SCE Position Paper

Independent Spent Fuel Storage Installation (ISFSI) Location

I. Summary

A variety of locations were considered and evaluated for the permanent dry fuel storage location of the spent fuel assemblies at San Onofre. The fuel assemblies will remain at this location until collected by the Department of Energy (DOE). SCE's current plan is to expand the current location of the ISFSI because it offers the highest level of certainty for safely moving the spent fuel from wet to dry storage as expeditiously as possible as well as the lowest cost for customers.

II. Scope

The purpose of this paper is to provide the background and basis for SCE's decision for the location of the ISFSI at San Onofre.

A detailed evaluation of options for the final ISFSI pad site included analysis of three categories of locations. The sites were identified without regard for the current licensing status (i.e., these locations may or may not have the NRC license to store nuclear fuel). The three categories of locations were as follows: (1) within the San Onofre Easement, (2) the surrounding area of Camp Pendleton including the San Onofre Mesa location, and (3) offsite areas. Currently only the San Onofre Easement is permitted under the 10 CFR Part 50 license to store spent fuel, while neither the surrounding area of Camp Pendleton nor the offsite areas are licensed for spent fuel storage.

Factors considered in the evaluation were:

1. Siting requirements
2. State permits, geological analysis
3. Ability to transport spent fuel to these locations
4. NRC regulatory license requirements
5. Length of time the spent fuel would be in wet storage before it could be transferred to dry storage at the ISFSI pad

III. Analysis

A summary table of the evaluation compares the main factors for determining the ISFSI pad location.

Table 1. SCE ISFSI Pad Location Evaluation

A. Location	B. Currently maintains a license to store nuclear fuel (10 CFR Part 50 or Part 72)	C. Requires Siting, Permitting, Licensing and Geological studies	D. Duration of wet storage*	E. Confidence of stakeholder approvals (i.e., Regulatory, City, State, Public)	F. Direct Cost
Within San Onofre Easement	Yes	Minimal for existing, Yes for other sites	5-12 years	High	$400M + $50-$300M
Camp Pendleton Area including SCE Mesa area	No	Yes	24-33 years	Low	>$400M + $1 -$2.9B for extended wet storage
Offsite areas	No	Yes	40+ years	Very Low	>$400M + $1.8-$3.6B for extended wet storage

*Years from 2014

In considering the various locations for spent fuel storage, SCE assumed that selecting a location would entail four phases – agreement of site selection, site permitting and licensing, site construction and offloading the spent fuel pools and transporting the spent fuel to that site. For site selection, each potential location was evaluated for its technical feasibility to design and construct a licensed dry fuel storage system. The locations were then evaluated based on the ability to get consent to site an ISFSI, such as with state and local permitting, NRC licensing process, including Environmental Impact and the ability to transport spent fuel to the location. Activities highlighted in column C add uncertainty to options that are beyond the 10 CFR Part 50 licensed area.

Three specific San Onofre locations within the currently licensed area were considered: (1) the current location, (2) the South Bluff area and (3) the Reservoir. The benefits of these easement locations are that they are in the 10 CFR Part 50 licensed area, and can support a timely transportation of the spent fuel from the wet storage in pools to dry storage on the pad within 5-12 years. Among the options within the San Onofre Easement, the timing and success for the geological soil preparations, state and local permitting of the South Bluff and Reservoir areas bring uncertainty into the decommissioning project.

For the Camp Pendleton, including the Mesa dry storage site area option, SCE roughly estimates that it would take approximately 24-33 years. For example, for planning purposes, SCE estimates the consent-based process for site selection would be likely take 3-5 years, 10 years for site permitting and licensing, 5-10 years for site construction and 6-8 years to transfer fuel spent fuel to that site. For offsite areas, the rough order of magnitude estimate is 40 years or more – with 10 years for consent-based process for site selection, 10 years for site permitting and licensing, 5-10 years for site construction and 10 years to transfer fuel spent fuel to that site.

Column E of the table reflects these uncertainties and the level of confidence for approval of options. Another consideration was the ability to quickly move the spent fuel from wet to dry storage - a high priority for SCE, the San Onofre Community Engagement Panel, and the general public. As seen from Table 1 above, the locations within the San Onofre Easement provide the most practical options.

SCE concludes that the existing location best meets criteria of the most predictable licensing and permitting outcome, providing the quickest offload from wet to dry storage and most prudent cost to customers.

IV. Conclusion

SCE's analysis of the range of options concludes the existing ISFSI site as the best location for the expansion of the pad. The current location provides the highest level of certainty for safely moving the spent fuel from wet to dry storage as expeditiously as possible combined with the lowest cost.

SCE Position Paper
High Burnup Fuel Storage and Transportation

I. Summary

San Onofre Nuclear Generating Station has 1,115 high burnup fuel (HBF) assemblies, all of which are undamaged, currently stored in spent fuel pools. There has been some discussion on the purpose and requirements for “canning” undamaged, high burnup, spent fuel assemblies. SCE’s position is when these HBF assemblies are moved to dry storage, they do not need to be placed in “damaged fuel “cans. The NRC has determined “there is no safety basis to require canning of all high burnup fuel.”

SCE has concluded that canning undamaged HBF does not provide additional safety benefits, has no technical advantages, no regulatory requirements, and is unnecessary.

II. Scope

The purpose of this paper is to provide the background and basis for SCE’s decision related to canning undamaged HBF assemblies at the San Onofre Nuclear Generation Station (SONGS).

III. Analysis

Background

During the Community Engagement Panel (CEP) workshop on spent fuel, there was discussion on the storage of HBF assemblies and the CEP requested SCE to clarify its position on canning HBF.

SCE’s rationale for not canning its undamaged HBF assemblies is threefold:

- Canning does not provide an additional safety benefit
- There are technical drawbacks in canning undamaged fuel, such as diminished heat transfer capability, increased structural loading, complexity in fuel handling, and increased radiation exposure to workers
- It is not a regulatory requirement to can undamaged fuel

In the past, regulatory uncertainty led two sites to "can" their undamaged HBF for dry storage and transportation. Since that time, the NRC has clarified there is no safety basis for canning undamaged HBF, and they should be stored in accordance with the same regulatory requirements as other fuel types.

Regulatory Requirements

The governing NRC requirements for spent nuclear fuel are contained in 10 CFR Part 72 for storage and 10 CFR Part 71 for transportation. To meet these requirements the NRC provided additional definitions and guidance in Nuclear Regulations (NUREG) with definitions of when spent fuel assemblies are required to be canned.

NUREG-1536 defines:

> “C. Canning Damaged Fuel
> Spent fuel that has been classified as damaged for storage must be placed in a can designed for damaged fuel, or in an acceptable alternative. The purpose of a can designed for damaged fuel is to (1) confine gross fuel particles, debris, or damaged assemblies to a known volume within the cask; (2) to demonstrate that compliance with the criticality, shielding, thermal, and

> structural requirements are met; and (3) permit normal handling and retrieval from the cask….."

The purpose of canning is to confine damaged fuel to a known volume during storage and to facilitate future handling and ready retrieval of content, not just because it is a HBF assembly.

Contrary to some public opinions that canning would add additional protection, the dry cask storage industry experts have stated unnecessary canning of HBF has technical drawbacks, such as diminished heat transfer capability, and increased structural loading. Furthermore, the cans are actually not fully sealed; there are small holes at the top and bottom to allow water in the containers to be removed during drying operations. Canning also adds additional complexity and time to the cask loading evolution, resulting in workers receiving unnecessary radiation exposure.

To confirm safe storage of HBF for an extended period, the US Department of Energy sponsored a full-scale study by Electric Power Research Institute (EPRI) in 2013. The study will monitor conditions, long-term characteristics and behaviors of HBF assemblies in dry storage for the next 10 years. This study is similar to the mid-1980s demonstration at Idaho National Laboratory, where dry storage of low burnup fuel was studied and no degradation was found.

Undamaged HBF is currently being loaded into dry storage at multiple U.S. nuclear sites without being canned. Maine Yankee and Zion remain the only two plants to can their undamaged HBF. In the past, Maine Yankee and Zion placed their undamaged HBF in failed fuel cans due to regulatory uncertainty about requirements to transport HBF. With an approved license to transport HBF, there is no such uncertainty for SCE's HBF.

IV. Conclusion

There are no technical advantages and no regulatory requirements for canning HBF, however there are consequences in more fuel handling operations needed for canning and radiation exposure to workers. SCE's conclusion is that canning undamaged HBF is not necessary, and does not provide additional safety benefits.

SCE Position Paper

Tsunami Hazard Analysis & Protection

I. Summary

The effects of potential tsunamis at San Onofre are bounded by the design capability of the dry storage cask system and seawall protection for the Units 2&3 site (including the Spent Fuel Pools). The site is protected by two seawalls. The dry storage cask system seawall is constructed of continuous steel "sheetpile" members and the seawall for Units 2&3 spent fuel pools are constructed of reinforced concrete. Both seawalls are higher than the maximum water level postulated for a potential tsunami at San Onfore. In addition, the dry cask storage system (canisters and modules), are designed for total submersion during an extreme design basis flood event, postulated to result from natural phenomena such as tsunami. Engineering analyses demonstrate acceptable performance of the storage system for tsunami flood effects.

II. Scope

The purpose of this position paper is to explain how spent nuclear fuel stored at the San Onofre site (at the Independent Spent Fuel Storage Installation and Units 2&3 Spent Fuel Pools) is protected against a potential tsunami hazard. The paper summarizes the results of the site-specific tsunami analyses that have been performed, and how protection is assured for the ISFSI and the Spent Fuel Pools.

III. Analysis

Federal regulations require that spent fuel storage installations as well as nuclear structures, and systems are designed to withstand the effects of natural phenomena such as . . . tsunami [Code of Federal Regulations, Title 10, Part 72 (Sections 92 and 122), and Part 50, Appendix A (Criterion 2)].

<u>Tsunami Characteristics</u>

- A tsunami is generated by rapid large-scale dislocations of the surface or bottom of the sea, or of some equivalent impulse. This large wave action is generally caused by an earthquake.
- Because of its broad shelf topography offshore, the Southern California coast is not sensitive to tsunami waves generated by distant sources on the Pacific Rim, unlike other locations in the world. Because of the moderating effect of Southern California's offshore borderland, the maximum analyzed tsunami wave will be generated by a local offshore fault zone.
- An analysis of the local offshore fault zone, referenced in the Updated Final Analysis Report , results in a maximum tsunami water height for San Onofre site of not greater than 27 feet (for reference, sea level is elevation = 0 feet).

<u>Protection of the Units 2&3 Spent Fuel Pools</u>

- Tsunami protection for the Unit 2&3 site is provided by a reinforced concrete seawall and intake screen well perimeter wall constructed to elevation 30 feet above sea level. The San Onofre Units 2&3 plant grade is also 30 feet above sea level.

- The SONGS 2&3 seawall, intake perimeter wall, and plant grade elevation are above the maximum analyzed tsunami water level and there is no impact to the Units 2&3 Spent Fuel Pools.
- Even if a tsunami would disrupt spent fuel cooling, there is over 99 hours for the station to respond and return cooling to the pool with portable equipment.

<u>Protection of the Independent Spent Fuel Storage Installation (ISFSI)</u>

- Although the Unit 1 site was cleared of most structures for construction of the ISFSI, the 28 foot high seawall remains. It is constructed of continuous steel “sheetpile” members driven into the sandstone bedrock and covered in gunnite (a concrete protective coating).
- Both the dry shielded canister (DSC), which provides confinement of the spent nuclear fuel, and the Advanced Horizontal Storage Modules (AHSMs) are designed for an enveloping design basis flood, postulated to result from natural phenomena such as tsunami. To evaluate design capability from an extreme flood event, a water depth of 50 feet (measured from the bottom of the concrete modules) having a water velocity of 15 feet per second was used.
- The storage modules are located on a reinforced concrete foundation, at elevation 19.75 feet above sea level. As a result, San Onofre’s dry cask storage system flooding design capability is 69.75 feet. As determined by computer structural analysis, the strength of the storage cask system exceeds the forces generated during a tsunami flood event. The forces generated for overturning and sliding during a flood (tsunami) event are bounded by seismic design criteria, so the modules will be stable.
- Submersion of the modules does not adversely affect the thermal analysis for the self-cooling dry storage cask system. The dry cask system needs no electric power for cooling since it is a totally passive system. Any blockage would be identified during post-tsunami inspections. The reinforced concrete storage modules are designed to safely withstand tornado-generated missiles traveling at high velocity, including wooden telephone poles, steel pipes, and large deformable objects (e.g., automobiles) traveling at least 185 feet per second (over 100 miles per hour). Any debris moving with the tsunami wave would have a velocity much less than the tornado missiles for which the modules have been analyzed.

IV. Conclusion

The Units 2&3 site is protected from tsunami by a reinforced concrete seawall which is higher than the maximum water level determined for a tsunami at San Onfore. In addition, the SFP structure itself provides significant protection against external flooding, and the San Onofre has over 99 hours to respond to a sustained loss of SFP cooling with portable equipment.

The continuous steel seawall located between the Pacific Ocean and the ISFSI provides protection against inundation of the ISFSI site from ocean hazards. The design capability of the ISFSI is much greater than the potential effects of tsunami at the San Onofre site. The design of the DSC and AHSM exceeds the maximum analyzed tsunami water level, with significant design margin. Engineering analyses demonstrate acceptable performance of the storage system for tsunami flood effects, including structural capacity, stability, thermal effects during submersion, and missile protection.