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 2: Detailed Evaluation

1. Description of Proposed Issue

On March 18, 2015, the U.S. Nuclear Regulatory Commission (NRC) staff in Region III submitted[1] a proposed generic issue (GI) relating to a loss of ultimate heat sink (UHS) at nuclear power plants from storm-wave interactions or seiche, coincident with low Great Lakes water levels. The combination of these two events could potentially lower the water level in the intake forebay to below the suction head of the service water pumps, thereby causing a disruption of water flow and possibly damaging the service water supply pumps. This proposed issue was designated as Pre-GI-017.

During December 2012 and January 2013, water levels in Lake Michigan-Huron reached their lowest levels since systematic records began in 1860. As of spring of 2016, the Great Lakes have since returned to normal levels. In response to the proposed GI, the NRC regional office, in conjunction with NRC Headquarters staff, determined that absent any other natural events or other weather-related phenomena, there was no immediate safety impact to the plants using Lake Michigan-Huron as their UHS. However, the staff did identify a potential vulnerability to the service water pumps in the forebay intake structure if severe storm-wave or seiche conditions should occur when the Great Lakes are at very low levels. The primary concern is that permanent pump damage could occur from air ingestion as a result of vortex formation or cavitation from inadequate net positive suction head.

The UHS provides an indefinite supply of water for reactor decay heat removal and heat removal for other critical system components. The UHS typically supplies a heat sink for the service water and fire protection systems. Nuclear power plants are typically situated on large bodies of water, such as oceans, lakes, and rivers, in order to accommodate the large heat loads necessary to condense secondary steam after passing through the main turbines. These large bodies of water also normally serve as a reliable UHS for safe shutdown.

A seiche is a temporary disturbance or oscillation (i.e., standing wave)[2] in the level of a lake or partially enclosed body of water, typically caused by strong winds or rapid changes in atmospheric pressure (less commonly by earthquakes, tsunami, or tides). Depending on the intensity of the winds, water levels may oscillate back and forth for hours or even days. The phenomena described in the proposed GI is based on an actual event that occurred in 1954 on Lake Michigan. The event caused severe flooding and loss of property and life. Another well-documented seiche occurred on April 10, 2013, when the water level at the forebays of the Palisades and D.C. Cook nuclear power plants decreased by 0.5 meters (1.7 feet). Oscillatory wave motion disrupted the water supply for about 20 minutes. In addition, during the winter of 2012–2013, the NRC regional staff observed that water levels in the Great Lakes had receded to historic lows. The staff postulated that if a storm surge similar to the one in 1954 had occurred during the period of historic low water levels, then the availability of the UHS would be threatened for a short period of time. During the period of extreme set-down, the service water

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1 Memorandum to Steven West, Deputy Director, Office of Nuclear Regulatory Research, from Cynthia D. Pederson, Regional Administrator, "Submittal of Possible Generic Issue Concerning Loss of Ultimate Heat Sink due to Storm-Wave Interactions or Seiche with Low Great Lakes Water Levels," dated March 18, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15078A284).

2 In the Great Lakes, the term seiche is applied to any sudden rise (or fall) of water regardless of whether it is oscillatory. Although inaccurate in a strict sense, this usage is well established in the Great Lakes.

pumps could potentially lose suction and sustain irrecoverable damage. Hence, the staff concluded that a more detailed evaluation was warranted.

2. Regulatory Background

The primary purpose of the Generic Issues Program is to identify potential safety hazards and determine whether there are any gaps in regulation and guidance that need to be corrected. In regard to this proposed GI, Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," requires all nuclear power plants to maintain access to a UHS. Specifically, Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 includes the following relevant criteria:

- General Design Criterion (GDC) 2, "Design Bases for Protection Against Natural Phenomena," requires that components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiche.

- GDC 44, "Cooling Water," requires a system to be capable of transferring heat from systems and components important to safety to a UHS.

In addition, the NRC issues regulatory guides that describe methods the staff considers acceptable for use in implementing specific parts of the agency's regulations. Regulatory Guide 1.27[3] describes methods and procedures that the NRC finds acceptable for meeting the requirements of GDC 2, which states, "The design bases for these structures, systems, and components shall reflect: (1) Appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena and (3) the importance of the safety functions to be performed."[4]

3. Technical Evaluation

The NRC staff started an investigation to determine whether a seiche could pose a threat to the UHS operability for the three nuclear power plants located on Lake Michigan based on the frequency, strength, and duration of the winds experienced on this particular lake. After reviewing plant service water pump design requirements, the staff found that the plants claimed that margins exist before the onset of pump damage, varying between 1.7 and 5.2 meters (5.5 and 17 feet) from the starting lake level. These margins take into account that forebay levels are typically already 0.3 to 0.6 meter (1 to 2 feet) lower than actual lake level. Therefore, a postulated seiche occurring in Lake Michigan resulting in a wave set-down of 3 meters (10 feet) would impact the heat sink of those plants with margins of only 1.7 meters (5.5 feet). In discussions with NRC experts as well as experts at other federal agencies, the frequency of such events with large enough fluctuations to impact the UHS was deemed not likely, but the actual frequency is unknown. Therefore, to investigate the matter further, NRC Region III staff submitted the proposed GI into the Generic Issues Program.

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[3] Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

[4] " Criterion 2, "Design bases for protection against natural phenomena, Appendix A, 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants."

In addition to the seiche-related evaluation being performed by the GIRP, the NRC staff working in the Japan Lessons-Learned Division (JLD) within the Office of Nuclear Reactor Regulation (NRR) was concurrently evaluating nuclear power plants in the United States for effects from other natural hazards.[5] One of the hazards that the JLD staff evaluated was a low water level condition in the UHS. Because of this proposed GI, the scope of the evaluation was increased to include a seiche event. JLD prepared and released a white paper[6] for public comment on the staff's updated assessment of the Fukushima Tier 2 recommendation related to the evaluation of natural hazards other than flooding and seismic. Initially, JLD was not planning to report on its findings until the end of 2016, and intended to use the findings from this GIRP evaluation to prepare its report. However, the Commission accelerated its due date to the end of May 2016. Therefore, the JLD staff worked diligently with GIRP members to resolve this GI expeditiously to meet the new deadline. Where available, the staff leveraged low-water level estimates reported in licensee Flood Hazard Reevaluation Reports (FHRRs) submitted in response to NRC's March 2012 Request for Information (RFI).[7] The RFI instructed licensees to reevaluate their design-basis flooding hazards using guidance and methods applicable to early site permits and combined licensing applications. Some of these reports provided conservative low-water level estimates due to a postulated probable maximum wind storm (PMWS). For other sites, the staff used the reported PMWS parameters from the FHRR to conservatively estimate the set down. For some plants, the estimated low water level did not challenge the UHS. For the remaining plants, the staff consulted information provided by licensees regarding available mitigating strategies to determine whether each plant could respond with available equipment to meet critical safety system requirements. JLD published its final assessment on June 2, 2016, as documented in SECY-16-0074, "Assessment of Fukushima Tier 2 Recommendation Related to Evaluation of Natural Hazards other than Seismic and Flooding."[8] The GIRP determined that JLD's documentation of the findings of the joint investigation were sufficient to resolve whether the proposed GI satisfied the seven screening criteria described in Management Directive (MD) 6.4.

Applicability

Many nuclear power plants operate on enclosed large bodies of water, which may be subject to seiches. There are several nuclear power plants operating on the Great Lakes. Perry, Davis-Besse, and Fermi operate on Lake Erie. Fitzpatrick, Nine Mile Point, and Ginna operate on Lake Ontario. Point Beach, Palisades, and D.C. Cook operate on Lake Michigan. No U.S. nuclear power plants operate on Lake Superior, Lake Champlain, or Lake Huron.

In addition to the Great Lakes, the JLD staff identified several nuclear power plants located on other large bodies of water that may be adversely affected by a seiche. South Texas and Waterford are located near the Gulf of Mexico, but not directly on the coast. Calvert Cliffs is located on the Chesapeake Bay. Additionally, the JLD staff also performed a review of

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

6 "White Paper—NRC Staff Updated Assessment of Fukushima Tier 2 Recommendations Related to Evaluation of Natural Hazards Other Than Seismic and Flooding," (ADAMS Accession No. ML16039A054).

7 "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated March 12, 2012 (ML12053A340)

8 SECY-16-0074, "Evaluation of Natural Hazards Other than Seismic and Flooding," June 2, 2016 (ADAMS Accession No. ML16102A301).

Atlantic and Pacific coastal plants to determine if their safety related ultimate heat sinks relied on bays or inlets connected to the ocean that maybe susceptible to low water level conditions due to a seiche or other mechanisms such as tsunami or storm surge drawdown. The plants considered included Hope Creek and Salem, Oyster Creek, Brunswick, Saint Lucie, Seabrook, Turkey Point, and Diablo Canyon. Based on their evaluations, the JLD staff concluded that for these coastal plants, low water levels due to seiches or tsunamis did not warrant additional regulatory action.[9]

At several sites, the operation of the nuclear plant has been permanently ceased. These sites may still have used nuclear fuel stored in their spent fuel pools that requires cooling. However, a short-term loss of the UHS would not affect the plant's ability to maintain adequate cooling of the stored fuel. Therefore, the scope of this evaluation does not include these sites.

In addition to the U.S. nuclear power plants, Canada has several plants operating on the Great Lakes. The NRC regional office informed the Canadian regulator of this proposed GI; however, the GIRP did not include the Canadian nuclear power plants in its evaluation of adverse effects from a seiche. The NRC works closely with the Canadian regulator and shared the results of this evaluation to enable them to assess any concerns for their nuclear plants on the Great Lakes.

Plant-Specific Evaluations

In the event of a loss of access to the UHS, the plant must be able to sustain heat removal of key components until access to the UHS is restored or off-site resources are deployed and installed. Generally, off-site resources will be available on-site within 24 hours. The on-site water supplies must be sufficiently designed to withstand the hazards associated with a storm-driven seiche.

For the Great Lakes, the staff analyzed a hypothetical seiche that assumed winds of 161 kilometers per hour (100 miles per hour), sustained for 12 hours in the limiting direction, coupled with the 100-year low water level on the lake. The staff performed a detailed evaluation of each of these sites, using details of the plants' design from their updated final safety analysis reports. The staff also used information from the licensees' recent submittals showing how they complied with NRC Order EA-12-049, which required licensees to mitigate a significant external hazard that takes out the plant's normal access to the UHS along with a loss of all ac power. Enclosure 1[10] to SECY-16-0074 provides a brief synopsis of the mitigating strategy available in the event of a temporary loss of access to the UHS. Provided below is a paraphrase of the results of the staff's detailed individual plant evaluations, describing each plant's capability to remove decay heat without reliance on a large, natural body of water for a water supply.

Nuclear Power Plants Located on Lake Erie and Lake Ontario (Perry, Davis-Besse, Fitzpatrick, Nine Mile Point, Ginna, and Fermi)

Evaluation of Perry

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

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

The staff analyzed the effects on the Perry's emergency service water system from low water level conditions from a seiche. Section 2.4.11.2 of the plant's updated safety analysis report (USAR) states that the emergency service water system was analyzed for the maximum set-down from a seiche combined with historic low water level conditions. USAR Section 2.4.11.5 states that the corresponding minimum level in the emergency service water pump chamber for these conditions is 171.33 meters (562.09 feet). The staff notes that the intake is designed to dampen the wave action in the lake (as described in the USAR). The licensee also reevaluated low water level as part of the plant's Flood Hazard Reevaluation Report (FHRR). With the invert of the chamber for the essential service water pump at an elevation of 164 meters (537 feet), the 3-meter (10-foot) minimum depth requirement for the essential service water pumps is met with significant margin in all cases.

Perry's FLEX mitigation strategies credits water from Lake Erie within 6–7 hours in order to minimize challenges to reactor core isolation cooling (RCIC) operation, assuming the RCIC suction is initially aligned to the suppression pool. However, if either the condensate storage tank (CST), mixed-bed storage tank, or two-bed storage tank on the west side of the plant are available, the plant has sufficient water sources such that Lake Erie water is not needed for 24 hours. It is unlikely that conditions that create a seiche would affect these tanks.

The NRC staff notes that the Perry mitigation strategy for extended loss of alternating current (ac) power (ELAP) and loss of normal access to the UHS relies on a modified suppression pool cooling system using the UHS before 24 hours. This system is employed to eliminate the need for containment venting as part of the strategy to maintain containment integrity. As noted above, a seiche is not expected to challenge cooling water. However, if cooling water were lost and power to hydrogen igniters were available through use of the FLEX support equipment, onset of containment failure would be delayed past 24 hours.

Evaluation of Davis-Besse

Davis-Besse has a CST that provides 14 hours of decay heat removal, assuming that the CST is not damaged by the seiche conditions. It supplies water to the steam generator(s) using the installed turbine-driven auxiliary feedwater pump. Alternatively (or additionally), a newly installed, automatically started, diesel-driven, emergency feedwater pump can provide 24 hours of decay heat removal, taking suction from a newly installed 1,135,624-liter (300,000-gallon) emergency water storage tank that is seismically qualified and missile protected.

RCS inventory control is based on the use of low leakage N-9000 reactor coolant pump (RCP) seals. The clean water receiver tank is protected from natural hazards. The borated water storage tank is not tornado missile protected. Either tank can provide at least 24 hours of make-up cooling water to the reactor coolant system (RCS).

Evaluation of Fitzpatrick

Fitzpatrick has a considerable volume of water available in the suppression chamber, and its CST is considered robust to withstand the effects of a seiche. They provide sufficient quantity of water to the RCIC pump such that Lake Ontario water is not needed until approximately 24 hours into an ELAP event. The licensee can then use fire trucks or other equipment to provide injection into the core. The containment vent is credited to prevent overpressurization of the containment.

By letter dated November 18, 2015,[11] the licensee informed the Commission of its intent to cease operations of the facility, and the licensee suspended its implementation of Orders EA-12-049 (mitigating strategies)[12] and EA-13-109 (hardened containment vent). The staff's evaluation in SECY-16-0074 would have assumed compliance with the mitigation strategies Order EA-12-049; however, based upon the intent to cease operations letter, the staff concluded that the licensee may not completely implement all of the mitigating strategies such that the availability of electrical power may depend on the availability of off-site power. Due to the licensee's plans to close Fitzpatrick, the staff did not perform a detailed review of the licensee's ability to use the on-site water – an important aspect of mitigating strategies.

Since the writing of SECY-16-0074, the licensee has announced a possibility for continued operation of Fitzpatrick. If the facility does not close, then the licensee would need to comply with the Orders EA-12-049 and EA-13-109. Subsequently, the staff will review the licensee's ability to use the on-site water as part of the staff's review of the licensee's compliance with the Orders.

Evaluation of Nine Mile Point

The FHRR for Nine Mile Point Units 1 and 2[13] evaluated the plant's susceptibility to low water level conditions as a result of a seiche. Section 2.5.3 of the FHRR notes that the amplitude of a seiche wave is expected to be less than the probable maximum storm surge of 1.5 meters (4.8 feet). Section 2.6.2.2.2 of the FHRR evaluates the impact on the safety-related UHS from drawdown of 3 meters (9 feet) and concludes that there is sufficient margin to protect safety-related cooling water.

The staff reviewed the FLEX strategies for the Nine Mile Point Unit 1. The licensee will initially remove the core decay heat and cool down the reactor using the emergency condensers. This strategy will provide 8 hours of cooling water. If the extreme low water level persists, the licensee could access the CST or the water volume in the Nine Mile Point Unit 2 cooling tower, either of which provides more than 24 hours of cooling water, before the top of active fuel is reached as a result of the assumed leakage through the recirculation pump seals and other small sources of leakage. To provide makeup to the emergency condenser shells and reactor pressure vessel, the plant will deploy a FLEX pump, taking suction from Lake Ontario via the circulating water intake tunnel as an indefinite supply of water.

The staff also reviewed the FLEX strategies for the Nine Mile Point Unit 2. As stated above, based upon the information in the FHRR, the staff concluded that Nine Mile Point Unit 2 has sufficient margin to protect safety-related cooling water from a low water level condition. The licensee initially intends to remove decay heat using the RCIC pump taking suction from the suppression pool or the CSTs, if available. Within 16 hours, a portable FLEX pump will be connected to a dry hydrant, which takes suction 4.6 meters (15 feet) below the minimum lake level from the UHS (Lake Ontario). It will then be connected to one division of the residual heat removal system, allowing water to be supplied to the suppression pool or directly injected into the reactor pressure vessel. Therefore, Nine Mile Point Unit 2 does not have a 24-hour water

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11 "Notification of Permanent Cessation of Power Operations," dated November 18, 2015 (ADAMS Accession No. ML15322A273).

12 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 (ADAMS Accession No. ML12054A735).

13 "Nine Mile Point, Units 1 and 2, Transmittal of Flood Hazard Reevaluation Report," dated March12, 2013 (ADAMS Accession No. ML130740943).

supply before switching to Lake Ontario as a UHS water source; however, the connection is below the lowest level the lake is evaluated to recede. The licensee will use the hardened containment vent system to limit suppression chamber pressure and suppression pool temperature to support continued RCIC operation.

In addition to the above mentioned sources or water, both units can access the circulation water system, which contains 45,424,941 liters (12,000,000 gallons) of water. Of that volume, 26,119,341 liters (6,900,000 gallons) is contained within the cooling tower basin. Although not specifically mentioned as part of the FLEX strategy, the FLEX pumps for both Unit 1 and Unit 2 can be connected to the Unit 2 cooling tower basin, providing decay heat removal capabilities for both units for several days. Additionally, although not part of the Nine Mile Point Unit 1 mitigating strategy, the licensee has the capability to use the CST, which provides 20 hours of water supply to the reactor using the control rod drive pumps, if available. Therefore, both units have at least 24-hours of coping capability without relying on Lake Ontario water.

Evaluation of Ginna

Ginna intends to remove decay heat initially using the turbine-driven auxiliary feedwater pump, taking suction from the CST. However, this equipment is not considered to be robust to survive all external hazards. Therefore, if the turbine-driven auxiliary feedwater pump or CST becomes unavailable, the licensee plans use the two existing standby auxiliary feedwater (SAFW) pumps, which take suction from a new SAFW CST that is protected from all events. The SAFW pumps are electric and can be powered by off-site power or a FLEX diesel generator. This system was designed to provide water to the steam generators for core decay heat removal for 24 hours without requiring additional water.

The FLEX diesel generator can also power an RCS injection pump that takes suction from the refueling water storage tank (RWST), which is fully protected from all hazards. The RWST has enough water for 60 hours.

Evaluation of Fermi

A closed-loop cooling system, the residual heat removal complex, provides the UHS at Fermi Unit 2. This system contains the residual heat removal service water system, the emergency equipment service water system, the diesel generator service water system, the mechanical draft cooling towers, the emergency ac power system (diesel generators), and the reservoir. Fermi does have a service water system, but it is for non-nuclear-related loads and not required for safe shutdown of the reactor. Therefore, the Fermi Unit 2 safety-related heat sink is not susceptible to low water level conditions from a seiche. In May 2015, the Commission approved a combined construction and operating license for Fermi Unit 3, but DTE Energy stated that there were no plans for construction at that time.

Nuclear Power Plants Located on Lake Michigan (Point Beach, Palisades, and D.C. Cook)

The staff confirmed that the orientation of Lake Michigan makes it susceptible to excessive wind-driven storm surges. The staff identified three operating nuclear power plants on Lake Michigan that potentially could be affected by a seiche—Point Beach, Palisades, and D.C. Cook. Kewanee is also on Lake Michigan, but it is being decommissioned.

Evaluation of Point Beach

The Point Beach FHRR[14] evaluated the plant's susceptibility to low water level conditions as a result of a seiche. Section 5.10 of the FHRR provides an analysis of historical low levels of the lake combined with a seiche producing an additional set-down, although the licensee notes that an appreciable seiche is highly unlikely to occur at the site. The analysis concludes that even with the lowest historical lake level combined with a seiche set-down, there is sufficient margin to assure operability of the safety-related service water pumps. The licensee has procedures to monitor forebay level and secure circulating water pumps as needed to ensure the forebay remains at acceptable levels.

The staff also reviewed the FLEX mitigation strategies for the site. The FLEX strategy identifies sources of water to cope for more than 24 hours. The CSTs provide approximately 3–6 hours of cooling water. This time frame is conservatively based on the minimum values in the technical specifications, not the typical tank level (which is generally much higher). After the CSTs are depleted, the plant would switch to service water. The licensee analyzed a scenario under which normal UHS supply is lost and the plant would rely on water in the pump bay. Use of the pump bay would provide sufficient water to support decay heat removal capabilities for more than 24 hours. Manual actions would be taken to establish an alternative connection to the UHS.

RCS inventory control is based on the use of low leakage RCP seals. The boric acid storage tanks (BASTs) and RWST provide a sufficient supply of protected borated water for the plant to inject water into the RCS beyond 24 hours.

Evaluation of Palisades

The Palisades intake structure is designed such that the hypothetical seiche would not adversely impact the safety-related cooling water pumps. In the storm event on April 10, 2013, the plant experienced a seiche level set-down of up to 0.5 meter (1.7 feet) for approximately 20 minutes, while the lake was at historic low water levels. While the lowest water level approached the unusual event criterion of 174 meters (572 feet) in the licensee's emergency response plan, this water level would need to remain below 173.20 meters (568.25 feet) for an extended period of time in order to threaten the cooling water inlet (the cooling water pumps can operate down to 169.85 meters (557.25 feet) but the forebay has a weir at 173.20 meters (568.25 feet)). In the staff's evaluation, the hypothetical seiche (which would require wind direction opposite the prevailing wind direction) would not result in water levels dropping to 173.20 meters (568.25 feet).

Palisades has installed low leakage seals for RCS inventory control. The FLEX strategy for RCS makeup uses BASTs to provide makeup water. The BASTs allow for 29 hours of borated water. The safety injection and refueling water storage tank (SIRWT) is not missile protected but would have borated water available for injection into the RCS as well.

The CST and tank T-81 provide a minimum of 8 hours of cooling water to the steam generators. After this, the licensee could access the contents of the SIRWT, the primary makeup water tank, the utility water storage tank, and/or the demineralized water storage tank (DWST) if available; however, none is robust for all events. Either the SIRWT or the

[14] "NextEra Energy Point Beach, LLC, Response to NRC 10 CFR 50.54(f) Request for Information Regarding Near-Term Task Force Recommendation 2.1, Flooding- Submittal of Flooding Hazards Revaluation Report," dated March 12, 2015 (ADAMS Accession No. ML15071A413).

DWST would provide water beyond 24 hours, and they are on opposite sides of large intervening structures, so the staff expects at least one of them would survive the winds that cause the hypothetical seiche.

Evaluation of D.C. Cook

D.C. Cook can cope for 24 hours using water stored in on-site tanks to support the plant's FLEX strategy. Credited tanks are protected against all hazards. Steam generator makeup is from the CST for at least 12 hours, taking credit for only the bottom half of the tank because the top half is not protected from tornado missiles. The CST can provide more than 24 hours of water if it is not damaged. In addition, either of two fire water tanks can provide more than 24 hours of water, and the plant can draw water from the municipal water system. These sources are not considered robust for all events, but they are expected to survive the winds that generate a seiche and collectively provide reasonable assurance that a supply of water sufficient for more than 24 hours is available in a seiche condition.

RCS inventory control is based on low leakage RCP seals. RCS injection is from three BASTs and/or two RWSTs that are shared between the units. The addition of SHIELD® seals allows for an injection to be delayed until 16 hours if necessary. The amount of borated water in the BASTs and RWSTs allows for RCS injection well beyond 24 hours.

Nuclear Power Plants Located on the Gulf of Mexico (South Texas and Waterford)

The JLD staff reviewed plants on the Gulf of Mexico and confirmed that neither South Texas nor Waterford rely on the Gulf of Mexico for its safety-related UHS water supply. Therefore, the variance in water level of the Gulf of Mexico from a seiche would not adversely affect the plants' ability to remove decay heat.

Nuclear Power Plant Located on the Chesapeake Bay (Calvert Cliffs)

The CSTs at Calvert Cliffs provide 10 hours of cooling water to the steam generators. Afterwards, the two pretreated water storage tanks and two refueling water tanks could be accessed. Any of the four tanks will provide the needed water to last beyond 24 hours. The tanks are distributed around the site, with three in a tank farm such that they would provide shielding for each other from any hazard associated with a seiche event. Therefore, the staff expects that at least 24 hours of water would be available during a seiche.

RCS inventory control is based on the use of N-9000 low leakage RCP seals. The BASTs provide 22,712 liters (6,000 gallons) of borated water each, which is sufficient to provide RCS injection for 24 hours. The refueling water storage tanks should be available for RCS injection through the charging pumps as well.

4. Findings of Technical Evaluation

The staff evaluated the affected nuclear power plants' ability to respond to an event in which safety-related service water pumps that take suction from the UHS suffer irrecoverable damage from low water level conditions as a result of a set-down following a seiche. The staff used the success criterion that there was an independent means to remove decay heat that provided sufficient time (24 hours) for licensees to make arrangements for alternative sources of water to remove decay heat until access to the UHS was returned.

Given the design of the nuclear power plants, the staff found conservatism in the available margin for a low water level condition that could damage the safety-related service water pumps. Additionally, the staff found that the power plants have access to sufficient on-site stored water capacity and alternative delivery systems capable of maintaining decay heat removal until off-site resources became available or the UHS level has returned to an accessible level. Therefore, the staff concluded that the licensees would not be adversely affected by the low UHS levels created during a storm surge or seiche.

5. Generic Issue Review Panel Screening Results

MD 6.4 stipulates that a proposed GI must satisfy seven screening criteria in order to continue into the assessment stage of the Generic Issues Program. Based upon a detailed analysis perform by the JLD staff of the postulated environmental phenomena and the design of each affected nuclear power plant located on coasts of large bodies of water, the GIRP determined that the proposed GI does not meet all seven screening criteria. Specifically, the GIRP found that the nuclear power plants located on the Great Lakes are designed with sufficient resources to mitigate to consequences of a low level caused by a seiche. In addition, the GIRP finds that the JLD staff have sufficiently addressed the issue of a low level in the UHS caused by a seiche. Hence, the GIRP finds that the proposed GI does not meet the following criteria:

- Criterion 1, “The issue affects public health and safety, the common defense and security, or the environment.”

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

Enclosure 1 to this memorandum summarizes whether the proposed GI meets or does not meet each of the seven screening criteria. Based upon the technical evaluation presented above, the GIRP recommends that the proposed GI concerning the loss of UHS as a result of a seiche coincident with low water levels in the Great Lakes should not continue into the assessment stage and should exit the Generic Issues Program in accordance with MD 6.4.