

Screening Results for Pre-GI-017, Proposed Generic Issue on the Potential Loss of Ultimate Heat Sink from Storm-Wave Interactions or Seiche, Combined with Low Great Lakes Water Levels

Enclosure 1: Results for the Seven Screening Criteria

A generic issue (GI) is a well-defined, discrete technical safety or security issue for which the risk and/or safety significance can be adequately determined. Proposed GIs must meet all of the seven screening criteria listed below in order to proceed to the assessment stage. This enclosure lists each criterion, followed by an explanation of whether the proposed GI meets each criterion.

- 1. The issue affects public health and safety, the common defense and security, or the environment. For issues that are not amenable to quantification using risk assessment, qualitative factors may be developed and applied as necessary to assess safety/risk significance.**

The issue identified in the proposed GI centers around the vulnerability of the service water supply pumps to maintain adequate suction from the ultimate heat sink (UHS) in the event of an excessively low water level condition during a seiche set-down. In the event the service water pumps experience a loss of suction and continue to operate, the pumps may incur damage. If the damage becomes severe, then the pumps may become damaged beyond repair. The core damage frequency from a loss of service water can be derived from the U.S. Nuclear Regulatory Commission's (NRC's) Standardized Plant Analysis Risk models for each plant. However, the probability of such an excessive set-down occurring when lake levels are low cannot be determined accurately without extensive efforts. Therefore, the Generic Issue Review Panel (GIRP) used qualitative factors to assess the safety and risk impact to the affected nuclear plants.

The GIRP's evaluation paralleled the evaluation that was performed by the Japan Lessons-Learned Division (JLD) within the Office of Nuclear Reactor Regulation in its efforts to evaluate plants responses to NRC Order EA-12-049¹. The GIRP and JLD staff evaluated nuclear power plants situated on large bodies of water that could be affected by seiche. The plants potentially affected by a seiche are those situated on the Great Lakes, Gulf of Mexico, and Chesapeake Bay. The staff evaluated each plant individually to determine whether the plant had sufficient resources to establish an adequate defense in depth in order to survive a temporary loss of access to the UHS. The JLD staff documented the results of its assessment in a report to the Commissioners as part of SECY-16-0074². Enclosure 1³ to SECY-16-0074 summarizes the results of JLD's detailed individual plant evaluations.

Upon completing an evaluation of each plant, the staff found that all plants retained access to an immediate source of cooling water onsite to maintain core cooling for several hours. In addition, all plants have a strategy in place to deploy portable pumps after several hours to either access water from the UHS or, if the UHS was unavailable, to access alternate sources of water from tanks on site. Even though these tanks may not be completely protected from seismic events and tornado missiles, they were adequately constructed to survive the hazards associated with a storm surge/seiche. Hence, the staff found that each plant had access to

¹ NRC Order EA-12-049, "Issuance of Order to Modify Licenses with regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A735).

² SECY-16-0074, "Assessment of Fukushima Tier 2 Recommendation Related to Evaluation of Natural Hazards Other Than Seismic and Flooding," dated June 2, 2016 (ADAMS Accession No. ML16102A301).

³ SECY-16-0074, Enclosure 1, "Evaluation of Natural Hazards Other than Seismic and Flooding," dated June 2, 2016 (ADAMS Accession No. ML16102A303).

sufficient water on site that would enable it to survive at least 24 hours upon losing its service water pumps. After 24 hours, offsite resources would be delivered on site and be available to continue mitigating efforts.

Based on its analysis and that of JLD's, the GIRP finds that all U.S. nuclear power plants situated on large bodies of water have a strategy in place that could adequately mitigate the risk of core damage in the event of a low water level caused by a seiche. Hence, the GIRP concludes that there was no increase in the risk to the plants' safety from a low water level in their UHS as a result of a seiche.

- Therefore, the proposed GI would **not** meet screening criterion 1.

2. The issue applies to two or more facilities and/or licensees/certificate holders, or holders of other regulatory approvals.

Several nuclear power plants are situated on the Great Lakes, Gulf of Mexico, and Chesapeake Bay that credit these large bodies of water as their UHS. The nuclear power plants on Lake Michigan, Lake Erie, and Lake Ontario are susceptible to storm-driven wave action and lake level changes. Plants on the Chesapeake Bay and Gulf of Mexico may be affected by storm surge/seiche but to a lesser degree. Because more than one nuclear facility is susceptible to the conditions described in the proposed GI that produce adverse effects, the GIRP finds that this criterion would be met.

- Therefore, the proposed GI would meet screening criterion 2.

3. The issue is not being addressed using other regulatory programs and processes; existing regulations, policies, or guidance.

The JLD staff is working on the Near-Term Task Force review of insights from the accident at the Fukushima Dai-ichi facility on March 11, 2011. The NRC issued Order EA-12-049 to address the loss of normal access to the UHS coincident with a loss of all alternating current (ac) power. The order requires every licensee to install permanent plant equipment that is qualified to withstand catastrophic external events to initially mitigate a loss of an all-ac-power event, followed by temporary portable equipment that can be deployed and installed quickly to sustain critical functions. This equipment must sustain the plant until offsite resources can be brought on site within 24 hours. Part of the licensee's strategy must address maintaining critical safety functions without the restoration of the service water pumps. This strategy assumes that the UHS is still available and only the service water pumps are no longer operational. In this proposed GI, however, the UHS is unavailable for a period of time as a result of a set-down following a seiche that may significantly lower lake water levels.

In SECY-15-0137⁴, the NRC staff outlined a process for reviewing natural hazards other than seismic and flooding. Initially, the staff planned to provide the Commission with its final assessment of this recommendation by the end of calendar year 2016. However, a staff

⁴ SECY-15-0137, "Proposed Plans for Resolving Open Fukushima Tier 2 and 3 Recommendations," dated October 29, 2015 (ADAMS Accession No. ML15254A008).

requirements memorandum⁵ for SECY-15-0137 dated February 8, 2016, directed the staff to inform the Commission no later than May 2016 of the results of Task 2, “Determine and apply screening criteria to appropriately exclude certain natural hazards from further generic evaluations, or exclude some licensees from considering certain hazards.” In addition to seismic, flooding, and geomagnetic storms, the JLD staff were to assess the impact of other natural hazards, including high winds, extreme ambient temperatures, snow and ice loading on structures, and drought and other low-water conditions.

Initially, the JLD staff reviews did not include the scope of the proposed GI. However, JLD's work scope was expanded in SECY-15-0137 to include Tier 2 recommendations, which included evaluation of low-water conditions resulting from a seiche. In June 2016, the JLD staff provided the results of their assessment in a report to the Commissioners (SECY-16-0074). Enclosure 1 to SECY-16-0074 summarizes the results of the detailed individual plant evaluations. The JLD staff determined that additional regulatory actions related to extreme ambient temperatures, drought, and other low-water conditions are not warranted. Only those hazards associated with high winds and snow loads warrant further assessments and stakeholder interactions on possible regulatory action.

Another NRC program has performed the same evaluations that would address the concerns expressed in the proposed GI. The results of that evaluation were presented to the Commission and are publicly available.

- Therefore, the proposed GI would **not** meet screening criterion 3.

4. The issue can be resolved by new or revised regulation, policy, or guidance.

General Design Criterion (GDC) 44, “Cooling Water,” of Appendix A, “General Design Criteria for Nuclear Power Plants,” to Title 10 of the Code of Federal Regulations (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities,” requires, in part, that a system shall be provided to transfer heat from systems important to safety to an UHS. The nuclear plants on the Great Lakes credit the lakes as their UHS to comply with GDC 44. The licensees directly involved with this proposed GI replied to the NRC regional staff that they satisfy their current licensing basis, and that an extreme low water level event caused by a seiche is not part of their licensing basis. However, in the event of an extreme low water level event that causes a loss of service water, the licensees have procedures for abnormal events, such as loss of service water, that address such an occurrence.

The staff held several conversations with NRC regional and Headquarters staff to determine whether the proposed GI was a compliance issue. The staff considered the event of low water from surge/seiche to be either (1) a new mechanism that was not evaluated in the design basis or (2) a mechanism with effects that are more severe or different than previously understood in the design basis. The staff viewed this event to be very similar to situations encountered in response to the Near-Term Task Force Recommendation 2.1⁶, where a mechanism was considered in the plant's design basis, but now the hazard may be more severe or otherwise different than previously understood. These new flood hazards did not represent an automatic

⁵ SRM-SECY-15-0137, “Staff Requirements Memorandum SECY-15-0137—Proposed Plans for Resolving Open Fukushima Tier 2 & 3 Recommendations,” dated February 8, 2016 (ADAMS Accession No. ML16039A175).

⁶ “Enclosure 2 - Recommendation 2.1: Flooding”, Request for additional information associated with SECY-11-0124 and SECY-11-0137, dated March 12, 2012 (ADAMS Accession No. ML12056A048).

change in the plant's design basis and were considered "beyond design basis," until such time as the staff completed a backfit analysis to justify whether changes to the design basis or licensing basis were appropriate. Hence, the staff did not consider these new hazards to represent a compliance issue. Therefore, in order to specifically make a low water level seiche part of the licensing basis for each of these plants, the NRC may have to issue new or revise existing regulations, policy, or guidance, or possibly issue a compliance backfit.

- Therefore, the proposed GI would meet screening criterion 4.

5. The issue's risk or safety significance can be adequately determined in a timely manner (i.e., it does not involve phenomena or other uncertainties that would require long-term study and/or experimental research to establish the risk or safety significance).

The staff has the capability to calculate the results of a loss-of-service-water event for the affected plants to determine the core damage frequency and large early release frequency. Historical data for the Great Lakes show that in 1954, a severe storm caused a significant storm surge/seiche to occur. The staff created models to replicate the lake's response based on a storm with winds at a specific velocity and direction. However, the models do not include the specific configuration of the lake in front of the intake to the nuclear power plant. Hence, the models could only predict lake level changes at a distance off shore. This means that the exact response of level of the UHS at the plants' forebays is not readily available. The NRC would need to expend additional resources to develop a model to accurately predict the water level changes of the UHS at the point at which the service water pumps draw suction.

Even though an initiating event frequency for the conditions described in the proposed GI does not currently exist, given time and resources, the staff could develop models of the water level changes in the plants' forebays based on available historical information. The staff could then use those models to calculate the effects and safety significance.

- Therefore, the proposed GI would meet screening criterion 5.

6. The issue is well defined, discrete, and technical.

The NRC staff observed historical low water levels in the Great Lakes during the winter of 2012–2013. On April 10, 2013, the staff noted a low water level set-down resulting from a seiche in the forebay levels at Palisades and D.C. Cook nuclear power plants. Levels decreased by 0.5 meters (1.7 feet), and the oscillatory wave motion lasted about 20 minutes. Additionally, the historic storm of 1954 provides evidence of the magnitude a storm surge/seiche that can be produce.

With the Great Lakes at historically low levels, the NRC staff postulated that if such a storm that happened in 1954 would reoccur, a possible set-down condition could reach such magnitude to disrupt flow to the service water pumps. Since the pumps do not have automatic protection in such an event, it is possible that a large set-down could cause major damage to all service water pumps. Hence, while the scenario that the NRC staff described is possible, the probability of the events (i.e., a storm and low water level) happening simultaneously is not known.

- Therefore, the proposed GI would meet screening criterion 6.

7. Resolution of the issue may involve review, analysis, or action by the affected licensees, certificate holders, or holders of other regulatory approvals.

Water surface oscillations occur regularly at coastal nuclear power plants because of storm surges/seiche, and the Great Lakes reached historic low water levels during a recent time period. Even though a significant and unique storm did occur in 1954 and created a historic storm surge/seiche, the NRC staff could not predict the likelihood of these two events (i.e., a storm and low water level) happening simultaneously. If the two events were to occur at the same time, the combined effect for a given nuclear power plant site could not be determined without further analysis and modeling. Therefore, additional review, analysis, and action by the licensee may be required to thoroughly understand the probability of this kind of event occurring and its potential effects.

- Therefore, the proposed GI would meet screening criterion 7.