as millirems (**mrem**) or millisieverts. The millirem is the U.S. unit used to measure effective dose, and is one-thousandth of a rem. The potential effects from a one-time ingestion or inhalation of radioactive material are calculated over a period of 50 years as adults to account for radionuclides that have long half-lives and long residence time in the body. The result is called the *committed effective dose equivalent (CEDE).* The unit of effective dose equivalent is also the *rem. Total effective dose equivalent (TEDE)* is the sum of the committed effective dose equivalent from radionuclides in the body plus the dose equivalent from radiation sources external to the body (also in rem).

1 mrem Dose Equals…

3 days of background radiation in Atlanta.

2 days of background radiation in Denver.

1 year of wearing a watch with a luminous dial.

1 coast-to-coast airline flight.

1 year of living next door to a normally operating nuclear power plant.

The U.S. Nuclear Regulatory Commission (NRC) has adopted a concept of a “critical group” to regulate radiation dose to the public following license termination. The "critical group" is that group of individuals reasonably expected to receive the highest exposure to residual radioactivity within the assumptions of a particular scenario. The average dose to a member of the critical group is represented by the average of the doses for all members of the critical group, which in turn is assumed to represent the most likely exposure situation. For example, when considering whether it is appropriate to “release” a building that has been decontaminated (allow people to work in the building without restrictions), the critical group would be the group of employees who would regularly work in the building. If radiation in the soil is the concern, then the scenario used to represent the maximally exposed individual is that of a resident farmer. The assumptions used for this scenario are prudently conservative and tend to overestimate the potential doses. The added “sensitivity” of certain members of the population, such as pregnant women, infants, children, and any others who may be at higher risk from radiation exposures, are accounted for in the analysis (NRC 2002).

The radiation dose to an individual or to a group of people can be expressed as the total dose received or as a **dose rate**, which is dose per unit time (usually an hour or a year). The NRC has established a 0.25 mSv/year (25 mrem/year) total effective dose equivalent (TEDE) to an average member of the critical group as an acceptable criterion for release of any site for unrestricted use.

Collective dose is the total dose to an exposed population. Person-rem is the unit of collective dose. Collective dose is calculated by summing the individual dose to each member of a population. For example, if 100 workers each received 0.1 rem, then the collective dose would be 10 person-rem (100 × 0.1 rem).

Dose conversion factors are the factors used to convert estimates of radionuclide intake (by inhalation or ingestion) to dose. The external dose rate conversions used by the NRC are obtained directly from the USEPA Federal Guidance Report No. 12 developed by Oak Ridge National Laboratory (Eckerman and Ryman 1992). These factors provide the external effective dose equivalent by summing the product of individual organ doses and organ weighting factors over the body organs. For inhalation and ingestion of radioactive materials, unit CEDE conversion factors are obtained from USEPA Federal Guidance Report No. 11 (Eckerman et al. 1988). These factors are generally consistent with International Commission on Radiological Protection (ICRP) Publication 26 (1977) and ICRP Publication 30 (1979-1988) (NRC 1992).

All estimates of dose presented in this Environmental Impact Report, unless specifically noted as something else, are total effective dose equivalents, which are quantified in terms of rem or millirem.

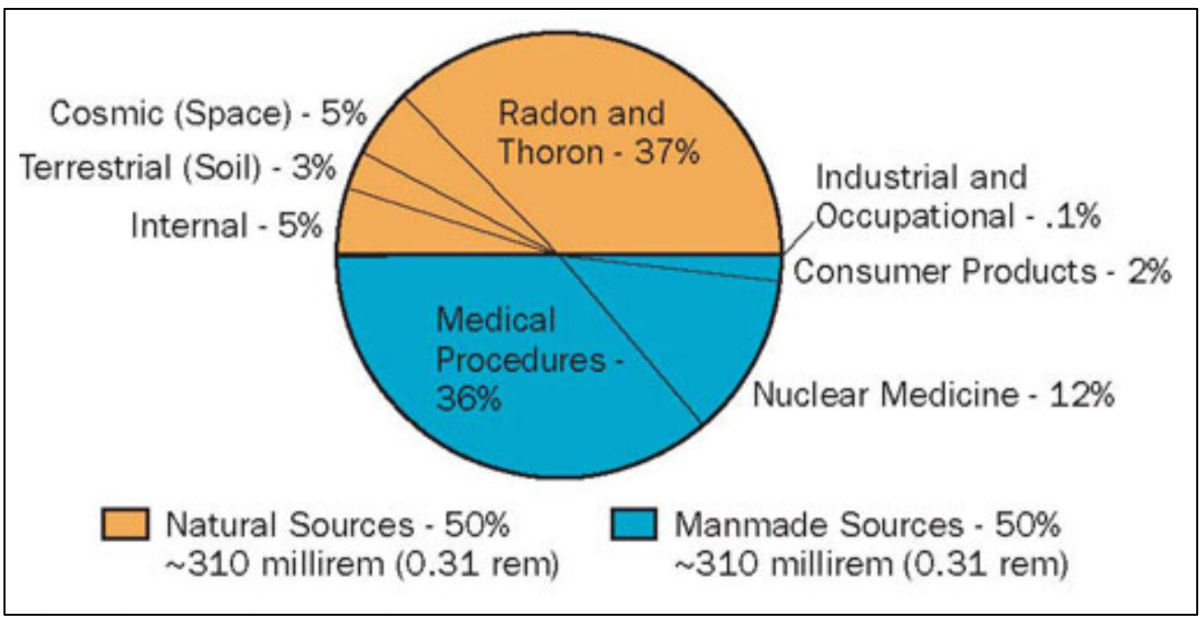
BACKGROUND RADIATION FROM NATURAL SOURCES

Natural background radiation comes from the following three sources:

- **Cosmic Radiation.** The sun and stars send a constant stream of cosmic radiation to Earth. Differences in elevation, atmospheric conditions, and the Earth's magnetic field can change the amount of cosmic radiation exposure.
- **Terrestrial Radiation.** The Earth is a source of terrestrial radiation. Radioactive elements (e.g., uranium, thorium, and radium) exist naturally in the minerals in soils and rock. The atmosphere contains radon, which is responsible for most of the dose that people receive each year from natural sources. Water contains small amounts of dissolved uranium and thorium, and all organic matter (both plant and animal) contains radioactive carbon and potassium. Some of these materials are ingested with food and water, while others (such as radon) are inhaled.
- **Internal Radiation.** All people have internal radiation, mainly from radioactive potassium-40 and carbon-14 inside their bodies from birth. This internal radiation is a source of exposure to others.

There can be large variances in natural background radiation levels from place to place, as well as changes in the same location over time (USEPA 2017). Nationwide, on average, members of the public are exposed to approximately 620 millirem per year from natural and manmade sources (National Council on Radiation Protection and Measurements [NCRP] 2009). Figure D4-3 shows the relative contributions of radiation sources to people living in the U. S. (NRC 2017 and NCRP 2009).

Figure D4-3. Sources of Radiation Exposure



Source: NRC 2017 and NCRP 2009.

As illustrated in the above figure, natural sources of radiation account for about 50 percent of radiation exposure in the U.S., while man-made sources account for the remaining 50 percent. The largest natural sources are radon-222 and its radioactive decay products in homes and buildings, which contribute approximately 229 millirem per year or 37 percent of the total annual dose. Additional natural sources include radioactive material in the Earth (primarily the uranium and thorium decay series, and potassium-40) and cosmic rays from space filtered through the atmosphere.

With respect to exposures resulting from human activities, medical exposure accounts for about 48 percent of the annual dose, and the combined doses from weapons testing fallout, consumer and industrial products, and air travel (cosmic radiation) account for the remaining 2 percent of the total annual dose. Nuclear fuel-cycle facilities contribute less than 0.1 percent (0.005 millirem per year per person) of the total dose (NRC 2017 and NCRP 2009).

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APPENDIX D6

Post-Shutdown Decommissioning Activities Report

SOUTHERN CALIFORNIA
EDISON®
An EDISON INTERNATIONAL® Company

Thomas J. Palmisano
Vice President & Chief Nuclear Officer

10 CFR 50.82(a)(4)(i)

September 23, 2014

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington D.C. 20555-0001

Subject: **Docket Nos. 50-361 and 50-362, San Onofre Nuclear Generating Station, Units 2 and 3 Post-Shutdown Decommissioning Activities Report**

Reference Letter from P.T. Dietrich (SCE) to the U.S. Nuclear Regulatory Commission dated June 12, 2013; Subject: Certification of Permanent Cessation of Power Operations, San Onofre Nuclear Generating Station, Units 2 and 3

Dear Sir or Madam:

On June 12, 2013, in accordance with 10 CFR 50.82(a)(1)(i), Southern California Edison (SCE) submitted the referenced letter to the U.S. Nuclear Regulatory Commission (NRC) certifying the permanent cessation of operations at San Onofre Nuclear Generating Station (SONGS), Units 2 and 3. In accordance with 10 CFR 50.54(bb) and 10 CFR 50.82(a)(4)(i), SCE is required to submit an Irradiated Fuel Management Plan (IFMP), Site Specific Decommissioning Cost Estimate (DCE) and Post-Shutdown Decommissioning Activities Report (PSDAR) within two years of permanent cessation of operations.

The SONGS, Units 2 and 3 PSDAR is attached. The SONGS, Units 2 and 3 IFMP and DCE are being concurrently submitted under separate cover letters. The descriptions of decommissioning activities and phases in the PSDAR are consistent with those described in the DCE. Both the PSDAR and DCE represent SCE's current plans and are subject to change as the project progresses.

Changes to significant details will be included in subsequent revisions to the PSDAR as required by 10 CFR 50.54(bb). Financial assurance information will be provided on an annual basis as required by 10 CFR 50.75(f)(1).

This letter does not contain any new commitments.

If there are any questions or if additional information is needed, please contact me or Ms. Andrea Sterdis at (949) 368-9985.

Sincerely,

P.O. Box 128
San Clemente, CA 92672
(949) 368-6575 PAX 86575
Fax: (949) 368-6183
Tom.Palmisano@sce.com

A001
NRR

Enclosure: San Onofre Nuclear Generating Station Units 2 and 3 Post-Shutdown Decommissioning Activities Report

cc: M. L. Dapas, Regional Administrator, NRC Region IV
T. J. Wengert, NRC Project Manager, San Onofre Units 2 and 3 Decommissioning
R. E. Lantz, NRC Region IV, San Onofre Units 2 and 3
G. G. Warnick, NRC Senior Resident Inspector, San Onofre Units 2 and 3
S. Y. Hsu, California Department of Health Services, Radiologic Health Branch

San Onofre Nuclear Generating Station Units 2 and 3
Post-Shutdown Decommissioning Activities Report

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List of Acronyms and Abbreviations

AADT	Average Annual Daily Traffic
AIF	Atomic Industrial Forum
ALARA	As Low As Reasonably Achievable
BMP	Best Management Practices
CCC	California Coastal Commission
CFR	Code of Federal Regulations
CRWQCB	California Regional Water Quality Control Board
CSLC	California State Lands Commission
DBA	Design Basis Accident
DCE	Decommissioning Cost Estimate
Decon Pd	License Termination Period
DGC	Decommissioning General Contractor
DOE	United States Department of Energy
DOT	United States Department of Transportation
DSC	Dry Storage Canister
FES	Final Environmental Statement, SONGS Units 2 and 3 (NUREG-0490)
GEIS	Generic Environmental Impact Statement (NUREG-0586)
GTCC	Greater than Class C
HSM	Horizontal Storage Modules
IFMP	Irradiated Fuel Management Plan
ISFSI	Independent Spent Fuel Storage Installation
LTP	License Termination Plan
LLRW	Low Level Radioactive waste
MARRSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MWDOC	Municipal Water District of Orange County
MWt	Megawatt-thermal
NEI	Nuclear Energy Institute
NPDES	National Pollutant Discharge Elimination System
NRC	United States Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
PSDAR	Post-Shutdown Decommissioning Activities Report
PWR	Pressurized Water Reactor
RCS	Reactor Coolant System
REMP	Radiological Environmental Monitoring Program
RV	Reactor Vessel
SONGS	San Onofre Nuclear Generating Station
SCE	Southern California Edison
SDAPCD	San Diego Air Pollution Control District
SFP	Spent Fuel Pool
SNF Pd	Spent Fuel Period
SFSM	Spent Fuel Storage Modules
SPCC	Spill Prevention Control and Countermeasures
SR Pd	Site Restoration Period
SSC	Structures, Systems, and Components
UFSAR	Updated Final Safety analysis Report
USCB	United States Census Bureau

I. INTRODUCTION AND SUMMARY

A. Introduction

1. Historical Perspectives

San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 have been owned by four entities. Two are municipalities (Riverside and Anaheim) and two are investor owned utilities: San Diego Gas & Electric (SDG&E) and Southern California Edison (SCE, the Owner-Operator and agent for the participants). The relative obligation for operation and decommissioning varies by unit and entity. The term "SONGS Participants" is used in this report to represent the four entities that have continuing decommissioning obligations.

SONGS Unit 1 was shut down in 1992 with on-shore facilities largely dismantled by 2009 and off-shore conduits being fully dispositioned this year (2014). The decision has been made to shut down and decommission Units 2 and 3. Since the decision to shut down SONGS Units 2 and 3, the focus of SONGS staff and other personnel has been to plan and begin execution of the necessary steps to achieve timely, cost-effective, and safe decommissioning and restoration of the SONGS site.

In developing its plans, SONGS has benchmarked the experiences of commercial decommissioning projects in the 1990s and 2000s and has sought the input from experienced individuals and groups with a wide range of such experience. SONGS maintains close communications with those facilities currently undergoing decommissioning and with many of the organizations supporting those efforts. In particular, both the Zion and Humboldt Bay plants are currently undergoing active decommissioning. Three others (Kewaunee, Crystal River 3, and Vermont Yankee) are, or soon will be, entering SAFSTOR conditions of varying durations prior to dismantlement.

Earlier decommissioning projects faced a number of first-time technical challenges, such as cutting reactor vessel (RV) internals in a high radiation environment. SONGS' reviews indicate that many of the technical challenges confronting SONGS decommissioning now have mature solutions. Similarly, our predecessors provide a wealth of knowledge to minimize worker radiation exposure, efficiently plan, and sequence a decommissioning project and safely manage and transport waste.

The SONGS Participants have the responsibility to restore the site in accordance with applicable regulations and agreements. The SONGS Participants have a responsibility to their stakeholders and the communities they serve to do so in a transparent and effective manner while striving to attain high standards of safety and environmental protection. Further, the SONGS Participants will have a limited, if any, role in the future use of the site. The ultimate use for the site is for the land-owner (U.S. Navy) to determine with input from the community at large.

2. Community Engagement

A key lesson-learned in our review of other decommissioning projects is the continued importance of community engagement during the decommissioning process. The SONGS Participants are committed to engaging the local community and its leaders in an open, transparent, and proactive manner. SONGS is actively engaged with external stakeholders to: understand their priorities; inform them of SONGS plans; and, to seek their input on the safe, timely, and cost-effective decommissioning of SONGS.

The SONGS Participants are actively engaging with the community through public outreach including briefings for community groups and routine educational updates for local, state, and federal officials. The SONGS participants have formed the Community Engagement Panel (CEP) with members representing a broad range of stakeholders to advise SONGS on decommissioning matters. The panel meets at least quarterly to facilitate dialogue and includes several representatives of government, members from academia, labor, business, environmental organization, and a local anti-nuclear leader. Members of the CEP were provided with the opportunity to review and provide input on this document as well as the Decommissioning Cost Estimate (DCE) and the Irradiated Fuel Management Plan (IFMP). As a precursor to review of these submittals, SONGS hosted two workshops with external technical experts to provide the CEP members with a depth of knowledge in these areas. Feedback from the panel was addressed prior to finalization and SCE senior management authorization of the submittals.

SONGS also has established a website, www.SONGScommunity.com, as a dedicated online source for information on the plant and the decommissioning process. The website includes background information on decommissioning, links to other websites including the NRC, and an "opt-in" feature that allows members of the community to register for automatic updates on decommissioning matters.

3. Regulatory Basis

In accordance with the requirements of 10 CFR 50.82, "Termination of License," paragraph (a)(4)(i), this report constitutes the Post-Shutdown Decommissioning Activities Report (PSDAR) for SONGS Units 2 and 3. The PSDAR contains the following:

1. A description of the planned decommissioning activities along with a schedule for their accomplishment.
2. A site-specific DCE including the projected cost of managing irradiated fuel and site restoration (being submitted concurrently).
3. A discussion that provides the basis for concluding that the environmental impacts associated with the site-specific decommissioning activities will be bounded by the appropriate previously issued generic and plant specific environmental impact statements.

The PSDAR has been developed consistent with NRC Regulatory Guide 1.185, Revision 1, "Standard Format and Content for Post-Shutdown Decommissioning Activities Report." This report is based on currently available information; however, the plans discussed may be modified as additional information becomes available or as circumstances change. As required by 10 CFR 50.82(a)(7), SCE will notify the Nuclear Regulatory Commission (NRC) in writing before performing any decommissioning activity inconsistent with, or making any significant schedule change from, those actions and schedules described in the PSDAR, including changes that significantly increase the decommissioning cost.

The IFMP and DCE are being submitted concurrently with the PSDAR. The technical, schedule, and cost information provided is consistent among these submittals.

B. Background

The SONGS site is located on the coast of southern California in San Diego County, approximately 62 miles southeast of Los Angeles and 51 miles northwest of San Diego. The site is located entirely within the boundaries of the United States Marine Corps Base Camp Pendleton. The site is approximately 4,500 feet long and 800 feet wide, comprising 84 acres. The site does not include office buildings and related facilities located east of Interstate 5 (I-5) referred to as "the Mesa" or other adjacent parcels.

The property on which the station is built is subject to an easement from the United States Government through the U. S. Navy. The nearest privately owned land is approximately 2.5 miles from the site.

SONGS Units 2 and 3 is a two-unit site with supporting facilities. The reactors were previously licensed to produce 3,438 MWt each. An on-site Independent Spent Fuel Storage Installation (ISFSI) used to store SONGS Units 1, 2 and 3 fuel, located on the portion of the site previously occupied by SONGS Unit 1. Storage at the ISFSI was initiated in 2003 and the pad was subsequently (2007) expanded to support the currently placed 63 Horizontal Storage Modules in which 51 Dry Storage Containers (DSCs) have been installed to-date: 50 containing irradiated fuel and one (1) containing Greater-Than-Class-C (GTCC) materials. The most recent loading campaign was conducted in 2012. As discussed in the Spent Fuel Management Period details and the concurrently submitted IFMP, it will be necessary to further expand the current ISFSI capacity to store the complete inventory of Units 2 and 3 spent fuel. The location, capacity, and technology to be employed have not yet been finalized.

A brief history of the major milestones related to plant construction and operation is as follows:

	UNIT 2	UNIT 3
• Construction Permit Issued	October 18, 1973	October 18, 1973
• Operating License Issued	February 16, 1982	November 15, 1982
• Full Power Operation	June 15, 1983	November 18, 1983
• Final Reactor Operation	January 9, 2012	January 31, 2012

On June 7, 2013, SCE announced its decision to permanently cease power operations and decommission SONGS Units 2 and 3. By letter dated June 12, 2013 (Reference 3), SCE notified the NRC of its decision to permanently cease power operations. SCE has submitted two letters dated July 22, 2013 (Reference 5) and June 28, 2013 (Reference 4) certifying that fuel has been removed from the Unit 2 and 3 reactors, respectively.

Pursuant to 10 CFR 50.51(b), "Continuation of License," the license for a facility that has permanently ceased operations, continues in effect beyond the expiration date to authorize ownership and possession of the facility until the NRC notifies the licensee in writing that the license has been terminated. During the period that the license remains in effect, 10 CFR 50.51 (b) requires the licensee to:

(1) Take actions necessary to decommission and decontaminate the facility and continue to maintain the facility, including, where applicable, the storage, control and maintenance of the spent fuel, in a safe condition, and

(2) Conduct activities in accordance with all other restrictions applicable to the facility in accordance with the NRC regulations and the provisions of the specific 10 CFR part 50 licenses for the facility.

C. Summary of Decommissioning Alternatives

The NRC has evaluated the environmental impacts of three general methods for decommissioning power reactor facilities in NUREG-0586, "Final Generic Environmental Impact Statement (GEIS) on Decommissioning Nuclear Facilities," Supplement 1 (Reference 6). The three general methods are:

- **DECON:** The equipment, structures, and portions of the facility and site that contain radioactive contaminants are promptly removed or decontaminated to a level that permits termination of the license after cessation of operations.
- **SAFSTOR:** The facility is placed in a safe stable condition and maintained in that state (safe storage) until it is subsequently decontaminated and dismantled to levels that permit license termination. During SAFSTOR, a facility is left intact or may be partially dismantled, but the fuel has been removed from the reactor vessel and radioactive liquids have been drained from systems and components and then processed. Radioactive decay occurs during the SAFSTOR period, thus reducing the levels of radioactivity in and on the material and potentially the quantity of radioactive material that must be disposed of during the decontamination and dismantlement.
- **ENTOMB:** Radioactive structures, systems, and components are encased in a structurally long-lived substance such as concrete. The entombed structure is appropriately maintained and continued surveillance is carried out until the radioactivity decays to a level that permits termination of the license.

The SONGS Participants have chosen the DECON method. SONGS is currently in the planning period during which the site is preparing for safe and orderly transition to dismantlement. More specifically:

- Permanent cessation of operations was announced on June 7, 2013.
- DECON methodology was selected (prompt decontamination and dismantlement after initial planning period).
- Additional ISFSI capacity will be added to meet all of the site's needs.
- Initial site characterization activities are underway.
- Plans to isolate the Spent Fuel Pools (referred to as "islanding") are in development.
- Other necessary actions to facilitate safe system retirement and removal (referred to as "cold and dark") are in development.

When the required regulatory reviews, planning, and preparation are sufficiently complete, the site will move into active decontamination and dismantlement. Current plans are for that period to overlap with completion of the relocation of spent fuel from the Spent Fuel Pools to the ISFSI.

The SONGS facility will be decontaminated and dismantled (D&D) to levels that permit termination of the NRC licenses and in accordance with the requirements agreed to by the United States Navy in the easement for the site. In support of this and in accordance with 10 CFR 50.82(a)(9), a License Termination Plan will be developed and submitted for NRC approval at least two years prior to termination of the license.

The decommissioning approach for SONGS is described in more detail in the following sections:

- Section II summarizes the planned decommissioning activities and general timing of their implementation.
- Section III summarizes the cost estimating methodology employed by Energy*Solutions* and references the site specific DCE being submitted concurrently.
- Section IV describes the basis for concluding that the environmental impacts associated with decommissioning SONGS Units 2 and 3 are bounded by the most recent site-specific environmental impact statement and NRC GEIS related to decommissioning.

II. DESCRIPTION OF PLANNED DECOMMISSIONING ACTIVITIES

The SONGS Units 2 and 3 decommissioning project is currently in the planning period transitioning to DECON as soon as necessary planning, approvals, and conditions permit doing so in a safe and cost-effective manner. DECON is defined in Section I.C of this report.

Table II-1 provides a summary of the current decommissioning plan and schedule for SONGS Units 2 and 3. The major decommissioning periods and general sequencing of the activities that will occur during each period identified in Table II-1 are discussed in more detail in the sections that follow. The periods are logical groupings of activities. The categories are also consistent with the Nuclear Decommissioning Trust (NDT) funds which are allocated based on specific regulatory requirements. The activities executed during these periods will, in many cases progress in parallel, and may not be as completely segregated as the description implies. For instance, while distinct decontamination and dismantlement activities are listed, it may be determined to be more effective from dose, labor, or waste disposal perspectives to dismantle structures and systems and dispose of them as radioactive waste rather than decontaminate them and dispose of the balance as non-radioactive waste.

The planning required for each decommissioning activity, including the selection of the process to perform the work, will be performed in accordance with appropriate governance and oversight processes. Based on current plans, no decommissioning activities unique to the site have been identified and no activities or environmental impacts outside the bounds considered in the GEIS have been identified. Appropriate radiological and environmental programs will be maintained throughout the decommissioning process to ensure radiological safety of the workforce and the public and environmental compliance is maintained.

Table II-1
San Onofre Nuclear Generating Station Units 2 and 3
Current Schedule of Decommissioning Periods

Task Name	Start	Finish
Part 50 License Termination (other than ISFSI)		
Announcement of Cessation of Operations	06/07/2013	N/A
Decon Period 1 – Transition to Decommissioning	06/07/2013	12/31/2013
Decon Period 2 – Decommissioning Planning and Site Modifications	01/01/2014	06/30/2015
Decon Period 3 – Decommissioning Preps/Reactor Internals Segmentation	06/30/2015	06/01/2019
Decon Period 4 – Plant Systems and Large Component Removal	06/01/2019	09/24/2022
Decon Period 5 – Building Decontamination	09/24/2022	07/13/2024
Decon Period 6 – License Termination During Demolition	07/13/2024	12/24/2032
Spent Fuel Management		
SNF Period 1 – Spent Fuel Management Transition	06/07/2013	12/31/2013
SNF Period 2 - Spent Fuel Transfer to Dry Storage	01/01/2014	06/01/2019
SNF Period 3 – Dry Storage During Decommissioning – Units 1, 2 & 3	06/01/2019	12/05/2031
SNF Period 4 – Dry Storage Only – Units 1, 2 & 3	12/05/2031	12/31/2035
SNF Period 5 – Dry Storage Only – Units 2 & 3	12/31/2035	12/31/2049
SNF D&D Period 1 – ISFSI Part 50 License Termination	12/31/2049	05/06/2050
SNF D&D Period 2 – ISFSI Demolition	05/06/2050	09/08/2051
Site Restoration		
SR Period 1 – Transition to Site Restoration	06/07/2013	06/30/2015
SR Period 2 – Building Demolition During Decommissioning	06/30/2015	07/11/2017
SR Period 3 – Subsurface Demolition Engineering and Permitting	10/01/2019	07/13/2024
SR Period 4 – Building Demolition to 3 Feet Below Grade	07/13/2024	10/14/2028
SR Period 5 – Subgrade Structure Removal Below -3 Feet	10/14/2028	12/5/2031
SR Period 6 – Final Site Restoration and Easement Termination	05/06/2050	12/15/2051
Final Easement Termination	12/15/2051	N/A

Note [1]: Shipping dates are assumed based on the previously documented positions of the DOE, which indicates that shipments from the industry could begin as early as 2024 and SONGS place in the current queue. Both are subject to changes.

A. Detailed Breakdown of License Termination Periods

The License Termination Periods (referred to as decontamination periods) include those activities necessary to remove or reduce the levels of radioactive contamination to levels necessary to terminate the Part 50 licenses for the site (other than the ISFSI) and release it back to the Navy. Also included are the development, submittal, and support for the review of the primary decommissioning documents.

Periods 1 and 2 generally consist of planning and transition of the site to a condition where it is ready for significant decontamination and dismantlement activities. As detailed below, these periods include: system abandonment and isolation of the remaining structures, systems and components (SSC) from normal power and water sources. System abandonment and isolation allow the decontamination and dismantlement to proceed safely and in an efficient sequence. Additionally, the selection of the contractor for managing the bulk of the decommissioning activities will be made.

Period 3 is focused on decontamination and dismantlement of the major components in the containment building (RV internals, vessel, head, steam generators, pressurizer, and main piping).

Period 4 addresses the decontamination and dismantlement of SSCs known to be substantially contaminated and the removal of the components from both Periods 3 and 4.

Period 5 is focused on decontamination of the various buildings. As noted elsewhere it may be more appropriate to simply proceed with dismantlement if it is more timely and cost-effective to simply dispose of building material as radioactive waste.

Period 6 is focused on the final site survey to confirm that the site is acceptable for release back to the Navy. The process for doing so "Multi-Agency Radiation Survey and Site Investigation Manual" (MARRSIM) was developed by the four federal agencies having authority over radioactive materials (Department of Defense, Department of Energy, the Environmental Protection Agency and the NRC) and is the consensus standard endorsed by other stakeholders. Its application will be validated by the NRC.

Decontamination Period 1 – Transition to Decommissioning

- Announcement of Cessation of Operations
- Defuel Reactors
- Notification of Permanent Fuel Removal
- Disposition of legacy Low Level Radioactive Waste (LLRW)

Decontamination Period 2 – Decommissioning Planning and Site Modifications

- Preparation of Decommissioning Related Licensing Submittals
    - Permanently Defueled Technical Specifications (Submitted March 21, 2014)
    - Permanently Defueled Radiological Emergency Plan (Submitted March 31, 2014)
- Submit PSDAR, DCE and IFMP to NRC
- Perform Historical Site Assessment and Site Characterization
- Planning, Design, and Implementation of Cold and Dark (Site Repowering)
- Design and Install Spent Fuel Pool Islanding, Control Room Relocation, and Security Modifications
- Select Decommissioning General Contractor (DGC)

Decontamination Period 3 – Decommissioning Preparations and Reactor Internal Segmentation

- DGC Mobilization and Planning
- System Decontamination
- Reactor Internals Removal Preparations

- Reactor Internals Segmentation Planning and Implementation
- Purchase Dry Storage Canisters for GTCC Waste
- Segment and Package Reactor Internals for Storage in the ISFSI

Decontamination Period 4 – Plant Systems and Large Component Removal

- Upgrade Rail Spur in Owner Controlled Area
- Install Large Array Radiation Detection System to Monitor Shipments In/Out of Site
- Remove, Package, and Dispose of Non-Essential Systems
- Asbestos and Lead Abatement
- Spent Fuel Pool Closure
- Remove Spent Fuel Pool Racks, Spent Fuel Pool Island Equipment, and Bridge Crane
- Remove and Dispose of Legacy Class B and C Wastes
- Remove, Package, and Dispose of Essential Systems
- Removal and Disposal of Spent Resins, Filter Media, and Tank Sludge
- Large Component Removal
- Prepare License Termination Plan

Decontamination Period 5 – Building Decontamination

- Decontaminate Containment Buildings
- Decontaminate Turbine Buildings
- Decontaminate Fuel Handling Buildings
- Decontaminate Auxiliary Rad-waste Building
- Decontaminate Auxiliary Control Building
- Decontaminate Penetration Buildings
- Decontaminate Safety Equipment and Main Steam Isolation Valve (MSIV) Buildings
- Radiological Survey of Structures During Decontamination

Decontamination Period 6 – License Termination

- Final Status Survey
- Verification and NRC Approval

B. Detailed Breakdown of Spent Fuel Management Periods

The Spent Nuclear Fuel Management Periods began with all spent fuel off-loaded from the reactor vessel into the Spent Fuel Pools and the certification of permanent defueling letters submitted to the NRC in accordance with 10 CFR 50.82(a)(1)(ii) (References 4 and 5).

During Period 1 measures will be planned, designed, and implemented to ensure spent fuel storage and handling systems will continue to function to support fuel storage in the spent fuel pool and to facilitate transfer of the spent fuel to the ISFSI. Systems, structures, and programs needed to support the safe storage and transfer of spent fuel such as security, fire protection, and environmental and radiological monitoring will be maintained in accordance with applicable requirements. Equipment maintenance, inspection, and operations will be performed on these systems and structures as appropriate.

During Period 2 the ISFSI capacity will be expanded to accommodate transfer of all spent fuel to dry storage. All spent fuel for Units 1, 2 and 3 will be transferred to the ISFSI and stored there until it is accepted by the Department of Energy (DOE) and transferred to an off-site facility.

The next three periods reflect slightly different ISFSI conditions. Period 3 is concurrent with ongoing site decontamination and dismantlement activities. Period 4 reflects the ISFSI with spent fuel from all three units in dry storage and Period 5 recognizes the potential that Unit 1 fuel may be accepted by the DOE earlier than Units 2 and 3 fuel and ends with DOE acceptance of all Units 2 and 3 fuel.

The SNF D&D Periods (1 and 2) follow DOE acceptance and may be well after License Termination for the balance of the site.

Spent Nuclear Fuel Period 1 – Spent Fuel Transfer Management Transition

- Implementation of Initial Security Enhancements Required for Reductions in Staff
- Design and Fabricate Dry Storage Canisters for Current ISFSI Scope

Spent Nuclear Fuel Period 2 – Spent Fuel Transfer to Dry Storage

- Submit IFMP
- Select Dry Storage System Canister Design and Vendor for Balance of the ISFSI
- Design and Construct ISFSI Expansion
- Purchase, Deliver, and Load Dry Storage Canisters and Storage Models for Balance of the ISFSI
- Complete Transfer of Spent Fuel to ISFSI

Spent Nuclear Fuel Period 3 – Dry Storage during Decommissioning Units 1, 2, and 3 Fuel

Spent Nuclear Fuel Period 4 – Dry Storage Only – Units 1, 2, and 3 Fuel

Spent Nuclear Fuel Period 5 – Dry Storage Only – Units 2 and 3 Fuel

Spent Nuclear Fuel Period D&D 1 – ISFSI License Termination

- Preparation and NRC Review of ISFSI Portion/Revision of License Termination Plan

Spent Nuclear Fuel Period D&D 2 – ISFSI Demolition

- Decontamination of Storage Modules (SFSMs)
- Final Status Survey of ISFSI
- Clean Demolition of HSM's and ISFSI Pad
- Clean Demolition of ISFSI Support Structures
- Restore ISFSI Site
- Preparation of Final Report on ISFSI Decommissioning and NRC Review

C. Detailed Breakdown of Site Restoration Periods

The Site Restoration periods reflect the planning and implementation of dismantlement activities not associated with radioactive materials. The DCE and descriptions below conservatively include activities from which the SONGS Participants will plan to seek alternatives. These include the complete removal of the intake and discharge conduits in the Pacific Ocean currently required by the California State Lands Commission (CSLC) easement. Previously, the CSLC and SONGS developed an alternative for the SONGS Unit 1 conduits. Another is associated with removal of all subsurface structures that may be required by the US Navy easement. The typical practice has been to remove structures to that depth necessary to remove contaminated materials.

Also included as part of site restoration are severance costs and cost associated with returning the Mesa and other parcels to the U. S. Navy.

Site Restoration Period 1 –Transition to Site Restoration

- Severance Costs Associated with Staffing Reduction in Accordance with State Law
- Other off-site activities are included in the DCE but are not considered part of the Units 2 and 3 PSDAR activities

Site Restoration Period 2 –Building Demolition During Decommissioning

- Demolish South Access for Decommissioning, South Yard Facility
- Other off-site activities are included in the DCE but are not considered part of the Units 2 and 3 PSDAR activities

Site Restoration Period 3 – Subsurface Demolition Engineering and Permitting

- Hydro-geologic Investigation and Outfall Conduit Survey
- Subsurface Structure Removal Analyses for Lease Termination Activities
- Final Site Grading and Shoreline Protection Engineering Planning and Design

Site Restoration Period 4 – Building Demolition to Three Feet Below-Grade

- Demolition Preparations
- De-tension and Remove Containment Building Tendons
- Demolish Diesel Generator Buildings
- Demolish Condensate Buildings and Transformer Pads
- Demolish Full Flow Areas and Turbine Buildings
- Demolish Auxiliary Rad-waste Building
- Demolish Auxiliary Control Building
- Remove Systems and Demolish Make-up Demineralizer Structures
- Demolish Penetration Buildings
- Demolish Safety Equipment and MSIV Buildings
- Demolish Fuel Handling Buildings
- Demolish Containment Buildings
- Demolish Intake and Discharge Structures

Site Restoration Period 5 – Subgrade Structure Removal below Three Feet (if required)

- Install Sheet Piling and Excavation Shoring, Dewatering System, and Effluent Treatment and Discharge Controls

- Demolish and Backfill Subsurface Structures
- Demolish and Backfill Intake Structure Inside Seawall
- Remove Off-shore Intake and Outfall Conduits
- Remove Sheet Piling and Excavation Shoring, and Perform Dewatering and Effluent Treatment
- Finish Grading and Re-vegetate Site As Needed/Required

Site Restoration Period 6 – Final Site Restoration and Easement Termination [details subject to final resolution of negotiations with the U. S. Navy]

- Install Dewatering System and Effluent Treatment and Discharge Controls
- Remove and Stockpile Existing Seawall Erosion Protection
- Remove Seawall and Pedestrian Walkway
- Remove Remaining Intake Structure Beneath Seawall
- Backfill and Compaction of Excavation
- Remove Dewatering System and Effluent Treatment
- Remove Railroad Tracks, Stabilized Slopes, Access Road, and North Parking Lot
- Finish Grading and Re-vegetate Site as Needed/Required

D. General Decommissioning Considerations

1. Major Decommissioning Activities

As defined in 10 CFR 50.2, "Definitions," a "major decommissioning activity" is "any activity that results in permanent removal of major radioactive components, permanently modifies the structure of the containment, or results in dismantling components for shipment containing greater than Class C waste in accordance with 10 CFR 61.55." The following discussion provides a general summary of the major decommissioning activities currently planned for SONGS Units 2 and 3. These activities may be modified as conditions dictate.

Prior to starting a major decommissioning activity, the plant components will be radiologically surveyed and decontaminated, as required, to minimize worker radiation exposure. Shipping casks and other equipment necessary to conduct decommissioning activities will be designed and procured.

The initial major decommissioning activities will focus on removal, packaging and disposal of piping and components. Following RV and cavity reflood and RV head removal and disposal; the reactor vessel internals will be removed from the reactor vessel and segmented as necessary to separate the GTCC waste which will be placed in storage canisters and modules on the ISFSI designated for that purpose. Using this approach, the internals will be packaged and disposed of independent of the reactor vessel (RV). When the internals segmentation effort is completed, the RV and cavity will be drained and any remaining debris will be removed.

Removal of the reactor vessel follows the removal of the reactor internals. It is likely that the components will be removed by sectioning or segmenting performed remotely. These activities may be performed in air, rather than underwater, using a control envelope to preclude the spread of contaminated materials.

Additional major decommissioning activities that will be conducted include removal and disposal of the steam generators, pressurizer, spent fuel storage racks, and spent fuel bridge crane. The dismantling of the containment structure will be undertaken as part of the reactor building demolition. As detailed in Section 3 (below) appropriate radiation protection and contamination control measures will be employed to manage these activities.

2. Other Decommissioning Activities

In addition to the major decommissioning activities discussed above, plant components will be removed from the Turbine Building including the turbine generator, condenser, feedwater heaters, moisture separator/reheaters, and miscellaneous system and support equipment. As detailed in Section 3 (below) appropriate radiation protection and contamination control measures will be employed to manage these activities.

3. Decontamination and Dismantlement Activities

The objectives of the decontamination effort are two-fold. The first objective is to reduce radiation levels throughout the facility to minimize personnel radiation exposure during dismantlement. The second objective is to clean as much material as possible to 'unrestricted use' levels, thereby allowing non-radiological demolition and disposal and minimizing the quantities of material that must be disposed of by costly burial as radioactive waste. The second objective will be achieved by decontaminating structural components including steel framing and concrete surfaces. The methods to accomplish this are typically mechanical, requiring the removal of the surface or surface coating and are used regularly in industrial and contaminated sites.

The decontamination and/or dismantlement of contaminated SSCs may be accomplished by: decontamination in place; decontamination and dismantlement; or dismantlement and disposal. A combination of these methods may be utilized to reduce contamination levels, worker radiation exposures, and project costs. Material below the applicable radiological limits may be released for unrestricted disposition (e.g., scrap, recycle, or general disposal). Radioactive contaminated or activated materials will be removed from the site as necessary to allow the site to be released for unrestricted use.

LLRW will be processed in accordance with plant procedures and existing commercial options. Contaminated material will be characterized and segregated for additional onsite decontamination or processing, off-site processing (e.g., disassembly, chemical cleaning, volume reduction, waste treatment), and/or packaged for controlled disposal at a low-level waste disposal facility.

Contaminated concrete and structural steel components will be decontaminated and removed as required to gain access to plant SSCs. After the SSCs are removed and processed as described above, the remaining contaminated concrete and structural steel components will be decontaminated and/or removed. Contaminated concrete will be packaged and shipped to a low-level waste disposal facility. Contaminated structural steel components may be removed to a processing area for decontamination, volume reduction, and packaging for shipment to processing facility or to a low-level waste disposal facility, as necessary.

Buried and embedded contaminated components (e.g., piping, drains) will be decontaminated in place, or excavated and decontaminated. Appropriate contamination controls will be employed to minimize the spread of contamination and to protect personnel.

4. Radioactive Waste Management

A major component of the total cost of decommissioning SONGS Units 2 and 3 is the cost of safely packaging and disposing of contaminated SSCs, contaminated soil, resins, water, and other plant process liquids. A waste management plan will be developed consistent with regulatory requirements for each waste type. Currently, LLRW Classes B and C may be disposed of at the Waste Control Services (WCS) waste disposal site in Andrews County, Texas. The waste management plan will be based on the evaluation of available methods and strategies for processing, packaging, and transporting radioactive waste in conjunction with the available disposal facility and associated waste acceptance criteria.

Class A LLRW will be disposed at a licensed disposal site. (SONGS has contracted with Energy*Solutions* to use the facility located in Clive, Utah as well as WCS). If other licensed Class B and C LLRW facilities become available in the future, SONGS may choose to use them as well.

5. Removal of Mixed Wastes

Mixed wastes (hazardous and radioactive) generated during decommissioning, if any, will be managed in accordance with applicable Federal and State regulations. If technology, resources, and approved processes are available, the processes will be evaluated to render the mixed waste non-hazardous. Otherwise, mixed wastes from SONGS will be transported by authorized and licensed transporters and shipped to authorized and licensed facilities.

6. Site Characterization

During the decommissioning process, a site characterization will be performed in which radiological, regulated, and hazardous wastes will be identified, categorized, and quantified. Surveys will be conducted to establish the contamination and radiation levels throughout the plant. The information will be used in developing procedures to ensure the contaminated areas are removed and ensure that worker exposure is controlled. Surveys of the selected outdoor areas will also be performed including surveys of soil and groundwater near the site. As decontamination and dismantlement work proceeds, surveys will be conducted to maintain the site characterization current and ensure that decommissioning activities are adjusted accordingly.

7. Groundwater Protection

A groundwater protection program was initiated at SONGS in accordance with NEI 07-07, "Industry Groundwater Protection Initiative, Final Guidance Document," in August 2007 (Reference 11). A site hydrology study was initially completed as part of this initiative and was updated in 2012. Monitoring wells were installed around the plant to monitor for radionuclides. Acceptable levels of contaminants, as defined by the program, have been observed throughout the sampling program implemented as part of this initiative. Appropriate program elements will be maintained during decommissioning.

8. Change to Management and Staffing

With the plant shut down and defueled, plant management and staffing levels have been and continue to be adjusted to reflect the transition from an operating plant to a plant in decommissioning status. Staffing plans are addressed in the DCE.

III. ESTIMATE OF EXPECTED DECOMMISSIONING AND SPENT FUEL MANAGEMENT COSTS

10 CFR 50.82(a)(8)(iii) requires that a site-specific decommissioning cost estimate be prepared, and submitted within two years following permanent cessation of operations. 10 CFR 50.82 (a)(4)(i) requires that the PSDAR contain a site-specific decommissioning cost estimate including the projected costs of managing irradiated fuel.

Energy*Solutions* has prepared a site-specific DCE for SONGS, which also provides projected costs of managing irradiated fuel, as well as non-radiological decommissioning and other site restoration costs,. The site-specific decommissioning cost analysis is being submitted concurrent with the IFMP and this PSDAR and fulfills the requirements of 10 CFR 50.82(a)(4)(i) and 10 CFR 50.82(a)(8)(iii). A summary of the annual costs associated with decommissioning, irradiated fuel management and site restoration are provided in the Irradiated Fuel Management Plan also being concurrently submitted in accordance with 10 CFR 50.54(bb).

The methodology used by Energy*Solutions* to develop the site-specific decommissioning cost analysis follows the approach originally developed by the Atomic Industrial Forum (now Nuclear Energy Institute) in their program to develop a standardized model for decommissioning cost estimates. The results of this program were published as AIF/NESP-036, "A Guideline for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates," (Reference 7). This document includes a unit cost factor method for estimating direct activity costs, simplifying the estimating process. The unit cost factors used in the study reflect the latest available data at the time of the study concerning worker productivity during decommissioning.

The decommissioning of the SONGS site will be funded from Nuclear Decommissioning Trusts established by each SONGS Participant for each unit. The relative liabilities of each SONGS Participant are detailed in the DCE. Sufficient funds (based on balances and earnings) are projected to be available to complete the planned decommissioning activities.

As discussed in Section IV of the IFMP the CPUC will establish processes for oversight of withdrawals from the nuclear decommissioning trusts by SCE and SDG&E, and designate the specific amounts from the existing fund balances that are available for the three decommissioning cost categories: (1) spent fuel management; (2) site restoration; and (3) license termination. As entities not subject to CPUC jurisdiction, Anaheim and Riverside are not required to obtain CPUC authorization with respect to withdrawals from their respective Nuclear Decommissioning Trusts.

IV. ENVIRONMENTAL IMPACTS

As shown in this section, SCE has evaluated the environmental impacts of decommissioning SONGS Units 2 and 3 to determine if anticipated impacts are bounded by existing environmental impact statements, the NRC's generic decommissioning EIS (GEIS, Reference 6) and the SONGS Final Environmental Statement (FES, Reference 8). As noted in Regulatory Guide 1.185, C.4 "the PSDAR does not need to include the analysis of the specific environmental impacts associated with decommissioning activities....the licensee must ensure that supporting documentation and analyses are available at the reactor site for inspection by the NRC Staff." Such detailed documentation and analyses are contained in the Environmental Impact Evaluation (EIE) and its supporting references as noted in the Developmental References. They are available on-site for NRC review as well as on the SONGScommunity.com website and are summarized below. Both the detailed documentation and analyses and the following summary were reviewed by internal and external subject matter experts, independent third-party reviewers and the Community Engagement Panel discussed in the Introduction to this report.

In the GEIS, the NRC reviewed the environmental impacts resulting from decommissioning on a generic basis, and identified a need for site-specific analyses for: (1) threatened and endangered species and (2) environmental justice. In addition, site-specific analyses are called for whenever decommissioning plans indicate that activities will impact areas beyond the operational portions of a facility. The SONGS FES addresses decommissioning, but does not establish bounding environmental impacts specific to decommissioning. However, the FES' discussion of impacts for construction does describe bounding impacts as it related to potential dewatering during decommissioning.

The NRC, in its GEIS, identified additional activities that are performed in conjunction with decommissioning. These activities are regulated by the NRC but any associated environmental impacts are addressed directly in conjunction with those regulated activities. These activities include those related to the decision to permanently cease operations, irradiated fuel management in wet or dry storage, irradiated fuel transport and disposal, and the treatment, and/or disposal of LLRW. SCE similarly excluded consideration of such activities to remain consistent with the NRC's approach.

A. Environmental Impacts of Decommissioning SONGS

SCE assessed the potential for environmental impacts to each resource area from decommissioning activities using the evaluations in the GEIS as a guide. Like the GEIS, the analysis assumed that operational mitigation measures will be continued and did not rely on the implementation of new mitigation measures unless specified. Releases to the environment, waste volumes, and other environmental interfaces were estimated in the DCE or other sources referenced in the EIE. This information was then assessed against the potential for impact and the existing environmental conditions at SONGS to identify impacts and determine whether the GEIS and FES remain bounding. The GEIS categorizes significance levels as SMALL (impacts are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource or do not exceed permissible levels in the NRC's regulations), MODERATE (impacts are sufficient to alter noticeably, but not to destabilize, important attributes of the resource), or LARGE (impacts are clearly noticeable, and are sufficient to destabilize important attributes of the resource).

To support the evaluation, SCE established the baseline environmental and societal conditions through site-specific information as well as vicinity and regional data available from local, state, and federal agencies. In addition, the evaluation considered the existing permit conditions and limitations for water and air permits and NRC regulatory requirements, including those focused on occupational dose, public dose, radiological effluents, and LLRW shipping. Federal, state, and local requirements for non-radiological interfaces with the environment were considered. These include regulatory limits on water withdrawal and discharges, air emissions including fugitive dust, noise levels, and protection of avian, terrestrial and aquatic species, protection of cultural resources, disposal of non-radiological waste, and worker health protection.

SCE reviewed the planned decommissioning activities for SONGS Units 2 and 3 and compared these to the decommissioning activities that NRC evaluated in the GEIS. The planned activities fall within the activities that NRC evaluated. While each decommissioning site is unique, no unusual site-specific features or aspects of the planned SONGS Units 2 and 3 decommissioning have been identified. Furthermore, the practices used to accomplish the individual decommissioning tasks will employ conventional methods.

SCE's review confirmed that the anticipated or potential impacts are within the bounds of the generic impacts that the NRC described in the GEIS. There are no applicable bounding impacts for threatened and endangered species and environmental justice. The site-specific analyses determined that the planned SONGS Units 2 and 3 decommissioning activities are not likely to result in significant impacts to threatened and endangered species nor have disproportionate impacts on minority or low-income populations. The following discussions summarize the full Environmental Impact Evaluation focusing on the reasons for reaching this conclusion.

1. Onsite/Offsite Land Use

SCE's decommissioning plans include building demolition and removal within the 84-acre easement hosting the SONGS Units 2 and 3 reactor units and infrastructure. SCE plans to seek an easement lease amendment from the CSLC for the partial removal or abandonment in-place of the SONGS Units 2 and 3 intake and discharge conduits. In addition, the existing rail spur serving the site will most likely be used in support of waste shipments.

The SONGS site is currently used for utility-related industrial land uses, with the majority of the property within the easement having been previously disturbed during construction and operation of the plant. The coastal bluff areas located in the northwest and southeast portions of the 84-acre easement have remained undeveloped in compliance with the California Coastal Commission (CCC) Guarantee Agreement, in which SCE provided assurance that they will be protected and that they will remain in their natural state. It is anticipated that there will be no changes in onsite land use patterns during decommissioning.

The GEIS assessment for land use concluded that the impact would be SMALL for sites that did not require additional land for decommissioning activities. If additional land was needed the impact should be determined on a site-specific basis. Because no additional lands are needed SONGS onsite land use impacts during decommissioning are bounded by the GEIS and are categorized as SMALL.

2. Water Use

SONGS Units 2 and 3 acquires potable water through the South Coast Water District, a member agency of the Municipal Water District of Orange County (MWDOC). The site historically used water from the Pacific Ocean for its condenser cooling and service water cooling functions. The operational demand for cooling and makeup water has been significantly reduced since SONGS Units 2 and 3 permanently ceased operation. Condenser cooling is not required when the plant is not operating and service water cooling demands have been reduced to the extent possible (primarily spent fuel pool cooling). The normal operation demand was previously over 830,000 gpm per unit and is currently approximately 34,000 gpm total for both Units 2 and 3. During the decommissioning period, SONGS intends to continue to reduce cooling water demands with the intent to eliminate such demands on the Pacific Ocean as soon as possible.

The GEIS assessment of water use concluded the impact on water use would be SMALL if the decommissioning did not significantly increase water use. Water uses for decommissioning include staff usage, fuel storage (replacement of evaporative losses, etc.), fuel transfer (washing down transport casks), large component segmentation generally performed underwater, decontamination and dismantlement (if water-jet or similar techniques are employed). Water uses are anticipated to be significantly less than during operation. Thus water use impacts during decommissioning are bounded by the GEIS.

3. Water Quality – Non-Radiological

Major activities that could impact surface and groundwater quality during decommissioning include site excavation, stabilization, decontamination, dismantlement, and dewatering. These activities present the potential of spills, migration of low concentrations of radioactivity or hazardous substances not previously identified, and leaching from subsurface structures.

As discussed in Section 2 above, the site uses water from the Pacific Ocean for its condenser cooling and service water cooling functions. Water used for cooling functions is discharged through the ocean outfalls for Units 2 and 3, and is currently regulated under individual National Pollutant Discharge Elimination System (NPDES) Permits from the San Diego Regional Water Quality Control Board (SDRWQCB). The individual unit permits may be merged into a single NPDES Permit which would also continue to address groundwater dewatering discharges, and multiple minor waste stream discharges from within SONGS Units 2 and 3.

Storm water discharge is regulated and controlled through an industrial storm water general permit issued by the SDRWQCB. This permit requires SONGS to develop, maintain, and implement a storm water pollution prevention plan (SWPPP) for the facility. Storm water-related monitoring plans and reporting protocols will be updated as necessary to address permit requirements and decommissioning activities.

A previous SCE study concluded that no drinking water pathway exists for exposure from SONGS operations. Furthermore, the nearest drinking water well is more than one mile inland. Previous studies indicate that even under extreme pumping conditions, a seaward gradient will exist. Therefore, any dewatering is not expected to result in saltwater intrusion.

The GEIS assessment of water quality impacts concluded the impacts would be SMALL based on compliance with regulatory requirements including the appropriate application of best management practices (BMPs) and controls. SCE will follow standard storm water BMPs as documented in the current Industrial SWPPP and implement the current SPCC plan to minimize the chance of both groundwater and surface water contamination. In the event an unknown area of hazardous substances is identified during sub-grade soil excavation and structures removal, the area will be assessed and controlled. Due to the implementation of BMPs and compliance with permits, the potential impacts of decommissioning on nonradioactive aspects of water quality for both surface water and groundwater are bounded by those addressed in the GEIS.

4. Air Quality

Emission sources in San Diego County are primarily mobile sources (vehicular traffic) and ambient air quality standards are frequently exceeded for ozone and particulate matter due to routine vehicular traffic. Relatively minor stationary sources, such as those planned for use at SONGS, are projected to be a fraction of the average daily emissions permitted by the San Diego Air Pollution Control District (SDAPCD).

The most likely impact of decommissioning on air quality will be due to dust. SCE will employ standard dust control measures during decommissioning in accordance with SDAPCD dust abatement and visible emissions requirements. Air emissions due to commuting workers will actually be less since the work force during all phases of decommissioning is expected to be smaller than the peak number of workers used for construction or refueling outages.

The NRC's GEIS generically determined air quality impacts associated with decommissioning to be SMALL due to the sufficiency of current and commonly used control and mitigation measures. SCE will implement standard mitigation measures to reduce emissions during decommissioning per the requirements of the SDAPCD. Therefore, air quality impacts related to decommissioning of SONGS Units 2 and 3 are bounded by the GEIS.

5. Aquatic Ecology

SCE has characterized the aquatic environment in the vicinity of the SONGS Units 2 and 3 intake and discharge conduits prior to construction of and during the operation of SONGS. There are a variety of habitat types surrounding the SONGS Units 2 and 3 conduits. The marine habitat offshore of SONGS consists of a mixture of sand, cobble, and isolated areas of exposed rock. The area of high marine productivity in the immediate vicinity of the plant site is the shallow sub-tidal zone, approximately 1,300 feet north of SONGS. This area supports a biological community dominated by surfgrass, and feather boa kelp. The San Onofre kelp bed is approximately 650 feet south of SONGS Unit 2 diffusers in a water depth of 40 to 50 feet. The benthic fish community is generally dominated by queenfish; northern anchovy; white croaker and speckled sanddab.

Since ceasing permanent operations at SONGS Units 2 and 3, SCE has reduced ocean water withdrawals and discharge by approximately 96 percent from normal operating flows. The remaining flow is primarily associated with cooling spent fuel while in wet storage. As noted earlier, spent fuel storage and cooling are existing operational activities and is not re-addressed as part of this environmental review. SONGS will continue to comply with its applicable regulatory and permit requirements associated with reduction of impingement and entrainment impacts due to water withdrawals.

SCE sought and obtained an amendment to the CSLC easement lease for Unit 1 which allowed the intake and discharge conduits to remain buried beneath the seafloor. SCE is planning to pursue similar amendments for SONGS Units 2 and 3. If the CSLC approves the amendment to allow SCE to abandon the conduits in place, the environmental impacts are projected to be SMALL with the application of appropriate mitigation measures enumerated in the lease amendment. Complete removal of the conduits, as is currently required by the CSLC lease, is anticipated to have significant adverse environmental impacts. The detailed Environmental Impact Evaluation assumes the CSLC lease is amended. If the CSLC lease is not amended, the environmental impacts from complete removal of the conduits will have to be further addressed. If necessary, SCE will update the PSDAR and initiate other regulatory interactions to address the results of this analysis.

There are no surface water bodies on the SONGS site, but the Pacific Ocean borders the site and vernal pools are found northwest of SONGS Parking Lot 4. Decommissioning activities for SONGS Units 2 and 3 will include the application of common BMPs, compliance with the SONGS storm water permit, and implementation of the storm water pollution prevention plan, which will be updated as necessary to address decommissioning activities. These measures will ensure that any changes in surface water quality will be non-detectable and non-destabilizing.

The NRC determined aquatic ecology impacts to be SMALL when only aquatic resources within a plant's operational areas are disturbed. The potential impacts to aquatic ecology are bounded by the GEIS and no additional mitigation measures beyond those anticipated as conditions of the CSLC easement lease amendment are likely to be warranted.

6. Terrestrial Ecology

The SONGS site is almost entirely paved and developed. However, there are small strips of intact scrub-shrub habitat and ornamental vegetation surrounding the parking lots and between developed areas of the plant. The SONGS site also has undeveloped coastal bluffs that are explicitly protected from development under the CCC Guarantee Agreement. The onsite coastal bluff in the northwest area of SONGS is sparsely vegetated, California desert-thorn scrub habitat. The larger onsite coastal bluff in the southeast area of SONGS is approximately 5 acres and is dominated by California sagebrush scrub vegetation. This bluff is contiguous with the San Onofre bluffs of the San Onofre State Beach, which supports two native vegetation associations (Diegan coastal sage scrub and southern foredune) and small areas of disturbed coastal sage scrub habitat. The coastal bluff areas provide opportunity to support wildlife; however, the light, noise, and frequent human presence due to the proximity of SONGS and the state beach result in a more disturbed habitat than will otherwise be optimal for many species. Avian species are highly mobile and not subject to barriers such as roads and developed areas and may utilize scrub habitat or open surfaces for nesting and temporary perching.

The decommissioning activities will include noise and dust from dismantlement of facilities and heavy equipment traffic, surface runoff, emissions from construction equipment, and the potential for bird interactions with crane booms or other construction equipment. These activities will be conducted in compliance with air quality and noise regulations, and SCE will use avoidance and minimization measures to address potential impacts. Compliance with applicable regulations, air permits, noise restrictions along with the temporary nature of the various decommissioning tasks (e.g., use of cranes) will minimize the impacts to terrestrial species as well as the human community. Decommissioning plans do not currently include the use of explosives, which could disturb terrestrial resources. Should those plans change the environmental impacts will be reevaluated.

SONGS is located within the coastal zone and prior to active dismantlement, SCE will file a coastal development permit application with the CCC. As part of this permitting process, decommissioning activities within the coastal sage habitat areas, coastal bluff, and beach areas will be reviewed by the CCC and United States Fish and Wildlife Service (USFWS) for potential environmental impacts including the federally listed coastal California gnatcatcher and other protected species and species of concern. Any necessary mitigation measures will be included as conditions of the CCC permit. The removal of various current SONGS features along the perimeter of the developed plant adjacent to and within the natural area could potentially require ground disturbance in unpaved areas. Appropriate avoidance and minimization measures will be used to minimize the impact of any ground disturbance.

With the implementation of appropriate avoidance and minimization measures and compliance with permit conditions as discussed above, decommissioning of SONGS Units 2 and 3 is not anticipated to adversely impact any terrestrial resources and the impacts will be bounded by the GEIS which determined them to be SMALL.

7. Threatened and Endangered Species

Seventeen federally or state protected species utilize habitat within the vicinity (a 6-mile radius) of the SONGS site. These species are listed in Table IV-1, along with their protection status and critical habitat designation. Other species of concern are also addressed in the detailed Environmental Impact Evaluation including both the critically imperiled and imperiled species listed in the California Natural Diversity Data Base and located within one mile of the site but are not otherwise addressed here.

The list includes four federally listed marine turtles. However, none is considered a full-time resident in the vicinity of SONGS and they only migrate through the vicinity. Another federally listed marine reptile, the Hawksbill turtle, sporadically nests in the southern part of the Baja peninsula and foraging sub-adults and juveniles have been sighted along the California coast. Given the SMALL impacts on water use and water quality during decommissioning and the ability of these species to migrate away from the site, these species should not be adversely impacted by decommissioning.

The decommissioning activities will indirectly impact protected species through dust generation from structure demolition, noise from dismantlement of facilities and heavy equipment traffic, surface runoff, emissions from construction equipment, and potential bird interactions with crane booms or other construction equipment. The decommissioning activities will be conducted in compliance with air quality and noise regulations and SCE will use appropriate avoidance and minimization measures. Compliance with applicable regulations, air permits, and noise restrictions related to daylight working along with the temporary nature of the various decommissioning tasks will minimize any such impacts. Decommissioning plans do not currently include the use of explosives, which could disturb protected species. These measures will minimize impacts to protected terrestrial species that inhabit or visit the SONGS site.

Although rare on the site, there has historically been one protected plant species in the vicinity of SONGS, the thread-leaved brodiaea. Decommissioning activities will generally be confined to previously disturbed areas (e.g., paved, high traffic areas). Otherwise, the SCE environmental staff will conduct an environmental assessment per established procedures. The procedure requires an assessment prior to any land disturbance, soil addition, digging, grading, or trenching outside the paved and concreted areas; maintenance activities near surface water, and wetlands and trimming or removal of native plants other than landscape maintenance. Therefore, adverse impacts on protected plant species are not anticipated.

Decommissioning of SONGS Units 2 and 3 is not anticipated to adversely impact any federally or state-listed species. As discussed above, decommissioning activities will generally be limited to previously disturbed areas on-site, near-shore and off-shore. SCE will employ mitigation measures as required by the regulatory agencies to minimize impacts to the environment and protect listed species. In addition, SCE will implement BMPs and conduct assessments as called for in its environmental protection procedure(s), as well as comply with permit and regulatory requirements to minimize indirect impacts from noise, air emission, dust, and runoff. Therefore, impacts to threatened or endangered species from decommissioning are expected to be SMALL.

Table IV-1

Threatened and Endangered Species Identified within the Vicinity of SONGS

Scientific Name	Common Name	State Status[a]	Federal Status[b]	Critical Habitat within Vicinity
AMPHIBIAN SPECIES				
Anaxyrus californicus	Arroyo toad	—	FE	yes[c]
AVIAN SPECIES				
Charadrius alexandrinus nivosus	Western snowy plover	—	FT	yes[c]
Empidonax traillii extimus	Southwestern willow flycatcher	SE	FE	No
Haliaeetus leucocephalus	Bald eagle	SE	delisted	No
Polioptilacalifornica californica	Coastal California gnatcatcher	—	FT	yes[c]
Vireo bellii pusillus	Least Bell's vireo	SE	FE	yes[c]
FISH SPECIES				
Orcorhynchus mykiss	Steelhead trout	—	FE	yes[c]
INVERTEBRATE SPECIES				
Branchinecta sandiegoensis	San Diego fairy shrimp	—	FE	yes[c]
Streptocephalus woottoni	Riverside fairy shrimp	—	FE	No
MAMMALIAN SPECIES				

Scientific Name	Common Name	State Status[a]	Federal Status[b]	Critical Habitat within Vicinity
Dipodomys stephensi	Stephen's kangaroo rat	ST	FE	No
Perognathus longimembris pacificus	Pacific pocket mouse	—	FE	No
PLANT SPECIES				
Brodiaea filifolia	Thread-leafed brodiaea	SE	FT	yes[c]
REPTILIAN SPECIES				
Caretta caretta	Loggerhead sea turtle	—	FE	No
Chelonia mydas	Green sea turtle	—	FT	No
Dermochelys coriacea	Leatherback sea turtle	—	FE	No
Lepidochelys olivacea	Olive Ridley's turtle	—	FT	No

a. SE = state endangered; ST = state threatened;
b. FE = federally endangered; FT = federally threatened
c. The USFWS has critical habitat delineated within the SONGS site vicinity. However, the designation explicitly excludes Camp Pendleton and thus the SONGS site. Further, the term vicinity includes any area within a 6 mile radius of the site and is not limited to the site itself.

8. Radiological

Decommissioning activities have the potential to contribute to radiological impacts. SONGS Units 2 and 3 may continue to have limited gaseous and liquid radiological effluents until most of the decommissioning activities are complete and the irradiated fuel is transferred to dry storage. SCE is evaluating options to significantly reduce, if not eliminate, routine liquid effluents through the use of self-contained clean-up systems for ongoing systems and activities.

Occupational Dose
The GEIS estimates for the reference pressurized water reactor (PWR) dose is 1,215 person-rem for DECON. In the most recent supplement to the GEIS, the NRC reviewed data available from decommissioning experience subsequent to their initial review (in 1988). Because the range of cumulative occupational doses reported by reactors undergoing decommissioning was similar to the range of estimates for reference plants presented in the 1988 revision of the GEIS, the NRC did not update its estimates for occupational dose.

SCE expects the SONGS dose to be bounded by the referenced PWR dose since: a number of major components which often contribute to area dose rates are relatively new (steam generators and reactor vessel head); and, as a result of SONGS operational dose reduction efforts (i.e., zinc injection). A more detailed estimate will be developed to support evaluation of decontamination scope.

The regulatory standard for worker exposure is a dose limit per worker rather than a cumulative dose. Detailed occupational dose estimates will be performed as part of the work planning process. Such planning will address means to reduce occupational dose where appropriate. SCE remains committed to keeping dose to plant personnel 'As Low as Reasonably Achievable' (ALARA). The activities that have potential radiological impacts will be conducted in a manner to keep doses ALARA and well within regulatory limits.

Public Dose
The NRC generically concluded that reactors undergoing decommissioning could reasonably be expected to have emissions and public doses comparable to or substantially less than the levels experienced during normal operation of those facilities. The Radiological Environmental Monitoring Program (REMP) results demonstrate that the radiological environmental impact of the operation of SONGS Units 2 and 3, and the resulting dose to a member of the general public, is negligible.

SCE will continue to monitor effluents, comply with all applicable regulatory limits, and continue its REMP to assess the impacts to the environment from these effluents.

In summary, SCE estimates that SONGS Units 2 and 3 decommissioning activities will result in occupational and public doses within NRC estimates. Therefore, SONGS' radiological impacts during decommissioning are bounded by the GEIS which determined the radiological impacts to be SMALL.

9. Radiological Accidents

Many activities that occur during decommissioning are similar to activities that commonly take place during maintenance outages at operating plants such as decontamination and equipment removal. Accidents that could occur during these activities may result in injury and local contamination. However, they are not likely to result in contamination off-site.

The limiting design basis accidents (DBAs) applicable to a decommissioning plant are those involving the spent fuel pool. All DBAs and severe accidents involving the reactor are precluded as a result of transfer of spent fuel from the reactor vessels to the pools and ultimately the ISFSI. The environmental impacts of DBAs, including those associated with the spent fuel pool, were evaluated during the initial licensing process and documented in the FES. Furthermore, the impacts of these events are less than previously evaluated due to the time since the fuel was most recently irradiated.

The NRC's GEIS analysis relies in part on the waste confidence rule regarding spent nuclear fuel related severe accidents. The waste confidence GEIS (Reference 9) continues to consider severe accidents involving the spent fuel pool to be a SMALL risk.

Thus, SONGS' radiological accident impacts during decommissioning are bounded by NRC's Decommissioning GEIS which determined such risks to be SMALL.

10. Occupational Issues

SONGS currently has an industrial safety program and safety personnel to promote safe work practices and respond to occupational injuries and illnesses. Equivalent safety programs will continue to be in effect during decommissioning activities.

SONGS has an average occupational injury rate well below that of the heavy construction industry sector and consistent with the power generation and nuclear power industry. Decommissioning activities will be conducted in a manner reflecting personnel safety as a critical element. Therefore, SONGS occupational safety impacts are considered to be bounded by the GEIS which generically determined occupational safety impacts to be SMALL.

11. Cost

Decommissioning costs for SONGS are discussed in the DCE being submitted concurrently.

12. Socioeconomics

The primary socioeconomic impacts of decommissioning are related to staffing changes and decreasing tax revenues. Impacts related to the decision to permanently cease operations are outside the scope of this evaluation. SCE determined the staff reduction impacts from the decision to be minimal. The staff reductions represent 0.04 percent and 0.03 percent of San Diego County's and Orange County's workforces, respectively. Any impacts will be deferred somewhat due to the employment of temporary staff necessary to accomplish the various decommissioning activities.

Similarly, SONGS is located in San Diego County and its property assessment is a relatively small portion of San Diego County's total tax collections. Historically, SONGS' contribution to the county property tax collections has been consistently less than 1 percent. SONGS' tax obligations will be reduced due to decommissioning, but SCE and SONGS will continue to contribute to county tax revenues.

It is anticipated that there will be limited or no changes or impacts to the local community and socioeconomic conditions and less impact than would be expected generically where other nuclear facilities have a higher relative impact on the job market or tax base. Thus, SONGS' impacts are bounded by those considered in the GEIS in which the NRC generically determined socioeconomic impacts to be SMALL.

13. Environmental Justice

Decommissioning activities that may potentially affect identified minority and low-income populations include those related to staffing changes and offsite transportation. However, the assessment of environmental justice also considered other specific issues (e.g., water use, air quality). SCE has determined that no significant offsite impacts will be created by SONGS 2 & 3 decommissioning activities. As generic NRC guidance recognizes, if no significant offsite impacts occur in connection with the proposed action, then no member of the public will be substantially affected. Therefore, there can be no disproportionately high and adverse impacts on members of the public, including minority and low-income populations. In addition, staffing is not anticipated to be an impact due to the large population and robust job market in the area (see Section 12 above).

The environmental justice evaluations utilize a 50-mile radius around the plant as the potentially impacted area. To complete this evaluation, the 2006–2010 low-income data and 2010 minority population data for California were obtained from the United States Census Bureau (USCB) and processed using ESRI ArcGIS 10.1 software. All census data were downloaded in USCB block group level geography so that the environmental justice evaluations were consistent between the minority and low-income analyses. The evaluations and results are detailed in the EIE which concluded there were no disproportionate impacts.

In its GEIS, the NRC concluded that adverse environmental justice impacts and associated significance of the impacts must be determined on a site-specific basis. Unlike many nuclear sites, SONGS is located in and near relatively large communities with significant other commercial and industrial activities. Thus, the impact of SONGS shutdown is less severe than may otherwise be the case. Further, SCE has determined that no significant offsite environmental impacts will be created by SONGS Units 2 and 3 decommissioning activities. Since no significant offsite impacts occur in connection with the proposed action, no member of the public will be substantially affected. Therefore, it is unlikely for there to be a disproportionately high and adverse impact or effects on specific groups or members of the public, including minority and low-income populations, resulting from the decommissioning of SONGS Units 2 and 3.

14. Cultural Historic and Archeological Resources

No prehistoric or historic archaeological sites or historic sites eligible for listing or listed on the National Register of Historic Places, California Register of Historical Resources, or San Diego County Local Register of Historical Resources are located within the SONGS site lease easement and no traditional cultural properties are known to be present. Two prehistoric archaeological sites and three historic archaeological sites were identified within 0.5 miles of SONGS Units 2 and 3.

All of these areas are outside the operational/decommissioning site. In its GEIS, the NRC concluded that for plants where the disturbance of lands beyond the operational areas is not anticipated, the impacts on cultural, historic, and archeological resources will be SMALL. Since decommissioning activities are confined to the SONGS site, no adverse impacts are anticipated. SONGS' impacts on cultural, historical, and archeological resources during decommissioning fall well within the bounds established by the NRC in the GEIS.

15. Aesthetic Issues

In its GEIS, the NRC stated that removal of structures is generally considered to be a beneficial aesthetic impact and drew the generic conclusion that for all plants, the potential impacts from decommissioning on aesthetics are SMALL and that any mitigation measures are not likely to be beneficial enough to be warranted. Similarly, the aesthetic impact of final result of decommissioning SONGS Units 2 and 3 will be less than that of the current aesthetic impact of the plant. During dismantlement, any adverse visual intrusion will be temporary and will ultimately serve to reduce the aesthetic impact of the site. Therefore, the impacts of SONGS on aesthetic resources during decommissioning are bounded by the GEIS.

16. Noise

Offsite noise sources that affect the ambient noise environment in the vicinity of SONGS include Interstate-5, the San Diego Northern Railroad, and military operations. During the decommissioning process, the sounds that might be heard at offsite locations include noise from construction vehicles and tools. The timing of noise impacts and the duration or intensity will vary. The nearest sensitive receptors to SONGS are recreational users of San Onofre State Beach where the ambient noise environment can exceed 70 dBA. The more intense decommissioning activities will occur 400 ft or more from the beach access public walkway in front of the SONGS sea wall.

Due to the relatively high ambient noise levels surrounding SONGS, decommissioning activities are not expected to produce noise levels that could impact the activities of humans or threatened and endangered species. In addition, SCE will comply with the local noise regulations for construction sites, which restrict the average sound level at the property boundary to 75 dBA between 7 a.m. and 7 p.m., and any additional agency permit requirements including any lower allowed limits during evenings and overnight. Therefore, noise impacts during decommissioning of SONGS Units 2 and 3 are bounded by the previously issued GEIS, which generically determined the noise impacts associated with decommissioning to be SMALL.

17. Transportation

Transportation impacts are dependent on the number of shipments to and from the facility, the type of shipments, the distance that material is shipped, and the number of workers commuting to and from the site.

Transportation infrastructure within the vicinity of SONGS includes one major north- and south-bound freeway, I-5, an assortment of local and county roads, passenger and cargo rail service (part of the Los Angeles–San Diego corridor), and an existing rail spur serving the SONGS site. The 2011 average annual daily traffic (AADT) count for this portion of I-5 was 132,000 vehicles.

SCE compared the assumptions and analysis inputs used for NRC's analysis with waste volumes estimated for SONGS Units 2 and 3 decommissioning, transport mode, and disposal facility options. Due to the availability of the rail line, a substantial portion of the shipments will likely use that mode of transportation. The NRC indicates use of rail reduces radiological impacts by more than a factor of 10 over truck shipments. Furthermore, disposal facilities available for SONGS Units 2 and 3 radiological wastes are less than half the distance assumed by NRC in its analysis. Therefore the generic impacts bound those associated with SONGS Units 2 and 3.

Furthermore, SCE will comply with all applicable NRC and U.S. Department of Transportation (DOT) regulations, including Federal Railroad Administration regulations and requirements, and will use approved packaging and shipping containers for waste shipment. SCE will also comply with State of California regulations enforced by Caltrans and the California Highway Patrol. The NRC has generically concluded that the radiological impacts of transporting radiological waste from decommissioning will be SMALL and those for SONGS Units 2 and 3 are bounded by the GEIS.

SCE estimated a peak of approximately 560 workers during decommissioning and the vehicular traffic due to commuting will likely exceed the 200 per peak hour threshold, prompting review for potential to impact traffic congestion as required under the local congestion management plan. SCE estimated peak truck traffic due to waste shipments to be approximately 150 per day. The decommissioning traffic associated with SONGS is considered negligible compared to existing traffic volumes and will not be expected to significantly alter congestion on roadways. In addition, this amount of traffic is not expected to significantly deteriorate roadways; therefore the GEIS is bounding and the non-radiological transportation impacts of decommissioning are SMALL.

Offshore activities to remove vertical risers on the intake and discharge conduits will increase marine vessel traffic in the area. It is expected that these activities will not cause either a navigational safety hazard or a substantial delay in the normal movements of commercial or recreational vessels. The environmental impacts review for the Unit 1 conduit disposition indicated that impacts to recreational and commercial transportation will be insignificant.

18. Irreversible and Irretrievable Commitment of Resources

SONGS Units 2 and 3 decommissioning will involve dismantlement and removal of structures and restoration of the property to a state for unrestricted release per NRC regulations in accordance with the criteria for license termination in 10 CFR 20, Subpart E. Furthermore, the property will be returned to the U.S. Navy under negotiated terms of the easement. The activities necessary to decommission SONGS Units 2 and 3 involve a minor irretrievable commitment of consumable materials (including materials for decontamination, solvents, industrial gases, tools, fuel, etc.). The irreversible commitment of such resources is not unique and is bounded by those considered by the NRC in the GEIS which concluded consumption to be minor.

Waste from decommissioning of SONGS Units 2 and 3 will consume space at waste facilities. California has multiple facilities permitted for the storage, treatment, and disposal of hazardous and universal waste. The nonradioactive waste is assumed to be shipped to an out-of-state landfill due to the moratorium on disposal of decommissioned materials at California nonhazardous landfills. The decommissioning of SONGS Units 2 and 3 will result in minor irretrievable or irreversible commitment of resources bounded by the GEIS in which the NRC determined will be SMALL impacts.

B. Environmental Impacts of License Termination – NUREG-1496

The License Termination Plan (LTP) has not yet been developed. As noted earlier, it is required to be submitted at least two years prior to the proposed termination date. In general, the LTP outlines the basis for an administrative/legal activity. No physical work beyond that already addressed is anticipated. Thus, there are no environmental impacts beyond those already addressed that need to be addressed at this point in the process.

C. Discussion of Decommissioning in the FES

Applicable portions of the FES were addressed as noted in each of the topics previously summarized.

D. Additional Considerations

SCE has not identified any unique considerations that need to be further addressed. The previous topic summaries address a sufficiently wide range of issues.

E. Conclusion

SCE has performed an environmental review to evaluate environmental impacts associated with decommissioning activities, confirming that the anticipated or potential impacts are within the bounds of the generic impacts that NRC described in the GEIS. Further, while there are no applicable bounding impacts for threatened and endangered species and environmental justice discussed in the GEIS, the SONGS Units 2 and 3 decommissioning activities are not anticipated to result in significant impacts to threatened and endangered species or disproportionate impacts on minority or low-income populations. This is principally due to the following:

- Planned activities fall within the activities that the NRC evaluated. There are no unique aspects of the plant or decommissioning techniques that will invalidate previously drawn conclusions.
- Methods to be employed to dismantle and decontaminate the site are standard construction-based techniques fully considered in the GEIS.
- SCE will continue to comply with NRC dose limits and conduct activities in accordance with ALARA principles.
- SCE will continue to comply with the SONGS Offsite Dose Calculation Manual, Radiological Effluent Monitoring Program, and the Ground Water Protection Initiative Program during decommissioning. Each will likely be modified somewhat to reflect changes in site configuration, etc.
- SCE will comply with all applicable NRC and DOT regulations, including Federal Railroad Administration regulations and requirements, and use approved packaging and shipping containers for the shipping of radiological waste. SCE will also comply with State of California regulations enforced by Caltrans and the California Highway Patrol.

- SCE will continue to comply with federal, state, and local requirements for non-radiological interfaces with the environment including limitations on water withdrawal and discharges, air emissions including criteria pollutants and fugitive dust, noise levels, protection of avian, terrestrial and aquatic species, cultural resources, disposal of non-radiological waste, and worker health protection.
- SCE will seek and comply with an amendment to its CSLC easement lease to largely abandon the intake and discharge conduits in place.
- SCE will seek and comply with a coastal development permit from the CCC for decommissioning.

V. REFERENCES

A. GENERAL DEVELOPMENTAL REFERENCES

1. NRC Regulatory Guide 1.185, Revision 1, June 2013, Standard Format and Content Guide for Post-Shutdown Decommissioning Activities Report
2. Energy*Solutions* Document No. 164001, "2014 Decommissioning Cost Analysis of the San Onofre Nuclear Generating Station Units 2 and 3"
3. Enercon Technical Data Record No. SONGS002, "SONGS Units 2 and 3 Environmental Impact Evaluation"

B. SPECIFIC REFERENCES IN TEXT

1. Letter from Thomas J. Palmisano (SCE) to the U. S. Nuclear Regulatory Commission dated February 13, 2014; Subject: Access to Nuclear Decommissioning Trust Funds, San Onofre Nuclear Station, Units 2 and 3.
2. Letter from Richard C. Brabec (SCE) to the U. S. Nuclear Regulatory Commission dated March 31, 2014; Subject: Decommissioning Funding Status Report, San Onofre Nuclear Generating Station Units 2 and 3
3. Letter from P. T. Dietrich (SCE) to the U. S. Nuclear Regulatory Commission dated June 12, 2013; Subject: Certification of Permanent Cessation of Power Operations San Onofre Nuclear Generating Station, Units 2 and 3
4. Letter from P. T. Dietrich (SCE) to the U. S. Nuclear Regulatory Commission dated June 28, 2013; Subject: Permanent Removal of Fuel from the Reactor Vessel, San Onofre Nuclear Generating Station Unit 3
5. Letter from P. T. Dietrich (SCE) to the U. S. Nuclear Regulatory Commission dated July 22, 2013; Subject: Permanent Removal of Fuel from the Reactor Vessel, San Onofre Nuclear Generating Station Unit 2
6. U. S. Nuclear Regulatory Commission; NUREG-0586, "Final Generic Environmental Impact Statement (GEIS) on Decommissioning Nuclear Facilities" (November 2002)
7. AIF/NESP-036, "A Guideline for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates"
8. U.S. Nuclear Regulatory Commission, NUREG-0490, "Final Environmental Statement related to the operation of San Onofre Nuclear Generating Station, Units 2 and 3" (April 1981)
9. U. S. Nuclear Regulatory Commission, NUREG-2157, "Waste Confidence Generic Environmental Impact Statement, Report for Comment" (August 2014)
10. U. S. Nuclear Regulatory Commission, NUREG-1496, Volume 1, "Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities" (July 1997)
11. NEI 07-07, "Industry Groundwater Protection Initiative, Final Guidance Document," in August 2007