UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

CHAIRMAN

May 29, 2018

The Honorable Edward J. Markey
United States Senate
Washington, DC 20510

Dear Senator Markey:

On behalf of the U.S. Nuclear Regulatory Commission, I am responding to your letter of April 23, 2018, expressing concern regarding spent fuel storage at Pilgrim Nuclear Power Station. Responses to your specific inquiries are enclosed.

If you need any additional information, please contact me or have your staff contact Eugene Dacus, Director of the Office of Congressional Affairs, at (301) 415-1776.

Sincerely,

Kristine L. Svinicki

Enclosure:
As stated

Responses to Request for Information
Senator Edward Markey
Letter dated April 23, 2018

1. **What time span and which climate models are used for the post-Fukushima flooding reevaluation? How will the NRC incorporate those models into the regulations governing decommissioned nuclear plants?**

The Pilgrim Nuclear Power Station (Pilgrim) flood hazard reevaluation focused on potential flooding over the life of the plant from extreme events characterized by the probable maximum hurricane and probable maximum wind storm that would produce the largest storm surge. The analysis of probable maximum events examines the expected worst case conditions based on U.S. Nuclear Regulatory Commission (NRC) guidance (JLD-ISG-2012-06, Agencywide Documents Access and Management System (ADAMS) Accession No. ML12314A412). The NRC's conclusions from its independent review of Pilgrim are documented in the August 4, 2016, letter (ADAMS Accession No. ML16215A076), which provides a summary of the NRC staff's assessment of reevaluated flood-causing mechanisms. The NRC concluded that Pilgrim's reevaluation of flooding hazards is appropriate and sufficient to ensure that the site remains safe. While recent scientific reports discuss the potential for more than a half-foot of sea level rise by 2065, the multiple conservatisms in other aspects of the storm surge calculation provide a significant safety margin in the event that sea level rise at the site exceeds a half-foot.

In 2016, the Commission directed the staff to develop an enhanced process to proactively and routinely aggregate and assess natural hazard information for operating nuclear power plants. The staff is currently establishing this process, referred to as the Process for Ongoing Assessment of Natural Hazard Information (POANH). POANHI will identify and evaluate new data, models, and assessment methods to determine if a change in natural hazard information requires generic or plant-specific actions to ensure public health and safety. POANHI is described in SECY-16-0144, "Proposed Resolution of Remaining Tier 2 and 3 Recommendations Resulting from the Fukushima Dai-Ichi Accident, Recommendation 2.2: Plan to Ensure Ongoing Assessment of Natural Hazard Information" (ADAMS Accession No. ML16286A569).

The NRC is implementing the framework for POANHI, which includes (1) knowledge base activities, (2) technical engagement and coordination activities, and (3) assessment activities. The NRC is also developing a joint office instruction that will implement the framework and clearly document the enhanced process. Further, the NRC is developing a database system to compile and maintain existing and re-evaluated natural hazard information for its licensed facilities. This database will be supplemented with new natural hazard information as it is collected and evaluated for potential significance to the safe operation of licensed sites. The NRC is continuing to engage with leading scientific organizations to maintain awareness of the latest developments related to natural hazards that may affect licensed sites. The NRC is also enhancing its coordination with other Federal agencies, the nuclear industry, academia, standards organizations, and international counterparts. Finally, the NRC is developing a four-stage approach for assessing the significance of changes in natural external hazards that includes (1) information collection, (2) information aggregation, (3) significance assessment, and (4) referral to the appropriate NRC regulatory programs or organizations.

As part of its post-Fukushima evaluations, the NRC staff determined that there is no need for additional regulatory action related to flooding for facilities other than operating power reactors. The NRC staff's determination included an assessment of the existing licensing bases regarding flooding for reactors that have permanently ceased operations (decommissioned) but still maintain fuel in a spent fuel pool and/or in independent spent fuel storage installations (ISFSIs), such as Kewaunee Power Station, San Onofre Nuclear Generating Station, and Vermont Yankee Nuclear Power Station. The staff concluded that bounding flooding analyses show no need for additional analysis. The NRC staff's complete evaluation is described in SECY-15-0081, "Staff Evaluation of Applicability of Lessons Learned from the Fukushima Dai-Ichi Accident to Facilities Other Than Operating Power Reactors" (ADAMS Accession No. ML15050A066).

2. **What is the protocol for continual monitoring of spent fuel sites? How is climate change being integrated into that protocol and into regulations governing decommissioned plants?**

The NRC's regulations provide requirements for the safe design and operation of ISFSIs. Any operational conditions, required actions, monitoring or surveillance requirements, or other technical specifications that are needed for safe operation are included in the license (for ISFSIs) or certificate of compliance (for spent fuel storage system designs). ISFSI licensees also conduct radiation monitoring to ensure compliance with the NRC requirements for radiation dose limits for the public and workers. The NRC maintains oversight of ISFSIs, and the agency staff routinely inspects the site operations to ensure continued compliance with all applicable regulatory requirements and the conditions and specifications of the license or certificate of compliance.

The NRC also requires aging management programs for ISFSIs and spent fuel storage systems as storage operations continue into a renewed storage term. Aging management programs include monitoring and inspections of ISFSIs and storage systems to detect any degradation and corrective actions (such as further inspections, repairs or replacement of components, and other mitigation measures) to ensure that the ISFSI continues to meet the NRC's requirements for safe spent fuel storage. In addition, licensees assess the effectiveness of these programs on an ongoing basis to determine if they need to be adjusted to address unexpected degradation or degradation that may be occurring at a greater rate than was initially assumed. The NRC's oversight of ISFSIs includes inspection of a licensee's aging management activities.

Operating experience is continually assessed by the licensees and the NRC to determine if new information, knowledge, and experience warrant any changes to licensed spent fuel storage operations. If significant environmental changes are identified, the NRC will determine if the licensee will need to reevaluate its analyses and associated spent fuel storage operations to address the identified change in environmental conditions.

The NRC's existing regulatory framework accounts for any changing environmental conditions that could cause or accelerate degradation of ISFSIs or otherwise challenge the safety of spent fuel storage. The NRC's oversight of licensees' ISFSI operations ensures the safe storage of spent fuel, regardless of whether an ISFSI is at an operating reactor or a decommissioned reactor site.

3. **A spokesman recently made public statements to the Boston Globe indicating that the NRC is not concerned about dry casks if submerged in sea water. What research has the NRC done on possible corrosion of the dry casks by exposure to saltwater?**

The NRC regulations in 10 CFR Part 72 require applicants to assess natural phenomena events as part of the safety basis for a storage facility or container design. This includes consideration of potential impacts of natural phenomena such as flooding. Moreover, as part of its post-Fukushima review, NRC staff considered scenarios such as a (1) storage system fully submerged in water, (2) partial flooding around the storage system, and (3) blockage of the vents for those canister-based systems with natural convection cooling. The results of the steady-state thermal analysis for a vertical cask system and a horizontal cask system indicate that cooling of the spent fuel would be maintained and a release of radioactive material is not expected to occur. The NRC staff's complete evaluation is described in SECY-15-0081.

Additionally, the NRC staff completed a review of dry cask storage systems for the development of guidance for management of degradation and aging mechanisms including possible corrosion of the dry casks. This review was documented in NUREG-2214, "Managing Aging Processes in Storage (MAPS) Report, Draft Report for Comment" (ADAMS Accession No. ML17289A237). The NRC review considered specific system designs, operating environments, materials of construction, and potential aging mechanisms that could challenge the capability of the systems to safely store spent fuel. For welded stainless steel canisters, chloride-induced stress corrosion cracking (from exposure to certain airborne chloride salts and hot-humid air) was determined to be the only plausible mechanism that could affect the confinement function provided by the canister. Potential chloride-induced stress corrosion cracking is considered by the NRC during its review of proposed storage systems and licensees' aging management programs, including measures to detect and mitigate this condition.

The NRC has also conducted testing to determine the conditions under which welded stainless steel canisters may be susceptible to stress corrosion cracking, after exposure to airborne salts and hot-humid air. The results of these studies were published in two reports:

- NUREG/CR-7030, "Atmospheric Stress Corrosion Cracking Susceptibility of Welded and Unwelded 304, 304L, and 316L Austenitic Stainless Steels Commonly Used for Dry Cask Storage Containers Exposed to Marine Environments," October 2010 (ADAMS Accession No. ML103120081).

- NUREG/CR-7170, "Assessment of Stress Corrosion Cracking Susceptibility for Austenitic Stainless Steels Exposed to Atmospheric Chloride and Non-Chloride Salts," February 2014 (ADAMS Accession No. ML14051A417).

The NRC used these reports, along with relevant operating experience at commercial nuclear power plants and research conducted by engineers in the United Kingdom and Japan, to develop the aging management program for localized corrosion and stress corrosion cracking of welded stainless steel dry storage canisters included in the MAPS report.

4. Because Pilgrim received an exemption from the seismic probabilistic risk assessment, how is the NRC assured that the dry casks will be safe from seismic activity? How will such risks be incorporated into the rule governing decommissioned plants, and will any decommissioned plants receive similar exemptions?

The NRC considered the applicability of the lessons learned from the Fukushima Dai-ichi accident (e.g., seismic reevaluation) to facilities other than operating power reactors, including ISFSIs and decommissioned reactors. The results of the NRC's evaluation are presented in

SECY-15-0081. The NRC staff did not identify a need for ISFSI licensees to reevaluate seismic risk because licensees analyze an accident that bounds the consequences of an earthquake. The bounding accident is analyzed as a defense-in-depth measure to provide additional assurance that the storage system will maintain its intended safety functions during storage. Additionally, operating experience is continually assessed by the licensees and the NRC to determine if new information, knowledge, and experience warrants any changes to licensed operations or changes to the NRC's regulatory framework to ensure continued safe and secure spent fuel storage.

As the NRC's current regulatory framework ensures the safety of spent fuel storage from seismic activity, the NRC does not plan to develop further seismic requirements in the reactor decommissioning rulemaking. The NRC staff is currently developing a rulemaking that proposes to adopt a graded approach that is commensurate with the reductions in radiological risk during decommissioning. Upon Commission approval of this approach or other alternative, the NRC staff will publish the proposed rule for public comment.

On April 17, 2017, the NRC granted the licensee's request for a deferral of actions at Pilgrim related to beyond-design-basis seismic and flooding hazard reevaluations until December 31, 2019. Prior to agreeing to this request, the NRC staff performed an evaluation that determined that the public health and safety will continue to be adequately protected at Pilgrim through the deferral period without additional assessments of the reevaluated seismic hazard being performed during that time. Further details of the staff's safety basis are contained in the staff's April 17, 2017, letter to Entergy (ADAMS Accession No. ML16278A313).