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| Filed: | 6/11/15 |
| 180th Day: | 12/8/15 |
| Staff: | J. Street - SF |
| Staff Report: | 9/25/15 |
| Hearing Date: | 10/6/15 |
| Commission Vote: | 11 – 0 |

## ADOPTED FINDINGS: REGULAR PERMIT

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| **Application No.:** | **9-15-0228** |
| **Applicant:** | **Southern California Edison Company** |
| **Location:** | San Onofre Nuclear Generating Station, San Diego County. |
| **Project Description:** | Construct and operate an Independent Spent Fuel Storage Installation (ISFSI) to store spent nuclear fuel from SONGS Units 2 and 3. |
| **Commission Action:** | Approval with conditions. |

## SUMMARY OF STAFF RECOMMENDATION

Southern California Edison Company (SCE) proposes to construct and operate a temporary facility to store spent nuclear fuel produced at the San Onofre Nuclear Generating Station (SONGS), on Camp Pendleton, in northern San Diego County (**Exhibit 1**). The facility, known as an Independent Spent Fuel Storage Installation (ISFSI), would consist mainly of a partially-below grade concrete and fill berm surrounding an array of 75 fuel storage modules, which would contain and protect stainless steel casks filled with spent fuel. The ISFSI would be located within the SONGS North Industrial Area (NIA), the former site of the decommissioned Unit 1 power plant, adjacent to and seaward of an existing ISFSI facility permitted in 2001 (**Exhibit 2**).

SONGS Units 2 and 3 were shut down in 2012, and some 2668 spent fuel assemblies remain in wet storage pools in the Units 2 and 3 fuel handling buildings. This fuel is highly radioactive and

requires secure storage for thousands of years to prevent harm to humans and the environment. Because the existing ISFSI does not have the capacity to hold the remaining spent fuel, a new ISFSI is being proposed in order to provide for the interim storage of the spent fuel until such time as it can be accepted at a federal permanent repository or other off-site interim storage facility. Removing the fuel from the existing wet storage pools would also facilitate the full decommissioning of SONGS Units 2 and 3 and the restoration of the site. The ISFSI is proposed to be installed beginning in 2016, fully loaded by 2019, and operated until 2049, when SCE assumes that the federal Department of Energy will have taken custody of all of the SONGS spent fuel. The facility would then be decommissioned, and the site restored, by 2051.

At present, there are no feasible off-site alternatives to the proposed project. No permanent fuel repository or other interim storage facility exists, and there are no near-term prospects for such a facility. SCE evaluated several on-site locations and ISFSI designs, and found the proposed project to be preferable in terms of site suitability and geologic stability, security, and cost, among other considerations. However, additional potentially superior on-site locations will become available for consideration upon completion of Units 2 and 3 decommissioning in 2032.

Within SCE's proposed 35-year timeframe, the siting and design of the ISFSI would be sufficient to assure stability and structural integrity against geologic hazards, including seismic ground shaking, slope failure, tsunamis and flooding, and coastal erosion, without requiring shoreline protection. Operation of the ISFSI would not involve the discharge of contaminants into coastal waters, and the implementation of construction BMPs designed to control runoff and prevent sediment and debris from entering the storm drain system would protect water quality and marine resources. Because of its location within the previously-developed SONGS site, the ISFSI would not interfere with coastal access and recreation within the proposed project life and would not significantly degrade visual resources so long as the other SONGS facilities remain in place.

Crucially, however, it remains uncertain whether it will be possible for SCE to remove the ISFSI as planned, in 2051. In the event that no permanent repository or other offsite interim storage facility emerges, if the shipment of SONGS spent fuel to an off-site location is otherwise delayed, or if the steel fuel storage casks proposed for use in the ISFSI (which is certified by the Nuclear Regulatory Commission for a 20-year period of use) degraded to the point of becoming unsafe to transport, the proposed ISFSI could be required beyond 2051, possibly for many decades. The ISFSI would eventually be exposed to coastal flooding and erosion hazards beyond its design capacity, or else would require protection by replacing or expanding the existing SONGS shoreline armoring. In either situation, retention of the ISFSI beyond 2051 would have the potential to adversely affect marine and visual resources and coastal access.

In order to address these uncertainties, and assure that the ISFSI facility remains safe from geologic hazards and avoids adverse impacts to coastal resources over the actual life of the project, the Commission adopts **Special Condition 2**, which authorizes the proposed development for a period of twenty years and requires SCE to return for a CDP Amendment to retain, remove or relocate the ISFSI facility, supported by: (i) an alternatives analysis, including locations within the decommissioned Units 2 and 3 area; (ii) assessment of coastal hazards and managed retreat; (iii) information on the physical condition of the fuel storage casks and a

maintenance and monitoring program; and (iv) proposed measures to avoid/minimize visual resource impacts. The Commission also adopts **Special Condition 7**, which requires SCE to submit, as soon as technologically feasible and no later than October 6, 2022, a maintenance and inspection program designed to ensure that the fuel storage casks will remain in a physical condition sufficient to allow both on-site transfer and off-site transport, for the term of the project as authorized under **Special Condition 2**. The Commission also adopts **Special Condition 3**, which requires SCE to agree to not enlarge or replace the existing NIA seawall for purposes of protecting the proposed project from coastal hazards. Additionally, the Commission attaches **Special Conditions 1, 4, 5**, and **6** which require evidence of the Applicant's legal ability to undertake the development as conditioned by the Commission, assumption of risk, liability for attorney's fees, and restrictions on future development.

The Commission finds that, as conditioned, the project would be consistent with the hazards, marine resources, water quality, and view protection policies of the Coastal Act, and therefore the Commission **APPROVES** coastal development permit application 9-15-0228, as conditioned.

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# I. MOTION AND RESOLUTION

**Motion:**

*I move that the Commission **approve** Coastal Development Permit 9-15-0228 subject to conditions set forth in the staff recommendation specified below.*

Staff recommends a **YES** vote on the foregoing motion. Passage of this motion will result in approval of the permit as conditioned and adoption of the following resolution and findings. The motion passes only by affirmative vote of a majority of Commissioners present.

**Resolution:**

*The Commission hereby approves the Coastal Development Permit for the proposed project and adopts the findings set forth below on grounds that the development as conditioned will be in conformity with the policies of Chapter 3 of the Coastal Act. Approval of the permit complies with the California Environmental Quality Act because either 1) feasible mitigation measures and/or alternatives have been incorporated to substantially lessen any significant adverse effects of the development on the environment, or 2) there are no further feasible mitigation measures or alternatives that would substantially lessen any significant adverse impacts of the development on the environment.*

# II. STANDARD CONDITIONS

This permit is granted subject to the following standard conditions:

1. **Notice of Receipt and Acknowledgment**. The permit is not valid and development shall not commence until a copy of the permit, signed by the applicant or authorized agent, acknowledging receipt of the permit and acceptance of the terms and conditions, is returned to the Commission office.

2. **Expiration**. If development has not commenced, the permit will expire two years from the date on which the Commission voted on the application. Development shall be pursued in a diligent manner and completed in a reasonable period of time. Application for extension of the permit must be made prior to the expiration date.

3. **Interpretation**. Any questions of intent of interpretation of any condition will be resolved by the Executive Director or the Commission.

4. **Assignment**. The permit may be assigned to any qualified person, provided assignee files with the Commission an affidavit accepting all terms and conditions of the permit.

5. **Terms and Conditions Run with the Land**. These terms and conditions shall be perpetual, and it is the intention of the Commission and applicant to bind all future owners and possessors of the subject property to the terms and conditions.

## III. SPECIAL CONDITIONS

This permit is granted subject to the following special conditions:

1. **Evidence of Landowner Approval.** PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT, the applicant shall submit to the Executive Director for review and approval evidence of their legal ability to undertake the development as conditioned by the Commission.

2. **Duration of Approval**. This coastal development permit authorizes the approved project for a period of twenty years from the date of approval (i.e., until October 6, 2035). No later than six months prior to the end of this authorization period, the Permittee shall apply for an amendment to this coastal development permit to retain, remove or relocate the ISFSI facility. This application shall be supported by:

   a. An evaluation of current and future coastal hazards based on the best available information;

   b. An analysis examining the merits and feasibility of off-site and on-site alternatives, including potential locations that are landward and/or at a higher elevation within areas made available by the decommissioning of SONGS Units 2 and 3;

   c. A plan for managed retreat, if retention of the ISFSI facility beyond 2051 is contemplated and coastal hazards may affect the site within the timeframe of the amended project;

   d. Evidence that the fuel storage casks will remain in a physical condition sufficient to allow off-site transport, and a description of a maintenance and inspection program designed to ensure that the casks remain transportable for the full life of the amended project.

   e. An evaluation of the effects on visual resources of retaining the project, an analysis of available project alternatives and their implications for coastal visual resources, and proposed mitigation measures to minimize adverse impacts to coastal views.

   Provided the application is received no later than six months prior to the end of the twenty-year period of development authorization, the date of development authorization shall be automatically extended until the time the Commission acts on the application. Failure to obtain an amendment to this coastal development permit by the specified deadline shall constitute a violation of the terms and conditions of this permit.

3. **No Future Shoreline Protective Device(s) to Protect the Proposed Development.**

   A. The existing shoreline protective devices (rock revetment, concrete retaining wall, and steel sheet-pile seawall) located seaward of the North Industrial Area shall not be extended, expanded, enlarged or replaced for purposes of protecting the development approved by this coastal development permit. As used in this condition, replaced is defined to include either an alteration of 50% or more of a shoreline protective device or an alteration of less than 50% or more of a shoreline protective device wherein the

alteration would result in a combined alteration of 50% or more of the structure from its condition on October 6, 2015.

PRIOR TO ISSUANCE OF THE COASTAL DEVELOPMENT PERMIT, the Applicant shall submit evidence of the condition of each of the shoreline protective devices adjoining the North Industrial Area.

B. No new shoreline protective device(s) shall ever be constructed to protect the development approved pursuant to Coastal Development Permit #9-15-0228, including the ISFSI facility, associated ancillary structures and any future improvements, in the event that the development is threatened with damage or destruction from erosion, landslides, waves, storm conditions, flooding, sea level rise or other natural coastal hazards in the future. By acceptance of this permit, the applicant hereby waives, on behalf of itself and all successors and assigns, any rights that may exist under Public Resources Code Section 30235 to augment, enlarge and/or replace any of the existing shoreline protective devices adjoining the NIA in order to protect the development approved by this coastal development permit.

4. **Assumption of Risk, Waiver of Liability and Indemnity.** By acceptance of this permit, the Permittee acknowledges and agrees:

   a. That the site may be subject to hazards from coastal erosion, storm conditions, wave uprush, and tsunami runup;

   b. To assume the risks to the Permittee and the property that is the subject of this permit of injury and damage from such hazards in connection with this permitted development;

   c. To unconditionally waive any claim of damage or liability against the Commission, its officers, agents, and employees for injury or damage from such hazards; and,

   d. To indemnify and hold harmless the Commission, its officers, agents, and employees with respect to the Commission's approval of the project against any and all liability, claims, demands, damages, costs (including costs and fees incurred in defense of such claims), expenses, and amounts paid in settlement arising from any injury or damage due to such hazards.

5. **Restriction on Future Development**. This permit is only for the development described in the project description set forth in this staff report. Pursuant to Title 14 California Code of Regulations (CCR) Section 13253(b)(6), the exemptions otherwise provided in Public Resources Code (PRC) Section 30610(b) shall not apply to the development governed by this permit. Accordingly, any future improvements to this structure shall require an amendment to this permit from Commission, including but not limited to an increase in storage capacity of spent fuel. In addition, a permit amendment shall be required for any repair or maintenance of the authorized development identified as requiring a permit in PRC Section 30610(d) and Title 14 CCR Sections 13252(a)-(b).

6. **Liability for Costs and Attorneys Fees:** SCE shall reimburse the Coastal Commission in full for all Coastal Commission costs and attorneys fees -- including (1) those charged by

the Office of the Attorney General, and (2) any court costs and attorneys fees that the Coastal Commission may be required by a court to pay – that the Coastal Commission incurs in connection with the defense of any action brought by a party other than SCE against the Coastal Commission, its officers, employees, agents, successors and assigns challenging the approval or issuance of this permit, the interpretation and/or enforcement of permit conditions, or any other matter related to this permit. The Coastal Commission retains complete authority to conduct and direct the defense of any such action against the Coastal Commission.

7. **Inspection and Maintenance Program**.

   A. As soon as technologically feasible, and no later than October 6, 2022, the Permittee shall provide for Commission review and approval an inspection and maintenance program designed to ensure that the fuel storage casks will remain in a physical condition sufficient to allow both on-site transfer and off-site transport, for the term of the project as authorized under Special Condition 2 (i.e., until October 6, 2035). The program shall include a description of: (1) the cask inspection, monitoring and maintenance techniques that will be implemented, including prospective non-destructive examination techniques and remote surface inspection tools; (2) what data will be collected and how often the results of the inspection and maintenance program will be reported to the Commission; (3) all available evidence related to the physical condition of the casks and their susceptibility to degradation processes such as stress corrosion cracking, and (4) remediation measures that will be implemented, including the submission of a coastal development permit amendment, if the results of the cask inspection and maintenance do not ensure that the fuel storage casks will remain in a physical condition sufficient to allow on-site transfer and off-site transport for the term of the project as authorized under Special Condition 2.

   B. If the Commission determines that the inspection and maintenance program required by Subsection A is not sufficient to assure cask transportability over the term of the project authorized under Special Condition 2, the Applicant shall submit an amendment to this coastal development permit proposing measures to assure cask transportability.

   C. The Permittee shall implement the inspection and maintenance program approved by the Commission. If the Permittee wishes to propose changes to the program approved by the Commission, it shall submit the proposed changed to the Executive Director. No changes to the approved program shall occur without an amendment to this coastal development permit unless the Executive Director determines no amendment is legally required.

# IV. FINDINGS AND DECLARATIONS

## A. PROJECT DESCRIPTION AND BACKGROUND

### Project Purpose

The primary purpose of the project is to move spent nuclear fuel from its current location in a wet storage facility at Units 2 and 3 of the San Onofre Nuclear Generating Station (SONGS) to a

dry storage system, known as an Independent Spent Fuel Storage Installation (ISFSI). An existing ISFSI at SONGS contains approximately 51 fuel storage modules filled with spent fuel from SONGS Units 1, 2 and 3, with space for 38 more. SCE proposes to construct a new ISFSI, with a capacity of 75 fuel storage modules (**Exhibit 3**), because the existing facility soon will reach full capacity while hundreds of spent fuel assemblies remain in the Units 2 and 3 pools. Only fuel and material generated at the SONGS is proposed to be stored at the ISFSI. Moving the spent fuel out of wet storage would facilitate dismantling the nuclear units at SONGS Units 2 and 3 and would allow their eventual decommissioning.

SCE proposes to store the material at the ISFSI until it can be moved to an off-site permanent repository to be established by the federal government. The ISFSI is proposed to remain in place through the year 2051. SCE plans to begin relocating SONGS spent fuel to the DOE as early as 2030, and to continue this process until 2049, when the last remaining spent fuel storage casks would be removed from the site (SCE 2014b). Based on the federal Department of Energy's (DOE) statutory obligation to accept commercial spent fuel (see below) and SCE's planned schedule for shipping the spent fuel to a federal off-site repository, the final two years of the proposed project term would be devoted to the decommissioning and removal of the ISFSI and site restoration. However, as discussed in more detail below, no such federal permanent repository currently exists, alternative interim off-site storage options (e.g., state- or privately-operated ISFSIs or repositories) are not currently available, and it is uncertain when or if such off-site facilities will become available. Thus, there is a possibility that the ISFSI would remain at SONGS beyond 2051.

The spent fuel that would be stored in the ISFSI is considered high-level radioactive waste and must be stored securely for tens of thousands of years. As the fuel is used in a nuclear reactor, its level of radioactivity increases significantly due to radioisotopes formed during the nuclear fission process. When the fuel is removed from the reactor, it is initially stored in a "wet storage" pool adjacent to the power plant. The water in the pool and the materials used in the pool's construction provide the shielding necessary to prevent human and environmental exposure to the high level of radioactivity present when the fuel is first removed from the reactor. The fuel must remain in the pool for several years until that initial level of radioactivity, and the heat that it produces, is reduced. It can then be relocated to another facility, if one is available. At SONGS, all fuel has been removed from the nuclear reactors and placed in the spent fuel pools. The spent fuel currently stored in the SONGS pools has been there for varying amounts of time; some of the fuel has been cooling for decades, such that much of its capacity to generate heat and radiation through radioactive decay has dissipated, while the youngest fuel assemblies in the pools have been cooling for only two to three years since the permanent shutdown of the Units 2 and 3 reactors. The SONGS spent fuel pools also contain a large number of "high burn-up" fuel assemblies, which produce greater amounts of radiation and heat and require more time to cool than regular fuel assemblies. In all cases, the inventory of spent fuel at SONGS requires secure storage, whether on-site or elsewhere, for many thousands of years.

**Site Characteristics & Background**

SONGS occupies an 84 acre site on the northern San Diego County coast, within the U.S. Marine Corps Base, Camp Pendleton, and approximately 2.5 miles south of the city of San

Clemente (**Exhibit 1**). SONGS is bounded on the north and northeast by Old Pacific Coast Highway and Interstate 5 (I-5), on the northwest by a surface parking lot for SCE employees, and on the west and south by San Onofre State Beach and the Pacific Ocean. The SONGS site comprises just over one mile of shoreline. The northern and southern portions of the site, consisting mostly of parking lots and auxiliary structures and facilities, respectively, are located on top of coastal bluffs of up to 120 feet above mean lower low water (MLLW). The generating units and other core facilities are located along the central portion of the site on a set of artificially-graded terraces, ranging in elevation from 13 to 80 feet MLLW, cut into the bluff at the time of construction. Shoreline protection devices, including a rip-rap revetment, a concrete bulkhead supporting a public access walkway, and a seawall, extend for approximately 2000 feet along the shoreline in front of the Units 1, 2 and 3 areas. **Exhibit 2** provides an overview of the SONGS site and its major features.

The plant is collectively owned by SCE (78.2% interest), San Diego Gas and Electric Company (20%) and the City of Riverside (1.8%). As a previous owner, the City of Anaheim is also a co-participant on the ISFSI project. The plant operates subject to a long-term easement granted by the U.S. Department of the Navy (Navy), executed in 1964 and effective through 2024.

SONGS previously consisted of three nuclear power reactors operated by SCE. The 430 MW generator at Unit 1 began operations in 1968, was shut down in 1992, and has since been decommissioned and dismantled. CDP #E-00-001, approved by the Commission on February 15, 2000, authorized the demolition of the structures comprising Unit 1 and the construction of an ISFSI comprising 19 fuel storage modules, located within the Unit 1 area (now referred to as the North Industrial Area) (**Exhibit 2**).

SONGS Units 2 and 3 were constructed beginning in 1974 (under CDP #183-73), and operated as twin 1127-MW commercial nuclear power plants beginning in 1983 and 1984, respectively. In 2000, in order to create additional storage capacity needed as the existing spent fuel pools begin to fill, SCE applied for and was granted authorization (CDP #E-00-014) for the construction of a much larger ISFSI facility (of up to 104 fuel storage modules) to store Units 2 and 3 spent fuel. The new ISFSI was co-located with and integrated into the previously-approved Unit 1 ISFSI. At present, the existing ISFSI contains 51 loaded and 12 empty fuel storage modules, with space remaining for an additional 26 modules. The location of the existing ISFSI within the North Industrial Area (NIA) is shown in **Exhibits 2 and 3**. Power generation at Units 2 and 3 ceased in 2012. Following an extended shutdown period, SCE announced plans to decommission Units 2 and 3 on June 7, 2013. Since then, SCE has taken a number of actions in preparation for decommissioning, including the installation of new electrical systems needed to supply the plant with power now that electricity generation at SONGS has ceased (CDP Waiver # 9-14-1550-W) and back-up diesel generators (CDP Waivers # 9-14-1550-W and 9-15-0265-W). Most recently, SCE has received Commission approval for projects to install a new spent fuel pool cooling system to replace the existing ocean water once-through cooling system (CDP 9-15-0162), and to replace the large seawater intake pumps serving Units 2 and 3 with smaller pumps better suited to the plant's reduced water needs (CDP Waiver #9-15-0417-W).

**Project Description**

SCE proposes to construct a new ISFSI incorporating 75 fuel storage modules within the NIA. The ISFSI, including its concrete approach aprons, would occupy approximately 40,000 square

feet and would be located immediately seaward of the existing ISFSI, approximately 100 feet inland of the seawall adjoining Unit 1 (**Exhibit 3**). In addition, the proposed project includes the construction of a new security building within the NIA to the east of the ISFSI, a new perimeter security fence, and associated lighting and security equipment. The total project area, including the ISFSI, ancillary structures, and security perimeter, is approximately 100,000 square feet.

There are several types of ISFSI designs, with most being a variation of different types of storage casks bolted to a thick concrete pad within a secured area. The storage casks are generally multi-layer containers made of concrete, steel and other metals, designed to contain most of the radiation emanating from the spent fuel assemblies. Depending on the ISFSI design, storage casks may be stored horizontally or vertically within a concrete superstructure or outer shell. To date, the NRC has licensed 75 ISFSIs at nuclear power plants around the country. Many power plants have constructed ISFSIs to provide additional storage in their wet storage pools for ongoing power plant operations. At SONGS, there is no additional spent fuel being produced, but SCE is proposing the ISFSI in part to allow the emptying of the existing spent fuel pools and to facilitate decommissioning of the power plant complex.

The ISFSI design at SONGS would differ from most other ISFSIs in that the storage casks would be stored partially below grade, encompassed by a berm composed of concrete and fill. The ISFSI system, known as a HI-STORM UMAX, is expected by its manufacturer (Holtec International) to provide better performance during seismic events, provide better security, and reduce radiation doses at the site boundary in comparison to competing designs (Holtec 2014a). The HI-STORM UMAX "ventilated vertical module" (VVM) is a vertical underground storage system designed to accommodate multi-purpose container (MPC) models produced by Holtec. The MPCs proposed for use at SONGS are Holtec MPC-37 canisters, composed of ⅝-inch thick austenitic stainless steel. Each MPC-37 contains an internal grid or "basket" allowing for the storage of up to 37 individual spent fuel assemblies. A 9.5-inch thick canister lid would be welded to the canister shell after loading.

As proposed, the SONGS facility would consist of 75 VVMs set in a surrounding berm measuring approximately 160 ft wide by 260 ft long by 24.5 ft in vertical height, including a 3-foot thick concrete foundation pad. Although the HI-STORM UMAX system has been designed to be 24.5 ft in vertical height, the proposed ISFSI would be installed 12.25 ft below the existing grade. In order to fully enclose the structure, as intended for the underground system, the portion of the structure above the NIA grade (approximately 12.25 feet) will be encased in a berm sloped from the top of the structure to the grade elevation at an approximate forty-five degree angle. As a result, no vertical wall of the concrete structure will be exposed. The top of the ISFSI pad would be at an elevation of approximately 32 feet MLLW. In addition to the array of VVMs, the ISFSI structure would include a reinforced concrete ramp and approach apron for use during the loading, unloading, and maintenance of the storage modules at the top of the ISFSI pad. Plan-view and cross-sectional diagrams of the proposed ISFSI are shown in **Exhibit 3**.

Within the HI-STORM UMAX, each individual VVM would operate independently from any other, and would allow for the storage of one MPC in a vertical configuration inside a cylindrical cavity entirely below the top of grade of the facility. The MPC storage cavity is defined by a so-called Cavity Enclosure container (CEC) comprised of a stainless steel Container Shell welded to a stainless steel Base Plate. Internal parts within the CEC include MPC bearing surfaces, upper

and lower guides to aid in the insertion of the MPC into the CEC and limit lateral movement of the MPCs during an earthquake, and a metal Divider Shell, which separates the space between the MPC and the wall of the CEC to allow for the inflow and outflow of air around the MPC. The CEC is capped with a 24,000-pound Closure Lid made of steel and concrete, which provides radiation shielding at the top of the ISFSI. The Closure Lid also includes inlet and outlet vents which connect to the ventilation space within the CEC and allow for the air cooling of the MPCs. Diagrams of the HI-STORM UMAX storage system and components are provided in **Exhibit 4**.

The ISFSI "berm", or surrounding support structure, would consist of a foundation pad and top pad ("ISFSI Pad") made of 3-foot thick reinforced concrete, and subgrade fill. The interstitial spaces between and surrounding the fuel storage modules would be composed of self-consolidating concrete with a minimum compressive strength of 3000 psi, while the subgrade of the outer perimeter of the berm would be composed of the material excavated from below the NIA grade during site preparation. The subgrade, foundation pad, and top pad and Closure Lid would completely surround the CECs and provide radiation shielding for the long-term storage of the MPCs.

*Construction*

The proposed project is anticipated to be constructed in a single phase, with field work commencing in January 2016. Construction activities, including site preparation and removal of several existing structures, grading, excavation and material placement, ISFSI construction, and the construction of the new security building, fencing, and lighting, are expected to continue for approximately one year. Most of the existing structures to be removed are temporary facilities storing non-radioactive remnants from Unit 1 (**Exhibit 5**). Because the proposed ISFSI would be installed partially below the existing NIA grade, project construction will require the excavation of approximately 14,800 cubic yards of material. This material would be stored on-site following SONGS best management practices and is proposed to be used in in the peripheral berm surrounding the ISFSI. Project construction would also include utility extensions to existing water, sewer, electric, and telephone lines to accommodate operational activities at the proposed security building.

Project construction will require heavy equipment, only some of which is currently located on the SONGS site. Off-site construction vehicles (such as delivery trucks) would access the site via Old Pacific Coast Highway and Interstate 5. In general, construction activities would be limited to daylight hours, with the possible exception of operations requiring the continuous placement of concrete, which could last for 12 to 16 hours and result in a limited amount of nighttime operations.

*Fuel Loading and Transfer of Casks from Spent Fuel Pools to the ISFSI*

To transfer the spent fuel from wet to dry storage, the MPCs would be brought to the wet storage pools, located in the Units 2 and 3 Fuel Handling Buildings approximately 1,200 feet east of the project site. The MPCs would be placed in a licensed transfer cask, lowered into the pools, loaded with spent fuel assemblies, and then removed from the pools. Water would be drained from the MPCs and replaced with helium, and they would be welded shut. Subsequently, the transfer casks containing the MPCs would be loaded onto a transfer vehicle that would use existing roads within the SONGS Protected Area to move the MPCs to the project site. The transfer vehicle would access the top of the ISFSI pad using the built-in access ramp and

approach pad (*see* **Exhibit 3**), and the MPCs would be loaded into the fuel storage modules and capped. Approximately six days are required to complete the transfer of one MPC, though more than one MPC can be processed for loading at any given time. SCE expects to begin the transfer of spent fuel to the new ISFSI facility beginning in 2017, and to complete the effort by June 2019.

*Maintenance & Monitoring*

The NRC requires licensees to implement an Aging Management Plan (AMP) to provide for the continued safe dry cask storage of spent fuel in order to renew the initial 20-year license for the HI-STORM UMAX ISFSI. SCE has indicated that it will develop its aging management program shortly after the fuel is transferred to the proposed ISFSI, in advance of NRC requirements. In a 9/14/2015 document submitted to Commission staff (SCE 2015f), SCE described this program as follows:

> *SCE's program will focus on engineered controls (i.e., conservative design, material selection and fabrication controls), operational controls (e.g., inspection and monitoring) and developing mitigation plans to address material degradation and/or mitigate its consequences. Site monitoring of environmental parameters such as temperature and humidity will be used to help determine the risk of corrosion to the canister and predict the time of onset of degradation. Inspections will include visual observation, collection of surface deposits and temperature, and more extensive non-destructive examination (NDE) techniques. Industry efforts are well underway to develop NDE methods, deployment methods, qualification processes and acceptance criteria. It is not unusual for such efforts to evolve over time and with greater collective experience. With the commitment that SCE will not wait until it is required by the NRC to implement an AMP, SCE expects to be an early, if not the first, user of such techniques.*
>
> *One of the challenges of inspections is getting to the entire surface of the loaded canisters which have a radiation environment that limits access. Remote surface inspection tools are currently being developed and are expected to be available for use at SONGS shortly after the fuel is transferred to the expanded ISFSI. In addition to developing these remote inspection tools, SCE will place an empty canister in the same environment as the loaded systems. This type-test specimen (i.e., coupon) can be thoroughly inspected and monitored in ways that a loaded canister cannot due to the presence of a spent fuel assembly. SCE has selected a canister to test, which will be located in the vicinity of the proposed ISFSI pad and will begin its initial exposure by the fourth quarter of 2015.*
>
> *SCE's AMP will include a combination of the inspections described above to monitor the condition of the ISFSI components throughout their service life. This will provide assurance that the ISFSI components are performing as designed and allow for the spent fuel to be safely removed when the DOE is ready to transfer the fuel to an interim storage facility or permanent repository.*

In summary, SCE's intended aging management program would include (a) the monitoring of environmental conditions, such as temperature and humidity, that could influence the risk of corrosion and degradation of the stainless steel MPCs; (b) visual observation, surface measurements, and other inspection techniques to provide information on the physical condition

of the MPCs; and (c) use of an empty cask ("coupon") as a surrogate for filled casks to allow for more thorough inspection and evaluation. However, the "non-destructive examination techniques", "remote surface inspection tools" and "NDE methods, employment methods, qualification processes and acceptance criteria" referenced by SCE are "in development", and their utility for the maintenance and monitoring of the spent fuel casks has not been demonstrated. Nor is it clear when these techniques, tools and standards would become available for use at SONGS.

*Off-site Transport & ISFSI Decommissioning*
Transportation of commercial spent nuclear fuel is regulated by the US Department of Transportation (49 CFR Part 172) and the NRC (10 CFR Part 71). The SONGS operating license issued by the NRC (10 CFR Part 50) allows for the off-site shipment of spent fuel, with no additional licensing action, so long as the transportation cask to be used has a current NRC Certificate of Compliance (CoC). Holtec has recently applied (August 7, 2015) to the NRC for a CoC for a new spent fuel transport cask (HI STAR 190) which would be designed and licensed to ship the MPC-37 storage casks that would be used in the proposed ISFSI (SCE 2015e). SCE anticipates that the HI STAR 190 transportation casks will have received NRC approval prior to the first planned shipments in 2030. When another facility becomes available for spent fuel storage (e.g., a federal repository, federal interim storage site, or a private storage site) the MPCs to be stored in the proposed ISFSI would be removed from the fuel storage modules and placed in transport casks, which would then be loaded onto transport vehicles (railcar or truck).

The timing of spent fuel shipments to an off-site storage site depends in part on the NRC requirements related to fuel composition, cooling time, the type of cladding used to shield the fuel assemblies, and the capabilities and design of the storage and transportation casks that would be used. Based on these factors, SCE anticipates that all of the Units 2 and 3 fuel assemblies currently stored in the spent fuel pools and awaiting transfer to the proposed ISFSI would be available for transportation between 2025 and 2030 (SCE 2015e). The actual removal of this fuel from the SONGS site would additionally depend on the availability of a permanent or interim storage site, and in the case of a federal repository, the DOE's need to coordinate spent fuel shipments from other nuclear power plants. Under the schedule contemplated in SCE's final SONGS Irradiated Fuel Management Plan (IFMP) and Decommissioning Cost Estimate (DCE) submitted to the NRC, offsite shipment of spent fuel would begin in 2030 and be completed by 2049 (SCE 2014a, 2014b).

The decommissioning of SONGS Units 2 and 3, comprising several distinct stages, is scheduled to continue through 2032. Major above-grade structures are slated to be removed by 2028, and sub-surface structures would be removed by 2031 (SCE 2014a). Due to the potential for effects on coastal resources, the deconstruction and removal activities associated with decommissioning will require Commission review under one or more separate CDP applications. Site clean-up, removal of the retaining walls, shore protection, berm and guard house and final disposition of other facilities will be addressed in these later permits.

**B. OTHER AGENCY APPROVALS**

**U.S. Nuclear Regulatory Commission**
The construction and operation of new facilities at SONGS are subject to the approval and oversight of the federal Nuclear Regulatory Commission (NRC) pursuant to NRC regulations.

The NRC regulates ISFSIs pursuant to 10 CFR Part 72. Part 72 provides for two types of licenses for ISFSIs:

(1) General license. The wet storage of spent fuel generated at a nuclear power plant is authorized under the plant's existing license issued pursuant to 10 CFR Part 50 (or Part 52 for newer plants). A plant may extend this general license to cover an ISFSI facility, without the need for a license amendment, by satisfying the requirements in Subpart K to 10 CFR Part 72, which include a variety of siting, safety and security requirements.

(2) Specific license. In order to construct and operate and ISFSI outside the licensed 10 CFR Part 50 area of a nuclear power plant, an operator (or other entity) must apply for and be granted a specific license from the NRC pursuant to 10 CFR Part 72. Such applications are subject to NRC review and approval and public hearing requirements.

The proposed ISFSI would be installed under SCE's 10 CFR Part 50 general operating license, and thus does not require additional NRC approval, though it is subject to NRC oversight to assure compliance with Part 72, Subpart K and other applicable regulations. The SONGS Part 50 license requires specific performance standards and operating conditions at the facility, including design specifications, testing requirements, security measures, and other measures. When the NRC acknowledged the cessation of power operations at SONGS, the Part 50 license was modified to allow for the possession of nuclear fuel by SCE and prohibit further power operations. NRC regulations provide for a 60-year decommissioning period once power operations have ceased. No further action is required by SCE unless the license cannot be terminated within 60 years. SCE will request NRC approval to reduce the licensed area to that of the ISFSI and its security footprint on or about 2031, as Units 2 and 3 decommissioning nears its conclusion. The SONGS Part 50 general operating license can only be terminated after meeting all the conditions specified in 10 CFR 50.82 for license termination, including the decontamination and demolition of the ISFSI.

*Federal Pre-emption*

The NRC has exclusive jurisdiction over radiological aspects of the proposed project. The state is preempted from imposing upon operators of nuclear facilities any regulatory requirements concerning radiation hazards and nuclear safety. The state may, however, impose requirements related to other issues. The U.S. Supreme Court, in *Pacific Gas and Electric Company v. State Energy Commission, 461 U.S. 190, 103 S.Ct. 1713 (1983),* held that the federal government has preempted the entire field of "radiological safety aspects involved in the construction and operation of a nuclear plant, but that the states retain their traditional responsibility in the field of regulating electrical utilities for determining questions of need, reliability, costs, and other related state concerns." The Coastal Commission findings herein address only those state concerns related to conformity to applicable policies of the Coastal Act, and do not evaluate or condition the proposed project with respect to nuclear safety or radiological issues.

**U. S. Department of the Navy**

SCE operates the SONGS site under the terms of a 60-year grant of easement from the U.S. Department of the Navy (Navy), executed on May 12, 1964 and effective through May 12, 2024. The easement was authorized by an act of Congress (Public Law 88-82, July 30, 1963). SCE has requested Navy authorization to renew the grant of easement to allow for plant

decommissioning, required site restoration, and the transfer of all SONGS spent fuel to DOE custody.

Pursuant to Coastal Act section 30601.5, where the Applicant is not the owner of a fee interest in the property on which a proposed development is to be located, but can demonstrate a legal right, interest, or other entitlement to use the property for the proposed development, the commission shall not require the holder or owner of the fee interest to join the applicant as co-applicant. Prior to issuance of the CDP, however, the Applicant must demonstrate their ability to comply with all conditions of approval. Accordingly, the Commission is imposing **Special Condition 1**, which requires SCE to submit, for the Executive Director's review and approval, evidence of their legal ability to comply with all conditions of approval.

### C. OTHER PROJECT-RELATED ISSUES

**Lack of a Permanent Storage Facility**

The need for onsite storage of spent nuclear fuel at power plants around the country is a consequence of the United States not yet establishing a permanent and safe repository for spent fuel and other nuclear materials. In 1977, the federal government announced it would take on the responsibility for spent fuel from all nuclear power plants in the U.S. In 1982, the Nuclear Waste Policy Act required the Department of Energy to accept spent fuel for permanent disposal by 1998. In 1987, after studies of several potential sites, the Act was amended to make a site at Yucca Mountain, Nevada, the only site undergoing further consideration. Spent fuel was to be shipped to the Yucca Mountain facility from power plants around the county in priority order – generally, the older the fuel, the earlier it would be accepted.

Since that time, the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the NRC have conducted numerous studies at Yucca Mountain and have constructed parts of the facility. It has not yet opened, however, due to several significant technological issues and court challenges. The facility was scheduled to start accepting materials in 2010; however, in July 2004, a decision by the District of Columbia Circuit Court (*Nuclear Energy Institute, Inc. v. Environmental Protection Agency, D.C. App. 2004, No.01-1258*) found that the EPA had improperly set the facility's design standard well below the safety level required by Congress.[1] In 2008, the DOE applied to the NRC for license to dispose of spent fuel at Yucca Mountain. However, the application received strong opposition from the State of Nevada and several local governments, as well as several threats of litigation. Following the 2008 presidential election, the Obama administration decided not to pursue the license application, and in 2010, the DOE filed a motion with the NRC seeking permission to withdraw its application for the Yucca Mountain repository. Although the motion was denied, the NRC process was subsequently suspended due to a lack of congressional funding. Although the

[1] In 2002, Congress determined that the facility must meet an "individual risk standard" for exposure to radioactive elements "based on and consistent with" the recommendations of the National Academy of Sciences. The Academy determined that the facility required designs ensuring exposures would not be exceeded for tens to hundreds of thousands of years. The EPA, however, set the exposure standard at 10,000 years. The court determined the EPA's selection of the 10,000 year standard was not "based upon and consistent with" the recommendations of the National Academy of Sciences, as had been required by Congress.

federal government has continued to study options for permanent or interim repositories, no federal facility for the disposal of spent fuel currently exists, and there are no near term prospects for the licensing and development of such a repository. As a result, it remains uncertain when, or if, the DOE will be in a position to accept SONGS spent fuel.

Commission staff is aware of two active proposals to develop private interim storage facilities that would, if built, accept commercial spent fuel. Waste Control Specialists (WCS) has announced its intention to apply for a 10 CFR Part 72 site-specific license for an ISFSI at the site of its existing low-level waste storage facility in Andrews County, Texas. WCS believes it could begin accepting spent fuel as early as December 2020 (SCE 2015c). More recently, Holtec and Eddy Lea Energy have announced plans to develop an underground consolidated interim storage facility in southeastern New Mexico. The facility is envisioned to consist of a greatly enlarged version of the HI-STORM UMAX system proposed for use at SONGS. While these private storage facilities hold promise for expanding the range of long-term storage options in the absence of a permanent federal repository, both proposals are likely to face significant opposition and have yet to undergo NRC licensing, and it is unclear when, or if, either would become available, of if they would be able to accept all of the SONGS spent fuel.

**Project Alternatives**

As part of its proposal, and in response to Commission staff queries, SCE evaluated several alternatives to the proposed project. These included a "no action" alternative, shipping the material offsite, siting the ISFSI at other locations on the SONGS site, and consideration of several design and configuration alternatives for the facility (SCE 2015a, b, c). In addition, Commission staff has evaluated the implications of several different project timeframes.

As detailed below, many of the potential alternatives were determined by the SCE to be infeasible. "Feasible" is defined in Coastal Act section 30108 as capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social and technological factors. SCE has indicated that a key project objective is to offload the spent fuel pools by mid-2019, and that a multi-year delay in meeting the project objective would significantly disrupt its schedule for decommissioning SONGS Units 2 and 3 and introduce significant new costs in comparison to the proposed project.

*No Action*

In the absence of the proposed project, the SONGS 2 and 3 spent fuel would remain in the existing spent fuel pools until it could be transferred to an off-site permanent repository or interim storage facility. While the NRC considers wet storage pools to provide adequate safety for the stored materials, as a general matter, dry cask storage is thought to provide an increased margin of safety. In part, this is because ISFSIs are a passive storage system, and unlike fuel pools, do not depend on active cooling systems or require continual maintenance (though they do require regular inspections). The ISFSIs additionally encapsulate the spent fuel into hardened structures, which are less likely than the wet storage pools to be affected by forces such as seismic activity, terrorist attack, or other phenomena. For example, the SONGS ISFSI has been designed to withstand significantly greater ground shaking intensities (1.5 g in two orthogonal directions, net 2.12 g) than the existing spent fuel pools (0.67 g in each direction). SCE has also indicated that keeping the spent fuel in the existing pools would interfere with the planned

decommissioning of Units 2 and 3, and would require SCE to maintain more infrastructure and active systems than the dry storage option. For these reasons, SCE does not consider continued storage of spent fuel in the pools as the preferred alternative.

*Off-site Locations*
Of the offsite storage alternatives considered by SCE, all were either unavailable or otherwise found to be infeasible. Alternatives considered included:

- Shipping the material to a reprocessing facility: There are several reprocessing facilities in other countries, but none in the U.S. This option was not considered feasible due to several significant political, legal, and logistical uncertainties.

- Shipping the material to a private storage facility: While there is one proposed private facility currently licensed by the NRC (at Skull Valley, Utah), the developer has been unable to obtain required non-nuclear permits from other agencies and the facility was never constructed. At present, there are no further plans to construct and operate the Skull Valley ISFSI. There are two active proposals to develop interim consolidated dry spent fuel storage facilities in New Mexico and Texas, respectively (see above). However, these facilities are not licensed and have not been constructed, and it is uncertain if or when these facilities might become available. There are no other private storage facilities available in the U.S. Therefore, this alternative is unavailable.

- Shipping the material to another nuclear power plant that had sufficient storage space: SCE found that other nuclear power plants either do not have adequate storage or have not included in their storage licenses the possibility of accepting spent fuel from other power plants. While in concept it may be possible for a plant to amend its license to accept fuel generated off-site, actually doing so would depend on another reactor operator being willing to take possession of SONGS spent fuel. Any such proposal would be controversial, as it would involve the shipment of spent fuel from one location to another, and in the unlikely event that another licensee were willing to accept the fuel, the NRC license amendment process would likely take a number of years, preventing the project from being accomplished within a reasonable timeframe. Thus, this alternative was deemed infeasible.

- Shipping the material to an off-site ISFSI to be developed by SCE: In theory, SCE could apply for a specific license to develop its own ISFSI away from the SONGS licensed area. In order to construct an ISFSI at an off-site location, SCE would need to identify suitable available land under its ownership, acquire new land, or obtain landowner approval for a project on land it did not own.

  One potential location evaluated by SCE and Commission staff is the SONGS "Mesa", a SCE-operated, non-nuclear auxiliary facility located within Camp Pendleton immediately north and inland of SONGS proper. While the Mesa has the advantages of being a previously-developed site also under SCE control, it is, like SONGS, located on an easement granted by the Navy, which is planned to be terminated in 2017 (SCE 2014a). Camp Pendleton representatives have informed Commission staff that the Marine Corps has other development plans for the off-site Mesa location once the site has been restored, and that the authorization of new SONGS-related projects here was highly unlikely.

> More generally, at any off-site location, SCE would need to evaluate the site suitability, including geological characteristics, against NRC criteria, a process which could take several years with no guarantee of a favorable outcome. For example, an ISFSI located outside the SONGS Part 50 licensed area could not be authorized under the general license provisions of 10 CFR Part 72 and a new, site-specific license would be required. As discussed above, the process of acquiring a new site-specific license is expected to take many years and would exceed the timeline for completion of the proposed project.

SCE has stated that it will continue to monitor the availability of offsite alternatives – in particular the emerging proposals for private consolidated storage facilities -- and will evaluate the feasibility of moving the SONGS spent fuel if other options become available.

*On-site Locations within SONGS Part 50 Licensed Area*
SCE evaluated possible on-site storage locations and haul paths as a part of the initial project design process (SCE 2015a, b, c). Taking into account the estimated area of the ISFSI footprint (including safety and security requirements), SCE selected five locations for further evaluation: the NIA, the Reservoir, the K Buildings, the MUD Area, and the South Yard (**Exhibit 2**). SCE then ranked these alternative sites based on multiple criteria. The highest-weighted criteria were as follows:

- Suitability of site for long-term storage
- Ease/duration of licensing & permitting
- Costs and potential for DOE reimbursement
- Exposure to known or potential geologic hazards
- Avoidance of natural or man-made events that could affect safety
- Site grade & foundation properties (e.g., bearing capacity, seismic response, etc.)
- Potential for environmental resource impacts (e.g., sensitive habitats)

The NIA site proposed in this application was ranked highest among the five on-site alternatives examined in SCE's analysis. In addition to having adequate space to accommodate the proposed ISFSI, the NIA possesses several key advantages: (1) It has been previously graded and developed (with an existing ISFSI), minimizing needed site preparation, and would not result in new impacts to land resources; (2) it lies in close proximity (within approx. 1200 feet) to the existing spent fuel pools along a stable, secure and proven haul path; (3) it is underlain by relatively stable San Mateo formation sandstone; (4) it could make use of existing security arrangements; and (5) as stated above, was available for use in the near term. Of particular importance for the Commission's analysis is the fact that the NIA has superior foundation conditions; each of the other four selected sites is partially or entirely underlain by poorly consolidated marine terrace deposits, which are considered to be more susceptible to erosion, slope failure, and seismic shaking than the San Mateo Formation. The Reservoir and South Yard sites in particular are located on top of high, erosion-prone bluffs and nearer to sensitive habitats and scenic areas. Thus, the NIA was judged by the Applicant to be the superior location of the 5 alternative sites examined within the SONGS licensed area.

Nonetheless, it cannot be ignored that the proposed ISFSI location within the NIA lies just over 100 feet from the shoreline, at some of the lowest grade elevations (approx. 13 to 20 feet MLLW) present at the SONGS site. As discussed in greater detail in the Geologic Hazards findings (Subsection D), the site could potentially be exposed to several coastal hazards

depending on how long the facility were to remain in place. During its review of SCE's alternatives analysis and in view of the fact that the applicant seeks authorization for temporary, interim storage, Commission staff noted that several areas currently occupied by Units 2 and 3 and related structures may share some of the advantages of the NIA (e.g., foundational stability sufficient to support two nuclear reactors) while also being both located farther inland (300 – 900 feet) and at a higher grade elevation (>30 feet MLLW) than the proposed ISFSI location. Though currently occupied by existing structures, these areas are expected to become available over the next 15 years as the decommissioning and dismantlement of Units 2 and 3 proceeds (SCE 2014b). SCE has expressed its willingness to reevaluate alternative locations as they become available, and, if warranted, relocate the spent fuel to a new ISFSI facility at a later date.

*Design & Technological Alternatives*
In addition to considering alternative locations, SCE evaluated several possible ISFSI configuration alternatives within the NIA. According to SCE, the currently proposed configuration (**Exhibit 3**) was selected because it would maximize the distance between the facility and the shoreline and avoid the need to fill or modify the existing NIA drainage sump, while still providing adequate storage capacity (75 modules). Other configurations, while feasible, would lessen the distance between the facility and the shoreline and/or require more extensive site preparation and modifications to existing structures.

Similarly, SCE considered several different ISFSI storage systems and cask types. While it would be feasible to use one of the other ISFSI designs and storage casks which are currently licensed by the NRC and in use at other U.S. facilities – such as the Areva NUHOMS horizontal storage system currently employed at the existing SONGS ISFSI – SCE did not find any clear environmental or practical benefit to selecting an alternate system. SCE has indicated that, in comparison to other options, the proposed HI-STORM UMAX system offers significant advantages in terms of increased security, greater protection against coastal airborne salinity, reduced visual impacts, improved ventilation, ease of cask handling, and increased stability during a seismic event (Holtec 2014b; SCE 2015a).

Opponents of SCE's proposed ISFSI system have argued that the thin-walled stainless steel storage casks that would be used are at risk of degradation, especially stress corrosion cracking, over time, and are not suitable for long-term storage in a coastal environment. These critics additionally state that thick-walled cask varieties commonly used in Europe, such as the CASTOR series (manufactured by GNS, a German company), would be superior in terms of safety, aging management, and future transportability. However, these thick-walled casks are not generally licensed for use at U.S. sites by the NRC.[2]

**Length of Development Authorization**
Though SCE seeks temporary development authorization until 2051, there is no assurance that SCE will be able to transfer the spent fuel to DOE custody and decommission the proposed facility as planned by 2051, complicating the analysis of the project's exposure to geologic hazards and its potential to adversely affect coastal resources. The uncertain duration of the ISFSI's presence at the proposed location also has implications for SCE's alternatives analysis,

[2] CASTOR models V/21 and X/33 are currently being used at the Surry Power Station in Virginia under a site-specific license (SCE 2015b).

as summarized above. A number of the project alternatives were rejected by SCE not because they were necessarily inferior in terms of safety, geologic hazards or environmental effects, but because they would introduce delays (and additional costs) into SCE's plans for transferring the spent fuel from the pools to the ISFSI. However, under a scenario in which there is no near-term prospect for transporting the spent fuel off-site to a permanent federal repository, considerations related to expedience, scheduling, and cost must be weighed against other factors, including the long-term vulnerability of the site to coastal hazards.

Over the next several decades, new information is likely to emerge that will clarify the current uncertainties: progress (or a lack thereof) on the development of a permanent federal repository and/or off-site interim storage facilities will influence SCE's schedule for spent fuel transfer, and the continued need for and expected lifespan of the ISFSI; the decommissioning of SONGS Units 2 and 3 will open up new on-site locations which may prove to be less vulnerable to geologic hazards over the long-term; new scientific observations and modeling (e.g., regional sea level rise, hazards risks) will help refine projections of the ISFSI site's vulnerability to coastal hazards; and new information, based on the actual experience at multiple nuclear power plants, will be available on the suitability of thin-walled casks for storage and transport beyond the NRC's initial 20-year license. Given the (albeit uncertain) transport of the spent fuel from these interim facilities to a more permanent repository, it is appropriate for the Commission to require a re-evaluation of the project and the available alternatives at a later date, but prior to the end of the 35-year project life proposed by SCE.

The Commission staff considered two potential CDP timeframes for the re-evaluation of the proposed project, including after seven years (at the time of the expiration of CDP #E-00-014 covering the existing ISFSI), and 20 years (after the anticipated completion of Units 2 and 3 decommissioning). As discussed above, staff also considered the implications of assuming that the ISFSI would remain at the proposed location in perpetuity. After seven years, in 2022, the proposed ISFSI is expected to be fully loaded, and all fuel removed from the existing pools. However, Units 2 and 3 would not have been decommissioned or deconstructed and the potential to relocate the ISFSI to other locations within the Part 50 licensed area would not yet be available. Further, there is a reasonable likelihood that the status of both the permanent federal repository and proposed private interim storage facilities would remain unresolved.

The Commission finds that in this case, a 20-year period of development authorization, with a requirement for the Applicant to propose a CDP Amendment to retain, remove or relocate the ISFSI at least six months prior to the end of this term, is justified by a number of considerations. First, by 2035, SONGS Units 2 and 3 will have been decommissioned, and additional on-site locations for the potential relocation of the ISFSI will be available for consideration. Second, 2035 occurs after the first planned shipments of SONGS spent fuel to the DOE, and at that point it will be apparent whether SCE's assumptions about the possibility and timing of the transport to DOE and the decommissioning of the ISFSI by 2051 are justified. It will also be apparent whether the current proposals for private interim storage facilities are viable alternatives. Third, 2035 is near enough in the future that it will precede the time at which the existing site will be threatened by coastal hazards, even accounting for the uncertainties associated with these hazards. Fourth, a 20-year period of authorization aligns closely with the period for which the NRC has certified the safety and structural integrity of the proposed ISFSI system, providing

assurance that the MPCs will still be transportable, and thus the ISFSI still removable, within that timeframe. Finally, it is expected that within 20 years, SCE will have developed the aging management strategies, and the tools and techniques needed for monitoring and inspection of the storage casks, which are necessary for ensuring the long-term transportability of the casks and eventual removal of the ISFSI from the site, which are not available at present.

Therefore, the Commission adopts **Special Condition 2**, which authorizes the project for a duration of twenty years from the date of approval (i.e., until October 6, 2035). At least six months prior to that date, SCE must apply for a new or amended CDP to retain, remove or relocate the ISFSI. Such application must be supported by, among other things, a re-evaluation of the available project alternatives.

**D. GEOLOGIC HAZARDS**

Coastal Act Section 30253 states, in relevant part:

> *New development shall:*
>
> *(a) Minimize risks to life and property in areas of high geologic, flood, and fire hazard.*
>
> *(b) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs …*

The proposed ISFSI site is located within the SONGS North Industrial Area (NIA, formerly the site of SONGS Unit 1) on a heavily-modified coastal bluff, as close as 115 feet to the Pacific Ocean. The site is potentially subject to several geologic and coastal hazards, including seismic activity, slope failure, coastal flooding and tsunamis, and coastal erosion, each of which is evaluated below. During the staff review of the prior ISFSI project (CDP #E-00-014), the Commission's Staff Geologist conducted an extensive evaluation of geologic hazards at the SONGS site, drawing on the information available at the time (through early 2001). This section summarizes his conclusions (contained in the staff report to CDP #E-00-014) as a starting point, but also evaluates new information, data, and analysis tools related to geologic hazards that have emerged in the last fifteen years.

As described above in subsection B, the Commission is proscribed from applying Section 30253 – or any section of the Coastal Act – to issues related to nuclear and radiological safety. Nevertheless, the proposed development must minimize hazards and assure geologic stability and structural integrity in order to conform to the California Coastal Act. The analysis and findings that follow relate to the susceptibility of the proposed development to geologic hazards pursuant to the Coastal Act, but does not attempt to address the consequences of these hazards in terms of nuclear safety. Such consequences are under the jurisdiction of the federal NRC.

**Geologic Setting**

The SONGS site lies in the Peninsular Ranges geomorphic province of southern California. Bedrock at the proposed ISFSI is the San Mateo Formation, a dense, well-lithified sandstone of Pliocene to Pleistocene age, which is thought to extend to a depth of approximately 900 feet below grade at the site. In the natural state, this bedrock unit is overlain by a series of marine

and non-marine terrace deposits, approximately 50 feet thick, of late Pleistocene age. During the construction of Unit 1, encompassing the current NIA, the terrace deposits and the upper 10 – 20 feet of the San Mateo Formation were removed, and the finished grade of the area is set well below the top of the coastal bluffs at an elevation of approximately 19 feet MLLW. The excavated material was placed on the beach in front of SONGS as sand nourishment, initially increasing the width of the beach, but much of the material has since been removed by longshore drift. A narrow beach still exists seaward of the NIA seawall.

**Seismic Hazards**

Like most of coastal California, the SONGS site lies in an area subject to earthquakes. SONGS is approximately 8 km from the Newport-Inglewood-Rose Canyon fault system, 38 km from the Elsinore Fault, 73 km from the San Jacinto Fault, and 93 km from the San Andreas Fault, all of which are considered "active" (evidence of movement in the past 11,700 years) by the California Geological Survey (Jennings and Bryant 2010). Several relatively nearby offshore faults, including the Coronado Bank Fault Zone, the San Diego Trough Fault Zone, the Thirty-Mile Bank Fault, and the Oceanside Thrust also may have been active during Quaternary time. Several smaller faults exist in closer proximity to SONGS, but are considered to be inactive. The Cristianitos fault, a low-angle normal fault, lies south and east of the site, intersecting the seacliff approximately 1 mile south of SONGS. The Cristianitos fault separates two zones of distinct bedrock (San Mateo Formation to the north, Miocene Monterey Formation to the south), but is overlain by undisturbed terrace deposits, indicating that this fault has not been active in the last ~120,000 years (Shlemon, 1987), and probably not within the last 1.6 million years (Jennings and Bryant 2010). Four minor, inactive faults have also been mapped in the San Onofre Hills to the east of the site (USNRC 1981). In general, seismicity in the vicinity of SONGS has historically been relatively quiet compared to much of the rest of southern California, probably because of the relatively great distance from the San Andreas Fault, which accommodates most of the plate motion in the area, and the relatively low slip rates of the nearer faults (Peterson et al., 1996). A magnitude ($M_L$) 5.4 earthquake, associated with an unusually large swarm of aftershocks, occurred near the offshore San Diego Trough Fault Zone in 1986, but no other moderate or large (>M 5.0) earthquake has occurred within 50 km in historic time.[3]

Seismic hazards (excluding tsunami hazards) at the site include ground shaking, surface rupture, liquefaction, and slope instability. Each of these issues is addressed in these findings.

*Ground Shaking*[4]

Geologists' understanding of the ground shaking risk at SONGS has evolved along with on-going research into the tectonic setting of the Southern California borderland. Studies

[3] $M_L$ refers to locally-measured Richter scale magnitude. *See* **Appendix B** for a discussion of the various measures of earthquake magnitude and ground shaking used by geologists.

[4] Seismic hazards are often discussed in terms of the strength or intensity of ground shaking rather than earthquake magnitude. Measures of ground-shaking account for the attenuation of seismic waves due to distance from a rupture and amplification or damping due to substrate types (e.g., soft sediments vs. hard rock) and thus provide a better estimate of the amount of damage that may occur at a given site. Ground shaking is often expressed as the *acceleration* experienced by an object during an earthquake. The *spectral acceleration* occurs at different oscillation frequencies, which can be plotted to form a ground shaking *response spectrum*. The *peak ground acceleration* (PGA) is a measure of is the maximum force (expressed as a % of the acceleration of gravity, g) experienced by a small mass located at the surface of the ground during an earthquake. PGA is often used in seismic design as a hazard index for short, stiff structures. **Appendix B** provides additional discussion of ground-shaking measurement.

undertaken at the time of the licensing of SONGS Units 2 and 3 identified an earthquake on the Newport-Inglewood-Rose Canyon fault system, centered on the portion of the fault nearest SONGS, to be the seismic event with the greatest potential for ground shaking at the SONGS site (NRC 1981). Based on the estimated magnitudes of the few historical earthquakes thought to have occurred on or near this fault system, and on an assessment of fault parameters (e.g., long-term rate of slip, etc.), the NRC adopted a magnitude ($M_S$) 7.0 event, occurring 8 km from the SONGS site, as the "design basis earthquake". Modeling of ground shaking associated with this event yielded response spectra with a peak ground acceleration (PGA) of 0.31 g. After comparison with empirical models, and in order to build in conservatism for inaccuracies in the model, the NRC approved the calculated spectra multiplied by a factor of about 2, resulting in a design basis PGA of 0.67 g.

The approach taken by the NRC during licensing review was deterministic in nature: A design basis earthquake was established, and that earthquake was used to calculate expected ground acceleration. In 1995, SCE and a team of consultants undertook a probabilistic study of seismic hazards at SONGS (SCE Geotech Group 1995). The results represent the annual frequency of exceedance of various ground motions at SONGS, shown as a family of seismic hazard curves and ground motion response spectra. Under this analysis, the "safe shutdown earthquake" (synonymous with the design basis earthquake discussed above), with a PGA of 0.67 g, had an annual probability of occurrence of 0.00014 (0.7% in 50 years), or a recurrence interval of 7,143 years.

In addition, a number of studies have provided evidence that, in addition to the strike-slip faulting recognized at the time of the SONGS licensing review, thrust faults exist in the area offshore of the SONGS site which might interact with the Newport-Inglewood-Rose Canyon fault system in a complex way during an earthquake (e.g., Rivero et al. 2000; Kuhn et al. 2000; Shlemon 2000; Rivero and Shaw 2011). Notably, the 1986 Oceanside earthquake ($M_L$) 5.4 was centered on one of these low-angle faults, and showed a thrust fault mechanism. Rivero et al. (2000) and Rivero and Shaw (2011) have hypothesized that blind thrust faults related to the Newport-Inglewood-Rose Canyon fault system may be capable of an earthquake ranging in magnitude from $M_W$ 7.1 to 7.6, larger than that of the design basis earthquake considered during SONGS licensing. However, other studies dispute the existence of blind thrust faults offshore of Orange and San Diego counties, and suggest that the observational data (seismic reflection profiling, earthquake clustering patterns, etc.) used by Rivero et al. to infer thrust faulting can be interpreted within a framework of step-overs and trend changes along known north-to-northwest oriented strike-slip fault systems (Ryan et al. 2012). New and reprocessed on- and offshore seismic reflection profiling data collected by SCE and Scripps Institute of Oceanography have been interpreted as supporting the step-over and trend change model (Malloney et al., *in press*), suggesting that the previously posited blind thrust faults do not exist. SCE has also sponsored a recent study of marine terrace uplift in coastal San Diego and southern Orange counties over the late Quaternary, which appears to have found no evidence of the deformation and differential uplift which could be expected to result from any recent activity on blind thrust faults in the vicinity of SONGS (SCE 2013).

In 2010, as an update to the older studies, SCE commissioned a new study (*Probabilistic Seismic Hazard Analysis Report*, GeoPentech, 2010) to assess the seismic hazard presented by both the previously-recognized strike-slip faulting and postulated offshore blind thrust faults (e.g.,

Oceanside and Thirty-Mile Bank thrust faults) near SONGS. Probabilistic peak ground accelerations and spectral accelerations for the SONGS site are shown below:

| | **10% in 50 yr** (475-yr return period) (GeoPentech 2010) | **2% in 50 yr** (2475-yr return period) (GeoPentech 2010) |
|---|---|---|
| **PGA** | 0.227 g | 0.477 g |
| **0.2 sec SA** | 0.530 g | 1.111 g |
| **1.0 sec SA** | 0.261 g | 0.501 g |

The GeoPentech analysis suggests that the inclusion of an offshore blind thrust fault earthquake source does not greatly increase the ground shaking hazard at the SONGS site, and that the PGA of 0.67 g assigned to the design basis earthquake at the time of Units 2 and 3 licensing remains conservative.

Independent evaluations of earthquake ground shaking hazards in the vicinity of SONGS are provided by the California Geological Survey (CGS) and U.S. Geological Survey (USGS). The CGS Earthquake Shaking Potential Map for California (Branum et al., 2008) portrays the San Onofre area as a region of relatively low ground shaking potential, with the Big Sur coast being the only other part of coastal California having a comparably low shaking potential according to this assessment. Comparable, quantitative assessments are provided by the USGS Seismic-Hazard Map for the Coterminous United States, 2014 (Peterson et al. 2015) and online analysis tools developed by both CGS and USGS. Probabilistic peak ground accelerations and spectral accelerations for the San Onofre area, assuming firm bedrock conditions, are shown below:

| | **10% in 50 yr** (475-yr return period) (USGS)[5] | **10% in 50 yr** (475-yr return period) **(CGS)**[6] | **2% in 50 yr** (2475-yr return period) **(USGS)**[3] | **2% in 50 yr** (2475-yr return period) **(CGS)**[4] |
|---|---|---|---|---|
| **PGA** | 0.20 – 0.25 g | 0.245 g | 0.40 – 0.50 g | 0.505 g |
| **0.2 sec SA** | 0.50 – 0.60 g | 0.564 g | 1.0 – 1.2 g | 1.113 g |
| **1.0 sec SA** | 0.15 – 0.20 g | 0.200 g | 0.30 – 0.40 g | 0.377 g |

These estimates of ground shaking potential at the SONGS site are quite similar to those from SCE's probabilistic study (GeoPentech 2010).

It is important to note that these assessments of ground shaking risk were based on the current understanding of the likelihood of earthquakes of varying intensities on nearby faults at the time they were released, and that as geologists' understanding of the network of faults underlying coastal California continues to evolve, estimates of ground-shaking risk at a specific site, such as SONGS, may change. A recent example of this iterative process is provided by the USGS *Uniform California Earthquake Rupture Forecast*, Version 3 (UCERF3) report (Field et al. 2014), which provided new estimates of the magnitude, location, and time-averaged frequency of potentially damaging earthquakes in California based on research since the previous report (UCERF2) in 2007. On a statewide basis, the estimated likelihood of a M 8.0 or greater earthquake in the next 30 years has increased from about 4.7% in UCERF2 to about 7.0% in UCERF3, in part due to

[5] U. S. Geological Survey, Seismic Hazards Science Center, Custom Hazard Maps tool, http://geohazards.usgs.gov/hazards/apps/cmaps/, and Peterson et al. (2015).

[6] California Geological Survey, Probabilistic Seismic Hazards Ground Motion Interpolator (2008), http://www.quake.ca.gov/gmaps/PSHA/psha_interpolator.html.

new research highlighting the potential for multi-fault ruptures during a single event. The implications of the revised earthquake forecast for ground shaking hazards at SONGS are not clear, though it is notable that the 30-year likelihood of a large (>M 6.7) earthquake on the offshore Newport-Inglewood-Rose Canyon fault system has been revised downward slightly since the 2007 forecast.

ISFSI Seismic Design

The proposed ISFSI has been designed to withstand ground shaking of much greater magnitude than contemplated in either the Units 2 and 3 licensing review or the more recent probabilistic analyses summarized above. The "Most Severe Earthquake" (MSE) variant of the spent fuel storage system,[7] for which the NRC approved an amendment to HI-STORM UMAX Certificate of Compliance (CoC) on September 8, 2015, has been designed to withstand a net horizontal zero-period acceleration (ZPA) of 2.12 g and vertical ZPA of 1.0 g (for a very high-rigidity structure, such as the proposed ISFSI, ZPA ≈ PGA). **Exhibit 6** shows the horizontal (X+Y) and vertical seismic spectra for which the proposed project is designed, together with spectra corresponding to the seismic design for SONGS as a whole, derived from the design basis earthquake described above (Holtec 2015). The spectra labeled "SONGS" are derived from the NRC-approved "free-field" spectra and take into account the interaction of the proposed structure with ground motions, which tends to amplify shaking. The design spectra for the ISFSI were generated following NRC Regulatory Guide 1.60, "Design response spectra for seismic design of nuclear power plants." Comparison of the ISFSI design spectra with the calculated spectra corresponding to the SONGS design basis earthquake shows a large factor of safety. The ISFSI design spectra exceed those of the design basis earthquake at all frequencies. It is accordingly reasonable to conclude that even an earthquake larger and/or closer to the site than the SONGS design basis earthquake, will not produce ground shaking exceeding the design of the proposed project.

Accordingly, the Commission finds that the proposed project, as conditioned, assures stability and structural integrity relating to seismic hazards, consistent with section 30253 of the Coastal Act.

*Surface Rupture*

No active faults were found at the SONGS site during geologic studies related to licensing and construction of Units 2 and 3 (Fugro 1977; Shlemon 1977, 1979). Though several sets of shears in the San Mateo Formation were uncovered during the excavation for Units 2 and 3, they did not offset the overlying terrace deposits, indicating that they had not been active for at least 120,000 years and do not represent recent faulting at the site. Hence, the risk of surface rupture at the SONGS site is very low.

The largest fault near the SONGS site is the Cristianitos fault, a low-angle normal fault passing less than one mile south of the site. Based on several observations, several studies have proposed recent right-lateral strike-slip movement on the onshore Cristianitos normal fault, as well as a re-

[7] The MSE version of the HI-STORM UMAX incorporates three physical design changes to augment the structural integrity of the system: (a) Addition of a hold-down system to the closure lid to prevent its uplift during the seismic event; (b) Use of plain concrete (min. compressive strength 3000 psi) in the interstitial space between storage modules instead of soil fill; (c) Strengthening of the MPC guides to increase their load bearing capacity. (NRC 2015)

activated extension of this fault offshore of northern San Diego County (Fisher and Mills 1991). However, others have shown that the Cristianitos fault near San Onofre beach is overlain by undisturbed terrace deposits, indicating that there has been no movement on it for at least 120,000 years (e.g., Shlemon 1987). The Cristianitos fault is not considered an active fault by the California Geological Survey (Jennings and Bryant 2010).

Accordingly, the Commission finds that the proposed project, as conditioned, assures stability and structural integrity with respect to surface rupture, consistent with Section 30253 of the Coastal Act.

*Liquefaction*

Like all existing SONGS structures, the proposed ISFSI would be underlain by the dense, well-consolidated sands of the San Mateo Formation, which are considered to be at low risk of seismically-induced liquefaction. The overlying terrace deposits were removed during the construction of Units 1, 2 and 3. Although the water table is shallow at the site (approximately +5 feet MLLW) (SCE 2015b), cyclic triaxial tests, field density tests, and very high blow counts during standard penetrometer tests show that liquefaction should not occur during a design basis earthquake (PGA of 0.67 g) (SCE 1998; GEI 2015). Minimum factors-of-safety against liquefaction in the plant area have been calculated at 1.5 to 2.0 (SCE 1998). An independent assessment of liquefaction hazards in the area has identified the SONGS site as an area at low risk of liquefaction (CGS 2002).

A number of studies in northern San Diego County have identified stratigraphic features, including sand dikes, lenses, fissures and disturbed bedding, which have been interpreted as the results of liquefaction occurring in recent geologic history (e.g., Kuhn et al. 1996; Kuhn et al. 2000; Shlemon 2000; Kuhn 2005). For example, Kuhn (2005) noted that a number of these paleo-liquefaction features disturbed late Holocene Native American middens and burial sites within the past 1,000 to 3,000 years, and suggested that they "were likely caused by M ~ 7+ tectonic events inferentially generated by the nearby offshore Newport-Inglewood-Rose Canyon fault system."

Although these features are suggestive, the Commission does not consider them indicative of a serious liquefaction hazard at the proposed project site. Liquefaction in sandstones as dense as those encountered at the SONGS site have not previously been documented in even very large earthquakes; it is far more common for unconsolidated sands or artificial fills to fail by liquefaction. While it is possible that an earthquake much larger than the design basis earthquake might be capable of causing liquefaction of the San Mateo formation sands, no estimates have been provided by any of the cited studies as to the required ground shaking needed to induce such cyclic stresses. In light of the high factor of safety evident in the site-specific studies, and without credible data to the contrary, the Commission finds that the applicant has adequately addressed the liquefaction hazard at the site.

Accordingly, the Commission finds that the proposed project, as conditioned, assures stability and structural integrity with respect to liquefaction, consistent with Section 30253 of the Coastal Act.

**Slope Stability**

The proposed ISFSI site is located approximately 55 feet southeast of a cut slope rising to 77 feet above the NIA grade, and approximately 300 feet southwest of a somewhat lower cut slope (**Exhibits 3, 9**). Both slopes are largely covered in gunnite. During studies for the SONGS Unit 1 ISFSI facility (CDP #E-00-001), SCE analyzed the stability of these slopes along four cross-sections during seismic shaking corresponding to the design basis earthquake (ground-shaking intensity of 0.67 g, described above), concluding that only minor sloughing of near slope surface material would occur and that minimum factors of safety ranged from 1.7 to greater than 3 (SCE 1995). An additional evaluation concluded that, if a massive failure on the nearer northwest slope were to occur, the maximum distance the soil would be likely to travel would be 120 feet from the toe of the bluff (Hadidi 2000). More recent re-analyses of slope stability and slope toe run-out at the site yielded factors of safety of about 1.5 and projected slope toe run-out distances between 91 feet and 107 feet (Pham 2007; Hinkle 2011; Ninyo and Moore 2015).

The design of the ISFSI is such that the storage modules will be built partially below grade and encased in a concrete and fill berm, with only the tops of the modules (the steel and concrete closure lids) exposed at the top of the ISFSI Pad, at an elevation of approximately 32 feet MLLW (about 12.5 feet above the NIA grade (**Exhibit 3**). Although portions of the ISFSI would be within the potential run-out zone during a large slope failure, but due to the design of the facility, would not be vulnerable to damage. The portion of the ISFSI nearest the northwest slope, the "the "Approach Slab", though only 54 feet from the bluff toe, is a flat expanse of concrete at the top of the ISFSI berm that could be covered by soil during a slope failure without affecting the structural integrity of the facility. The closure lids of the nearest row of storage modules would be 98 feet from the bluff toe (**Exhibit 3**), and thus within the larger of the projected run-out zones (107 ft; Ninyo and Moore 2015). However, the Ninyo and Moore (2015) analysis did not account for the relief of the ISFSI berm, which rises to a height of approximately 12.5 above the NIA grade, with a 45 degree slope at its margins. A more recent analysis provided by SCE, which accounts for the presence of the ISFSI berm, indicates that the maximum soil run-out could advance up the ISFSI berm to point approximately 70 feet from the bluff toe, well short of the nearest storage modules (Pham 2015).

In summary, the relatively high factors of safety calculated for the cut slopes adjacent to the project site suggest that the slopes are likely to remain stable during a large earthquake. Moreover, in the event that a major slope failure does occur, soil run-out would not reach the fuel storage modules or otherwise compromise the stability and structural integrity of the proposed ISFSI.

Previous studies have identified several coalescing large active landslides affecting the coastal bluffs south of SONGS (e.g., Kuhn 2000, Kuhn and McArthur 2000). These slides are seated within the Monterey Formation, which is known to contain weak layers making it vulnerable to landsliding. In contrast, the project site, and the SONGS as a whole, is underlain by well-consolidated San Mateo Formation sandstone to a depth of at least 900 feet, and there is very little risk that a landslide similar to those occurring to the south could involve the SONGS site itself. Information provided by SCE to the Commission during the review of the previous ISFSI project (CDP #E-00-014) demonstrated that the SONGS site has experienced very little

settlement or differential vertical movement since it was constructed, ruling out the existence of a slow-moving, deep-seated landslide beneath the site.

Based on this information, the Commission finds that the proposed project, as conditioned, assures stability and structural integrity with respect to the stability of the slopes adjacent to and underlying the proposed project, consistent with Section 30253 of the Coastal Act.

**Bearing Capacity**

The proposed ISFSI facility is a massive structure (approximately 584,000 cubic feet in volume), consisting of a concrete foundation pad, a concrete and fill subgrade, a concrete surface pad, and 75 steel and concrete fuel storage modules, each receiving a stainless steel MPC (containing the spent fuel assemblies) and weighing approximately 190,000 pounds. When fully loaded, the UMAX system would weigh approximately 87 million pounds. For perspective, this figure can be compared with the weight of the terrace deposits and upper portions of the San Mateo Formation formerly overlying the site. Since these deposits were approximately 70 feet thick, with a unit weight of approximately 102 – 117 pounds per cubic foot, the deposits formerly overlying the 25,000 square foot area of the UMAX system would have weighed approximately 179 to 205 million pounds. Thus, even after the construction of the project, the weight applied to the San Mateo Formation would be less than 50% of the weight of the overlying rock prior to the development of SONGS.

More relevant to the question of the ability of the site materials to support the ISFSI is a calculation of the bearing capacity of the San Mateo Formation relative to general or local shear failure. SCE has provided a technical analysis showing the static ultimate bearing capacity for the proposed ISFSI (SCE 2015g). When calculating the allowable static bearing capacity, a standard safety-factor equal to 3 is built into the capacity value for a static loading combination.

The calculated allowable static bearing capacity for substrates underlying the ISFSI (San Mateo Formation plus overlying sand/gravel fill layer) is approximately 43,500 pounds per square foot. When considering the calculated weight of the ISFSI and the effective area, the foundation will only be loaded to approximately 3,900 pounds per square foot (additional factor of safety > 11). SCE also provided a dynamic analysis of the proposed ISFSI demonstrating the capacity of the pad design under seismic loading. This analysis uses 1.5 g horizontal and 1.0 g vertical ground acceleration in order to demonstrate the adequacy of the foundation and to show that the concrete pads will not fail during an earthquake with the specified ground accelerations. When calculating the allowable seismic loading combination bearing capacity, a standard safety-factor equal to 2 is built into the capacity value for a seismic loading combination. The calculated seismic allowable bearing capacity is shown to be approximately 65,150 pounds per square foot while the seismic bearing pressure as a result of the ISFSI is shown to be 12,800 pounds per square foot (additional factor of safety > 5). In both the static and dynamic cases, a sufficient factor of safety exists to conclude that the ISFSI will not exceed the bearing capacity of the site, and that the concrete pad will not fail during an earthquake with the specified ground accelerations.

Accordingly, the Commission finds that the proposed project, as conditioned, assures stability and structural integrity, with respect to materials at the site have sufficient bearing capacity, consistent with section 30253 of the Coastal Act.

**Coastal Hazards**

*Tsunamis*

Several previous studies have estimated the potential run-up and inundation that would occur on the SONGS site during a tsunami event. The Safety Evaluation Report prepared by the NRC at the time of licensing hearing of Units 2 and 3 examined both local- and distant-sourced tsunamis (NRC 1981). SCE's model of the local-source tsunami (resulting from a 7.5 earthquake occurring along the Newport-Inglewood-Rose Canyon fault system, 8 km offshore, with vertical ground motion of 7.1 feet) projected a wave height of 7.6 feet. Superimposing this tsunami on a 7-foot high tide (the 10% exceedance Spring high tide for the site) and a one-foot storm surge, resulted in a maximum "still" water level of 15.6 feet MLLW (SONGS 2&3 FSAR). In its review, the NRC generally agreed with this model, arriving at a maximum still water level of 15.83 feet MLLW. In these calculations, the presence of the seawall was ignored. In its application to the Commission for the 2001 ISFSI (CDP #E-00-014), SCE provided additional modeling addressing the wave runup that could be expected if tsunami struck the site in conjunction with both high tide and storm surge (SCE Geotech Group 1995). Under these conditions, and discounting the presence of the Unit 1 seawall, it was projected that maximum wave runup would reach an elevation of 18.8 feet MLLW. Notably, these analyses considered only tsunamis generated by earthquakes, but did not address the potential for tsunamis generated by submarine landslides, which are known to have occurred along the Southern California coast in the past (Legg and Kamerling 2003).

More recently, a new site-specific analysis was conducted as part of SCE's 2013 *Calculations for a Probable Maximum Tsunami* report (Kirby 2013), which considered both local- and distant-sourced events as well as local tsunamis generated by submarine landslides. Models of far field tsunami sources associated with large subduction-zone earthquakes (M 9.0 – 9.5) from around the Pacific Rim (e.g., Aleutians, Kuril Islands, Japan Islands, Chile) yielded tsunami wave run-up elevations ranging from 8.5 to 22 feet MLLW, with the largest tsunamis produced by earthquakes in the eastern Aleutian Islands.[8] Models of locally-sourced tsunamis, including those resulting from a M 7.5 earthquake along a theorized offshore blind thrust fault and from submarine landslides offshore of San Diego County, yielded maximum run-up elevations ranging from 10 to 21.5 feet MLLW. A recent, independent evaluation of potential tsunami inundation at the SONGS site is provided by the *Tsunami Inundation Map for Emergency Planning* (San Onofre Bluff quadrangle), prepared by the State of California in 2009. The purpose of this series of maps was to identify a "credible upper bound" of potential inundation at any location along the coast, based on a combination of potential tsunami source events, including both local and fair field sources. At SONGS, the map shows the entire NIA area to be within the potential tsunami inundation zone and suggests a credible upper bound to potential inundation of 20 to 23 feet MLLW.

Given that the grade elevation within the NIA is approximately 19-20 feet above MLLW, it is possible that the base of the ISFSI structure could be inundated or subject to wave runup during a

[8] For comparison, actual tsunami run-up heights observed along the Southern California coast following large historical earthquakes on the Pacific Rim, including the M9.5 1960 Chilean earthquake, M9.2 1964 Alaskan earthquake, and M8.8 2010 Chilean earthquake, ranged from 4.9 to 12.5 feet above MLLW. (California Geologic Survey, *Historic Tsunamis in California*, http://www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/Pages/About_Tsunamis.aspx#historic)

large tsunami event at some point during the life of the project. In the near term, the top of the ISFSI pad, at +32 feet MLLW, would likely remain above the inundation elevation under the scenarios discussed above. However, the entire structure could be subject to wave run-up in the most extreme scenario, if a large tsunami were to coincide with both high tide and major winter storm and high wave conditions (see below). Rising sea level will further exacerbate this situation (e.g., *see* **Exhibit 7**).

Information provided by SCE indicates that temporary inundation has been factored into the design of the ISFSI and its components, including the MPCs, such that overtopping of the facility by a large tsunami would not adversely affect its stability and structural integrity. Specifically, the storage module components, including the Cavity Enclosure Containers (CEC), Closure Lids, and MPCs, have been designed to withstand water submergence to a depth of 125 feet and missile impacts exceeding those that could be expected from tsunami-carried debris (Holtec 2014a, b). Additionally, the weld-sealed MPCs have been designed to prevent water intrusion in the event that flood water entered the ventilation space between the MPC and CEC.

In summary, the Commission concludes that although the project could be subject to tsunami flooding within the next 35 years, particularly if projected levels of sea level rise occur, the proposed ISFSI has been designed to resist temporary inundation, wave run-up and water contact. Therefore, the proposed development, as conditioned, will minimize flooding hazards consistent with Section 30235 of the Coastal Act.

*Coastal Flooding & Sea Level Rise*

With a grade elevation of approximately 19-20 feet MLLW, and a top elevation of 32 feet MLLW, the proposed ISFSI would not, at present, be vulnerable to inundation under normal high tide (MHHW ≈ +5.8 feet MLLW) and/or storm conditions. As a part of its CDP application, SCE prepared an analysis of future flood conditions over the proposed life of the development (SCE 2015a, d, h), using the sea level rise projections (National Research Council 2012) recommended in the Commission's 2015 Sea-level Rise Policy Guidance (CCC 2015). The analysis examined changes in water level and wave run-up conditions resulting from several sea level rise scenarios at different points in the future. SCE used an additive approach to examining changes in runup, assuming that the future high still water level would be the current mean high tide plus some amount of sea level rise, and that the future runup would be the current runup plus future sea level rise plus some forcing and surge. The analysis indicates that sea level can be expected to rise 0.4 to 2.0 feet by 2051, depending on which scenario is used. Under the high sea level rise scenario, and assuming an additional foot of sea level height associate with wind and storm surge and/or oceanographic forcing (such as due to an El Niño event), SCE estimated that the still-water level in 2051 at mean high tide could reach 7.8 feet MLLW. A more extreme high tide of +6.9 feet MLLW, combined with 1 foot of storm surge, 2 feet of sea level rise and maximum wave run-up, could result in temporary flooding up to 25.0 feet MLLW (SCE 2015h).[9] Commission staff notes that a maximum high tide at SONGS (>7.2 feet MLLW), 1 foot of storm surge *and* temporary high sea level associated with a large El Nino event (+0.4 to 1 ft) (Flick 1998; CCC 2015) could add an additional 0.5 to 1.5 feet to this projected flooding.

[9] However, run up does not change linearly with changes in water level, so these estimates of how run-up will change with changes in water levels likely underestimate potential run-up.

In summary, it appears possible that, in the absence of expanded or enlarged shoreline protection, the ISFSI site could be subject to occasional coastal flooding. However, as discussed above in relation to tsunami hazards, the proposed ISFSI has been designed to resist temporary inundation, wave run-up and water contact. Therefore, the proposed development, as conditioned, will minimize flooding hazards consistent with Section 30235 of the Coastal Act.

*Coastal Erosion & Bluff Retreat*
In their natural state, coastal bluffs at the SONGS are composed of highly-erodible terrace deposits underlain by the more resistant San Mateo Formation sandstone. During the construction of Unit 1 in the 1960s, the bluff was essentially removed. Over 70 vertical feet of terrace deposits and upper layers of the San Mateo Formation were removed, and the plant foundations were set in San Mateo Formation bedrock. The result of the excavation is that the new "bluff face" and upper edge is situated landward of the NIA. At this time SCE also installed a shoreline protection system, consisting of a rock revetment and a concrete encased, steel sheet-pile seawall rising to an elevation of approximately 28 feet MLLW, in front of Unit 1 at the time of construction. As a result, there has been little or no measurable shoreline retreat at the project site over the past 50 years.

The natural rate of bluff retreat in the San Onofre area is somewhat difficult to assess, due both to its episodic nature and to the varying mechanisms of retreat along the coast. Active bluff retreat is occurring south of the project site at San Onofre State Beach, where the bluffs consist of Monterey Formation bedrock overlain by terrace deposits and where runoff has been artificially concentrated in drainage channels associated with Interstate 5. Substantial subaerial erosion of the terrace deposits and Monterey formation has occurred in this area, taking the form of headward erosion of gullies, slumping of the bluff faces, and deep-seated landslides. However, as discussed above, these landslides are seated in the Monterey Formation (known to be susceptible to sliding) south of the Cristianitos Fault, and have not occurred in the dense San Mateo Formation sandstones underlying the SONGS site. The mechanisms of seacliff retreat in the San Mateo Formation at the SONGS site are less clear, but the shape of the seacliff suggests dominantly marine processes, such as undercutting, block collapse, and slumping of poorly consolidated upper bluff terrace materials. Distinct gullying of the terrace deposits is also evident in the unaltered seacliffs to the north and south of the SONGS seawall (**Exhibit 2**).

Studies undertaken by the U.S. Army Corps of Engineers in the 1950s concluded that no measureable retreat of the bluff line occurred near the SONGS site between 1889 and 1954 (USACE 1960). More recently, the U.S. Geological Survey has evaluated coastal bluffs to the north and south of SONGS, and estimated that long-term bluff retreat rates range from 6 - 20 inches per year at the base of unprotected slopes within the San Mateo Formation (Hapke and Reed 2007; Hapke et al. 2007). Due to the presence of shoreline protection at the project site, no site-specific estimates of bluff retreat rates are available, but it is likely that the USGS upper estimate of 20 inches per year provides a conservative basis for evaluating the project's vulnerability to undercutting by coastal erosion in the absence of shoreline protection.

At its nearest, the proposed ISFSI pad would be located approximately 100 feet from the seawall adjoining the NIA (**Exhibit 3**), which, based on shoreline cross-sections provided by SCE, is

assumed to correspond to the toe of the remnant bluff underlying the project site. The nearest UMAX storage module would be approximately 125 feet from the seawall. Discounting the presence of the existing shoreline armoring, a maximum average bluff retreat rate of 20 inches per year over the proposed 35-year life of the project would equate to a total bluff retreat of 58 feet, or about half of the distance between the existing seawall and the proposed ISFSI facility. Even recognizing that shoreline erosion processes are highly episodic, and that the actual magnitude of bluff retreat from year to year can deviate greatly from the long-term average, the proposed setback of approximately 100 feet would appear to be adequate to assure stability of the project site through the proposed project duration, without requiring new or expanded shoreline protection.

*NIA Seawall Adjoining Proposed Development*
Past bluff erosion at the project site has been greatly retarded over natural rates by the existing shoreline armoring in front of the NIA, consisting of a steel sheet pile and gunnite seawall, a concrete public access walkway and retaining wall, and a rock revetment (**Exhibit 8**).
The NIA seawall was built in 1966 to protect SONGS Unit 1from tsunami hazards. The wall extends approximately 650 feet on the seaward side of the NIA between the northwestern bluff and the junction with the Units 2 and 3 seawall. The seawall is composed of ⅜-inch think steel sheet piling covered on both faces by a 2½-inch layer of gunnite secured by wire mesh. The sheet piling is embedded to a depth of approximately 22 feet below the NIA grade (to an elevation of approx. -10 feet MLLW), and extends to a height of approximately 28 feet MLLW. The toe of the seawall was initially protected by a 12-foot wide rock revetment (1-4 ton rocks), but in 1982 a 15-foot wide public access walkway and reinforced concrete retaining wall were built over the original revetment, and a new, 20-foot wide revetment was placed at the base of the retaining wall to protect the walkway and seawall from undercutting.

Information provided by SCE indicates that the embedded portion of the seawall suffers from areas of localized corrosion, including several through-going holes, and that the structure has outlived its project design life (SCE 2015b). In 1986, when the corrosion was first discovered, SCE installed a corrosion monitoring system to ensure that the seawall sheet piling was structurally adequate, but this monitoring was discontinued in 2007 with the final decommissioning of Unit 1. SCE has acknowledged that as of 1996, the seawall is "no longer credited in the design for tsunami protection of the site" (SCE 2015b). In contrast, SCE has indicated that the condition of the rock revetment has not changed since its emplacement, and argues that the seawall is protected from scour by the revetment (extending down to +3 feet MLLW) and retaining wall (extending to +7 feet MLLW).

The uncertain level of degradation to the seawall sheet piling, together with its relatively shallow depth of emplacement, lack of foundation elements, and the lack of an engineered key to the rock revetment, suggests that maintenance and repairs may be necessary for the continued function of the shoreline protection structures, and that they cannot be counted upon to prevent erosion and flooding at the site in future decades.

**Reasonably Foreseeable Long-term Hazards**
As discussed previously, there remains a significant degree of doubt as to when, or if, a permanent, off-site repository for the SONGS spent nuclear fuel will become available. It is

similarly uncertain whether an off-site interim storage facility will be developed which could eventually accept SONGS spent fuel after the proposed project term of 2051. The proposed life of the ISFSI project is based on the assumption that the DOE will begin accepting spent fuel, on a nation-wide basis, beginning in 2024, with the first transport of SONGS 2 and 3 fuel beginning in 2030 (SCE 2014a, 2014b). If the DOE is unable to fulfill this commitment, or if the shipment of spent fuel to an off-site location is otherwise delayed, storage in the proposed ISFSI could be required beyond 2049, and the ISFSI would not be decommissioned and removed by 2051, as proposed. In the worst case, no federal repository or other storage alternative would be developed, and the proposed ISFSI would remain on the SONGS site in perpetuity.

In this scenario, or any other in which the ISFSI remained in its proposed location for many decades, there would come a time when the facility would be exposed to geologic hazards, and when the proposed project configuration and design could no longer assure stability and structural integrity without requiring shoreline protection, and would thus no longer fulfill the requirements of Coastal Act Section 30253.

For purposes of illustration, it is useful to consider potential future coastal hazards in relation to the project after 100 years, in the early 22nd century. SCE's flood risk analysis suggests that after 100 years, in the year 2117, sea level could have risen between 1.8 and 7 feet; at future mean higher high tide, the still water elevation could be up to 12.8 feet above modern MLLW, approaching the lowest elevations within the NIA (about 13 ft MLLW in the drainage sump area and near the seawall). Factoring in additional water height attributable to storm surge, oceanographic forcing, and wave run-up could result in flooding to elevations above 30 feet MLLW. The combined results of high tide, storm surge, and a large tsunami would be expected to flood the entire NIA area, as illustrated in **Exhibit 7**.[10] If, as expected, sea level continues to rise in response to global warming, higher water levels would expose the project site to ever more frequent flooding, and eventually permanent inundation.[11] Even if the proposed ISFSI could be shown to be designed to withstand frequent flooding, inundation and exposure to ocean waves, a location within the surf zone would place major practical constraints on SCE's ability to load and unload fuel-filled MPCs, monitor and maintain the ISFSI components, and eventually decommission and remove the facility without adverse impacts to marine resources.

Similarly, in the absence of shoreline protection, the natural processes of coastal erosion and bluff retreat would eventually undermine the proposed project site and compromise the stability and structural integrity of the ISFSI. A crude calculation using a maximum estimated bluff retreat rate of 20 inches per year (Hapke et al. 2007, for unprotected slopes in San Mateo Formation bedrock) indicates that erosion could begin to undermine the ISFSI structure by approximately 2077. However, several factors, including the fact that the upper layers of the

[10] **Exhibit 7** illustrates a scenario of complete flooding within the NIA in the year 2100, based on the water level contributions sea level rise (National Research Council 2012 high scenario), mean higher high tide conditions, 1 foot of storm surge and/or oceanographic forcing, and an additional tsunami wave run-up of 22 feet. A maximum flood scenario would factor in storm waves in addition to the tsunami and a larger term for surge and oceanographic forcing.

[11] For example, one recent modeling study projected between 7 – 17 feet of sea level rise (base year 2000) by the year 2300 under a moderate greenhouse gas emissions scenario (Schaeffer et al. 2012); another, examining a high emissions ("business-as-usual") scenario, projected between 7.4 and 38 feet of sea level rise by the year 2500 (Jevrejeva et al. 2012). The broad ranges in these projections reflect the high degree of uncertainty inherent to long-term modeling, but nonetheless demonstrate the potential for extreme sea level rise within the next several centuries.

subsurface within the NIA consist of fill, which may be more easily eroded that native bedrock, that the rate of erosion would be expected to increase with rising sea level, and the inherently unpredictable and episodic nature of bluff retreat, could put the ISFSI at risk much sooner.

The Commission cannot conclude that the proposed ISFSI location would assure stability and structural integrity and minimize risks to life and property from coastal hazards, and shoreline erosion in particular, without requiring new or expanded shoreline protection. Thus, in order to find the project consistent with the policies of Coastal Act Section 30253(a) and (b), it must be able to assure the following:

(1) Shoreline protection devices would not be extended, nor new devices constructed;

(2) The ISFSI would no longer be present when the project site became threatened by long-term coastal hazards.

Given that there is presently no certainty that the spent fuel to be stored in the ISFSI will have been removed to a federal repository (or other off-site facility) by 2051 or any other specific future date, assurance of (2) above would need to be supported by three additional assurances:

(a) The fuel could be transferred to a new, on-site ISFSI at lower risk from long-term geologic hazards than the proposed NIA facility; or

(b) Based the best evidence available at the time, the proposed ISFSI location within the NIA would not be threatened by geologic hazards within the timeframe of a revised/updated schedule for off-site transfer of the fuel; and

(c) The MPCs stored within the ISFSI fuel modules would remain in a physical condition adequate to allow safe off-site transport (i.e., to a DOE facility) or on-site relocation (i.e., to a new ISFSI), and thus allow the proposed ISFSI to be removed.

*No New or Extended Shoreline Protection*

The existing shoreline protection system (rock revetment, sheet-pile seawall) seaward of the NIA was installed in 1966 to protect Unit 1, and was later expanded (to include the public access walkway and retaining wall) and effectively joined with the newer structures protection Units 2 and 3. During this time, the SONGS shoreline protective devices have adversely affected shoreline sand supply and contributed to the erosion of the beach by (a) directly encroaching on beach area; and (b) retarding the natural retreat of the bluff, which both prevents new beach area from being created and eliminates the delivery of sand to the beach and local littoral cell through bluff erosion.

In the absence of a permanent federal repository for spent nuclear fuel, or the development of some other federal, state or private off-site interim storage facility, the SONGS spent fuel could remain in the proposed ISFSI for many years beyond the intended date of removal. The long-term potential therefore exists that the proposed ISFSI site could be undermined by shoreline retreat and/or subjected to flooding as a result of sea level rise, storm waves or a tsunami event and the proposed new development could potentially require an expanded or replaced shoreline protective device.

Coastal Act section 30253 prohibits the approval of new development if hazards would affect the proposed development and necessitate construction of a new, expanded or replaced shoreline

protective device to protect it. Because this policy requires that new development avoid the need for a new, expanded or replaced shoreline protective device, the Commission finds that the proposed development is consistent with the Coastal Act only if it is conditioned to provide that such shoreline protection will not be constructed. Therefore, in order to find the proposed development consistent with Section 30253 of the Coastal Act, the Commission imposes **Special Condition 3**. This condition requires that SCE agree to not extend, enlarge or replace the existing shoreline protective devices, or to construct new shoreline protection, for purposes of protecting the proposed ISFSI facility and ancillary structures (e.g., security building, fencing, etc.) from future coastal hazards.

*Future On-site Alternatives and Managed Retreat*
As discussed in a previous section, the decommissioning of SONGS Units 2 and 3 is planned to occur over the next 15 – 20 years, and would result in the removal of most major structures currently occupying the site. Thus, beginning in the early 2030s, there will be a number of additional locations within the area covered by the SONGS Part 50 site license where an ISFSI could conceivably be built, which were not available at the time SCE initially conducted its alternatives analysis. A number of these locations are at higher elevations (+30 – 80 feet MLLW) and greater distances from the shoreline (up to 900 feet) than the proposed ISFSI site in the NIA, and may prove to be safe from coastal hazards over a longer period of time. If the proposed ISFSI must remain on-site beyond 2051 for a long or indefinite period of time, it may prove necessary to relocate the ISFSI to another site better able to minimize hazards and assure the stability of the facility over the long-term.

In order to guard against the possibility that the proposed ISFSI would remain in place beyond 2051 *and* become exposed to geologic hazards in the future, the Commission adopts **Special Condition 2**, which authorizes the proposed development for a period of twenty years from the date of approval (i.e., until October 6, 2035). Special Condition 2 also requires that, at least six months prior to the end of this term, SCE apply for a CDP Amendment to retain, remove or relocate the proposed ISFSI facility. The CDP Amendment application shall be supported by (a) an evaluation of current and future coastal hazards based on the best available information; (b) an alternatives analysis examining the merits and feasibility of both off-site and on-site alternatives, including potential locations within areas made available by the decommissioning of SONGS Units 2 and 3; and (c) a plan for managed retreat, if retention of the ISFSI facility beyond 2051 is contemplated and coastal hazards may affect the site within the timeframe of the amended project.

*Cask Transportability and Removal of the ISFSI*
Ultimately, SCE's ability to avoid long term coastal hazards and the need for shoreline protection, and thus assure consistency with Coastal Act Section 30253, depends on its ability to eventually remove the ISFSI from the proposed site. In turn, the removal of the ISFSI depends on the fuel storage casks (MPCs) remaining in a condition adequate to allow safe removal from the storage modules and transfer to a new location. This is true regardless of the timing and circumstances of the ISFSI removal, whether in 2051, with the fuel being transferred to a permanent repository, in 2035, in conjunction with relocation to a new on-site ISFSI, or at some future date as a part of a plan of managed retreat to avoid coastal hazards.

The storage cask that would be used in the proposed ISFSI, the Holtec model MPC-37, is constructed from corrosion-resistant stainless steel, with a design life of 60 years (Holtec 2014a, b). With implementation of a monitoring and maintenance program, as well as an Aging Management Plan to be developed as a condition of license renewal for the HI-STORM UMAX system beyond the initial 20-yr term, SCE expects the service life of the ISFSI and casks to be at least 100 years (SCE 2015b). SCE does not anticipate that major repairs to the ISFSI or components would be needed within either the 60-year design life or 100-year service life of the system, but has stated that corrective actions and contingency plans will be developed in the future as a part of the Aging Management Plan (*see* Subsection A, above).

While the designs of the ISFSI and fuel storage casks appear to be robust, there are several uncertainties. The first is that the stainless steel MPCs will be in continual contact with moist, salt-laden marine air, and as a result could, over time, experience a type of degradation known as stress corrosion cracking. The initiation and growth of stress corrosion cracking in stainless steel fuel storage casks are not fully understood and remain a topic of active research, but these processes are likely to be accelerated in a coastal environment such as at SONGS (e.g., Kain 1990; Bryan and Enos 2014; EPRI 2014). Commission staff is not aware of any documented instances of stress corrosion cracking in fuel storage casks at other nuclear power plants. However, the NRC has collected evidence of stress corrosion cracking in other welded stainless steel components at several coastal nuclear power plants (Dunn 2014). The components in question had been in service for 16 to 33 years (average 25 years), and estimated crack growth rates ranged from 0.11 to 0.91 mm/yr. Elsewhere, the NRC has estimated that at least 30 years would be required for the initiation of stress corrosion cracking in steel fuel storage casks (NRC 2014).

Additional long-term uncertainties remain due to lack of completion of SCE's proposed MPC monitoring and maintenance program. Based on information provided to staff, SCE would implement the following measures: (a) the monitoring of environmental conditions, such as temperature and humidity, that could influence the risk of corrosion and degradation of the stainless steel MPCs; (b) visual observation, surface measurements, and other inspection techniques to provide information on the physical condition of the MPCs; and (c) use of an empty cask ("coupon") as a surrogate for filled casks to allow for more thorough inspection and evaluation (SCE 2015f). However, SCE has also indicated that the "non-destructive examination techniques" and "remote surface inspection tools" that would be used to inspect the storage casks have not yet been developed or tested for effectiveness, and it is unclear when they would be available for use at SONGS. It must also be noted that the only existing requirements for the development of a monitoring and inspection program are associated with the Aging Management Plan required for *renewal* of the 20-year NRC license for the ISFSI system. Though SCE has indicated that it would seek to begin the monitoring and inspection of the ISFSI components well before the end of the initial license, it is possible that no detailed inspection of the casks would occur within the first 20 years of their emplacement.

As a part of its licensing processes, the NRC has reviewed the design of the HI-STORM UMAX (version MSE) system and the supporting documentation and analyses supplied by Holtec, the manufacturer (e.g., Holtec FSAR, CoC amendment application). In the Preliminary Safety

Evaluation Report (SER) supporting the September 8, 2015, final approval of an amendment to the UMAX system's Certificate of Compliance, the NRC determined the following:

> *F3.3 The applicant has met the specific requirements of 10 CFR 72.236(g) and (h) as they apply to the structural design for spent fuel storage cask approval. The cask system structural design acceptably provides for*
>
> - *Storage of the spent fuel for **a certified term of 20 years.***
>
> *F3.4 The applicant has met the requirements of 10 CFR 72.236 with regard to the inclusion of the following provisions in the structural design:*
>
> - *Adequate structural protection against environmental conditions and natural phenomena.*
>
> …
>
> - *Structural design that is compatible with retrievability of spent nuclear fuel (SNF).*
>
> *The staff concludes that the structural properties of the structures, systems and components of the CoC No. 1040, Amendment No. 1 are in compliance with 10 CFR Part 72, and that the applicable design and acceptance criteria have been satisfied.* ***The evaluation of the structural properties provides reasonable assurance that the HI-STORM UMAX Canister Storage System Amendment No. 1 will allow safe storage of SNF for a licensed (certified) life of 20 years.*** *This finding is reached on the basis of a review that considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices.* [Emphasis added]

As described previously, the Commission is preempted from imposing regulatory requirements concerning radiation hazards and safety. However, in order to find the project consistent with the geologic hazards policies of the Coastal Act and in recognition that the project itself proposes interim temporary storage for eventual transport to a federal or other off-site repository, the Commission must have reasonable assurance that the SONGS spent fuel will continue to be transportable, and the ISFSI itself removable, as long as the facility occupies its proposed location. The 20-year NRC licensing and certification of the structural adequacy of the proposed ISFSI system provides such assurance within this limited timeframe, and is roughly consistent with the limited available evidence on when stress corrosion cracking may begin to affect certain stainless steel components in marine environments. Thus, in order to minimize the possibility that the proposed ISFSI would become unremovable, and thus subject to long-term geologic hazards necessitating the use of shoreline protection devices, the Commission adopts **Special Condition 2**, which authorizes the proposed development for a period of twenty years from the date of approval (i.e., until October 6, 2035), and requires that SCE apply for a CDP Amendment to retain, remove or relocate the ISFSI facility prior to the end of this term. Among other things, Special Condition 2 requires that the CDP Amendment application be supported by evidence that the fuel storage casks will remain in a physical condition sufficient to allow off-site transport, and a description of a maintenance and inspection program designed to ensure that the casks remain transportable for the full life of the amended project. The Commission also adopts **Special Condition 7**, which requires that, as soon as technologically feasible and no later than October 6, 2022, SCE provide, for Commission review and approval, a maintenance and inspection program designed to ensure that the ISFSI system and fuel storage casks will remain

in a physical condition sufficient to allow both on-site transfer and off-site transport, for the term of the of the project authorized under **Special Condition 2**. The program shall include descriptions of the cask inspection, monitoring and maintenance techniques that will be implemented (including prospective non-destructive examination and remote surface inspection tools), a data collection and reporting regime, all available evidence related to the physical condition of the casks and their susceptibility to degradation processes such as stress corrosion cracking, and remediation measures that would be implemented if the results of the cask inspection and maintenance do not ensure that the fuel storage casks will remain in a physical condition sufficient to allow on-site transfer and off-site transport for the term of the project as authorized under **Special Condition 2**. If the Commission determines that the maintenance and inspection program is not sufficient to assure cask transportability over the term of the project authorized under **Special Condition 2**, the Applicant shall submit an amendment to the coastal development permit proposing measures to assure cask transportability.

*Assumption of Risk & Restriction on Development*
Although the proposed project has been evaluated, designed and conditioned in a manner to minimize the risk of geologic hazards, the underlying uncertainties of any geotechnical evaluation and the fact that the risks associated with inherently hazardous oceanfront property can never be completely eliminated support a finding that no guarantees can be made regarding the safety of the proposed development with respect to coastal hazards. Geologic hazards are episodic, and areas that may seem stable now may not be so in the future. Accordingly, the Commission is adopting **Special Condition 4**, which requires the Permittee to assume the risks of extraordinary erosion and geologic hazards of the property and waive any claim of liability on the part of the Commission. Given that the applicants have chosen to implement the project despite these risks, the applicants must assume the risks. In this way, the applicants are notified that the Commission is not liable for damage as a result of approving the permit for development. The condition also requires the applicants to indemnify the Commission in the event that third parties bring an action against the Commission as a result of the failure of the development to withstand hazards.

The Commission further finds that Section 30610(b) of the Coastal Act exempts certain additions to existing structures from coastal development permit requirements. Depending on its nature, extent, and location, such an addition or accessory structure at this location could contribute to geologic hazards at the site. Accordingly, Section 30610(b) requires the Commission to specify by regulation those classes of development which involve a risk of adverse environmental effects and require that a permit be obtained for such improvements. Pursuant to Section 30610(b) of the Coastal Act, the Commission adopted Section 13253 of Title 14 of the California Code of Regulations (CCR). Section 13253(b)(6) specifically authorizes the Commission to require a permit for additions to existing structures that could involve a risk of adverse environmental effect by indicating in the development permit issued for the original structure that any future improvements would require a development permit. Since certain additions or improvements to the approved structure could involve a risk of creating geologic hazards at the site, pursuant to Section 13253 (b)(6) of Title 14 of the CCR, the Commission attaches **Special Condition 5**, which requires that all future development on the subject parcel that might otherwise be exempt from coastal permit requirements requires an amendment or coastal development permit. This

condition will allow future development to be reviewed by the Commission to ensure that future improvements will not be sited or designed in a manner that would result in a geologic hazard.

**Conclusion**
Based on the proposed project design and construction, and with the special conditions described above, the Commission finds that the proposed project, as conditioned, is consistent with Coastal Act Section 30253(a) and (b).

**E. MARINE RESOURCES & WATER QUALITY**
Section 30230 of the Coastal Act states:

> *Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.*

Section 30231 of the Coastal Act states:

> *The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface water flow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.*

Section 30232 of the Coastal Act states:

> *Protection against the spillage of crude oil, gas, petroleum products or hazardous substances shall be provided in relation to any development or transportation of such materials. Effective containment and cleanup facilities and procedures shall be provided for accidental spills that do occur.*

The ISFSI would be built approximately 100 feet from the shoreline and would involve construction, excavation and grading activities within the NIA, a previously graded, paved and developed area of the SONGS site. The SONGS site is currently subject to NPDES permits issued by the San Diego Regional Water Quality Control Board (RWQCB); the NIA area is governed by the Unit 2 NPDES permit. The permit includes conditions related to allowable volumes and types of non-radiological discharges from the various facilities on the site and other measures meant to prevent adverse impacts to coastal waters. To the extent that it could lead to new discharges, construction of the ISFSI would be subject to additional review and possible permitting by the RWQCB for conformity to requirements for construction stormwater discharges.

**Construction-related Discharges**
Normal operation of the proposed ISFSI would not result in the discharge of pollutants to coastal waters or otherwise affect marine resources. However, grading and ground disturbance during construction could mobilize sediments which, if washed into the ocean, could adversely affect coastal water quality and marine organisms. Similarly, accidental leaks or spills from construction vehicles and heavy equipment could introduce pollutants into coastal waters.

The proposed construction and grading activities during the installation of the ISFSI would comply with existing water quality, storm water management, and spill prevention plans and their associated best management practices (BMPs). Because these activities – excavation, pouring of concrete, earth movement, use of heavy equipment, etc. – are similar to activities already occurring at SONGS, the existing plans and BMPs provide appropriate controls to avoid and minimize potential water quality impacts. The facility's Storm Water Management Plan (SWMP) includes procedures regard dust control, sediment management and debris cleanup that apply to the types of equipment to be used and activities to be conducted during construction, and use of these procedures will minimize storm water runoff and prevent soil and sediment from entering the ocean. The approximately 14,800 cubic yards of soil that would be excavated from within the NIA would be repurposed as fill material within the ISFSI berm.

The risk of spills of oil or fuel from construction equipment would be minimized by implementation of the existing SONGS Spill Prevention, Control and Countermeasures (SPCC) Plan, which describes the procedures and equipment availability needed to prevent and control spills of hazardous materials on site. SCE will stage all project-related construction machinery and heavy equipment in paved, developed areas inside the SONGS perimeter where the necessary spill prevention controls are already in place, and will refuel vehicles within already authorized areas.

**Potential for Reasonably Foreseeable Impacts**
As discussed in greater detail in previous sections, there remain a number of significant uncertainties related to SCE's ability to decommission and remove the ISFSI facility by 2051, as proposed. In the absence of a permanent federal repository for spent nuclear fuel, or the development of some other federal, state or private off-site interim storage facility, the SONGS spent fuel could remain in the proposed ISFSI for many years beyond the intended date of removal. There is therefore the potential that the proposed ISFSI site will be undermined by shoreline retreat and/or subjected to flooding as a result of sea level rise, storm waves or a tsunami event. Despite the facility's robust design, these geologic forces would eventually result in a loss of stability and structural integrity, and cause the discharge of debris into the coastal ocean to the detriment of water quality and marine organisms.

In order to avoid this outcome, the Commission imposes **Special Condition 2**, which authorizes the approved project for twenty years from the date of approval (i.e., until October 6, 2035), and requires SCE, before this date, to submit an application for a CDP amendment to retain, remove or relocate the ISFSI. This application shall be supported by (a) an evaluation of current and future coastal hazards based on the best available information; (b) an analysis examining the merits and feasibility of off-site and on-site alternatives, including potential locations within areas made available by the decommissioning of SONGS Units 2 and 3; (c) a plan for managed retreat, if retention of the ISFSI facility beyond 2051 is contemplated and coastal hazards may

affect the site within the timeframe of the amended project; and (d) evidence that the fuel storage casks will remain in a physical condition sufficient to allow off-site transport, and a description of a maintenance and inspection program designed to ensure that the casks remain transportable for the full life of the amended project. In addition, the Commission imposes **Special Condition 7**, which requires that as soon as technologically feasible, and no later than October 6, 2022, SCE provide, for Commission review and approval, a maintenance and inspection program designed to ensure that the fuel storage casks will remain in a physical condition sufficient to allow both on-site transfer and off-site transport, for the term of the project as authorized under **Special Condition 2**. If the Commission determines that the maintenance and inspection program is not sufficient to assure cask transportability over the term of the project authorized under **Special Condition 2**, the Applicant shall submit an amendment to this coastal development permit proposing measures to assure cask transportability.

These requirements will afford the Commission the opportunity to re-evaluate the likelihood of SCE's proposed timeline for the removal of the ISFSI before the site becomes vulnerable to coastal hazards and when potential alternative locations on and off-site may be available (including by the decommissioning of SONGS Units 2 and 3), and if necessary impose conditions necessary to mitigate and avoid adverse impacts to marine resources.

**Conclusion**
With the special conditions described above, the Commission finds that the proposed project is consistent with Coastal Act Sections 30230, 30231, and 30232.

**F. COASTAL ACCESS AND RECREATION**
Section 30210 of the Coastal Act states:

> *In carrying out the requirement of Section 4 of Article X of the California Constitution, maximum access, which shall be conspicuously posted, and recreational opportunities shall be provided for all the people consistent with public safety needs and the need to protect public rights, rights of private property owners, and natural resource areas from overuse.*

Section 30211 of the Coastal Act states:

> *Development shall not interfere with the public's right of access to the sea where acquired through use or legislative authorization, including, but not limited to, the use of dry sand and rocky coastal beaches to the first line of terrestrial vegetation.*

Section 30220 of the Coastal Act states:

> *Coastal areas suited for water-oriented recreational activities that cannot readily be provided at inland water areas shall be protected for such uses.*

Section 30212(a) of the Coastal Act states:

> *Public access from the nearest public roadway to the shoreline and along the coast shall be provided in new development projects except where: (1) It is inconsistent with public safety, military security needs, or the protection of fragile coastal resources, (2) Adequate access exists nearby, or, (3) Agriculture would be adversely affected. Dedicated accessways shall not be required to be opened to public use until a public agency or private association agrees to accept responsibility for maintenance and liability of the accessway.*

Coastal Act policies generally require that developments such as the proposed ISFSI, located adjacent to the shoreline in an area with ongoing public use, not interfere with that use and provide access to the shoreline. The proposed ISFSI would be located within the existing SONGS restricted area, to which public access is prohibited under NRC security requirements. Thus, the project would not directly interfere with existing public access. Adequate public access and recreational opportunities are already available in close proximity to the SONGS site, including at public beaches to the north, south and directly in front of the plant, and along the existing pedestrian pathway below the SONGS seawall. However, the project could potentially result in a number of indirect adverse effects on coastal access and recreation through construction-related traffic and noise, and through impacts to shoreline sand supply should the retention and/or extension of the existing shoreline protective devices become necessary to protect the project from future coastal hazards.

**Construction Traffic and Noise**

During project construction, trucks and workers travelling to and from the project site could increase traffic congestion along Old Pacific Coast Highway, a coastal access route inland of the plant. However, the expected traffic volumes are small, would be concentrated during off-peak hours, and would be limited to the approximately one-year period of construction. Construction would not occur during weekends and holidays, with the possible exception of operations such as excavation, pouring concrete or other activities that require continuous work. As a result, increased traffic associated with project construction would not significantly interfere with access to the coast along public roads.

Construction activities also will generate noise, which if loud enough could discourage public shoreline access and recreational activities and adversely affect other sensitive receptors (i.e., sensitive wildlife species). The closest sensitive receptors to the project site would be recreational users and wildlife on the shoreline (including the pedestrian walkway) immediately seaward of the NIA and the Unit 1 seawall, approximately 100 – 150 feet from the project site. Noise impact analyses conducted by SCE indicate that in the worst case, with multiple construction vehicles and heavy equipment operating simultaneously, the maximum noise level at 50 feet would reach 90 dBA ($L_{max}$) (SCE 2015a). At the pedestrian walkway, factoring in the shielding provided by the seawall, the maximum noise levels are estimated to be 60 – 65 dBA, which would not be significantly greater than ambient noise levels at this location. Other sensitive receptors (more distant recreational and habitat areas) would not be significantly affected by construction-related noise.

**Public Beach Access and Recreation**

The existing shoreline protection system (rock revetment, access walkway and retaining wall, and sheet-pile seawall) at SONGS extends approximately 2000 feet between the bluffs northwest of the NIA to beyond the Units 2 and 3 K Buildings (**Exhibits 2, 8**). The segment of this structure seaward of the NIA was installed in 1966 to protect SONGS Unit 1, and was later effectively joined with the structures protecting Units 2 and 3. Landward of the mean high tide line, public access to the SONGS site is prohibited in conformance with NRC requirements, except for passage between sections of San Onofre State Beach north and south of SONGS along the designated public access walkway (*see* **Exhibit 8**).

The NIA shoreline protective devices have adversely affected the beach area and shoreline sand supply by (a) directly encroaching on beach area; and (b) retarding the natural retreat of the bluff, which both prevents new beach area from being created and eliminates the delivery of sand to the beach and local littoral cell through bluff erosion.[12] The direct and indirect loss of public beach below the mean high tide line as a result of these processes necessarily reduces public access and recreational opportunities. This loss of coastal access may occur on the beach area in front of the shoreline protective device or at beaches on either side, depending on local patterns of littoral sand transport. San Onofre lies near the boundary between two local littoral cells (Patsch and Griggs 2006), suggesting that under different conditions, sand may be transported either the north or the south of the SONGS site.

As discussed previously, there are a number of significant uncertainties related to SCE's ability to decommission and remove the ISFSI facility by 2051, as planned. In the absence of a permanent federal repository for spent nuclear fuel, or the development of some other federal, state or private off-site interim storage facility, the SONGS spent fuel could remain in the proposed ISFSI for many years beyond the intended date of removal. Under this scenario, the ISFSI will eventually become threatened by coastal hazards, such as erosion or coastal flooding. As stated above, Section 30253 of the Coastal Act prohibits the approval of new development if hazards would affect the proposed development and necessitate construction of a new or expanded shoreline protective device to protect it. Further, any enlargement or replacement of the existing NIA seawall undertaken in order to protect the proposed ISFSI from coastal hazards has the potential to prolong or increase the adverse effects of the NIA seawall on shoreline sand supply and beach access and recreation in the vicinity of San Onofre.

In order to avoid this outcome, the Commission attaches **Special Condition 2**, which authorizes the approved project for twenty years from the date of approval (i.e., until October 6, 2035), and requires SCE, before this date, to submit an application for CDP amendment to retain, remove or relocate the ISFSI, supported by (a) an evaluation of current and future coastal hazards based on the best available information; (b) an analysis examining the merits and feasibility of off-site and on-site alternatives, including potential locations within areas made available by the decommissioning of SONGS Units 2 and 3; (c) a plan for managed retreat, if retention of the ISFSI facility beyond 2051 is contemplated and coastal hazards may affect the site within the timeframe of the amended project; and (d) evidence that the fuel storage casks will remain in a physical condition sufficient to allow off-site transport, and a description of a maintenance and

[12] This latter effect is likely to have been ameliorated by the placement on the beach of several hundred-thousand cubic yards of sand-sized material excavated from the bluff during plant construction.

inspection program designed to ensure that the casks remain transportable for the full life of the amended project. Additionally, **Special Condition 7** requires that as soon as technologically feasible, and no later than October 6, 2022, SCE provide, for Commission review and approval, an inspection and maintenance program designed to ensure that the ISFSI system and fuel storage casks will remain in a physical condition sufficient to allow both on-site transfer and off-site transport, for the term of the project as authorized under **Special Condition 2**. If the Commission determines that the maintenance and inspection program is not sufficient to assure cask transportability over the term of the project authorized under **Special Condition 2**, the Applicant shall submit an amendment to this coastal development permit proposing measures to assure cask transportability. The Commission also adopts **Special Condition 3**, which requires that SCE agree to not extend, enlarge or replace the existing shoreline protective devices, or to construct new shoreline protection, for purposes of protecting the proposed ISFSI facility and ancillary structures (e.g., security building, fencing, etc.) from future coastal hazards.

With the implementation of the special conditions described above, the Commission finds that the proposed project is consistent with the public access and recreation policies of the Coastal Act.

**G. VISUAL RESOURCES**

Section 30251 of the Coastal Act states:

> *The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas. New development in highly scenic areas such as those designated in the prepared by the Department of Parks and Recreation and by local government shall be subordinate to the character of its setting.*

The SONGS site is situated adjacent to the Pacific Ocean and in close proximity to several scenic areas, including San Onofre State Beach and Camp Pendleton, which were identified in the *California Coastline Preservation and Recreation Plan* (Baker1971). Existing structures at SONGS are partially visible from public roads (Interstate 5, Old Pacific Coast Highway) inland of the site, and from nearby beach and shoreline vantage points. However, the proposed location of the new ISFSI, within the NIA, is one of the least visible portions of the site. Due to the relatively low grade elevation of the NIA (+19 feet MLLW) and the partially below-ground configuration of the proposed ISFSI , the top of the ISFSI pad would rise to only +32 feet MLLW, and thus would be situated below the lines of site of drivers on the public roads inland of the site. Views of the NIA from shoreline vantage points to the north (such as San Onofre State Beach) are blocked by the 96-foot high bluff immediately northwest of the NIA, while SONGS Units 2 and 3 structures obscure views of the site from the beaches and bluffs to the south. The existing NIA seawall, which rises 14 feet above the public access walkway seaward of SONGS, would block views of the ISFSI site from the walkway and the beach. To the extent that the proposed ISFSI would be visible from public vantage points, it would be visually

compatible with the heavily developed, industrial character of the SONGS site. Existing and simulated post-project views of the site are provided in **Exhibit 9**.

Although a substantial amount of excavation (approx. 14,800 cubic yards) will be necessary in order to install the concrete foundation pad and the other subgrade portions of the ISFSI, the coastal bluff remnant on which the NIA is situated was heavily graded (more than 70 vertical feet of bluff material removed) during the construction of SONGS Unit 1, and the present project would not result in significant further alteration of natural landforms.

However, during the process of plant decommissioning it is anticipated that most, if not all, of the structures comprising SONGS will be dismantled and removed, leaving the ISFSI as one of the few remaining major structures on site (SCE 2014a). If the planned work proceeds according to SCE's plans, decommissioning and site restoration will be substantially complete by 2032. On a restored site, the proposed ISFSI will be much more obtrusive and visually incompatible. In the best case, if SCE's assumptions about the removal of the spent fuel to an off-site repository prove true, the adverse visual effects of the ISFSI would persist through 2051. In the event that no permanent repository becomes available, or if the off-site transport of fuel is otherwise delayed, the adverse visual effects of the ISFSI could persist for much longer. In order to minimize impacts to scenic resources, assure that the proposed development would be visually compatible with the character of the surrounding area and allow for the restoration and enhancement of visual quality in a visually degraded area to the maximum extent feasible, the Commission adopts **Special Condition 2**, which will authorize the project for a duration of twenty years from the date of approval (i.e., until October 6, 2035). At least six months prior to that date, SCE is required to submit an application for a new or amended CDP supported by an evaluation of the effects on visual resources of retaining the project, an analysis of available project alternatives and their implications for coastal visual resources, and proposed mitigation measures to minimize adverse impacts to coastal views.

As conditioned, the Commission finds that the proposed project is consistent with Section 30251 of the Coastal Act.

### H. ATTORNEYS' FEES AND COSTS

Coastal Act section 30620(c)(1) authorizes the Commission to require applicants to reimburse the Commission for expenses incurred in processing CDP applications. *See also* 14 C.C.R. § 13055(e). Thus, the Commission is authorized to require reimbursement for expenses incurred in defending its action on the pending CDP application. Therefore, consistent with Section 30620(c), the Commission imposes **Special Condition 6**, requiring reimbursement of any costs and attorneys' fees the Commission incurs "in connection with the defense of any action brought by a party other than the Applicant/Permittee … challenging the approval or issuance of this permit."

### I. RESPONSE TO PUBLIC COMMENTS ON STAFF RECOMMENDATION

Public comments received on the staff recommendation and included in the October 5, 2015 staff report addendum provided disparate perspectives on the proposed project and staff recommendation. A number of commenters expressed support for the staff recommendation. Southern California Edison (SCE), the applicant, offered several comments and multiple

clarifications and technical corrections, but also supported the staff recommendation. Numerous other commenters opposed the project and urged the Commission to deny SCE's coastal development permit (CDP) application. The U. S. Marine Corps did not comment on the project itself, but argued that the Commission lacks jurisdiction to require or issue a CDP for development at the San Onofre Nuclear Generating Station (SONGS) site. The Commission provides the following summary and responses to the arguments made by commenters opposing the staff recommendation:

**Comments Related to Geologic Hazards**
Several commenters, including Ray Lutz, Dorah Shuey, Patricia Borchmann, and Jane Swanson, expressed concern that the proposed ISFSI could be undermined by shoreline erosion, fail during an earthquake, or be flooded during a tsunami or as a result of future sea level rise. Mr. Lutz and Ms. Swanson also noted that the groundwater table at the project site would be near the bottom of the ISFSI structure, and expressed concern that the ISFSI could be adversely affected by contact with groundwater during its period of emplacement.

As discussed at length in the September 25, 2015 staff report, Commission staff evaluated the vulnerability of the proposed project to geologic hazards, including earthquakes, erosion, and coastal flooding, and concluded that the proposed project, with the adoption of **Special Condition 2**, would minimize hazards to life and property and assure stability and structural integrity consistent with Section 30253 of the Coastal Act. No changes to the staff recommendation were made in response to comments regarding these hazards.

Commission staff also evaluated the hydrogeology of the project site and reviewed monitoring well data provided by SCE (SCE 2015b). At the two monitoring wells within the proposed ISFSI footprint, the water table elevation varies by approximately 0.7 feet above and below a mean elevation of about +5.4 feet MLLW, indicating that, at present, natural variability in the water table is not likely to bring groundwater into contact with the base of the concrete ISFSI foundation pad (at +7.5 feet MLLW). Increases in the water table elevation related to sea level rise could potentially lead to intermittent groundwater contact with the base of the ISFSI toward the end of the proposed 35-year life of the project. However, the design of the ISFSI is such that there are multiple barriers, including the 3-foot thick foundation pad and the steel cavity enclosure container (CEC), between the groundwater and the fuel storage casks, and limited contact with groundwater would not undermine the structural integrity of the ISFSI during the proposed project life. Furthermore, as a part of **Special Condition 2,** SCE would be required to evaluate current and future coastal hazards, including the effects of groundwater intrusion, as part of its CDP amendment application should it wish to retain the ISFSI in its proposed location beyond 2035.

**Comments Related to Site Alternatives**
Comments submitted by Michael Aguirre, Ray Lutz and several others argued that SCE has not adequately explored alternative project locations off of the SONGS site. Mr. Lutz's comments included an extensive discussion of the benefits of siting the project away from the coast, and present a conceptual analysis of a hypothetical ISFSI site in the Mojave Desert. In their comments, Ms. Gilmore and Ms. Lynch stated that the potential future alternative (discussed in

the staff report) of relocating the ISFSI within the SONGS site would require a major expense and would greatly increase the current estimate of decommissioning costs.

As discussed previously, Commission staff has reviewed SCE's analysis of off-site alternatives and the Commission agrees with the conclusion that such alternatives are either unavailable or infeasible. No off-site federal permanent repository or private interim storage facility currently exists, and there is no prospect of such a facility becoming available in the near term. Nor is there another inland nuclear power plant with an existing ISFSI that is willing to or licensed to accept spent fuel from another site. Finally, there is no other site under SCE's control that is licensed for the siting of an ISFSI or at which an ISFSI could be developed in a reasonable period of time.

The staff recommendation was based on findings that the proposed project, as conditioned, would be consistent with Coastal Act policies related to geological hazards, the protection of marine and visual resources, and public access and recreation, excluding matters of radiological safety, and does not evaluate the potential cost of any future relocation of the ISFSI within the SONGS site. **Special Condition 2** requires that SCE evaluate the merits and feasibility (including costs) of such alternatives as part of a CDP amendment application to retain, remove or relocate the ISFSI prior to the end of a 20-year term of approval.

**Comments Related to ISFSI and Cask Safety & Radiological Issues**
Comments submitted by Donna Gilmore, Laura Lynch, Gary Headrick, Donald Mosier, Dorah Shuey, Patricia Borchmann, Jane Swanson, Michael Aguirre, Rita Conn, Marv Lewis, Rick Morgal and many others offered numerous arguments for why the proposed Holtec HI-STORM UMAX ISFSI and storage casks are inadequate or inappropriate for storing spent fuel at the proposed site. The main contentions of these comments are summarized below:

(a) *The proposed underground system is unproven and experimental.*
(b) *The 60-year design life and 100-year service life for the UMAX system claimed by SCE and Holtec are unsubstantiated; the Holtec warranty for the system is only ten years.*
(c) *The proposed fuel storage casks are unsafe; stress corrosion cracking can be expected to occur in the stainless steel casks within 20 years.*
(d) *Storage casks used in the existing ISFSI have been loaded since 2003, so SCE will need to have an aging management plan much sooner than 20 years from now.*
(e) *The UMAX system configuration planned for SONGS has not been approved by the NRC; the NRC has only licensed a fully underground system using ½-inch thick fuel storage casks, not the partially-underground system and 5/8-inch casks proposed by SCE.*
(f) *The proposed aging management program is inadequate, and the proposed casks cannot be repaired if damaged.*
(g) *The NRC does not consider or require aging management in their initial 20-year license approvals.*
(h) *High burn-up fuel to be stored in the proposed ISFSI could require up to 45 years of cooling prior to transport to permanent storage.*
(i) *The Commission should not rely on vendor promises of future solutions for inspecting the casks in order to approve this project; there is already sufficient evidence that the*

*proposed casks may not be transportable and maintainable to reject their use; the Commission should demand SCE use a proven system that can be inspected, maintained, monitored and transported, and that doesn't crack.*

(j) *Thick-walled casks are available, and currently used in the U.S., that would provide superior performance in terms of safety and future transportability; the need to acquire a site-specific license to use such casks at SONGS is not sufficient grounds for rejection; the Commission should require SCE to use thick-walled casks as a special condition for approval.*

(k) *Numerous past discharges of radioactive materials have occurred at SONGS; locating the ISFSI at the proposed site would make the area unsafe for public access.*

(l) *SCE is considering loading Areva storage casks from the existing ISFSI into the new UMAX system.*

Without assessing the validity of these concerns, the Commission notes that the consequences of any failure, malfunction, or defects in the proposed ISFSI system are primarily a matter of radiological safety, which is under the exclusive jurisdiction of the federal Nuclear Regulatory Commission (NRC). The state is preempted from imposing upon operators of nuclear facilities any regulatory requirements concerning radiation hazards and nuclear safety. Thus, the findings contained in the staff recommendation addressed only those state concerns related to conformity to applicable policies of the Coastal Act, and do not evaluate or condition the proposed project with respect to nuclear safety or radiological issues.

Staff's analysis indicates that the avoidance of long-term coastal erosion and flooding hazards at the project site (without resorting to shoreline armoring) is dependent on the ability to remove the ISFSI before it becomes vulnerable. At present, the integrity of the proposed ISFSI system is certified by the NRC for 20 years, providing assurance that the casks will be transportable, and the ISFSI system removable, within this timeframe. Commission staff believes that the 20-year duration of approval recommended in **Special Condition 2** is necessary to assure that potential future geologic hazards (and the need for shoreline protection) are avoided, is consistent with the 20-year certification of the HI-STORM UMAX system granted by the NRC, and does not impose any additional regulatory requirements concerning radiation hazards and nuclear safety.

SCE has informed Commission staff that SONGS fuel transported within a HI-STAR 190 transportation cask will require less than 15 years of cooling time starting from reactor shutdown in 2012, with even the most recently offloaded spent fuel ready for transport by 2027 (SCE 10/5/2015). Furthermore, fuel transport schedules contained in SCE's Irradiated Fuel Management Plan and Decommissioning Cost Estimate, both formal regulatory documents submitted to the NRC, indicate that all SONGS spent fuel can be transported offsite by 2049, 37 years after the 2012 reactor shutdown.

Commission staff is not aware of any plan to transfer older fuel storage casks from the existing ISFSI to the new system. This activity was not proposed in SCE's CDP application and would not be authorized by the proposed CDP.

**U. S. Marine Corps Comments**

On October 1, 2015, Commission staff received a letter from the United States Navy and Marine Corps asserting that the Commission lacks jurisdiction to require or issue a CDP for development occurring on the SONGS site. The basis for the Navy and Marine Corps position is that under the Federal Coastal Zone Management Act (CZMA), land, "the use of which is by law subject solely to the discretion of … the Federal Government, its officers or agents" is excluded from the definition of the coastal zone. (16 U.S.C. § 1453(1)).

The U.S. Supreme Court, however, has addressed this issue and determined that the CZMA does not pre-empt application of the California Coastal Act to private activities on federal land. It held that "[b]ecause Congress specifically disclaimed any intention to pre-empt pre-existing state authority in the CZMA, we conclude that even if all federal lands are excluded from the CZMA definition of 'coastal zone,' the CZMA does not automatically pre-empt all state regulation of activities on federal lands." *California Coastal Commission v. Granite Rock Co.* (1987) 480 U.S. 572, 593. Thus, under *Granite Rock*, the Commission retains the authority under the Coastal Act to require coastal development permits for non-federal activities taking place on federal land, such as Southern California Edison's proposed project pending before the Commission.

The U.S. Navy and Marine Corps support their argument that the Commission does not have coastal development permit jurisdiction on federal land by reference to an unpublished U.S. District Court decision, *Manchester Pacific Gateway v. California Coastal Commission* (2008 WL 5642245 (S.D. Cal.)). First, to the extent that the *Manchester* case is inconsistent with the Supreme Court holding in *Granite Rock,* the Supreme Court's decision in *Granite Rock* controls. Second, the *Manchester* case is factually distinguishable from the situation presented by the pending proposal from SCE. The *Manchester* case involved a Congressionally authorized public-private venture that resulted in the Navy obtaining new office space at no cost to the federal government. *Id*. at 1. The court acknowledged that the purpose of that project, as mandated by Congress, was to "provide for the use of private parties to accomplish the federal objective to construct Navy administrative facilities." *Id.* at 5. The project was authorized through legislation that spelled out the general parameters of the project and specifically authorized the project to be jointly developed by the Navy and the private developer. *Id.* at 6. Thus, the project was both a Navy and a private project.

The pending application from SCE does not involve a joint public-private venture. Thus, the facts are not analogous to those presented in the *Manchester* case. Thus, both under *Granite Rock* and due to factual distinctions between these facts and those raised in the *Manchester* case, the CZMA does not pre-empt the California Coastal Act here, and the Commission does have the jurisdiction to require a coastal development permit for the proposed development.

Finally, the Commission notes that the October 1, 2015 letter includes a statement, without elaboration, that the SONGS site is under exclusive federal jurisdiction where State law generally does not apply and the Commission only has jurisdiction over the SONGS site through the consistency provisions of the Coastal Zone Management Act. While the Commission does not disagree that it has jurisdiction over the SONGS site through the consistency provisions of the Federal Coastal Zone Management Act, the Commission finds that the singular statement in the October 1, 2015 letter neither establishes that the SONGS site is under exclusive federal

jurisdiction where state law generally does not apply nor provides sufficient documentation, analysis or other supporting evidence.

### J. CALIFORNIA ENVIRONMENTAL QUALITY ACT

Section 13096 of the Commission's administrative regulations requires Commission approval of coastal development permit applications to be supported by a finding showing the application, as modified by any conditions of approval, to be consistent with any applicable requirements of the California Environmental Quality Act ("CEQA"). Section 21080.5(d)(2)(A) of CEQA prohibits approval of a proposed development if there are feasible alternatives or feasible mitigation measures available that would substantially lessen any significant impacts that the activity may have on the environment. The project as conditioned herein incorporates measures necessary to avoid any significant environmental effects under the Coastal Act, and there are no less environmentally damaging feasible alternatives or mitigation measures. Therefore, the proposed project is consistent with CEQA.

The Coastal Commission's review and analysis of CDP applications has been certified by the Secretary of Resources as being the functional equivalent of environmental review under CEQA. As a responsible agency, the Commission conducted its analysis of the potential impacts of the proposed development that the Commission is authorized by the Coastal Act to review. The Commission has reviewed the relevant coastal resource issues associated with the proposed project and has identified appropriate and necessary conditions to assure protection of coastal resources consistent with the requirements of the Coastal Act. The staff report discusses the relevant coastal resource issues with the proposed development. All public comments received to date have been addressed in the staff report, including staff's oral presentation and the findings adopted by the Commission. The Commission incorporates its findings on Coastal Act consistency at this point as if set forth in full. As conditioned, there are no additional feasible alternatives or feasible mitigation measures available, beyond those required, which would substantially lessen any significant adverse environmental effect that approval of the proposed project, as modified, would have on the environment. Therefore, the Commission finds that the proposed project can be found to be consistent with the Coastal Act and CEQA Section 21080.5(d)(2)(A).

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**Appendix B – Ground Shaking as a Measure of Earthquake Strength**

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Many different measures have been used over the years to assess earthquake magnitude. The familiar Richter, or local, magnitude ($M_L$) is based on the ground shaking observed on a particular type of seismograph that is most sensitive to short period (0.8 second) seismic waves. These waves die out with distance, and so this measure is inappropriate when applied over long distances (> ~500 km) to measure distant earthquakes. Moreover, for large earthquakes, the Richter magnitude "saturates," and fails to accurately reflect differences between large earthquakes of different magnitudes. The surface wave magnitude ($M_S$) was developed to measure shaking of long period (20 second) waves, and is more suited to larger earthquakes. This scale, like its counterpart the body wave magnitude ($M_B$) also saturates in large earthquakes and, like the Richter magnitude, is based solely on ground shaking, not the amount of energy released by an earthquake. Currently, most seismologists prefer the moment magnitude ($M_W$) for measuring large earthquakes. This measure is based on the strength of the rocks, the area of fault rupture, and the amount of slip during an earthquake, and is a better measure of the amount of energy released by an earthquake.

An earthquake of a given magnitude will produce different levels of ground shaking at different locations, depending on the distance of the location from the earthquake hypocenter, the nature of the soil or rock between the location and the earthquake, and soil and rock conditions at the site. The level of shaking is expressed by a term called "intensity," and is quantified by the Modified Mercalli Index, whereby intensities ranging from I (not felt) through XII (near total destruction) are assigned based on the level of damage sustained by structures. Better quantification of the level of shaking also is possible; and the standard measure is peak ground acceleration (PGA), usually expressed as a fraction of the acceleration due to gravity (9.81 $m/s^2$, or 1.0 g). Peak ground acceleration is typically measured in horizontal and vertical directions. It can be expressed deterministically ("a given earthquake can be expected to produce a peak horizontal ground accelerations at the site of *X* g"), or probabilistically ("given the seismic environment at the site, there is a 10% chance that a peak ground acceleration of *X* g will be exceeded in 50 years"). The current trend is to express seismic risk in probabilistic terms. The State of California has defined ground accelerations with a 10% chance of exceedance in 50 years as corresponding to the "maximum probable earthquake" for the site. Ground shaking with a 10% chance of exceedance in 100 years is defined as the "maximum credible earthquake." Peak ground accelerations depend not only on the intensity of the causative earthquake and the distance of the site from the hypocenter of the earthquake, but also on site characteristics. Most important is the depth and firmness of the soil and/or bedrock underlying the site. All of these parameters are evaluated in producing a seismic shaking hazard assessment of a site.

In evaluating the response of structures to ground shaking, the frequency (cycles per second) of that shaking is important—higher frequency shaking is more damaging to smaller, more rigid structures, whereas lower frequency shaking is more damaging to larger, or more flexible structures. The proposed ISFSI facility fits into the latter category. Different ground acceleration values apply to seismic waves with different frequencies. The inverse of the frequency of a seismic wave is its period. Thus, an earthquake with a peak ground acceleration of 0.7 g may have a peak "spectral acceleration" (SA) of 1.1 g for waves of 0.3 second period, but only 0.5 g for waves with periods of 1 second. A typical earthquake produces seismic waves with many different periods, and a plot of spectral accelerations for an earthquake shows the ground accelerations for waves of all periods. In addition, the duration of shaking appears to be important in determining the amount of damage caused by ground shaking. The duration of shaking correlates reasonably well with earthquake magnitude, but there are no currently accepted means of estimating the expected duration of ground shaking from a given earthquake.