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

January 31, 2017

Mr. Bryan C. Hanson
Senior Vice President
Exelon Generation Company, Inc.
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Rd
Warrenville, IL 60555

SUBJECT: NINE MILE POINT NUCLEAR STATION, UNITS 1 AND 2 – SAFETY EVALUATION REGARDING IMPLEMENTATION OF MITIGATING STRATEGIES AND RELIABLE SPENT FUEL POOL INSTRUMENTATION RELATED TO ORDERS EA-12-049 AND EA-12-051 (CAC NOS. MF1129, MF1130, MF1131, AND MF1132)

Dear Mr. Hanson:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design-Basis External Events" and Order EA-12-051, "Order to Modify Licenses With Regard To Reliable Spent Fuel Pool Instrumentation," (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML12054A736 and ML12054A679, respectively). The orders require holders of operating reactor licenses and construction permits issued under Title 10 of the *Code of Federal Regulations* Part 50 to modify the plants to provide additional capabilities and defense-in-depth for responding to beyond-design-basis external events, and to submit for review Overall Integrated Plans (OIPs) that describe how compliance with the requirements of Attachment 2 of each order will be achieved.

By letter dated February 28, 2013 (ADAMS Accession No. ML13066A171), Exelon Generation Company, Inc.(Exelon, the licensee), previously as Constellation Energy Nuclear Group, LLC submitted its OIP for Nine Mile Point Nuclear Station, Units 1 and 2 (Nine Mile Point) in response to Order EA-12-049. By letter dated March 8, 2013 (ADAMS Accession No. ML13074A056), Exelon submitted a complete revision of the OIP for Nine Mile Point. At six month intervals following the submittal of the OIP, the licensee submitted reports on its progress in complying with Order EA-12-049. These reports were required by the order, and are listed in the attached safety evaluation. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049 in accordance with NRC Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, "Regulatory Audits," (ADAMS Accession No. ML082900195). By letters dated December 19, 2013 (ADAMS Accession No. ML13225A584), April 28, 2015 (ADAMS Accession No. ML15110A026), and February 4, 2016 (ADAMS Accession No. ML16006A213), the NRC issued an Interim Staff Evaluation (ISE) and audit reports, respectively, on the licensee's progress. By letters dated June 8, 2015 (ADAMS Accession No. ML15163A097), and July 1, 2016 (two letters)(ADAMS Accession Nos. ML16188A265 and ML16188A271), Exelon submitted compliance letters and Final Integrated

Plans (FIPs) in response to Order EA-12-049 for Units 1 and 2, respectively. The compliance letter stated that the licensee had achieved full compliance with Order EA-12-049.
By letter dated February 28, 2013 (ADAMS Accession No. ML13066A172), the licensee submitted its OIP for Nine Mile Point in response to Order EA-12-051. At six month intervals following the submittal of the OIP, the licensee submitted reports on its progress in complying with Order EA-12-051. These reports were required by the order, and are listed in the attached safety evaluation. By letters dated November 15, 2013 (ADAMS Accession No. ML13281A205), and April 28, 2015 (ADAMS Accession No. ML15110A026), the NRC staff issued an ISE and audit report, respectively, on the licensee's progress. By letter dated March 26, 2014 (ADAMS Accession No. ML14083A620), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-051 in accordance with NRC NRR Office Instruction LIC-111, similar to the process used for Order EA-12-049. By letters dated June 8, 2015 (ADAMS Accession No. ML15159A385), and June 14, 2016 (ADAMS Accession No. ML16167A162), Exelon submitted compliance letters in response to Order EA-12-051. The compliance letter stated that the licensee had achieved full compliance with Order EA-12-051.

The enclosed safety evaluations provide the results of the NRC staff's review of Exelon's strategies for Nine Mile Point, Units 1 and 2. Enclosure 1 contains Nine Mile Point, Unit 1's safety evaluation and Enclosure 2 contains Nine Mile Point, Unit 2's safety evaluation. The intent of the safety evaluation is to inform Exelon on whether or not its integrated plans, if implemented as described, appear to adequately address the requirements of Orders EA-12-049 and EA-12-051. The staff will evaluate implementation of the plans through inspection, using Temporary Instruction 191, "Implementation of Mitigation Strategies and Spent Fuel Pool Instrumentation Orders and Emergency Preparedness Communications/Staffing/ Multi-Unit Dose Assessment Plans" (ADAMS Accession No. ML14273A444). This inspection will be conducted in accordance with the NRC's inspection schedule for the plant.

If you have any questions, please contact Jason Paige, Orders Management Branch, Nine Mile Point Project Manager, at Jason.Paige@nrc.gov.

Sincerely,

Mandy K Halter

Mandy K. Halter, Acting Chief
Orders Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Docket Nos.: 50-220 and 50-410

Enclosures:
1. Nine Mile Point, Unit 1 Safety Evaluation
2. Nine Mile Point, Unit 2 Safety Evaluation

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO ORDERS EA-12-049 AND EA-12-051

EXELON GENERATION COMPANY, INC.

NINE MILE POINT NUCLEAR STATION, UNIT 1

DOCKET NO. 50-220

1.0 INTRODUCTION

The earthquake and tsunami at the Fukushima Dai-ichi nuclear power plant in March 2011 highlighted the possibility that extreme natural phenomena could challenge the prevention, mitigation and emergency preparedness defense-in-depth layers already in place in nuclear power plants in the United States. At Fukushima, limitations in time and unpredictable conditions associated with the accident significantly challenged attempts by the responders to preclude core damage and containment failure. During the events in Fukushima, the challenges faced by the operators were beyond any faced previously at a commercial nuclear reactor and beyond the anticipated design-basis of the plants. The U.S. Nuclear Regulatory Commission (NRC) determined that additional requirements needed to be imposed at U.S. commercial power reactors to mitigate such beyond-design-basis external events (BDBEEs).

On March 12, 2012, the NRC issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A736). This order directed licensees to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities in the event of a BDBEE. Order EA-12-049 applies to all power reactor licensees and all holders of construction permits for power reactors.

On March 12, 2012, the NRC also issued Order EA-12-051, "Order Modifying Licenses With Regard to Reliable Spent Fuel Pool Instrumentation" (ADAMS Accession No. ML12054A679). This order directed licensees to install reliable SFP level instrumentation with a primary channel and a backup channel, and with independent power supplies that are independent of the plant alternating current (ac) and direct current (dc) power distribution systems. Order EA-12-051 applies to all power reactor licensees and all holders of construction permits for power reactors.

2.0 REGULATORY EVALUATION

Following the events at the Fukushima Dai-ichi nuclear power plant on March 11, 2011, the NRC established a senior-level agency task force referred to as the Near-Term Task Force

(NTTF). The NTTF was tasked with conducting a systematic and methodical review of the NRC regulations and processes and determining if the agency should make additional improvements to these programs in light of the events at Fukushima Dai-ichi. As a result of this review, the NTTF developed a comprehensive set of recommendations, documented in SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011 (ADAMS Accession No. ML11186A950). Following interactions with stakeholders, these recommendations were enhanced by the NRC staff and presented to the Commission.

On February 17, 2012, the NRC staff provided SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," (ADAMS Accession No. ML12039A103) to the Commission. This paper included a proposal to order licensees to implement enhanced BDBEE mitigation strategies. As directed by the Commission in staff requirements memorandum (SRM)-SECY-12-0025 (ADAMS Accession No. ML120690347), the NRC staff issued Orders EA-12-049 and EA-12-051.

2.1 Order EA-12-049

Order EA-12-049, Attachment 2 (ADAMS Accession No. ML12054A736), requires that operating power reactor licensees and construction permit holders use a three-phase approach for mitigating BDBEEs. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment and SFP cooling capabilities. The transition phase requires providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. Specific requirements of the order are listed below:

1) Licensees or construction permit (CP) holders shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities following a beyond-design-basis external event.

2) These strategies must be capable of mitigating a simultaneous loss of all alternating current (ac) power and loss of normal access to the ultimate heat sink [UHS] and have adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to this Order.

3) Licensees or CP holders must provide reasonable protection for the associated equipment from external events. Such protection must demonstrate that there is adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to this Order.

4) Licensees or CP holders must be capable of implementing the strategies in all modes of operation.

5) Full compliance shall include procedures, guidance, training, and acquisition, staging, or installing of equipment needed for the strategies.

On August 21, 2012, following several submittals and discussions in public meetings with NRC staff, the Nuclear Energy Institute (NEI) submitted document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0 (ADAMS Accession No. ML12242A378), to the NRC to provide specifications for an industry-developed methodology for the development, implementation, and maintenance of guidance and strategies in response to the Mitigation Strategies order. The NRC staff reviewed NEI 12-06 and on August 29, 2012, issued its final version of Japan Lessons-Learned Directorate (JLD) Interim Staff Guidance (ISG) JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12229A174), endorsing NEI 12-06, Revision 0, with comments, as an acceptable means of meeting the requirements of Order EA-12-049, and published a notice of its availability in the *Federal Register* (77 FR 55230).

2.2 Order EA-12-051

Order EA-12-051, Attachment 2 (ADAMS Accession No. ML12054A679), requires that operating power reactor licensees and construction permit holders install reliable SFP level instrumentation. Specific requirements of the order are listed below:

> All licensees identified in Attachment 1 to the order shall have a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system, (2) level that is adequate to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.
>
> 1. The spent fuel pool level instrumentation shall include the following design features:
>
> 1.1 Instruments: The instrumentation shall consist of a permanent, fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor spent fuel pool water level under conditions that restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or heat and humidity from a boiling pool.
>
> 1.2 Arrangement: The spent fuel pool level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the spent fuel pool. This protection may be provided by locating the primary instrument channel and fixed portions of the backup instrument channel, if applicable, to maintain instrument channel separation within the spent fuel pool area, and to utilize inherent shielding

from missiles provided by existing recesses and corners in the spent fuel pool structure.

1.3 Mounting: Installed instrument channel equipment within the spent fuel pool shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the spent fuel pool structure.

1.4 Qualification: The primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period. This reliability shall be established through use of an augmented quality assurance process (e.g., a process similar to that applied to the site fire protection program).

1.5 Independence: The primary instrument channel shall be independent of the backup instrument channel.

1.6 Power supplies: Permanently installed instrumentation channels shall each be powered by a separate power supply. Permanently installed and portable instrumentation channels shall provide for power connections from sources independent of the plant ac and dc power distribution systems, such as portable generators or replaceable batteries. Onsite generators used as an alternate power source and replaceable batteries used for instrument channel power shall have sufficient capacity to maintain the level indication function until offsite resource availability is reasonably assured.

1.7 Accuracy: The instrument channels shall maintain their designed accuracy following a power interruption or change in power source without recalibration.

1.8 Testing: The instrument channel design shall provide for routine testing and calibration.

1.9 Display: Trained personnel shall be able to monitor the spent fuel pool water level from the control room, alternate shutdown panel, or other appropriate and accessible location. The display shall provide on-demand or continuous indication of spent fuel pool water level.

2. The spent fuel pool instrumentation shall be maintained available and reliable through appropriate development and implementation of the following programs:

2.1 Training: Personnel shall be trained in the use and the provision of alternate power to the primary and backup instrument channels.

2.2 Procedures: Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels.

2.3 Testing and Calibration: Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup spent fuel pool level instrument channels to maintain the instrument channels at the design accuracy.

On August 24, 2012, following several NEI submittals and discussions in public meetings with NRC staff, the NEI submitted document NEI 12-02, "Industry Guidance for Compliance With NRC Order EA-12-051, To Modify Licenses With Regard to Reliable Spent Fuel Pool Instrumentation," Revision 1 (ADAMS Accession No. ML12240A307) to the NRC to provide specifications for an industry-developed methodology for compliance with Order EA-12-051. On August 29, 2012, the NRC staff issued its final version of JLD-ISG-2012-03, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation" (ADAMS Accession No. ML12221A339), endorsing NEI 12-02, Revision 1, as an acceptable means of meeting the requirements of Order EA-12-051 with certain clarifications and exceptions, and published a notice of its availability in the *Federal Register* (77 FR 55232).

3.0 TECHNICAL EVALUATION OF ORDER EA-12-049

By letter dated February 28, 2013 (ADAMS Accession No. ML13066A171), Exelon Generation Company, Inc,(Exelon, the licensee), previously as Constellation Energy Nuclear Group, LLC submitted its OIP for Nine Mile Point Nuclear Station, Units 1 and 2 (Nine Mile Point, NMP1 and NMP2) in response to Order EA-12-049. By letter dated March 8, 2013 (ADAMS Accession No. ML13074A056), Exelon submitted a complete revision of the OIP for Nine Mile Point. By letters dated August 27, 2013 (ADAMS Accession No. ML13254A278), February 27, 2014 (ADAMS Accession No. ML14069A318), August 26, 2014 (ADAMS Accession No. ML14241A380), and February 19, 2015 (ADAMS Accession No. ML15062A036), the licensee submitted six-month updates to the OIP. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049 in accordance with NRC Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, "Regulatory Audits" (ADAMS Accession No. ML082900195). By letters dated December 19, 2013 (ADAMS Accession No. ML13225A584), and April 28, 2015 (ADAMS Accession No. ML15110A026), the NRC issued an Interim Staff Evaluation (ISE) and audit report, respectively, on the licensee's progress. By letter dated June 8, 2015 (ADAMS Accession No. ML15163A097), Exelon submitted a compliance letter and Final Integrated Plan (FIP) in response to Order EA-12-049 for Nine Mile Point, Unit 1. The compliance letter stated that the licensee had achieved full compliance with Order EA-12-049.

3.1 Overall Mitigation Strategy

Attachment 2 to Order EA-12-049 describes the three-phase approach required for mitigating BDBEEs in order to maintain or restore core cooling, containment, and SFP cooling capabilities. The phases consist of an initial phase (Phase 1) using installed equipment and resources, followed by a transition phase (Phase 2) in which portable onsite equipment is placed in service, and a final phase (Phase 3) in which offsite resources may be placed in service. The timing of when to transition to the next phase is determined by plant-specific analyses.

While the initiating event is undefined, it is assumed to result in an extended loss of ac power (ELAP) with a loss of normal access to the UHS. Thus, the ELAP with loss of normal access to the UHS is used as a surrogate for a BDBEE. The initial conditions and assumptions for the analyses are stated in NEI 12-06, Section 3.2.1, and include the following:

1. The reactor is assumed to have safely shut down with all rods inserted (subcritical).
2. The dc power supplied by the plant batteries is initially available, as is the ac power from inverters supplied by those batteries; however, over time the batteries may be depleted.
3. There is no core damage initially.
4. There is no assumption of any concurrent event.
5. Because the loss of ac power presupposes random failures of safety-related equipment (emergency power sources), there is no requirement to consider further random failures.

Nine Mile Point, Unit 1 is a General Electric boiling-water reactor (BWR) Model 2 with a Mark I containment. The licensee's three-phase approach to mitigate a postulated ELAP event, as described in the FIP, is summarized below.

At the onset of an ELAP, the reactor is assumed to trip from full power. The main condenser is unavailable due to the loss of circulating water. Initially electromatic relief valves (ERVs) will automatically cycle, rejecting heat to the suppression pool, to control reactor pressure until the emergency cooling (EC) system is placed into service. Once in service, the reactor core will be cooled by water from the EC tanks. The operators will throttle valves from the EC makeup tanks in order to conserve water. Steam from the reactor is routed through the emergency condensers where it is condensed. The water is then returned to the reactor pressure vessel (RPV) via natural circulation. The fuel will remain covered for 5.7 hours after the ELAP event in this configuration. Makeup to the RPV relies on Phase 2 FLEX components that include a diesel-driven makeup pump. The FLEX pump will be deployed to the Unit 1 screen house and take suction from the circulating water intake tunnel or Lake Ontario. The FLEX pump will discharge to a manifold located in the reactor building. From the reactor building manifold, the primary injection into the RPV is the control rod drive return line and the alternate path is a connection on the feedwater line in the turbine building. The reactor building manifold also supplies makeup water to the emergency condenser shells and SFP.

With two EC loops in operation, RPV pressure lowers from 1030 pounds per square inch gage (psig) to below 93 psig at 3 hours after the onset of an ELAP. The objective of the cooldown of the primary system is to reach a pressure less than 127 psig to ensure sufficient RPV makeup is provided to compensate for the 45 gallons per minute (gpm) total reactor coolant pressure boundary leakage during an ELAP.

Unit 1 has a Mark I pressure suppression containment consisting of a drywell and a pressure suppression chamber. The licensee indicated that using the emergency condensers the peak torus temperature will remain below 175 degrees Fahrenheit (°F) for at least 72 hours during the ELAP scenario, which is below the torus design temperature limit of 205°F. After 72-hours, should containment temperature/pressure parameters eventually reach the level that require containment venting, as required by emergency operating procedures (EOPs), existing vent pathways may be utilized. Procedure direction and appropriate equipment is available in order to implement containment venting. It is expected that this will alleviate any further challenge to containment integrity and should allow containment temperature and pressure to stay within acceptable levels until equipment from the National Strategic Alliance of FLEX Emergency Response (SAFER) Response Center (NSRC) can be set up for recovery of containment cooling systems.

The Unit 1 SFP is located in the reactor building. To maintain SFP cooling capabilities, the licensee stated that the required action is to establish the water injection lineup before the environment on the SFP operating deck degrades due to boiling in the pool. The pool will initially heat up due to the unavailability of the normal cooling system. The licensee has calculated that, depending on the spent fuel loading in the pool, boiling could start as soon as 8 hours after the start of the ELAP. The pool water level would boil off to a level 10 feet (ft.) above the top of fuel in 45 hours from initiation of the event with no operator action at the maximum design basis heat load. To makeup to the SFP, the licensee has a primary and alternate strategy based on the condition of the pool. As mentioned above, operators will deploy a portable FLEX pump to supply water from Lake Ontario at the circulating water intake location in the screen house to a manifold in the reactor building. The primary strategy routes the SFP makeup hoses from the FLEX distribution manifold to a hard-pipe connection (not requiring refueling floor access). The alternate strategy is to either route the hoses from the manifold to the refueling floor to provide direct makeup to the pool or provide spray flow via portable nozzles.

The operators will complete a dc bus load stripping within the initial 30 minutes from ELAP initiation to ensure safety-related battery life is extended up to 8 hours. Following dc load stripping and prior to battery depletion, one 450 kilowatt (kW), 600 volt alternating current (Vac) generator will be deployed from the FLEX storage building (FSB). The primary strategy is to connect the portable generator to the Unit 1 static battery charger, or as the alternate strategy, connect the generator to the portable National Fire Protection Association (NFPA) 805 battery charger to power battery board 11 or 12. The portable generator will be used to repower essential battery chargers within 8 hours of ELAP initiation. Procedures direct the removal of a battery from service if the battery terminal voltage drops below 106 Vdc to prevent permanent battery damage.

In addition, a NSRC will provide high capacity pumps and large turbine-driven diesel generators (DGs) to backup the Phase 2 portable equipment or repower existing plant systems, if necessary. There are two NSRCs in the United States.

Below are specific details on the licensee's strategies to restore or maintain core cooling, containment, and SFP cooling capabilities in the event of a BDBEE and the results of the staff's review of these strategies. The NRC staff evaluated the licensee's strategies against the endorsed NEI 12-06, Revision 0, guidance.

3.2 Reactor Core Cooling Strategies

Order EA-12-049 requires licensees to maintain or restore cooling to the reactor core in the event of an ELAP concurrent with a loss of normal access to the UHS. Although the ELAP results in an immediate trip of the reactor, sufficient core cooling must be provided to account for fission product decay and other sources of residual heat. Consistent with endorsed guidance from NEI 12-06, Phase 1 of the licensee's core cooling strategy credits installed equipment (other than that presumed lost to the ELAP with loss of normal access to the UHS) that is robust in accordance with the guidance in NEI 12-06. In Phase 2, robust installed equipment is supplemented by onsite FLEX equipment, which is used to cool the core either directly (e.g., pumps and hoses) or indirectly (e.g., FLEX electrical generators and cables repowering robust installed equipment). The equipment available onsite for Phases 1 and 2 is further supplemented in Phase 3 by equipment transported from the NSRCs.

As reviewed in this section, the licensee's core cooling analysis for the ELAP with loss of normal access to the UHS event presumes that, per endorsed guidance from NEI 12-06, the unit would have been operating at full power prior to the event. Therefore, the suppression pool may be credited as the heat sink for core cooling during the ELAP with loss of normal access to the UHS event. Maintenance of sufficient reactor pressure vessel (RPV) inventory, despite steam release from the ERVs and ongoing system leakage expected under ELAP conditions, is accomplished through a combination of installed systems and FLEX equipment. The specific means used by the licensee to accomplish adequate core cooling during the ELAP with loss of normal access to the UHS event are discussed in further detail below. The licensee's strategy for ensuring compliance with Order EA-12-049 for conditions where one or more units are shut down or being refueled is reviewed separately in Section 3.11 of this evaluation.

3.2.1 Core Cooling Strategy and RPV Makeup

3.2.1.1 Phase 1

In its FIP, Section 2.3.1.1, the licensee states that at the initiation of the BDBEE, main steam isolation valves (MSIVs) automatically close, feed water flow to the reactor is lost, and ERVs automatically cycle to control pressure, causing reactor water level to decrease. In order to preserve inventory in the reactor, existing procedures were revised so that operators will manually initiate both EC loops and close MSIVs when it is determined that a station blackout (SBO) condition exists versus waiting for an automatic initiation to occur. With both EC loops in service, reactor water level remains above the top of active fuel (TAF) for approximately 5.7 hours, ensuring adequate reactor heat removal.

Phase 1 of core cooling relies on the use of installed plant equipment. The reactor core will be cooled by the water in the EC tanks. Steam is routed from the reactor through the emergency condensers where it is condensed with the water and then returned to the RPV through natural circulation. The water on the shell side of the emergency condensers is boiled-off and released to the atmosphere. The operators will throttle valves from the EC makeup tanks in order to conserve water and control the cooldown.

The operators will begin setting up FLEX equipment to ensure RPV injection and EC cooling capability into Phase 2. The licensee performed a calculation to verify that the fuel will remain covered up to 5.7 hours after ELAP initiation. Seal leakage from the reactor recirculation pumps is a large contributor to the loss of RPV level. The assumed leakage from the RPV is less than 45 gpm.

3.2.1.2 Phase 2

In its FIP, Sections 2.3.1.1 and 2.3.2, the licensee states that deployment of Phase 2 portable equipment will begin when it is recognized a SBO/ELAP condition exists (within 1 hour). The portable FLEX pump will inject to the RPV via the CRD return line or the capability exists to connect the discharge hose of a FLEX pump to a hose connection into the feedwater line to the reactor in the turbine building within the coping time for Phase 1. The RPV pressure will be lowered to accommodate the injection of the FLEX pump.

For Phase 2 core cooling strategy, Unit 1 relies on FLEX diesel-driven makeup pumps. The Unit 1 analysis conservatively determined that the diesel-driven pump will provide a makeup flowrate of at least 100 gpm with an assumed constant RPV leakage rate of 45 gpm to ensure the core remains covered throughout the event.

The FLEX pump will be set up by the north wall of the Unit 1 screen house. The hose will take suction from the circulating water intake tunnel to use Lake Ontario as a coping source. The pump can also be located on the west wall if the north wall is not available. The discharge hoses will be sent to a manifold in the reactor building. From the reactor building manifold the primary injection into the RPV is through the control rod drive (CRD) return line. This manifold can also provide make up to the emergency condensers and SFP. The alternative RPV injection strategy consists of a connection into the feedwater line in the turbine building. The connection is installed on a cross tie between the fire water header and the high pressure feedwater piping.

3.2.1.3 Phase 3

In its FIP, Section 2.3.3, the licensee states that the Phase 3 strategy is to use the Phase 2 connections, both mechanical and electrical, but supply water using Phase 3 portable pumps and supply ac power using the Phase 3 portable generators, if necessary. The Phase 3 equipment will act as a backup to the Phase 2 portable equipment and is deployed from an off-site facility and delivered to the site by the NSRC.

The usage of Lake Ontario will provide an indefinite volume for the core cooling strategy, but this water is not reactor grade water (the licensee is not receiving a water filtration skid from the NSRC). The licensee provided information for the use of raw water in the core that included generic work by the BWR Owners Group (BWROG) that referenced PWR steam generator degradation with raw water. In addition, the licensee evaluated the use of raw water and concluded that using Lake Ontario water is acceptable to inject into the RPV to maintain level above the TAF during an ELAP event.

3.2.2 Staff Evaluations

3.2.2.1 Availability of Structures, Systems, and Components (SSCs)

Guidance document NEI 12-06 provides guidance that the baseline assumptions have been established on the presumption that other than the loss of the ac power sources and normal access to the UHS, installed equipment that is designed to be robust with respect to design basis external events is assumed to be fully available. Installed equipment that is not robust is assumed to be unavailable. Below are the baseline assumptions for the availability of SSCs for core cooling during an ELAP caused by a BDBEE.

3.2.2.1.1 Plant SSCs

Phase 1 relies on the use of the EC system for reactor decay heat removal when the vessel is isolated from the main heat sink. Updated final safety analysis report (UFSAR) Section V states that the EC system is connected to the reactor and operates by natural circulation and serves as an alternate heat sink when the reactor is isolated from the main condenser. It also states that seismic considerations for the reactor coolant system (RCS), which includes the EC system, are described in UFSAR Section III. In the UFSAR, Section III states that Class I structures and components whose failure could cause significant release of radioactivity, or are vital to safe shutdown and isolation of the reactor, were designed so that the probability of failure would approach zero when subjected to the maximum credible earthquake motion. Based on the location in the reactor building, and the safety-related classification and function of the EC system, the staff concludes that the system is robust and is expected to be available at the start of an ELAP event consistent with NEI 12-06, Section 3.2.1.3.

3.2.2.1.2 Plant Instrumentation

The Nine Mile Point plan includes monitoring instrumentation in the control room. The instrumentation will be powered by batteries and will be maintained for indefinite coping via battery chargers powered by the FLEXDGs. A more detailed evaluation of the instrumentation power supply is contained in Section 3.2.2.6 of this safety evaluation (SE).

As described in the FIP, instrumentation for the following parameters is credited for all phases of core cooling and RPV inventory control:

- RPV Level
- RPV Pressure
- Emergency Cooling Condenser Level
- Torus Water Temperature
- Torus Water Level
- Torus Pressure
- Drywell Ambient Temperature
- Drywell Pressure

The instrumentation identified by the licensee to support its core cooling strategy appears to be consistent with the recommendations specified in the endorsed guidance of NEI 12-06.

The instrumentation is available both prior to and after load shedding of dc busses during Phase 1. The battery chargers or portable flex battery charger for station batteries will be repowered by FLEX portable DGs to maintain availability of instrumentation during Phase 2 and 3. In addition, the instrument indications would be continuously accessible throughout the ELAP event.

In accordance with NEI 12-06 Section 5.3.3.1, guidelines for obtaining critical parameters locally are provided in a Flex Support Guideline (FSG). Should it be required, the licensee will use guidance that provides a list of key parameters, locations, and equipment needed to obtain local readings of key parameters. Procedure N1-SOP-29.1, "EOP [emergency operating procedure] Key Parameter-Alternate Instrumentation," was reviewed during the audit to verify this plan, and it provides alternate methods for obtaining critical parameters if key parameter instrumentation is unavailable. The SFP level instruments are discussed in Section 4 below.

3.2.2.2 Thermal-Hydraulic Analyses

The licensee based its mitigating strategy for reactor core cooling, in part, on thermal-hydraulic analysis performed using the GE SAFE code described in its FIP, Section 2.3.6. In its FIP, Section 2.3.6 the licensee also describes the use of a GE SHEX analysis and a GOTHIC model to evaluate the containment thermal-hydraulic behavior. The NRC staff's discussion in this section of the SE solely focuses on the licensee's analysis of reactor core cooling. The review of the licensee's analysis of containment thermal-hydraulic behavior is provided in Section 3.4.4.2 of this evaluation.

The reactor water level evaluation (GE SAFE code) and the primary containment analysis (GE SHEX analysis, NMP1 GOTHIC calculation) assume a reactor coolant leak located at the bottom of the reactor vessel. The leakage is defined by assuming two phase critical flow assuming discharge to the primary containment. The GE SHEX drywell model and the GOTHIC model are a single lumped volume of the drywell atmosphere, which assumes uniform mixing. The design basis SAFE analysis includes a conservative initial condition case which scrams on low level and has MSIV closure on low-low levels. These conditions bound the potential inventory loss either through an ERV lift or inventory lost through the main turbine bypass valves. The evaluation includes initiation of both EC loops which are sufficient to control reactor pressure such that an ERV lift or bypass valve opening results in an inventory loss less than the SAFE analysis assumptions.

The Unit 1 ELAP is the same scenario as the design basis Appendix R coping evaluation, which is the licensee's analysis performed to show compliance with 10 CFR Part 50, Appendix R. Specifically, the Appendix R analysis deals with events caused by fires within the plant. However, conditions in the licensee's Appendix R analysis are similar to (or the same as) SBO and ELAP conditions, and therefore, the NRC staff considers the licensee's analysis to be applicable for setting the sequence of events for mitigating strategies. The Appendix R eight-hour coping evaluation bounds the assumed loss of ac and dc power as it considers conservative initial conditions. The evaluation considered a total leakage of 45 gpm (pressure dependent) saturated liquid line break and credits the Unit 1 emergency condensers.

The analysis uses safety related GEH software qualified to perform LOCA analyses. This analysis has been reviewed and the assumptions are consistent with the conditions required to evaluate the FLEX coping strategy. Based on the review of this calculation, the time to reach Top of Active Fuel (TAF) is shown to be 5.7 hours.

In support of the FLEX strategy, the analysis SO-GOTHIC-ELAP002, "Primary Containment Response Following an Extended Loss of AC Power," shows that with two EC loops in operation for the first 8 hours of the ELAP, RPV pressure lowers from 1030 psig to below 93 psig at 3 hours. RPV makeup flowrate of 100 gpm with the FLEX pump is achieved at an RPV pressure of 93 psig or less and RPV level will begin to rise. Although the use of two EC loops for the removal of decay heat will result in a cooldown rate greater than allowed by technical specifications, it assures that the FLEX strategy will be able to inject to the RPV with the FLEX pump within 5 hours and maintain reactor level above TAF. In addition, reactor pressure is lowered at a faster rate using two EC loops thereby decreasing the RCS leakage driving head and any recirculation pump seal leakage. With one EC taken out-of- service (or if one becomes unavailable) at 8 hours after the ELAP, the reactor pressure quickly increases above 93 psig between the 8 to 35 hour timeframe and then slowly drops below 93 psig. The peak RPV pressure reached during this time is 127 psig. Hydraulic calculations performed for RPV makeup demonstrate that adequate RPV makeup flow can be supplied at the peak RPV pressure of 127 psig.

The code used is the same as the Appendix R coping evaluation. The 8 hour evaluation considers the 45 gpm break as well as the use of the ECs. The calculation shows that the time to reach TAF is 5.7 hours. The licensees calculations show that throughout the event the water level will remain above TAF. The station will set up its FLEX RCS injection pump by 5 hours and the 100 gpm flow rate will allow water level to recover. Once one EC is secured pressure will increase and FLEX RCS makeup will decrease, however, the level will remain above TAF. The lower RCS pressure will mean a lower RCS leakage and therefore less makeup will be necessary to ensure control of the RCS level.

Therefore, based on the evaluation above, the NRC staff concludes that the licensee's analytical approach should appropriately determine the sequence of events for reactor core cooling, including time-sensitive operator actions, and evaluate the required equipment to mitigate the analyzed ELAP event, including pump sizing and cooling water capacity.

3.2.2.3 Recirculation Pump Seals

An ELAP event would result in the interruption of cooling to the recirculation pump seals, potentially resulting in increased leakage due to the distortion or failure of the seals, elastomeric O-rings, or other components. Sufficient primary make-up must be provided to offset recirculation pump seal leakage and other expected sources of primary leakage, in addition to removing decay heat from the reactor core.

During the audit, the NRC staff discussed recirculation pump seal leakage with the licensee and requested that the licensee justify the applicability of the assumed leakage rate during the ELAP event. The licensee has Model CAN2A recirculation pump seals that were manufactured by Atomic Energy of Canada Limited (AECL). The first CAN2A seal was installed to provide improved overall seal performance, with consideration given to postulated SBO conditions wherein seal cooling is lost. The SBO testing was performed in the early 1990s with relatively strict acceptance criteria. The results of the CAN2A SBO testing showed that, provided that conditions are maintained within a qualification envelope, the seal faces did not "pop-open," nor did the seals otherwise experience excessive leakage when seal cooling was lost.

Nine Mile Point, Unit 1 assumed that the reactor recirculation pump seals leaked at a maximum of 20 gpm (or 4 gpm per seal). The station has five recirculation pumps.

The licensee's calculations assumed a total RCS leakage rate at normal RPV operating pressure of 45 gpm. This leakage rate includes 4 gpm per recirculation pump seal and additional primary system leakage rate equal to the technical specification limit of 25 gpm.

Considering the above factors, the NRC staff concludes that the leakage rate assumed for Unit 1 is reasonable based on previous data and testing. The staff further notes that gross seal failures are not anticipated to occur during the postulated ELAP event. As is not typical of the majority of United States BWRs, Unit 1 does not have an installed steam-driven pump (i.e., RCIC) capable of injecting into the primary system at a flow rate well in excess of the primary system leakage rate expected during an ELAP. However, the natural circulation from the EC system should allow for the RCS inventory to be maintained above TAF until the FLEX pump is available to inject into the RPV. The FLEX pump capacity is more than double the assumed seal leakage rate and therefore should have the capacity to overcome the losses and increase the RPV level.

Based upon the discussion above, the NRC staff concludes that the recirculation pump seal leakage rates assumed in the licensee's thermal-hydraulic analysis may be applied to the beyond-design basis ELAP event for Unit 1.

3.2.2.4 Shutdown Margin Analyses

Nine Mile Point, Unit 1's design is such that the control rods provide adequate shutdown margin under all anticipated plant conditions, with the assumption that the highest-worth control rod remains fully withdrawn. The Unit 1 technical specification Section 3.1.1 further clarifies that shutdown margin is to be calculated for a cold shutdown and greater than either .38% dk/k with the highest rod worth analytically determined or .28 percent dk/k with the highest worth rod determined by test.

Based on the NRC staff's audit review, the licensee's ELAP mitigating strategy appears to maintain the reactor within the envelope of conditions analyzed by the licensee's existing shutdown margin calculation. Furthermore, the existing calculation retains conservatism because the guidance in NEI 12-06 permits analyses of the beyond-design-basis ELAP event to assume that all control rods fully insert into the reactor core.

Therefore, based on the evaluation above, the NRC staff concludes that the sequence of events in the proposed mitigating strategy should result in acceptable shutdown margin for the analyzed ELAP event.

3.2.2.5 FLEX Pumps and Water Supplies

The licensee's FLEX strategy relies on one portable pump during Phase 2 to provide make up to the EC system and RPV. The FLEX pump is a trailer-mounted Power Prime model 3419MX (diesel-driven engine centrifugal pump) rated at 770 gpm (at 363 per square inch differential (psid)), which is stored in the robust FSB. In the FIP, Table 4 identifies the performance criteria (e.g., flow rate, discharge pressure) for the Phase 2 portable pump. The NRC staff noted that the performance criteria for the FLEX Phase 3 portable pumps are consistent with or exceed those of the FLEX Phase 2 portable pumps capacities.

In the FIP, Section 2.3.9 states that a hydraulic calculation was performed to verify the capability of the FLEX pump and piping/hose system to deliver the required amount of water to each required location in the plant. The licensee explained that for RPV makeup, the hydraulic calculation conservatively determined a makeup flowrate of 97 gpm was required with an assumed constant RPV leakage rate of 45 gpm (despite slowly lowering RPV pressure which would decrease RPV leakage) and an additional 52 gpm to account for RPV level shrink. The hydraulic calculation conservatively rounded up the RPV makeup rate to 100 gpm (45 gpm + 52 gpm + margin) to verify that the RPV water level stays above TAF. For EC system makeup, the hydraulic calculation determined an EC system makeup flowrate of 113 GPM was required, based on the ANSI/ANS 5.1-1979 decay heat curve and a decay time of 8 hours. The licensee conservatively rounded up the calculated EC makeup value of 113 gpm to establish the EC system makeup requirement of 130 gpm.

The NRC staff reviewed the flow rates and pressures evaluated in the hydraulic analyses and confirmed that the equipment is capable of providing the needed flow rates. During the onsite audit, the staff conducted a walk down of the hose deployment routes for the above FLEX pump to confirm the evaluations of the pump staging locations, hose distance runs, and connection points as described in the above hydraulic analyses and FIP.

Based on the staff's review of the FLEX pumping capabilities at Unit 1, as described in the above hydraulic analysis and the FIP, the licensee has demonstrated that, if implemented appropriately, its FLEX pump should perform as intended to support core cooling and RCS makeup during an ELAP caused by an BDBEE, consistent with NEI 12-06, Section 11.2.

3.2.2.6 Electrical Analyses

The licensee's electrical strategies provide power to the equipment and instrumentation used to mitigate the ELAP and LUHS. The electrical strategies described in the FIP are practically identical for strategy for maintaining or restoring core cooling, containment, and SFP cooling, except as noted in Sections 3.3.4.4 and 3.4.4.4 of this SE.

The NRC staff reviewed the licensee's FIP, conceptual electrical single-line diagrams, and the summary of calculations for sizing the FLEX generators and station batteries. The staff also reviewed the licensee's evaluations that addressed the effects of temperature on the electrical equipment credited in the FIP as a result of the loss of heating, ventilation, and air conditioning (HVAC) caused by the event.

According to the licensee's FIP, ELAP entry conditions can be verified by control room staff. As stated in the FIP, a transition to procedure N1-SOP-33A.2, "Station Blackout," will be made upon the diagnosis of the total loss of ac power. Procedure N1-SOP-33A.2 provides guidance on reduction of dc loads on the station Class 1E batteries, and establishes electrical equipment alignment in preparation for eventual power restoration.

The Unit 1 Phase 1 FLEX strategy involves relying on installed plant equipment and onsite resources such as installed Class 1E station batteries, Class 1E Inverters and dc distribution system. The installed equipment are located within the turbine building, which is a safety-related Class 1 structure, and are protected from all applicable external hazards as defined in NEI 12-06. The Class 1E station batteries 11 and 12 will provide power to system instrumentation, control systems, and other required loads. Operators will strip or shed unnecessary loads to extend the battery life until backup power is available. The plant operators would begin load shed within 10 minutes into an ELAP event, and will complete load shedding within 30 minutes from the onset of an ELAP event. Procedure N1-SOP-33A.2 provides actions to complete load shedding of the Class 1E station batteries within 30 minutes of the event to ensure battery operation for at least 8 hours.

The Unit 1 Class 1E Station Batteries 11 and 12 were manufactured by C&D Technologies, Model LCR-33. Each battery contains 60 cells and has a rated capacity of 2320 ampere hours.

The NRC staff's review has indicated that the licensee had followed the guidance in NEI White Paper, "EA-12-049 Mitigating Strategies Resolution of Extended Battery Duty Cycles Generic Concern" (ADAMS Accession No. ML13241A186), when calculating the duty cycle of the batteries. This paper was endorsed by the NRC (ADAMS Accession No. ML13241A188). In addition to the white paper, the NRC sponsored testing at Brookhaven National Laboratory that resulted in the issuance of NUREG/CR-7188, "Testing to Evaluate Extended battery Operation in Nuclear Power Plants," in May of 2015. The testing provided additional validation that the NEI white paper method was technically acceptable. The NRC staff reviewed the licensee's battery calculations and confirmed that they had followed the guidance in the NEI white paper.

The NRC staff reviewed the summary of the dc system analyses in calculation 125DCTRAIN11/12LFVD, "125 VDC Power Systems 11 and 12 Load Flow Voltage Drop," Revision 01.00. In the calculation, the licensee verified the adequacy and capability of the dc system to supply the required Phase 1 loads during an ELAP as a result of a BDBEE. The licensee's analysis identified the required loads and their associated ratings (amperage and minimum voltage). According to the FIP, the licensee expects to restore power (via a FLEX DG) to the battery charger within 5 hours of the occurrence of an ELAP event to charge battery 12 before it depletes to the minimum acceptable voltage. The licensee's Phase 2 strategies also include deploying a NFPA805/FLEX battery charger to charge Battery 11 or 12 as part of their alternate charging strategy, if needed, within 2-6 hours elapsed time into the ELAP event.

Based on the staff's review of the licensee's analysis and procedures, and information from the battery vendor, the NRC staff concludes that the Unit 1 dc systems should have adequate capacity and capability to power the loads required to mitigate the consequences during Phase 1 of an ELAP as a result of a BDBEE provided that necessary load shedding is completed within the times assumed in the licensee's analysis.

According to the licensee's FIP, the Phase 2 strategy involves transition from installed equipment to the onsite FLEX equipment including repowering Class 1E battery chargers. The Nine Mile Point on-site electrical FLEX equipment includes two (2) trailer mounted 600 Vac, 450 kW FLEX DGs, associated cables, connectors, and one (1) NFPA 805/FLEX battery charger. Only one of the two FLEX DGs is required to provide sufficient electrical power for the expected loads. The Phase 2 600 Vac FLEX DGs are stored in a robust storage facility. One of the FLEX DGs will be moved out of the storage building and deployed outdoors in an area south of the turbine building within 2 hours of the ELAP event, in order to re-power the necessary equipment including safety-related battery chargers within 8 hours after initiation of an of the ELAP condition.

The NRC staff reviewed licensee calculation 600VACDGES-FLEX-BDB, "Fukushima 600VAC FLEX-BDB 450kW/536KVA Diesel Generator Sizing," Revision 00. In the calculation, the licensee determined that the total estimated Phase 2 continuous loads would be approximately 165.3 kW which is well within the 450 kW rating of each Phase 2 600 Vac DG. The calculation showed that the 600 Vac DG will be loaded to a total of 36.7 percent of its continuous duty rating when supplying ac power to the Unit 1 static battery charger (SBC 171A or SBC 171B) which is the primary strategy (Fukushima strategy B) or to a portable NFPA 805 battery charger to power battery 11 or 12 as an alternate strategy (Fukushima strategy A). The NFPA 805/FLEX portable charger is a trailer-mounted, solid state, constant current/constant voltage battery charger that will be powered from the FLEX DGs via cables and connectors. In the Unit 1 calculation, "125VDCSCES-FLEX-BDB, Fukushima/ NFPA-805 125VDC Portable Battery

Charger Equipment Sizing," Revision 00, the licensee stated that the portable NFPA 805 battery charger is capable of continuously supplying the loads on the number 12 or number11 dc system and at the same time recharging the number 12 or number 11 battery.

If one ("N") of the two DGs becomes unavailable or is out of service for maintenance, the other ("N+1") DG would be deployed to continue to support the required loads. The "N+1" DG is identical to the "N" DG, thus ensuring electrical compatibility and sufficient electrical capacity in an instance where substitution is required. Since the "N+1" DG is identical and interchangeable with the "N" DG, the NRC staff concludes that the licensee has met the provisions of NEI 12-06, Revision 0 for spare equipment capability regarding the Phase 2 DGs.

During the audit process, the NRC staff reviewed key licensee electrical documents including: calculations, single line electrical diagrams, and FLEX procedures. The staff review considered the locations of stored, staged and deployed FLEX portable DGs (PDGs), protection and diversity of the power supply pathways, separation and isolation of the FLEX DGs from the Class 1E emergency DGs, and availability of procedures to direct operators how to align, connect, and protect associated systems and components. Based on its review and the licensee evaluation, the NRC staff concludes that the FLEX DGs should have sufficient capacity and capability to supply the necessary loads following a BDBEE that results in an ELAP.

For Phase 3, the licensee plans to continue its Phase 2 coping strategies with additional assistance provided from offsite equipment/resources. Off-site equipment from an NSRC is expected to arrive on-site within 24 hours to support Phase 3 operation, as necessary. The NSRC supplied electrical equipment includes two (two per unit) 4160 Vac, 1 megawatt (MW) combustion turbine generators (CTGs), one (one per unit) 480 Vac 1.1 MW CTG, and one (1 per unit) low voltage step-up transformer (480/600 Vac), one (one per unit) electrical distribution trailer, and necessary cabling. In its FIP, the licensee stated that the NSRC supplied 480 Vac, 1.1 MW CTG is a backup or redundant to the on-site phase 2 equipment. Since the Phase 3 480 Vac CTG is of higher capacity (1.1 MW) than the Phase 2 600 Vac DG capacity (450 MW), the Phase 3 CTGs capacity and capability will be adequate to repower the Phase 3 required loads. In its FIP, the licensee stated that the NSRC CTGs are equipped with the same size connectors as the on-site Phase 2 FLEX DGs. Based on its review of the licensee's analyses, the NRC staff concludes that the Phase 3 480 Vac, 1.1 MW CTG should provide adequate capacity to repower the minimum required loads to maintain or restore core cooling indefinitely following an ELAP.

Based on its review, the NRC staff concludes that the plant batteries used in the strategy should have sufficient capacity to support the licensee's strategy, and that the FLEX DGs and CTGs that the licensee plans to use should have sufficient capacity and capability to supply the necessary loads during an ELAP event.

3.2.3 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that should maintain or restore core cooling and RCS inventory during an ELAP event consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.3 Spent Fuel Pool Cooling Strategies

In NEI 12-06, Table 3-1 and Appendix C summarize an acceptable approach consisting of three separate capabilities for the SFP cooling strategies. This approach uses a portable injection source to provide the capability for 1) makeup via hoses on the refueling floor capable of exceeding the boil-off rate for the design basis heat load; 2) makeup via connection to SFP cooling piping or other alternate location capable of exceeding the boil-off rate for the design basis heat load; and 3) spray via portable monitor nozzles from the refueling floor using a portable pump capable of providing a minimum of 200 gpm per unit (250 gpm if overspray occurs). During the event, the licensee selects the method to use based on plant conditions. This approach also requires a strategy to mitigate the effects of steam from the SFP, such as venting.

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 1.1, strategies that must be completed within a certain period of should be identified and a basis that the time can be reasonably met should be provided. In NEI 12-06, Section 3 provides the performance attributes, general criteria, and baseline assumptions to be used in developing the technical basis for the time constraints. Since the event is beyond-design-basis (BDB), the analysis used to provide the technical basis for time constraints for the mitigation strategies may use nominal initial values (without uncertainties) for plant parameters, and best-estimate physics data. All equipment used for consequence mitigation may be assumed to operate at nominal setpoints and capacities. In NEI 12-06, Section 3.2.1.2 describes the initial plant conditions for the at-power mode of operation; Section 3.2.1.3 describes the initial conditions; and Section 3.2.1.6 describes SFP initial conditions.

In NEI 12-06, Section 3.2.1.1 provides the acceptance criterion for the analyses serving as the technical basis for establishing the time constraints for the baseline coping capabilities to maintain SFP cooling. This criterion is keeping the fuel in the SFP covered with water.

The ELAP causes a loss of cooling in the SFP. As a result, the pool water will heat up and eventually boil off. The licensee's response is to provide makeup water. The timing of operator actions and the required makeup rates depend on the decay heat level of the fuel assemblies in the SFP. The sections below address the response during operating, pre-fuel transfer or post-fuel transfer operations. The effects of an ELAP with full core offload to the SFP is addressed in Section 3.11.

3.3.1 Phase 1

In the FIP, Section 2.5 indicates that the water in the SFP will gradually heat up and evaporate from decay heat following a loss of SFP cooling and that no actions are required during an ELAP for Phase 1. Specifically, the licensee stated that at the SFP maximum design heat load (outage condition, full core offload, SFP gates installed), the SFP will reach 212°F in approximately 8 hours and during non-outage conditions, the time to boiling in the pool is greater than 24 hours. Adequate SFP inventory exists to provide radiation shielding for personnel well beyond the time of boiling. During Phase 1, operators will establish ventilation pathways in the reactor building and turbine building and monitor level using the SFP level instrumentation installed per Order EA-12-051.

3.3.2 Phase 2

During Phase 2, FIP Section 2.5 states that operators will deploy a portable FLEX pump to supply water from Lake Ontario at the circulating water intake location in the screen house to a distribution manifold by the reactor building. The SFP makeup hoses are routed from the FLEX distribution manifold to a hard-pipe connection (not requiring refueling floor access), or routed to the refuel floor to provide direct makeup to the pool or provide spray flow via portable nozzles.

3.3.3 Phase 3

The licensee stated that the Phase 3 strategy is to continue with the Phase 2 methodologies using the FLEX pumps and that additional high capacity pumps will be available from the NSRC as a backup to the on-site FLEX pumps.

3.3.4 Staff Evaluations

3.3.4.1 Availability of Structures, Systems, and Components

3.3.4.1.1 Plant SSCs

Condition 6 of NEI 12-06, Section 3.2.1.3, states that permanent plant equipment contained in structures with designs that are robust with respect to seismic events, floods, and high winds, and associated missiles, are available. In addition, Section 3.2.1.6 states that the initial SFP conditions are: 1) all boundaries of the SFP are intact, including the liner, gates, transfer canals, etc., 2) although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the refueling deck around the pool and 3) SFP cooling system is intact, including attached piping.

The staff reviewed the licensee's calculation on habitability on the SFP refuel floor. This calculation and the FIP indicate that boiling begins at greater than 24 hours during a normal, non-outage situation. The staff noted that the licensee's sequence of events timeline in the FIP indicates that operators will deploy hoses and spray nozzles as a contingency for SFP makeup within 1 hour from event initiation to ensure the SFP area remains habitable for personnel entry, which is well in advance of the expected time for bulk boiling in the SFP.

As described in the licensee's FIP, the licensee's Phase 1 SFP cooling strategy does not require any operator actions. However, the licensee does establish a ventilation path to cope with temperature, humidity and condensation from evaporation and/or boiling of the SFP. The operators are directed to initiate passive cooling and ventilation in the reactor building by opening specified doors in the reactor building and the turbine building, in addition to the turbine building side-wall vents, within 8 hours of the event onset.

The licensee's Phase 2 and Phase 3 SFP cooling strategy involves the use of the FLEX pump or NSRC supplied pump for Phase 3, with suction from Lake Ontario, to supply water to the SFP. The staff's evaluation of the robustness and availability of FLEX connections points for the FLEX pump is discussed in Section 3.7.3.1 below. Furthermore, the staff's evaluation of the robustness and availability of the UHS for an ELAP event is discussed in Section 3.10.

3.3.4.1.2 Plant Instrumentation

In its FIP, the licensee stated that the instrumentation for SFP level will meet the requirements of Order EA-12-051. Furthermore, the licensee stated that these instruments will have initial local battery power with the capability to be powered from the FLEX DGs. The NRC staff's review of the SFP level instrumentation, including the primary and back-up channels, the display to monitor the SFP water level and environmental qualifications to operate reliably for an extended period are discussed in Section 4 of this SE.

3.3.4.2 Thermal-Hydraulic Analyses

The licensee stated in its FIP that for Unit 1, the normal SFP water level at the event initiation is approximately 23 ft. over the top of the spent fuel in the storage racks and that maintaining the SFP full of water at all times during the ELAP event is not required. The licensee explained that its FLEX strategy is to maintain the SFP level at least 10 ft. above the spent fuel in the fuel racks.

As described in FIP Section 2.5.1, the SFP will boil in approximately 8 hours and boil off to a level 10 ft. above the top of fuel in 45 hours from initiation of the event with no operator action at the maximum design basis heat load. In the FIP, Section 2.5.6 states that the bounding scenario used for its FLEX strategy is the maximum normal/emergency refueling heat load, which includes a full core offload, requires a make-up rate of 42 gpm.

Therefore, the licensee conservatively determined that a SFP makeup flow rate of at least 42 gpm will maintain adequate SFP level at least 10 ft. above the top of fuel for an ELAP occurring during normal power operation. In NEI 12-06, Section 3.2.1.6 states that the SFP heat load assumes the maximum design-basis heat load for the site as one of the initial SFP conditions. Consistent with this guidance in NEI 12-06, Section 3.2.1.6, the staff concludes that the licensee has considered the maximum design-basis SFP heat load.

The licensee explained that SFP cooling will be established in Phase 2 utilizing the FLEX pump to makeup to the SFP in order to keep the spent fuel covered. Phase 2 actions to have the pump connected and available for makeup are targeted to occur at less than or equal to 16 hours, which, by then, SFP water level should only have lowered by about 4.5 ft. The staff concludes that the licensee's strategy for normal non-outage scenerios is conservative because the timelines are based on a full-core offload during a refueling outage. In addition, the licensee's actions to deploy and stage hoses and the FLEX pump are in advance of this conservative full-core offload timeline.

3.3.4.3 FLEX Pumps and Water Supplies

As described in the FIP, the SFP cooling strategy relies on the FLEX pump to provide SFP makeup during Phase 2. In the FIP, Section 2.5.7 describes the hydraulic performance criteria (e.g., flow rate, discharge pressure) for the FLEX pump. Specifically, the FLEX pump is a trailer-mounted Power Prime model 3419MX (diesel-driven engine centrifugal pump) rated at 770 gpm (at 363 psid), which is stored in the robust FSB. A hydraulic calculation was performed to verify the capability of the FLEX pumps and piping/hose system to deliver the required amount of water to each required location in the plant. The staff noted that the hydraulic calculation accounts for the FLEX pump providing makeup to the SFP, RPV and EC loops simultaneously. The licensee explained in its FIP, the capability of 250 gpm of SFP spray is identified in NEI 12-06 in the event of a crack in the pool or other means of unforeseen leakage. The 250 gpm is inclusive of the 42 gpm boil off rate; therefore, 250 gpm was established as the SFP makeup in the hydraulic calculation. Furthermore, one FLEX pump is capable of supplying the necessary make up to the RPV, EC loops and SFP. A second pump is available and will have to be used if the maximum SFP makeup flow of 250 gpm is required while the first pump is supplying maximum make up to the EC loops and RPV.

The staff noted that the performance criteria of a FLEX pump supplied from an NSRC for Phase 3 would allow the NSRC pump to fulfill the mission of the onsite FLEX pump if the onsite FLEX pump were to fail. As stated above, the SFP makeup rate of 42 gpm and SFP spray rate of 250 gpm both meet or exceed the maximum SFP makeup requirements. Furthermore, the staff concludes that the analysis above appears to be consistent with NEI 12-06 Section 11.2 and the FLEX equipment is capable of supporting the SFP cooling strategy and is expected to be available during an ELAP event.

3.3.4.4 Electrical Analyses

The licensee's FIP defined strategies capable of mitigating a simultaneous loss of all ac power and LUHS, resulting from a BDBEE, by providing the capability to maintain or restore SFP cooling at Nine Mile Point, Unit 1.

The NRC staff review of the Unit 1 FIP indicated that the only electrical components credited by the licensee as part of its FLEX mitigation strategies, outside of instrumentation to monitor SFP level (which is described in other areas of this SE), is the ability to use the onsite FLEX DGs as an alternative source for providing power to the instrumentation and panels required by Order EA-12-051 within 8 hours, if necessary. The staff reviewed the licensee's FLEX DG sizing calculation (600VACDGES-FLEX-BDB), and determined that the FLEX DGs have sufficient capacity and capability to supply these loads, if necessary. During Phase 3, the SFP instruments and panels can be repowered from the NSRC supplied 480 Vac, 1.1 MW CTG, which is a back up to the FLEX DG, if required. Since the NSRC supplied CTG has higher capacity than the capacity of the FLEX DG, the NRC staff concludes that the NSRC CTG will have sufficient capacity to supply the SFP instruments and panels.

The staff reviewed the licensee's FLEX DG sizing calculation 600VACDGES-FLEX-BDB, and determined that the FLEX DGs have sufficient capacity and capability to supply these loads as alternate power source, if necessary. Since the NSRC supplied CTG has higher capacity than the capacity of the FLEX DG, the NRC staff concludes that the NSRC CTG will have sufficient capacity to supply the SFP instruments and panels as alternate power source, if necessary.

3.3.5 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should maintain or restore SFP cooling following an ELAP consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.4 Containment Function Strategies

The industry guidance document, NEI 12-06, Table 3-1, provides some examples of acceptable approaches for demonstrating the baseline capability of the containment strategies to effectively maintain containment functions during all phases of an ELAP event. One such approach is for a licensee to perform an analysis demonstrating that containment pressure control is not challenged. Nine Mile Point, Unit 1 is a General Electric Boiling Water Reactor with a Mark 1 containment.

The licensee performed a containment evaluation, S0-GOTHIC-ELAP002, "Primary Containment Response Following an Extended Loss of AC Power," Revision 0, based on the boundary conditions described in Section 2 of NEI 12-06. The calculation analyzed the strategy of isolating containment and monitoring containment pressure and temperature and concluded that the containment parameters of pressure and temperature remain well below the respective UFSAR Section VI.B.2.1 design limits of 62 psig and 310°F for the drywell and 35 psig and 205°F for the suppression pool (Torus) for more than 72 hours. From its review of the evaluation, the NRC staff noted that the required actions to maintain containment integrity and required instrumentation functions have been developed, and are summarized below.

Eventual containment cooling and depressurization to normal values may utilize off-site equipment and resources during Phase 3 if onsite capability is not restored.

3.4.1 Phase 1

The FIP states during Phase 1, the primary containment integrity is maintained by normal design features of the containment, such as the containment isolation valves. Initially ERVs will cycle, rejecting heat to the suppression pool, to control reactor pressure until the emergency condensers are placed into service. Decay heat is removed from the reactor by emergency condensers. Initial actions of isolating the MSIVs are covered in N1-SOP-33A.2, "Station Blackout/ELAP." Containment parameters are monitored in accordance with N1-EOP-4, "Primary Containment Control."

3.4.2 Phase 2

Phase 2 continues removing decay heat from the RPV through the emergency condensers. Emergency condenser makeup will be provided by the portable FLEX pump aligned to the emergency condenser make-up tanks. Containment temperature and pressure will continue to be monitored. Based on evaluation S0-GOTHIC-ELAP002, the licensee expects the containment temperature and pressure to remain below design limits for 72 hours. Procedure N1-EOP-4 directs operators to vent the primary containment before torus parameters exceed limits using the existing hardened containment vent stack using procedure N1-DRP-OPS-001, "Emergency Damage Repair."

3.4.3 Phase 3

The FIP indicated that the Unit 1 Phase 3 strategy is to maintain Phase 2 continued monitoring of key containment parameters and venting as required. Offsite equipment and resources will be used to supplement Phase 2 equipment. If required, containment temperature and pressure can be reduced using existing procedures and existing plant systems restored by off-site equipment and resources. Procedure S-DRP-OPS-005, "Use of FLEX Phase 3 SAFER Equipment," provides guidance for utilizing offsite equipment to repower existing plant systems. Existing plant procedures would then be used to cool and depressurize the primary containment.

3.4.4 Staff Evaluations

3.4.4.1 Availability of Structures, Systems, and Components

Guidance document NEI 12-06 baseline assumptions have been established on the presumption that other than the loss of the ac power sources and normal access to the UHS, installed equipment that is designed to be robust with respect to design-basis external events is assumed to be fully available. Installed equipment that is not robust is assumed to be unavailable. Below are the baseline assumptions for the availability of SSCs for maintaining containment functions during an ELAP.

3.4.4.1.1 Plant SSCs

Nine Mile Point, Unit 1 has a General Electric Mark 1 pressure suppression containment consisting of a drywell and a pressure suppression chamber. The drywell is a steel pressure vessel with a 70-foot diameter spherical lower section and a 33-foot diameter cylindrical upper section. Approximate free volume of the drywell is 180,000 cubic feet. The UFSAR, Section VI, gives the internal design pressure of 62 psig with an internal maximum design temperature of 310°F.

The drywell is connected to a suppression pool in a steel pressure vessel in the shape of a torus. The torus is below and encircles the drywell. The torus approximate free volume is 120,000 cubic feet. The UFSAR, Section VI, gives the internal design pressure of 35 psig with an internal maximum design temperature of 205°F.

The containment is designed as a seismic Class I structure. The containment is completely enclosed in the reactor building. That portion of the reactor building enclosing the containment is a seismic Class I structure.

3.4.4.1.2 Plant Instrumentation

In NEI 12-06, Table 3-1, specifies that containment pressure, suppression pool level, and suppression pool temperature are key containment parameters which should be monitored by repowering the appropriate instruments. The licensee's FIP states that control room instrumentation would be available due to the coping capability of the station batteries and associated inverters in Phase 1, or the FLEX DGs deployed in Phase 2. If no ac or dc power was available, the FIP states that key credited plant parameters, including these containment parameters, would be available using alternate methods.

The FIP identifies the following as key parameters credited for all phases of the strategy for maintaining the containment integrity:

- Torus Water Temperature TI 201.2-519, TI 201.2-520
- Torus Water Level LI 201.2-594C, LI 201.2-595D

- Torus Pressure PI 201.2-594A, PI 201.2-595A
- Drywell Ambient Temperature TI 201-27B, TI 201-33B
- Drywell Pressure PI 201.2-483A, PI 201.2-484A

The FIP also states that in the unlikely event that the number 12 or 11 battery bus infrastructures or supporting equipment is damaged and non-functional rendering key parameter instrumentation unavailable in the Unit 1 control room, alternate methods for obtaining the critical parameters locally is provided in procedure N1-SOP-29.1, "EOP Key Parameter-Alternate Instrumentation."

3.4.4.2 Thermal-Hydraulic Analyses

The licensee performed Calculation S0-GOTHIC-ELAP002, "Primary Containment Response Following an Extended Loss of AC Power," Revision 0, to determine the primary containment temperature and pressure response following an ELAP event. The calculation uses the GOTHIC (Generation of Thermal-Hydraulic Information for Containments), version 8 thermal hydraulic computer program. Both emergency condensers are credited for the first 8 hours and one emergency condenser is credited for the remainder of the event (72 hours). Reactor coolant leakage is assumed to be 45 gpm at normal operating conditions.

The calculation shows the drywell temperature reaching 310°F at roughly 40 hours and remaining constant after that (Figure 4 of the calculation). The drywell pressure gradually increases until it reaches 35 per square inch absolute (psia) and the torus is approximately 33 psia at 72 hours (Figure 3 of the calculation). The isolation condensers remove most of the decay heat from the containment. As a result, the suppression pool temperature increase was approximately 10°F.

3.4.4.3 FLEX Pumps and Water Supplies

As previously discussed, the licensee's FLEX strategies for Phase 1 maintains containment integrity by normal design features, and the EC loops will remove the decay heat energy from the RPV and return the water to the RPV. Furthermore, for Phase 2, the two EC loops continue to operate so that decay heat is removed from the RPV thus limiting the heat released to the primary containment; however, additional make-up capability to the EC condensers will be necessary to preserve EC operation. This is accomplished by providing makeup from a portable FLEX pump to a connection point on the makeup supply line to the EC loop. The staff's review of the FLEX pump's capability to provide adequate make-up to the supply line on the EC loop is documented in SE Section 3.2.2.5.

In the FIP, Section 2.4.6 states that the NSRC is providing additional pumps in Phase 3 with suction from Lake Ontario can be used, if required, to provide water for containment cooling. The staff reviewed FIP Table 5 and noted the pump capacity (i.e., flow rate and discharge pressure) for several of the NSRC pumps meet or exceed the capability of the onsite FLEX pump. Thus, the staff concludes that the pumps provided by the NSRC should be capable of supporting containment cooling, if required.

3.4.4.4 Electrical Analyses

The licensee performed a containment evaluation based on the boundary conditions described in Section 2 of NEI 12-06 to determine the temperature and pressure increase in the containment vessels resulting from an ELAP as a result of a BDBEE. Based on the results of the evaluation, the licensee developed required actions to ensure maintenance of containment integrity and required instrumentation function. In calculation S0-GOTHIC-ELAP002, "Primary Containment Response Following An Extended Loss of AC Power (NMP1)," Revision 0000, and in an evaluation dated October 18, 2016, the licensee determined that the primary containment temperature and pressure will remain below containment design limits and that key parameter instruments subject to the primary containment environment will remain functional in the expected temperature for a minimum of 7 days. During Phase 1, the licensee will continue to monitor containment pressure and temperature to ensure that these parameters remain within the containment design limits and the functionality limits of required instruments. The licensee stated that during Phase 1, both loops of EC will be in service for the first 8 hours. During Phase 2, at or before 8 hours if one EC were taken out-of-service (or if one loop becomes unavailable), at least one loop of EC continues to remove heat, which is sufficient to ensure containment temperature and pressure remain below containment design-basis limits for up to 72 hours. Procedure N1-EOP-4 directs operators to vent the primary containment before containment parameters exceed limits using the existing hardened containment vent stack. Special Operating Procedure N1-SOP-33A.2, "Station Blackout/ELAP," provides guidance to the operators to initiate core cooling using the EC loops. During Phase 2, the primary strategy is to supply makeup water from a FLEX diesel-driven pump to EC loop 12, which is expected to reduce the temperature below the containment equipment and instrument design temperature limits to ensure instruments remain functional until such time that the containment is vented.

The NRC staff reviewed the Class 1E battery capacity and capability in calculation 125DCTRAIN11/12LFVD discussed in Section 3.2.2.6 of this SE and concludes that the Class 1E batteries should have sufficient capacity and capability for at least 8 hours to supply power to the containment instruments to ensure instruments remain functional. The NRC staff reviewed the capacity and capability of the Phase 2 600 Vac DG in calculation 600VACDGES-FLEX-BDB discussed in Section 3.2.2.6 of this SE and concludes that the Phase 2 DG should have sufficient capacity and capability to repower required plant instruments through the static battery chargers and inverters.

In its FIP, the licensee stated that the Unit 1 strategy will utilize existing plant systems restored by offsite equipment and resources during Phase 3 that should arrive onsite from one of the two NSRCs within 24 hours of the start of an ELAP event to reduce containment temperature and pressure to ensure continued functionality of key parameters.

During Phase 3, #12 EC will remain in service with EC makeup continuing to be provided by Phase 2 equipment and backed up by the NSRC diesel pumps. Containment pressure and temperature will be monitored using existing plant instruments and, if necessary, the primary containment will be vented using existing procedures and systems. The NRC staff reviewed the capacity and capability of the Phase 3 480 Vac CTG in Section 3.2.3.6 of this SE. Since the capacity of the NSRC supplied 480 Vac, 1.1 MW CTG is higher than the capacity of the FLEX 600 Vac, 450 kW DG, the Phase 3 480 Vac CTG should have sufficient capacity and capability to repower required plant instruments and electrical controls, if necessary.

The NRC staff reviewed a summary of calculations S0-GOTHIC-ELAP002, 125DCTRAIN11/12LFVD, 600VACDGES-FLEX-BDB, procedure N1-SOP-33A.2, and determined that the electrical equipment should have sufficient capacity and capability to supply power to the required loads to reduce containment temperature and pressure, if necessary, to ensure that containment function is maintained and that key instrumentation remains functional.

3.4.5 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should maintain or restore containment functions following an ELAP event consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.5 Characterization of External Hazards

Sections 4 through 9 of NEI 12-06 provide the methodology to identify and characterize the applicable BDBEEs for each site. In addition, NEI 12-06 provides a process to identify potential complicating factors for the protection and deployment of equipment needed for mitigation of applicable site-specific external hazards leading to an ELAP and loss of normal access to the UHS.

Characterization of the applicable hazards for a specific site includes the identification of realistic timelines for the hazard, characterization of the functional threats due to the hazard, development of a strategy for responding to events with warning, and development of a strategy for responding to events without warning.

The licensee reviewed the plant site against NEI 12-06 and determined that FLEX equipment should be protected from the following hazards: seismic; external flooding; severe storms with high winds; snow, ice and extreme cold; and extreme high temperatures.

References to external hazards within the licensee's mitigating strategies and this SE are consistent with the guidance in NEI-12-06 and the related NRC endorsement of NEI 12-06 in JLD-ISG-2012-01. Guidance document NEI 12-06 directed licensees to proceed with evaluating external hazards based on currently available information. For most licensees, this meant that the OIP used the current design-basis information for hazard evaluation. Coincident with the issuance of Order EA-12-049, on March 12, 2012, the NRC staff issued a Request for Information pursuant to Title 10 of the *Code of Federal Regulations* Part 50, Section 50.54(f) (ADAMS Accession No. ML12053A340) (hereafter referred to as the 50.54(f) letter), which requested that licensees reevaluate the seismic and flooding hazards at their sites using updated hazard information and current regulatory guidance and methodologies. Due to the time needed to reevaluate the hazards, and for the NRC to review and approve them, the reevaluated hazards were generally not available until after the mitigation strategies had been developed. The NRC staff has developed a proposed rule, titled "Mitigation of Beyond-Design-Basis Events," hereafter called the MBDBE rule, which was published for comment in the *Federal Register* on November 13, 2015 (80 *FR*.70610). The proposed MBDBE rule would make the intent of Orders EA-12-049 and EA-12-051 generically applicable to all present and future power reactor licensees, while also requiring that licensees consider the reevaluated hazard information developed in response to the 50.54(f) letter.

The NRC staff requested Commission guidance related to the relationship between the reevaluated flooding hazards provided in response to the 50.54(f) letter and the requirements for Order EA-12-049 and the MBDBE rulemaking (see COMSECY-14-0037, Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards" (ADAMS Accession No. ML14309A256). The Commission provided guidance in an SRM to COMSECY-14-0037 (ADAMS Accession No. ML15089A236). The Commission approved the staff's recommendations that licensees would need to address the reevaluated flooding hazards within their mitigating strategies for BDBEEs, and that licensees may need to address some specific flooding scenarios that could significantly damage the power plant site by developing scenario-specific mitigating strategies, possibly including unconventional measures, to prevent fuel damage in reactor cores or SFPs. The NRC staff did not request that the Commission consider making a requirement for mitigating strategies capable of addressing the reevaluated flooding hazards be immediately imposed, and the Commission did not require immediate imposition. In a letter to licensees dated September 1, 2015 (ADAMS Accession No. ML15174A257), the NRC staff informed the licensees that the implementation of mitigation strategies should continue as described in licensee's OIPs, and that the NRC SEs and inspections related to Order EA-12-049 will rely on the guidance provided in JLD-ISG-2012-01, Revision 0, and the related industry guidance in NEI 12-06, Revision 0. The hazard reevaluations may also identify issues to be entered into the licensee's corrective action program consistent with the OIPs submitted in accordance with Order EA-12-049.

As discussed above, licensees are reevaluating the site seismic and flood hazards as requested in the NRC's 50.54(f) letter. After the NRC staff approves the reevaluated hazards, licensees will use this information to perform flood and seismic mitigating strategies assessments (MSAs) per the guidance in NEI 12-06, Revision 2, Appendices G and H (ADAMS Accession No. ML16005A625). The NRC staff endorsed Revision 2 of NEI 12-06 in JLD-ISG-2012-01, Revision 1 (ADAMS Accession No. ML15357A163). The licensee's MSAs will evaluate the mitigating strategies described in this SE using the revised seismic hazard information and, if necessary, make changes to the strategies or equipment. Licensees will submit the MSAs for NRC staff review.

The licensee developed its OIP for mitigation strategies by considering the guidance in NEI 12-06 and the site's design-basis hazards. Therefore, this SE makes a determination based on the licensee's OIP and FIP. The characterization of the applicable external hazards for the plant site is discussed below.

3.5.1 Seismic

In its FIP, the licensee described the current design-basis seismic hazard, the safe shutdown earthquake (SSE). Nine Mile Point, Unit 1's licensing basis SSE is 0.11g. However, new equipment that is installed at Unit 1 is designed to 0.13g as a result of upgraded design-basis requirements instituted in 1984.

As the licensee's seismic reevaluation activities are completed, the licensee is expected to assess the mitigation strategies to ensure they can be implemented under the reevaluated hazard conditions as will potentially be required by the proposed MBDBE rulemaking. The licensee has appropriately screened in this external hazard and identified the hazard levels to be evaluated.

3.5.2 Flooding

In its FIP, the licensee stated that Unit 1 was designed and built prior to the requirements presented in the NRC standard review plan (SRP) criteria for external floods. Therefore, the licensee used various possible flood scenarios and information from calculations for Nine Mile Point, Unit 2 to show that the only flooding scenario of concern for the plant was one involving a probable maximum precipitation (PMP) event. Based on the Nine Mile Point, Unit 2 flood analysis, the worst flood height for Nine Mile Point, Unit 1 resulting from the PMP event is 261.75 ft.

As the licensee's flooding reevaluation activities are completed, the licensee is expected to assess the mitigation strategies to ensure they can be implemented under the reevaluated hazard conditions as will potentially be required by the proposed MBDBE rulemaking. The licensee has appropriately screened in this external hazard and identified the hazard levels to be evaluated.

3.5.3 High Winds

In NEI 12-06, Section 7 provides the NRC-endorsed screening process for evaluation of high wind hazards. This screening process considers the hazard due to hurricanes and tornadoes.

The screening for high wind hazards associated with hurricanes should be accomplished by comparing the site location to NEI 12-06, Figure 7-1 (Figure 3-1 of U.S. NRC, "Technical Basis for Regulatory Guidance on Design Basis Hurricane Wind Speeds for Nuclear Power Plants," NUREG/CR-7005, December, 2009); if the resulting frequency of recurrence of hurricanes with wind speeds in excess of 130 mph exceeds 1E-6 per year, the site should address hazards due to extreme high winds associated with hurricanes using the current licensing basis for hurricanes.

The screening for high wind hazard associated with tornadoes should be accomplished by comparing the site location to NEI 12-06, Figure 7-2, from U.S. NRC, "Tornado Climatology of the Contiguous United States," NUREG/CR-4461, Revision 2, February 2007; if the recommended tornado design wind speed for a 1E-6/year probability exceeds 130 mph, the site should address hazards due to extreme high winds associated with tornadoes using the current licensing basis for tornados or Regulatory Guide 1.76, Revision 1.

In its FIP, regarding the determination of applicable extreme external hazards, the licensee stated that the site is located at 43° 31' 17" North latitude and 76° 24' 36" West longitude. Per NEI 12-06, Figure 7-1, Nine Mile Point has a 1 in 1 million chance per year of a hurricane induced peak-gust wind speed of greater than120 mph. Thus, Nine Mile Point does not need to address high straight wind hazards. However, NEI 12-06, Figure 7-2 indicates that the site is in Region 1, where the tornado design wind speed exceeds 130 mph. Therefore, the plant screens in for an assessment for high winds, and tornados, including missiles produced by these events.

Therefore, high-wind hazards are applicable to the plant site. The licensee has appropriately screened in the high wind hazard and characterized the hazard in terms of wind velocities and wind-borne missiles.

3.5.4 Snow, Ice, and Extreme Cold

As discussed in NEI 12-06, Section 8.2.1, all sites should consider the temperature ranges and weather conditions for their site in storing and deploying FLEX equipment consistent with normal design practices. All sites outside of Southern California, Arizona, the Gulf Coast and Florida are expected to address deployment for conditions of snow, ice, and extreme cold. All sites located north of the 35th Parallel should provide the capability to address extreme snowfall with snow removal equipment. Finally, all sites except for those within Level 1 and 2 of the maximum ice storm severity map contained in Figure 8-2 should address the impact of ice storms.

In its FIP, regarding the determination of applicable extreme external hazards, the licensee stated that the site is located at 43° 31' 17" North latitude and 76° 24' 36" West longitude. The lowest recorded temperature at or near the site was -26°F in 1979. In addition, the site is located within the region characterized by EPRI as ice severity Level 5 (NEI 12-06, Figure 8-2, Maximum Ice Storm Severity Maps). Consequently, the site is subject to severe icing conditions that could cause severe damage to electrical transmission lines. The licensee concludes that the plant screens in for an assessment for snow, ice, and extreme cold hazard.

In summary, based on the available local data and Figures 8-1 and 8-2 of NEI 12-06, the plant site does experience significant amounts of snow, ice, and extreme cold temperatures; therefore, the hazard is screened in. The licensee has appropriately screened in the hazard and characterized the hazard in terms of expected temperatures.

3.5.5 Extreme Heat

In the section of its FIP regarding the determination of applicable extreme external hazards, the licensee stated that, as per NEI 12-06 Section 9.2, all sites are required to consider the impact of extreme high temperatures. The licensee stated that the maximum temperature observed at Unit 1 was 98°F in 1953. However, the maximum temperature referenced in the Unit 2 UFSAR, Section 2.3.1.2.2, Climatological Normals and Extremes, is 102°F. Therefore, given the location of Unit 1 in the immediate vicinity of Unit 2, the licensee indicated that it is reasonable to extend this maximum referenced temperature of 102°F to both units.

In summary, based on the available local data and the guidance in Section 9 of NEI 12-06, the plant site does experience extreme high temperatures. The licensee has appropriately screened in the high temperature hazard and characterized the hazard in terms of expected temperatures.

3.5.6 Conclusions

Based on the evaluation above, the NRC staff concludes that the licensee has developed a characterization of external hazards that is consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order in regard to the characterization of external hazards.

3.6 Planned Protection of FLEX Equipment

3.6.1 Protection from External Hazards

In its FIP, the licensee stated that Nine Mile Point has constructed a single hardened FLEX storage structure of approximately 8,400 square ft. that will meet the requirements for the external events identified in NEI 12-06, such as earthquakes, external floods, storms (high winds, and tornadoes), extreme snow, ice, extreme heat, and cold temperature conditions. The FSB is located inside the protected area fence on the West side of Unit 1, South of the sewage treatment plant and North of the independent spent fuel storage installation (ISFSI) area. In addition, the licensee stated that additional credited FLEX equipment will be stored in existing seismically qualified structures. Specifically, the Unit 1 reactor building, turbine building, and screen house building.

Below are additional details on how FLEX equipment is protected from each of the applicable external hazards.

3.6.1.1 Seismic

In its FIP, the licensee stated that the FSB is designated as a seismic Category I and QA Category II structure (non-safety related) structure. The building design is based on SDC-1, "Structural Design Criteria," Revision 07 (Unit 2 SSC current licensing basis for external hazards), which envelopes Unit 1 requirements. In addition, the licensee stated that large FLEX portable equipment such as pumps, generators, portable battery charger, fuel trailers, pay loader, tractor, and trucks are secured with tie-down straps to floor anchors inside the FSB to protect them from seismic interactions from other components during an event. The FSB anchors are integrated into the floor slab.

3.6.1.2 Flooding

As stated above, the limiting flood mechanism at Nine Mile Point, Unit 1 is the PMP event, which produces a flood height of 261.75 ft. In its FIP, the licensee stated that the top of the floor elevation of the FSB is 263.3 ft., which is above the limiting flooding hazard elevation at Unit 1. Also, the licensee indicated that the FSB was designed and constructed to prevent water intrusion. Lastly, the Lake Ontario shoreline adjacent to Nine Mile Point is protected by a 1,000 ft. long rock dike adjacent to Unit 1 transitioning to a revetment ditch adjacent to Unit 2, both with a top elevation of 263 ft.

3.6.1.3 High Winds

In its FIP, the licensee stated that the FLEX portable N and N+1 equipment is stored in the tornado and tornado missile proof FSB. Deployment pathways blocked by tornado debris can be cleared using the FLEX pay loader and other debris removal tools such as chainsaws, disaster saws, tow chains, etc., which are stored in the FSB.

3.6.1.4 Snow, Ice, Extreme Cold and Extreme Heat

The licensee has evaluated and procured FLEX equipment (i.e., pumps, DGs, etc.) that are capable of operating in extreme temperatures. In its FIP, the licensee stated that the FLEX generators are rated for full load operation at temperatures as low as -25°F. The NFPA 805/FLEX portable battery charger is rated to operate as low as 0°F and is equipped with a space heater to maintain the charger at or above 0°F. Freeze protection for FLEX pumps and hoses is provided by maintaining flow in the pump/hose through the use of a minimum flow line controlled at the FLEX distribution manifold by the operator. Diesel fuel for FLEX equipment is treated with a fuel additive during cold weather conditions to prevent gelling.

Regarding extreme high temperatures, the FLEX generators vendor manual shows a maximum ambient temperature of 158°F for the control unit and 122°F for the cooling system. The NFPA 805/FLEX battery charger vendor manual shows a maximum ambient temperature of 122°F for the machine. The FLEX pumps are capable of operating in temperatures up to 132°F.

In addition, the FSB has its own heating and ventilation system. Per the building design, the maximum predicted temperature of 105.34°F inside the building is based on a maximum outdoor temperature of 103°F. This 105.34°F temperature does not challenge the FLEX portable equipment capabilities.

3.6.2 Reliability of FLEX Equipment

Section 3.2.2 of NEI 12-06 states, in part, that in order to assure reliability and availability of the FLEX equipment, the site should have sufficient equipment to address all functions at all units on-site, plus one additional spare (i.e., an N+1 capability, where "N" is the number of units on site). It is also acceptable to have a single resource that is sized to support the required functions for multiple units at a site (e.g., a single pump capable of all water supply functions for a dual unit site). In this case, the N+1 could simply involve a second pump of equivalent capability. In addition, it is also acceptable to have multiple strategies to accomplish a function, in which case the equipment associated with each strategy does not require an additional spare.

Based on the number of portable FLEX pumps, FLEX DGs, and support equipment identified in the FIP and during the audit review, the NRC staff concludes that, if implemented appropriately, the licensee's FLEX strategies include a sufficient number of portable FLEX pumps, FLEX DGs, and equipment for RPV makeup and core cooling, SFP makeup, and maintaining containment consistent with the N+1 recommendation in Section 3.2.2 of NEI 12-06.

3.6.3 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should protect the FLEX equipment during a BDBEE consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.7 Planned Deployment of FLEX Equipment

The licensee stated in its FIP, that pre-determined, preferred haul paths have been identified and documented in procedures N1-DRP-FLEX-MECH and N1-DRP-FLEX-ELEC. Figure 3 of the FIP shows the haul paths from the FSB to the various deployment locations. These haul paths have been reviewed for potential soil liquefaction and have been determined that the impact to be minimal following a seismic event.

3.7.1 Means of Deployment

The deployment of onsite FLEX equipment to implement coping strategies beyond the initial plant capabilities (Phase 1) requires that pathways between the FSB and various deployment locations be clear of debris resulting from seismic, high wind (tornado), excessive snow/ice, or flooding events. The stored FLEX equipment includes debris removal equipment, including tractors with the capability to remove snow. In addition, FLEX debris removal hand held tools (e.g., tow chains, chains, etc.) are available. All equipment is stored in the FSB.

The licensee may need to open doors and gates that rely on electric power for opening and/or locking mechanisms. The licensee has contingencies for access upon loss of all ac/dc power as part of the security plan. Access to the owner-controlled area, the plant protected area, and areas within the plant structures will be controlled under this access contingency.

Phase 3 of the FLEX strategies involves the receipt of equipment from offsite sources including the NSRC and various commodities such as fuel and supplies. Transportation of this equipment can be through airlift or via ground transportation. Debris removal for the pathway between staging areas 'A' and the NSRC receiving location staging area 'B' and from the various plant access routes may be required based on conditions present. The same debris removal equipment used for on-site pathways will be used to support debris removal to facilitate road access to the site.

3.7.2 Deployment Strategies

In its FIP, the licensee stated that the haul paths were reviewed for potential soil liquefaction. The licensee evaluated the primary and alternate routes using original site borings, the extensive borings conducted for the installation of the ISFSI and the associate heavy haul path, and the recent soil borings for the design of the new FSB. The licensee concluded that the soil liquefaction potential for the primary and alternate deployment paths is considered minimal. During the onsite audit, the NRC staff reviewed the licensee's evaluation to verify the licensee's conclusions and the NRC staff believes that liquefaction should not inhibit the necessary equipment deployment after an earthquake.

For the makeup water supply strategy, the licensee will deploy portable FLEX pumps from the FSB to a location near the selected water source. The primary staging location and suction source is from the North side of the screen house. An alternate staging area for the FLEX pump and suction hose is available from the West side of the screen house in the event the North side screen house area is not accessible.

For RPV, EC loops, and SFP makeup, the primary strategy utilizes a manifold, mounted on a push cart, located in the reactor building track bay. The manifold will receive water from the portable FLEX pump staged at the screen house. When not in use, the manifold and cart are stored locally in the reactor building.

For the electrical strategy, the primary strategy is to deploy the FLEX portable generator to the South side of the Unit 1 turbine building and running cables to a junction box located in the turbine building. The alternate strategy is to use the FLEX portable generator to provide power to the NFPA 805/FLEX portable battery charger, which will be deployed to outside the turbine building on the South side of the battery board rooms in close proximity to the FLEX DG.

3.7.3 Connection Points

3.7.3.1 Mechanical Connection Points

FLEX Pump Suction

In the FIP, Section 2.9.1 states that on the North wall of the Unit 1 screen house, 2 penetrations, which use 12 inch, schedule 40 pipe in order to accommodate the 6 inch suction hoses and the hose fittings, have been installed in pre-cast wall panels. To access the circulating water system intake tunnel, two 16 inch x 16 inch hinged access openings can be opened to lower 6 inch suction hose that is routed from the FLEX pump suction. In the FIP, Section 2.7 indicates that the turbine building, reactor building and screen house building were designed for a SSE. In the event the North side screen house area is not accessible, the licensee's FLEX strategy provides flexibility and diversity such that the FLEX pump can be staged on the West side of the screen house and the suction hose will be installed in an opening upstream of the intake trash rakes.

FLEX Pump Discharge

In the FIP, Section 2.9.2 states that the primary water make up to the RPV, EC loops and SFP will all be via a manifold, mounted on a push cart, located in the reactor building track bay which will receive water from the portable FLEX pump. When not in use, the manifold/cart will be stored locally, just outside the track bay (in the reactor building), with the wheels chocked to prevent movement. When needed, the manifold/cart will be un-chocked and moved to the track bay. This manifold provides the ability for a single operator to control the flow rates to each of the three injection points when deployment of the primary injection paths is successful for all three key safety functions. A 3 inch diameter hose is used to make the connection between the FLEX pump discharge and the inlet of the portable distribution manifold. As an alternate strategy, hoses from the FLEX pump discharge can be routed indoors, through the turbine building and the reactor building, which will require parallel runs of 800 ft. of hose if make-up to all three locations (i.e., RPV, EC loops and SFP) is required through this route.

In NEI 12-06 Section 3.2.2 states, in part, that to assure reliability and availability of the FLEX equipment, the site should have sufficient equipment plus one additional spare. Furthermore, NEI 12-06 clarifies that states it is acceptable to have multiple strategies to accomplish a function rather than have (e.g., two separate means to repower instrumentation). The staff concludes that the licensee's strategy for providing make-up water is consistent with NEI 12-06 Section 3.2.2 and includes two separate methods for distributing water to the nessecary locations (i.e., discharge from portable manifold or direct discharge from the FLEX pump).

RPV Make-up Strategy

In NEI 12-06, Table C-1, states, in part, that the performance attributes for make-up for core cooling with a portable pump should include primary and alternate injection points to establish capability to inject through separate divisions/trains, i.e., should not have both connections in one division/train.

In the FIP, Section 2.9.2 states that the primary RPV makeup utilizes a 1.5 inch hose routed from the portable distribution manifold, through the reactor building and connects the CRD return to the RPV line. The alternate RPV makeup utilizes a hose connection in the cross tie between fire protection piping and high pressure feedwater piping located between the feedwater pumps and the 5th point feedwater heater. The 3 inch hose is routed from the FLEX pump discharge through the screen house, the turbine building, and then to this hose connection located inside the turbine building on the 261 ft. elevation near the electric feedwater pumps.

Emergency Cooling Make-up Strategy

In NEI 12-06, Table C-1, states, in part, that the performance attributes for makeup for core cooling with a portable pump should include primary and alternate injection points to establish capability to inject through separate divisions/trains, i.e., should not have both connections in one division/train.

In the FIP, Section 2.9.3 states that the primary EC condenser makeup strategy uses a permanent hose connection point on reactor building 318 ft. elevation for a FLEX pump to supply lake water to the EC makeup piping. From the portable distribution manifold, 200 ft. of 1.5 inch EC makeup hose is routed to the hard-pipe connection point on elevation 318 ft. of the reactor building which ties into the EC makeup piping. The alternate EC makeup strategy is to route hose from the FLEX pump discharge to supply lake water to a qualified section of the turbine building fire water distribution header that can be aligned to the EC makeup tanks. The 3 inch FLEX hose from the FLEX pump located at the screen house is routed through the turbine building, to connect at fire hose station FS-128 in the turbine building 261 ft. track bay.

SFP Make-up Strategy

In NEI 12-06, Table C-3, states, in part, that the baseline capabilities for SFP cooling include makeup via hoses on the refueling floor, spray capability via portable monitor nozzles from the refueling floor and makeup via connection to SFP cooling piping or other alternate location.

In the FIP, Section 2.9.4 states that the primary SFP makeup strategy routes hose from the portable distribution manifold to a permanent hose connection point on reactor building 318 ft. elevation that will supply makeup water to the SFP on reactor building elevation 340 ft. The alternate SFP makeup strategy involves routing hose from the FLEX pump discharge into the reactor building and up the stairs to elevation 318 ft. On reactor building elevation 318 ft., a valved hose splitter is used to create two hose paths to the SFP, one route to the side of the SFP and connected to an oscillating spray nozzle (Ozzi), and the other is tied down to the SFP railing on the side of the pool for direct SFP makeup. The oscillating spray nozzle can be used to provide spray flow over the SFP for cooling in the event that the pool's integrity has been compromised.

Given the design and location of the primary and alternate connection points, as described in the above paragraphs, the staff concludes that at least one of the connection points should be available to support RPV makeup, EC condenser makeup and, SFP makeup via a portable pump during an ELAP caused by an external event, consistent with NEI 12-06 Section 3.2.2. Furthermore, the staff concludes, consistent with NEI 12-06, Table C-1, the licensee appears to have the capability to provide makeup to the RPV and the EC condensers through a primary and alternate injection point that is through separate divisions/trains. In addition, the staff concludes that the available connection points and strategies to provide SFP makeup and cooling appear to be consistent with NEI 12-06, Table C-3.

3.7.3.2 Electrical Connection Points

In its FIP, the licensee noted that the Phase 2 strategies use installed and portable onsite equipment that will be deployed to plant locations to provide for continued RPV makeup and containment cooling, as well as power to the vital 480 Vac buses. Portable FLEX DGs will provide power to all necessary loads. The electrical equipment will be relied upon throughout Phase 2 and be supplemented by NSRC equipment in Phase 3. All electrical connection points are located in the turbine building; thus all connections are within seismic Category I structures and are protected from all postulated external hazards as defined in NEI 12-06.

In its FIP, the licensee stated that the primary strategy includes deploying a FLEX Phase 2 DG to the South side of the Unit 1 turbine building to power the 600 Vac /125 Vdc static battery charger 171A or 171B to restore and maintain charging of the #12 battery. The connection between the FLEX DG and 600 Vac /125 Vdc static battery charger 171A or 171B is via temporary cables and connectors at a junction box and a fused disconnect switch located adjacent to static battery charger 171A and SBC 171B. The FLEX DG is then started, a phase rotation check is performed in accordance with procedure N1-DRP-FLEX-ELEC, "Emergency Damage Repair – BDB/FLEX Generator Deployment Strategy," Revision 01, and then connected to the selected static battery charger for charging the number 12 battery.

The licensee's alternate strategy is to use a portable static battery charger to provide power during a flooding event as discussed below.

The licensee's alternate strategy for Phase 2 is to use the FLEX DG to provide power to the NFPA 805/FLEX portable static battery charger. Connections and associated cabling for providing 125 Vdc electric power from the NFPA 805/FLEX portable static battery charger to either of the two existing vital 125 Vdc battery boards (battery board 11 or 12) are installed at Nine Mile Point, Unit 1. The connection to the junction boxes in the battery board rooms (dc connections) are via four (4) 100 ft. 4/0 cables and connectors. There is one (1) connector junction box in each battery board room (number 11 and 12) which is to be connected to the respective battery board bus via a disconnect switch, fuses, and associated cables. The connection between the FLEX DG and the NFPA805/FLEX portable static battery charger (ac connections) is via four (4) 4/0 cables and connectors. The NFPA805/FLEX static battery charger would be staged outside of the turbine building on the South side of the battery board rooms in close proximity to the FLEX DG.

The FSG support procedures N1-DRP-FLEX-ELEC provides guidance to the operators on how to connect the Phase 2 FLEX DG and static battery charger (if necessary) to the station's ac power system for restoring and maintaining power to the instruments and equipment and to verify correct phase rotation of the DG by using phase rotation meters.

In its FIP, the licensee stated that the NSRC will supply two (1 per unit) 1100 kW, 480 Vac CTGs with a 480/600 Vac step up transformer and will be used as a back up to the onsite Phase 2 equipment. As the Phase 3 NSRC supplied equipment is intended to back up or replace the Phase 2 FLEX DG, the proposed onsite staging locations, cable pathways, and connections would be the same as those used for the connections of the Phase 2 equipment.

Guidance provided in procedure N1-DRP-FLEX- ELEC for Phase 3 equipment for staging, cable routing, connections and phase rotation verification will be the same as the Phase 2 onsite equipment. Procedure CC-NM-118-1001, "SAFER Response Plan for NMP," describes the responsibilities of SAFER to connect the Phase 3 CTGs to the existing plant equipment. As Phase 3 equipment will be delivered, ERO personnel will develop plans for connections to the permanently installed equipment.

Based on its review of conceptual single line electrical diagrams and station procedures, the NRC staff concludes that the licensee's approach appears to be acceptable given the protection and diversity of the power supply pathways, the separation and isolation of the FLEX DGs from the Class 1E emergency DGs, and availability of procedures to direct operators how to align, connect, and protect associated systems and components.

3.7.4 Accessibility and Lighting

During the onsite audit, the licensee stated that the potential impairments to required access are: 1) doors and gates, and 2) site debris blocking personnel or equipment access. The coping strategy to maintain site accessibility through doors and gates is applicable to all phases of the FLEX coping strategies, and is immediately required as part of the immediate activities required during Phase 1. Doors and gates serve a variety of barrier functions on the site. One primary function is security and is discussed below. However, other barrier functions include fire, flood, radiation, ventilation, tornado, and high energy line break. As barriers, these doors and gates are typically administratively controlled to maintain their function as barriers during normal operations.

The licensee noted that following an BDBEE and subsequent ELAP event, FLEX coping strategies require the routing of hoses and cables to be run through various barriers in order to connect BDB equipment to station fluid and electric systems or require the ability to provide ventilation. For this reason, certain barriers (gates and doors) will be opened and remain open. This deviation of normal administrative controls is acknowledged and is acceptable during the implementation of FLEX coping strategies. The ability to open doors for ingress and egress, ventilation, or temporary cables/hoses routing is necessary to implement the FLEX coping strategies.

Regarding lighting, the licensee evaluated the tasks to be performed and the available lighting in the designated task areas to validate the adequacy of supplemental lighting and the adequacy and practicality of using portable lighting to perform FLEX strategy actions. The licensee determined that the battery powered Appendix R emergency lights provide adequate lighting for all primary FLEX connection points in the FLEX strategies including the illumination for all interior travel pathways needed to access the connection points. These emergency lights provide a minimum of 8 hours of lighting with no external ac power sources. However, the licensee recognized that this lighting may not be available following a seismic event.

A supply of flashlights, headlights, batteries and other lighting tools are routinely used by operators. These supplies are stored in different locations throughout the site, including the control room. In addition, the licensee recognized that there are no emergency lighting fixtures in the outside areas of the protected area to provide necessary lighting in those areas where portable FLEX equipment is to be deployed. Therefore, the tow vehicles for the FLEX portable pump and generator carry hand held flash lights and head lamps that can be used while deploying the pump and hoses, generator and cables. Also, the FSB contains flashlights and batteries, head lamps and batteries, and battle lanterns.

3.7.5 Access to Protected and Vital Areas

During the audit process, the licensee provided information describing that access to protected areas will not be hindered. The licensee has contingencies in place to provide access to areas required for the ELAP response if the normal access control systems are without power.

3.7.6 Fueling of FLEX Equipment

FIP Section 2.9.6 states that the coping strategy for supplying fuel oil to diesel-driven portable equipment during an ELAP event is to draw fuel oil out of the Nine Mile Point, Unit 2 emergency DG fuel oil storage tanks. The licensee explained that the Unit 1 emergency DG fuel oil storage tanks are below grade and the tank access ports will not be accessible based on the reevaluated flood hazard. Calculations associated with fuel oil consumption were performed assuming the equipment required for full implementation of mitigation strategies at both units are in operation simultaneously. For conservatism, the licensee assumed that only two of the three Unit 2 emergency DG fuel oil storage tanks will be available, which equates to a capacity of greater than 85,000 gallons. Fuel consumption for portable equipment operating at full load for both units to support FLEX (4 diesel-driven portable pumps, 2 diesel-driven portable generators and 1 diesel-driven portable air compressor) is approximately 130 gallons per hour. Based on the fuel oil consumption of the FLEX equipment from both units operating at full load, the staff noted that the available fuel oil in two of the robust Unit 2 fuel oil storage tanks would support the FLEX strategies for over 26 days of continuous operation. The licensee indicated that it expects the emergency response organization can ensure delivery of replenishment fuel as required within 26 days from the initiation of the ELAP event. Based on the safety-related classification and location of the Unit 2 fuel oil storage tanks, the staff concludes that the tanks are robust and the fuel oil contents should be available to support the licensee's FLEX strategies during an ELAP event and the quantity available is sufficient until off-site resources can provide fuel oil replenishment to the site.

FIP Section 2.9.6 states that the site has two 528 gallon fuel tanks mounted on separate trailers equipped dc-powered fuel transfer pump, which are stored in the FSB, to support FLEX equipment refueling. These tankers will be filled by using portable fuel oil transfer pumps, stored in the FSB, taking suction from the Unit 2 fuel oil storage tanks. The portable transfer pumps are capable of providing over 31 gpm flowrate and the on-board transfer pumps on the trailers are capable of providing approximately 20 gpm. Based on the available protected equipment to support refueling operation, the available run-time and fuel oil consumption rate on each piece of FLEX equipment, the staff concludes that the diesel-powered FLEX equipment can be adequately refueled to ensure uninterrupted operation to support the licensee's FLEX strategies.

FIP Section 2.18.6 states that a fleet procedure has been developed to address preventative maintenance using EPRI templates or manufacturer provided information and recommendations. Preventative maintenance templates for the major FLEX equipment including the portable diesel pumps and generators have also been issued and include activities such as fluid analyses. Since the Unit 1 relies on the Unit 2 fuel oil storage tanks, the staff noted that the technical specifications for Unit 2 (surveillance requirement (SR) 3.8.3.3) require that fuel oil properties of new and stored fuel oil are tested in accordance with, and maintained within the limits of, the diesel fuel oil testing program. Based on the licensee's technical specification requirements and preventative maintenance activities for FLEX equipment, the staff concludes that the licensee has addressed management of fuel oil in the fuel oil storage tanks and portable FLEX equipment to ensure FLEX equipment will be supplied with quality fuel oil during an ELAP event.

3.7.7 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should allow deploying the FLEX equipment following a BDBEE consistent with NEI 12-06 guidance as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.8 Considerations in Using Offsite Resources

3.8.1 Nine Mile Point SAFER Plan

The industry has collectively established the needed off-site capabilities to support FLEX Phase 3 equipment needs via the SAFER Team. SAFER consists of the Pooled Equipment Inventory Company (PEICo) and AREVA Inc. and provides FLEX Phase 3 management and deployment plans through contractual agreements with every commercial nuclear operating company in the United States.

There are two NSRCs located near Memphis, Tennessee and Phoenix, Arizona, established to support nuclear power plants in the event of a BDBEE. Each NSRC holds five sets of equipment, four of which will be able to be fully deployed to the plant when requested. The fifth set allows removal of equipment from availability to conduct maintenance cycles. In addition, the plant's FLEX equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC.

By letter dated September 26, 2014 (ADAMS Accession No. ML14265A107), the NRC staff issued its assessment of the NSRCs established in response to Order EA-12-049. In its assessment, the staff concluded that SAFER has procured equipment, implemented appropriate processes to maintain the equipment, and developed plans to deliver the equipment needed to support site responses to BDBEEs, consistent with NEI 12-06 guidance; therefore, the staff concluded in its assessment that licensees can reference the SAFER program and implement their SAFER Response Plans to meet the Phase 3 requirements of Order EA-12-049.

The NRC staff noted that the licensee's SAFER Response Plan contains (1) SAFER control center procedures, (2) NSRC procedures, (3) logistics and transportation procedures, (4) staging area procedures, which include travel routes between staging areas to the site, (5) guidance for site interface procedure development, and (6) a listing of site-specific equipment (generic and non-generic) to be deployed for FLEX Phase 3.

3.8.2 Staging Areas

In general, up to four staging areas for NSRC supplied Phase 3 equipment are identified in the SAFER Plans for each reactor site. These are a Primary (Area C) and an Alternate (Area D), if available, which are offsite areas utilized for receipt of ground transported or airlifted equipment from the NSRCs. From Staging Areas C and/or D, the SAFER team will transport the Phase 3 equipment to the on-site Staging Area B for interim staging prior to it being transported to the final location in the plant (Staging Area A) for use in Phase 3. For Nine Mile Point Staging Area C is the Syracuse Hancock International Airport. Staging Area B is the parking lot located south of the P-building and the overflow parking lot on the east side of the warehouse access road. Staging Area A for the NSRC pumps is the north side of the Unit 1 screenhouse and Staging Area A for the NSRC portable generators is the east side of the Unit 1 turbine building, outside of the DG rooms and the south side of the Unit 1 turbine building. Procedure S-DRP-OPS-005 "Use of FLEX Phase 3 SAFER Equipment," provides a map depicting the Staging A and B Areas.

Use of helicopters to transport equipment from Staging Area C to Staging Area B is recognized as a potential need within the Nine Mile Point SAFER Plan.

3.8.3 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should allow utilization of offsite resources following a BDBEE consistent with NEI 12-06 guidance as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.9 Habitability and Operations

3.9.1 Equipment Operating Conditions

3.9.1.1 Loss of Ventilation and Cooling

Following a BDBEE and subsequent ELAP event, plant HVAC in occupied areas and areas containing permanent plant and FLEX mitigation strategy equipment will be lost. Per NEI 12-06, FLEX mitigation strategies must be capable of execution under the adverse conditions (unavailability of normal plant lighting, ventilation, etc.) expected following a BDBEE resulting in an ELAP and a loss of normal access to the ultimate heat sink. The primary concern with regard to ventilation is the heat buildup, which occurs with the loss of forced ventilation in areas that continue to have heat loads.

The areas identified for all phases of execution of the FLEX mitigation strategy activities are the reactor building, main control room, auxiliary control room, containment, switchgear rooms, battery charger rooms, and battery rooms. The licensee evaluated these areas to determine the temperature profiles following an ELAP event.

Reactor Building

In calculation S0-GOTHIC-ELAP001, "Reactor Building Response Following an ELAP," Revision 00, the licensee determined that the area temperature on reactor building elevation 340 ft. in the first one (1) hour and three (3) hours (prior to opening doors) is predicted to be 120°F and 135°F, respectively. The licensee will implement passive cooling actions such as opening specified doors in the reactor building and turbine building, in addition to the turbine building side-wall vents, to cool down areas in the reactor building and channel potentially contaminated air/steam mixture from the turbine building roof to the atmosphere within eight (8) hours of the ELAP event. This action is expected to create a convection path, i.e., air is drawn in through an exterior personnel access door at the reactor building ground level and exits through the reactor building 340 ft. elevation into the turbine building and then out the roof door and side wall vents to the atmosphere, which would help to minimize the temperature rise within the reactor building. In its FIP, the licensee credited RPV level, RPV pressure and EC condenser level monitoring instruments for reactor core cooling. These instruments located in the reactor building are required to remain functional during an ELAP. In response dated August 30, 2016, the licensee stated that attachment 8, "Reactor Building Passive Cooling and Ventilation," to procedure N1-SOP-33A.2 includes actions to open selected doors in the reactor building and turbine building sidewall vents to maintain passive cooling that should maintain temperatures in the areas where the credited instruments are located, lower than the instruments design temperature limits to ensure credited instruments remain functional.

In its FIP, the licensee credited ERVs to prevent reactor heatup and re-pressurization. The ERVs are located in the drywell. In response dated October 18, 2016, the licensee determined in calculation S0-GOTHIC-ELAP002 that the expected temperature would be 301°F at approximately 23 days in the area where ERVs are located in the drywell, if cooling is not established. In accordance with the Unit 1 environmental qualification document 1EQDP-SOV002DOR, "Solenoid Operated Valve (Solenoid Actuator Assembly)," the solenoid actuator assembly was steam tested at 301°F and a peak pressure of 62 psi for 10 hours, and the valve operated successfully at 5-Vdc intervals from 125 Vdc down to minimum voltage (105 Vdc). Based on the above licensee evaluation, the NRC staff concludes that the ERVs should remain functional in the expected temperature and pressure.

During Phase 1, these credited instruments will be repowerd from the Class 1E battery 11 or 12 for up to 8 hours into the ELAP. In calculation 125VDCTRAIN 11/12LFVD, the licensee verified that the batteries will have sufficient capacity and capability to supply power to these instruments. Within 8 hours during Phase 2, and before the battery is depleted to the minimum acceptable voltage, the FLEX DG will repower the static battery chargers, which will supply power to these instruments through inverters. In calculation 600VACDGES-FLEX-BDB, the licensee determined that the FLEX DGs will have sufficient capacity and capability to repower these instruments. During Phase 3, the NRC staff concludes that the NSRC supplied 480 Vac, 1.1 MW CTG is of higher capacity than the capacity of the FLEX DG (480 Vac, 450 kW) and as such, the NSRC CTG will have adequate capacity to supply power to the credited instruments. Based on the above, the NRC staff concludes that the licensee strategy to monitor reactor building credited instruments should remain functional indefinitely.

Main Control Room and Auxiliary Control Room

In calculation S10-210-HV12, "Evaluate Control Room and Auxiliary Control Room Building Temperatures for Cold and Hot Weather Scenarios with a loss of offsite Power (Appendix R) and Loss of Coolant Accident," Revision 1, the licensee determined that the maximum expected temperature in the control room and auxiliary control room would be 94.89°F and 98.87°F, respectively, at the end of an 8 hour Appendix R event and with no ventilation. Since the heat loads during an Appendix R scenario would be higher than during an ELAP event, the expected temperatures for Appendix R scenario will be conservative and will envelop an ELAP event. In its FIP, the licensee stated that selected main control room doors and auxiliary control room doors are directed by procedure N1-SOP-33A.2, "Station Blackout/ELAP," Revision 01300.00, to be opened prior to temperatures in those areas reaching 94°F in order to establish a passive cooling flow path by convection. Based on environmental conditions and cooling needs, these doors are subsequently cycled open/close as needed for temperature control. Procedure N1-SOP-33A.2 directs other heat load reduction actions before two (2) hours has elapsed from event onset, including removing the plant process computer from service by shutting down power to the uninterruptible power supply (UPS 175). Additional actions include opening all main control room and auxiliary control room instrument panel doors within 30 minutes of event onset for equipment cooling. Additionally, the flowchart associated with special operating procedure, N1-SOP-33A.2, "Station Blackout/ELAP," directs that all control room and auxiliary control room instrument cabinet doors be opened before 30 minutes have elapsed.

Based on the main control room and auxiliary control room expected temperatures remaining below 120°F (the temperature limit, as identified in NUMARC-87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," Revision 1, for equipment to be able to survive indefinitely), the NRC staff concludes that it is reasonable to assume that the equipment in the main control room and auxiliary control room should not be adversely impacted by the loss of ventilation as a result of an ELAP event.

Static Battery Charger (SBC) 171A/B (BC-B12-1/-2) area

The static battery chargers are located in the turbine building. In calculation S10HVACHV11, "Turbine Building Maximum and Minimum Temperature," Revision 0, the licensee determined that the peak temperature in the turbine building where the static battery chargers are located is expected to reach approximately 100°F, which is less than the battery charger vendor recommended maximum temperature limit of 122°F. The calculation bounds the ELAP scenario temperature due to higher 7-day LOOP/LOCA heat up loads assumed in the calculation.

Based on the turbine building (where the static battery chargers are located) temperature remaining below 120°F (the temperature limit, as identified in NUMARC-87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," Revision 1, for most equipment to be able to survive indefinitely), the NRC staff concludes that it is reasonable to assume that the equipment in the static battery charger area should not be adversely impacted by a loss of ventilation as a result of an ELAP event.

Emergency Switchgear and DC Equipment Rooms (referred to as Foam/Valve Boards 11 and 12 Rooms at NMP1)

Valve Boards 11 and 12 are located in the turbine building, elevation 291 ft. and 261 ft., respectively. In calculation S10HVAC-HV14, "Foam Room Maximum and Minimum Temperature during ELAP," Revision 00.00, the licensee determined that the maximum steady state temperature in the turbine building 291 ft. and 261 ft. elevation areas are expected to reach approximately 102.4°F and 99°F, respectively. These temperatures are less than the equipment vendor recommended maximum equipment design temperature limit of 104°F. The calculation bounds the ELAP scenario temperature due to higher LOOP/LOCA heat up loads assumed in the calculation.

Based on the turbine building elevation 291 ft. and 261 ft. foam room temperatures remaining below 120°F (the temperature limit, as identified in NUMARC-87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," Revision

1, for most equipment to be able to survive indefinitely), the NRC staff concludes that it is reasonable to assume that the equipment valve boards in the foam/valve boards 11 and 12 rooms should not be adversely impacted by a loss of ventilation as a result of an ELAP event.

Battery Rooms 11 and 12

In attachment 1, "Battery Room 12 Temperature," of the licensee's evaluation 1-065, "Tracking Form for NRC Audit Related Questions or Document Request," Revision 2, the licensee stated that the highest temperature in battery room 12 is expected to reach 113.04°F (peak) during an Appendix R scenario within the first hour with 93°F outdoor temperature and then stabilizes at 105.84°F at 8 hours. The Appendix R scenario bounds the ELAP scenario maximum temperature due to higher assumed heat up loads.

In response dated October 18, 2016, the licensee stated that a procedure change request (PCR-16-03420) has been issued to include a note to monitor the Unit 1 battery conditions, including electrolyte levels, and obtain support as necessary to mitigate adverse environmental conditions in the battery rooms.

Since the maximum expected room temperature of 113°F is lower than the battery manufacturer's (C&D Technologies) typical battery temperature limit of 122°F for satisfactory battery operation, and the licensee has established a mitigation strategy to monitor battery conditions, opening doors, etc. in procedure N1-DRP-FLEX-ELEC (PCR-16-03420), the NRC staff concludes that the temperature in the battery rooms should not have any adverse impact on the vital battery performance during a loss of ventilation due to an ELAP.

Primary Containment

See Section 3.4.4.4 of this SE for details pertaining to availability of the critical instruments and credited solenoid valves within containment due to a loss of ventilation during an ELAP.

Based on its review, the NRC staff did not identify any issues with the licensee's ability to ensure that the electrical equipment relied upon as part of the Unit 1 mitigation strategy should not be adversely affected by increases in temperature as a result of loss of HVAC.

3.9.1.2 Loss of Heating

At Nine Mile Point, Unit 1, the battery rooms are located in the interior of the turbine building and the battery rooms are normally maintained at approximately 77°F. The impact on the performance of the safety-related batteries based on low temperatures is minimal. The safety-related batteries are located in the interior of the turbine building such that outside air temperature would not impact battery performance. In addition, during battery discharge the battery will be producing heat which will keep electrolyte temperature above the room temperature. Based on its review of the licensee's battery room assessment, the NRC staff concludes that the Unit 1 safety-related batteries should perform their required functions as a result of loss of heating during an ELAP event.

The FIP indicates that Nine Mile Point has cold weather garments (coats, boots, and gloves) in various sizes, for responders to wear during foul weather conditions supporting outside FLEX deployment actions. Portable propane heaters and shelters are also available for deployment when outside actions during adverse weather conditions are needed for extended periods. All of the cold weather garments and portable heaters are stored in the FSB. In response to an audit question, the licensee indicated that they reviewed existing building temperature calculations and determined that the temperature in the reactor and turbine buildings remain above freezing.

3.9.1.3 Hydrogen Gas Control in Vital Battery Rooms

In order to assess the potential for hydrogen gas to accumulate into the battery rooms, the licensee calculated (Calculation S10-H2GAS-HV01, "Hydrogen Gas Concentration in Battery Rooms 11 and 12," Revision 0) that the hydrogen concentration level would not reach 2 percent concentration if ventilation is not available. In its FIP, the licensee stated that the battery room ventilation will be restored prior to restoring the battery chargers. During an ELAP, the hydrogen gas will accumulate in the ventilation duct work, which is located above the battery rooms, while the batteries are being recharged during Phase 2 and Phase 3. To prevent unacceptable hydrogen gas concentrations in the battery room ductwork, 3 inch diameter holes are located in the top of the battery room exhaust ducts. The exhaust holes are normally closed by dampers and open during a loss of power. The exhaust holes will allow the hydrogen gas to escape from the duct into the turbine building atmosphere. Due to the large volume of air in the turbine building, the hydrogen concentration is expected to be extremely low (below 1%) and will dissipate into the air.

Based on its review, the NRC staff concludes that the licensee's evaluation demonstrated that hydrogen accumulation in the Class 1E station battery rooms should not reach the combustibility limit for hydrogen (4 percent) during an ELAP as a result of a BDBEE.

3.9.2 Personnel Habitability

3.9.2.1 Main Control Room

Calculation S10-210HV12, "Evaluate Control Room & Auxiliary Control Room Building for Cold & Hot Weather Scenarios With A Loss of Offsite Power (Appendix R) & Loss of Coolant Accident," states that the Appendix R scenario assumes loss of all ac power for 8 hours. Summer outdoor ambient temperature is assumed to be 93°F with a 20°F diurnal temperature difference. Winter minimum temperature is assumed to be a constant -10°F. The calculation employs a lumped parameter model to determine bulk average room air temperature. The cold weather analysis shows at the end of 8 hours the auxiliary control room temperature is calculated to be 68.69°F and 63.12°F in the control room with an initial room temperature of 75°F. Calculation S10-210HV12-02, showed that, over a duration of 72 hours, and utilizing a peak daytime temperature of 93°F, the main control room and the auxiliary control room maximum temperatures can be maintained below the 104°F mild environment limit delineated in the guidelines and technical bases for NUMARC initiatives addressing station blackout at light water reactors. The maximum high temperature at the end of 8 hours is estimated to be 98.9°F in the auxiliary control room and 94.9°F in the control room. Procedure N1-SOP-33A.2, "Station Blackout/ELAP," addresses establishing ventilation flow through opening selected doors.

3.9.2.2 Spent Fuel Pool Area

The licensee performed calculation S0-GOTHIC-ELAP001, Revision 0, to address the environmental conditions on the refueling floor following an extended loss of all ac power. The calculation used the GOTHIC (Generation of Thermal-Hydraulic Information for Containments) thermal-hydraulic computer program, version 8.0. The ambient temperature was assumed to be 100°F, which bounds the design basis outdoor temperature for the site. The suppression pool temperature was assumed to be 110°F. Selected doors are assumed to be opened within 8 hours to establish natural circulation cooling. The area temperature for the habitability region on reactor building elevation 340 ft. in the first one (1) hour and three (3) hours (prior to opening doors) is predicted to be 120°F and 135°F, respectively. The significant temperature rise is due to the heat from the uninsulated emergency condenser surfaces which are placed into service immediately and the loss of decay heat removal to the SFP. Human activity in the Unit 1 reactor building 340 ft. elevation following an ELAP should be limited to the first hour after the onset of the event. Procedure N1-SOP-33A.2 provides guidance for establishing a vent pathway from the SFP which could cause equipment and access problems.

3.9.2.3 Other Plant Areas

Reactor Building

As part of the audit process, NRC staff reviewed calculation S0-GOTHIC-ELAP001, "Reactor Building Response Following an Extended Loss of AC Power," Revision 1. The ambient temperature was assumed to be 100°F, which bounds the design basis outdoor temperature for the site. The suppression pool temperature was assumed to be 110°F. Selected doors are assumed to be opened within 8 hours to establish natural circulation cooling. The area temperature on elevation 318 ft. is predicted to be 122°F. The calculation indicated the limiting temperature for required equipment (SFP level sensing devices) is 176°F. Procedure N1-SOP-33A.2, "Station Blackout/ELAP," addresses establishing ventilation flow by manually opening selected vents and doors.

3.9.3 Conclusions

The NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should maintain or restore equipment and personnel habitability conditions following a BDBEE consistent with NEI 12-06 guidance as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.10 Water Sources

In the FIP, Section 2.9.1 states Lake Ontario provides an indefinite supply of water as make-up to the screen house inlet structure, specifically the water will be drawn from the circulating water system intake tunnel. The staff noted that Lake Ontario will be used as the water source for make up to the RPV, emergency condensers and SFP during Phase 2 and 3, and for containment cooling during Phase 3. The licensee confirmed that the intake and discharge tunnels are Class I seismic structures (see UFSAR Section III). Furthermore, there are diverse locations for the deployment of the FLEX pump (i.e., north side or west side of the screen house); thus, the staff concludes that it is reasonable to assume that the FLEX Pump will be able to take suction from Lake Ontario from at least one of the screenhouse locations following a BDBEE.

As stated above, the FLEX pump takes suction upstream of the circulating water screens and trash rakes and the licensee explained that at the required FLEX pump flow rates, intake water will be flowing at a very low velocity such that it is not expected that significant debris will be carried into the area where the FLEX pumps will be taking their suction. However, to be conservative, an inlet barrel strainer at the end of the suction hose will be installed. Furthermore, the staff noted that the licensee performed an evaluation, "NMP FLEX Position Paper, NMP-WP-07, NMP1 Raw Water Issue: Fuel Inlet Blockage from Debris," December 2014, for using Lake Ontario water that concluded it is acceptable to inject this raw water into the RPV to maintain level above the TAF fuel during an ELAP event.

Consistent with NEI 12-06 Sections 3.2.2.5, the staff concludes that Lake Ontario via the circulating water system intake tunnel is robust, and a water source of adequate quality and quantity that should be available during an ELAP to support the FLEX mitigation strategy for RPV, EC loops and SFP make-up.

Based on the evaluation above, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should maintain satisfactory water sources following a BDBEE consistent with NEI 12-06 guidance as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.11 Shutdown and Refueling Analyses

Order EA-12-049 requires that licensees must be capable of implementing the mitigation strategies in all modes. In general, the discussion above focuses on an ELAP occurring during power operations. This is appropriate, as plants typically operate at power for 90 percent or more of the year. When the ELAP occurs with the plant at power, the mitigation strategy initially focuses on the use of the ECs, which are manually initiated. If the plant has been shut down and all or most of the fuel has been removed from the RPV and placed in the SFP, there may be a shorter timeline to implement the makeup of water to the SFP. However, this is balanced by the fact that if immediate cooling is not required for the fuel in the reactor vessel, the operators can concentrate on providing makeup to the SFP. The licensee's analysis shows that following a full core offload to the SFP, about 45 hours are available to implement makeup before boil-off results in the water level in the SFP dropping far enough to uncover fuel assemblies, and the licensee has stated that they have the ability to implement makeup to the SFP within that time.

When a plant is in a shutdown mode, typically another strategy must be used for decay heat removal. On September 18, 2013, NEI submitted to the NRC a position paper entitled "Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514), which described methods to ensure plant safety in those shutdown modes. By letter dated September 30, 2013 (ADAMS Accession No. ML13267A382), the NRC staff endorsed this position paper as a means of meeting the requirements of the order.

The position paper provides guidance to licensees for reducing shutdown risk by incorporating FLEX equipment in the shutdown risk process and procedures. Considerations in the shutdown risk assessment process include maintaining necessary FLEX equipment readily available and potentially pre-deploying or pre-staging equipment to support maintaining or restoring key safety functions in the event of a loss of shutdown cooling. The NRC staff concludes that the position paper provides an acceptable approach for demonstrating that the licensees are capable of implementing mitigating strategies in shutdown and refueling modes of operation. In its FIP, the licensee informed the NRC staff of its plans to follow the guidance in this position paper. During the audit process, the NRC staff observed that the licensee had made progress in implementing this guidance.

Based on the licensee's incorporation of the use of FLEX equipment in the shutdown risk process and procedures, the NRC staff concludes that the licensee has developed guidance that if implemented appropriately should maintain or restore core cooling, SFP cooling, and containment following a BDBEE in shutdown and refueling modes consistent with NEI 12-06 guidance as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.12 Procedures and Training

3.12.1 Procedures

Regarding procedures, the licensee stated in its FIP that the inability to predict actual plant conditions that require the use of BDB equipment makes it impossible to provide specific procedural guidance. As such, the FSGs will provide guidance that can be employed for a variety of conditions. Clear criteria for entry into FSGs will ensure that FLEX strategies are used only as directed for BDBEE conditions, and are not used inappropriately in lieu of existing procedures. When BDB equipment is needed to supplement emergency operating procedures (EOPs or abnormal/special operating procedures (SOPs) strategies, the EOP or SOP, severe accident mitigation guidelines (SAMGs), or extreme damage mitigation guidelines (EDMGs) will direct the entry into and exit from the appropriate FSG procedure.

FLEX strategy support guidelines have been developed in accordance with BWROG guidelines. The FSGs will provide available, preplanned FLEX strategies for accomplishing specific tasks in the EOPs or SOPs. The FSGs will be used to supplement (not replace) the existing procedure structure that establishes command and control for the event. Procedural interfaces have been incorporated into N1- SOP-33A.2, "Station Blackout/ELAP," to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP. Additionally, procedural interfaces have been incorporated to include appropriate reference to FSGs:

- N1-SOP-29.1, EOP Key Parameter-Alternate Instrumentation
- N1-OP-64, Meteorological Monitoring

The licensee also stated in its FIP, that changes to FSGs are controlled by Exelon fleet procedure AD-AA-101, "Processing of Procedures and T&RMs." The FSG changes will be reviewed and validated by the involved groups to the extent necessary to ensure the strategy remains feasible. Validation for existing FSGs has been accomplished in accordance with the guidelines provided in NEI APC14-17, "FLEX Validation Process," issued July 18, 2014.

3.12.2 Training

In its FIP, the licensee stated that the Nine Mile Point nuclear training program has been revised to assure response leaders proficiency on beyond-design-basis emergency response strategies and implementing guidelines. In addition, personnel assigned to the direct execution of mitigation strategies for BDBEEs have received the necessary training to ensure familiarity with the associated tasks, instructions, and mitigating strategy time constraints. The training plan development was done in accordance with Nine Mile Point's procedures using the Systematic Approach to Training (SAT) process.

Based on the description provided above, the NRC staff concludes that, as described, the licensee's established procedural guidance meets the provisions of NEI 12-06, Section 11.4 (Procedure Guidance). Similarly, the NRC staff concludes that the training plan, including use of the SAT process for the groups most directly impacted by the FLEX program, meets the provisions of NEI 12-06, Section 11.6 (Training).

3.13 Maintenance and Testing of FLEX Equipment

As a generic issue, NEI submitted a letter to the NRC dated October 3, 2013 (ADAMS Accession No. ML13276A573), which included EPRI Technical Report 3002000623, "Nuclear Maintenance Applications Center: Preventive Maintenance Basis for FLEX Equipment." By letter dated October 7, 2013 (ADAMS Accession No. ML13276A224), the NRC endorsed the use of the EPRI report and the EPRI database as providing a useful input for licensees to use in developing their maintenance and testing programs. In its FIP, the licensee stated that they would conduct maintenance and testing of the FLEX equipment in accordance with the industry letter.

In its FIP, the licensee stated that Nine Mile Point followed the EPRI generic industry guidance program for maintenance and testing of FLEX equipment or manufacturer provided information/recommendations, equipment testing, and the unavailability of equipment. The licensee states in its FIP, that preventive maintenance procedures and intervals have been established to ensure FLEX equipment is reliably maintained per manufacturer recommendations. The EPRI templates are used for equipment where applicable. However, in those cases where EPRI templates were not available, preventative maintenance actions were developed based on manufacturer provided information/recommendations and Exelon fleet procedure ER-AA-200, "Preventive Maintenance Program."

The NRC staff concludes that the licensee has adequately addressed equipment maintenance and testing activities associated with FLEX equipment because a maintenance and testing program has been established in accordance with NEI 12-06, Section 11.5.

3.14 Conclusions for Order EA-12-049

Based on the evaluations above, the NRC staff concludes that the licensee has developed guidance to maintain or restore core cooling, SFP cooling, and containment following a BDBEE which, if implemented appropriately, and appears to adequately address the requirements of Order EA-12-049.

4.0 TECHNICAL EVALUATION OF ORDER EA-12-051

By letters dated February 28, 2013 (ADAMS Accession No. ML13066A172), and March 8, 2013 (ADAMS Accession No. ML13073A155), the licensee submitted its OIP for Nine Mile Point, Unit 1 in response to Order EA-12-051. By letter dated June 5, 2013 (ADAMS Accession No. ML13154A399), the NRC staff sent a request for additional information (RAI) to the licensee. The licensee provided a response by letter dated July 5, 2013 (ADAMS Accession No. ML13197A220). By letter dated November 15, 2013 (ADAMS Accession No. ML13281A205), the NRC staff issued an ISE and RAI to the licensee.

By letters dated August 27, 2013 (ADAMS Accession Nos. ML13254A279), February 24, 2014 (ADAMS Accession No. ML14069A180), August 26, 2014 (ADAMS Accession No. ML14241A016), and February 19, 2015 (ADAMS Accession No. ML15062A035), the licensee submitted status reports for the integrated plan. The integrated plan describes the strategies and guidance to be implemented by the licensee for the installation of reliable SFP level instrumentation which will function following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-051. By letter dated June 8, 2015 (ADAMS Accession No. ML15159A385), the licensee reported that full compliance with the requirements of Order EA-12-051 was achieved.

The licensee has installed a SFP level instrumentation system designed by Areva. The NRC staff reviewed the vendor's SFP level instrumentation system design specifications, calculations and analyses, test plans, and test reports. The staff issued an audit report on October 9, 2014 (ADAMS Accession No. ML14241A454).

The staff performed an onsite audit to review the implementation of SFP level instrumentation related to Order EA-12-051. The scope of the audit included verification of (a) site's seismic and environmental conditions enveloped by the equipment qualifications, (b) equipment installation met the requirements and vendor's recommendations, and (c) program features met the requirements. By letter dated April 28, 2015 (ADAMS Accession No. ML15110A026), the NRC issued an audit report on the licensee's progress. Refer to Section 2.2 above for the regulatory background for this section.

4.1 Levels of Required Monitoring

Nine Mile Point, Unit 1 Level 1 is at elevation 338 ft. 10.5 inches (in.). The NRC staff evaluated Level 1 in the ISE as being the higher of two points for operation of the SFP cooling system and determined that it met the NEI 12-02 criteria.
Level 2 was changed to elevation 325 ft. 11.5 in. as documented in the Unit 1 fourth six-month update. The NRC staff confirmed that this elevation is 10 ft. above the fuel rack and meets the criteria of NEI-12-02. In its OIP, the licensee declared Level 2 at a lower elevation based on a dose rate calculation. The new level is higher, provides more shielding at the edge of the pool deck, and, per the NEI 12-02 guidance, no longer requires the support of a dose rate calculation.

Level 3 is at elevation 315 ft. 11.5 in. The NRC staff confirmed, in the ISE, that Level 3 corresponds to the highest point (+/- 1 ft.) of any fuel rack seated in the SFP based on a sketch provided in the licensee's July 5, 2013, RAI response.

Based on the above, the NRC staff concludes that the licensee's proposed Levels 1, 2 and 3 appear to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2 Evaluation of Design Features

Order EA-12-051 required that the SFP level instrumentation shall include specific design features, including specifications on the instruments, arrangement, mounting, qualification, independence, power supplies, accuracy, testing, and display. Refer to Section 2.2 above for the requirements of the order in regards to the design features. Below is the staff's assessment of the design features of the SFP level instrumentation.

4.2.1 Design Features: Instruments

The licensee stated in its OIP that it intends to implement one permanent fixed primary and one permanent fixed backup level instrument for the SFP. These instruments would be permanently located and mounted in the SFP. For Unit 1, each instrument channel will be capable of monitoring SFP water level from the top of the fuel racks (315ft. 11.5 in.. elevation) to the normal water level in the pool (340 ft. 0 in. elevation), for a minimum range of about 24 ft.

The NRC confirmed the design configuration in a sketch provided with the June 8, 2015, full compliance letter and during SFP walkdowns during the onsite audit.

Based on the above, the NRC staff concludes that the licensee's design, with respect to the number of channels and measurement range for its SFP, appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.2 Design Features: Arrangement

In its OIP, the licensee stated that the primary instrument channel level sensing components would be located in the Northeast corner of the SFP; and the backup would be located near the Northwest corner of the SFP at elevation 340 ft. The OIP includes a plan view of Unit 1 showing the proposed location for both the primary and the backup instruments. The licensee also stated that the transmitter would be located in the reactor building at elevation 318 ft. directly below the SFP operating floor. According to the licensee, these locations would provide reasonable protection against missiles without interfering with SFP activities. Cabling for power supplies and indications for each channel would be routed in separate conduits from cabling from other channels; and separation between cables for the primary and backup channels would be maintained.

In its letter dated July 5, 2013, the licensee stated that it intends to implement the fixed primary level instrument in the northeast corner of the Unit 1 SFP and the backup level instrument in the Southeast corner of the SFP. The licensee also provided a plan view of the Unit 1 SFP depicting the proposed sensor placements. This figure also depicts the horns and waveguides cantilevered over the pool edge, above the water surface in the corners described above. The licensee also stated that the waveguides are routed through a core bore in the refueling floor to the sensor in the reactor building below. Finally, the licensee stated in its fourth six-month update that the electronics and display units will be mounted in the Unit 1 auxiliary control room.

In its letter dated August 27, 2013, the licensee stated that the SFP level instrument sensors would be located in the Northeast and Southeast corners of the SFP, instead of the Northeast and Northwest corners. The licensee noted that this change would enhance separation of the level instruments. In addition, the licensee provided updated sketches in the June 8, 2015, full compliance letter. The June 8, 2015, letter also identified the final display locations as the auxiliary control room.

The NRC staff notes that the separation between the sensors appears to be the longer, East side of the pool with a dimension of approximately 37 ft. 5.5 in. In addition, the staff notes that the licensee modified the locations of the backup sensor and both displays that were identified in its OIP. The as-built location for the backup sensor is the Southeast corner. The displays are located in the auxiliary control room below the main control room.

The NRC staff noted that there is sufficient channel separation within the SFP area between the primary and back-up level instruments, sensor electronics, and routing cables to provide reasonable protection against loss of indication of SFP level due to missiles that may result from damage to the structure over the SFP. The staff also notes that the displays are promptly accessible from the main control room. The staff observed the equipment locations during plant walkdowns as part of the onsite audit.

Based on the above, the NRC staff concludes that, if implemented appropriately, the licensee's proposed arrangement for the SFP level instrumentation appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.3 Design Features: Mounting

In its OIP, the licensee stated, for NMP1, in part, that mounting will be on seismic Class I structures.

In its letter dated July 5, 2013, the licensee provided a sketch and description stating that it intends to mount the SFP Level Instrument sensing element to the refueling floor just outside the SFP. The design for this mounting will apply the seismic design criteria applicable to the design basis maximum for the plant, capable of withstanding all active and passive loads, including the effects of pool sloshing during a seismic event. The licensee also stated that the design loading considerations for the mounting hardware include the static weight loads and dynamic weight loads of the horn antenna, waveguide assembly, and attached waveguide pipe up to the nearest pipe support. The dynamic loading on the mounting bracket consists of the design basis maximum seismic loading on the bracket and mounted components, along with the hydrodynamic loads produced by impinging surface waves caused by seismically-induced pool sloshing. The methodology for ensuring that the mounting bracket and attached equipment can withstand the seismic dynamic forces will be by analysis and/or test of the combined maximum seismic and hydrodynamic forces on the cantilevered portion of the waveguide assembly and horn antenna exposed to potential seismically induced wave action. In addition to the analysis described above, seismic qualification testing will be performed to seismic response spectra that envelope the maximum seismic ground motion for the installed location.

During the onsite audit, the NRC staff reviewed hydrodynamic loading analysis for Unit 1, calculation S14-54SFP-SL1 and confirmed the combined hydrodynamic and seismic loading to be within the tested limits of the equipment.

During the vendor audit, the NRC reviewed qualification testing for the Areva product, including the seismic testing. The Areva vendor audit report is documented as part of the McGuire Nuclear Station Mitigating Strategies onsite audit report dated October 9, 2014.

Based on the above, the NRC staff concludes that the licensee's proposed mounting design appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.4 Design Features: Qualification

4.2.4.1 Augmented Quality Process

Appendix A-1 of the guidance in NEI 12 02 describes a quality assurance process for non-safety systems and equipment that are not already covered by existing quality assurance requirements. In JLD-ISG-2012-03, the NRC staff found the use of this quality assurance process to be an acceptable means of meeting the augmented quality requirements of Order EA 12 051.

By letter dated February 28, 2013, the licensee stated in the OIP that instrument channel reliability shall be established by use of an augmented quality assurance process similar to that described in NEI 12-02.

Based on the above, the NRC staff concludes that, If implemented appropriately, this approach appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.4.2 Instrument Channel Reliability

Section 3.4 of NEI 12-02 states, in part:

The instrument channel reliability shall be demonstrated via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the following sets of parameters, as described in the paragraphs below:

- conditions in the area of instrument channel component use for all instrument components,
- effects of shock and vibration on instrument channel components used during any applicable event for only installed components, and
- seismic effects on instrument channel components used during and following a potential seismic event for only installed components.

Equipment reliability performance testing was performed to (1) demonstrate that the SFP instrumentation will not experience failures during BDB conditions of temperature, humidity, emissions, surge, and radiation, and (2) to verify those tests envelope the plant-specific requirements.

The NRC staff reviewed vendor qualification testing and results during the vendor audit which is documented in letter dated October 9, 2014. The Unit 1 configuration has just the horns and waveguides in the SFP area. These components contain no electronics devices. The sensor electronics are seismic Category I mounted to concrete walls outside the SFP area on a lower elevation than the pool deck. The display electronics are seismic Category I mounted to concrete walls near each of the control rooms.

During the on-site audit, the staff reviewed calculation H21C112 and confirmed the anticipated radiological conditions during an ELAP/SFP drain down event and for the normal radiation in the area for each installed location of the electronic units is less than 1E3 Rad. The staff notes that the passive horn and waveguide devices in the SFP area contain no active components and their performance are not susceptible to the anticipated radiological conditions. Shielding provided by the concrete walls for the electronic components outside the SFP area limit exposure to less than 1 E3 RAD. In its February 19, 2015, letter, the licensee provided a summary of the analysis in RAI 7 response.

Temperature and humidity conditions in the pool area, per NEI 12-02, are assumed to be 212°F condensing. Areva testing confirms temperature does not impact the performance of the passive horn and waveguide. The condensing steam conditions, however, may have minor impact on the instrument accuracy, but as determined in the vendor audit, the impact is less than the accuracy criteria in NEI 12-02. The staff confirmed that the anticipated maximum temperature of the auxiliary control room during an ELAP is 104°F, which is well within the qualification temperature of the display.

During the audit, NRC staff reviewed Gothic analysis ECP-13-000651-MU-009 S0-GOTHIC-ELAP001-N/A and confirmed the anticipated temperature and humidity conditions for the sensor electronic units is 122°F, non-condensing and within the operating characteristics determined by Areva testing. The licensee also provided a response to RAIs 5 and 6 in its letter dated February 19, 2015.

Seismic qualification was discussed in the mounting Section 4.2.3 above. The licensee also provided a seismic testing summary of the Areva equipment in RAI 12 response in letter dated February 19, 2015. During the onsite audit, the staff confirmed the anticipated seismic accelerations at the equipment locations for Unit 1 in Document DCD-115, Revision 1.

Based on the walk downs of the partially installed instruments during the on-site audit, the NRC staff determined that the as-installed configuration is consistent with the guidance for shock and vibration.

Based on the above, the NRC staff concludes that the licensee's proposed instrument qualification process appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.5 <u>Design Features: Independence</u>

Primary and backup channels maintain approximately 37 ft. of separation in the area of the SFP. The waveguides for each maintain separation leaving the pool edge toward refueling floor core bores a short distance away. The NRC staff observed the installed configuration of the waveguides during the onsite audit and confirmed the separation. Final installation details were provided in the June 8, 2015, compliance letter in RAI response 2.

Changes to the electrical supply were provided with the June 8, 2015, compliance letter in RAI response 13 which details the final electrical supply configuration. The staff confirmed in the final configuration that the primary and backup instruments are supplied by separate electrical busses in accordance with NEI 12-02.

Based on the above, the NRC staff concludes that the licensee's proposed design, with respect to instrument channel independence, appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.6 Design Features: Power Supplies

In its OIP, the licensee stated, in part, that the primary and backup power supplies would be independent. During the onsite audit, the NRC staff reviewed drawing C-23321-C, sheet 1 to confirm the proposed power supplies are independent. The final electrical supply configuration was provided with the June 8, 2015, compliance letter in RAI response 13. The NRC staff confirmed in the final configuration that the primary and backup instruments are supplied by separate electrical busses in accordance with NEI 12-02.

Fixed aspects of the Areva system such as the on-board battery backup capabilities were reviewed and confirmed during the vendor audit and are documented in the report dated October 9, 2014.

Based on the above, the NRC staff concludes that the licensee's proposed power supply design appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.7 Design Features: Accuracy

Accuracy of the Areva system was reviewed and confirmed to meet the criteria of NEI 12-02 during the vendor audit and is documented in the report dated October 9, 2014.

Based on the above, the NRC staff concludes that the licensee's proposed instrument accuracy appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.8 Design Features: Testing

The Areva system uses an articulating horn that can be turned up away from the SFP toward a fixed object of known distance (e.g. a wall) for calibration testing. The NRC staff assessed the testability of the Areva system during the vendor audit and is documented in the report dated October 9, 2014.

During the onsite audit, the NRC staff reviewed procedure N1-IPM-054-003 which included calibration procedures. The staff also sampled other procedures provided by the licensee during the audit to confirm they were updated. The licensee provided a list of the updated procedures with descriptions in RAI response 16 in its letter dated February 19, 2015.

Based on the above, the NRC staff concludes that the licensee's proposed SFP instrumentation design allows for testing consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.9 Design Features: Display

Aspects of the display design and operation were reviewed and confirmed to meet the criteria of NEI 12-02 during the vendor audit and are documented in the report dated October 9, 2014.

The primary and backup display locations were described in the OIP as being the main control room. However, the design was changed during the design phase and the displays were moved to the auxiliary control room as noted in ISE RAI 2 and 16 responses reviewed during the audit. During the onsite audit, the staff confirmed the environment conditions of the auxiliary control room, and the licensee stated that the ELAP conditions in the auxiliary control room is expected to reach a maximum temperature of 104°F. The staff noted the auxiliary control room's proximity to the main control room meets the prompt accessibility requirements of the NEI 12-02 guidance. The staff also reviewed document ECP-13-000651 during the audit process.

Based on the above, the NRC staff concludes that the licensee's proposed location and design of the SFP instrumentation displays appear to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.3 Evaluation of Programmatic Controls

Order EA-12-051 specified that the SFP instrumentation shall be maintained available and reliable through appropriate development and implementation programmatic controls, including training, procedures, and testing and calibration. Below is the NRC staff's assessment of the programmatic controls for the SFP instrumentation.

4.3.1 Programmatic Controls: Training

In its OIP, the licensee stated, for Nine Mile Point, Unit 1, in part, that the SAT process will be used to identify the population to be trained and to determine both the initial and continuing elements of the required training. Training will be completed prior to placing the instrumentation in service.

In its compliance letter for Unit 1 dated June 8, 2015, the licensee stated, in part, training for Nine Mile Point Nuclear Station, Unit 1 has been completed in accordance with an accepted training process as recommended in NEI 12-02, Section 4.1.

Based on the above, the NRC staff concludes that the licensee's plan to train personnel in the operation, maintenance, calibration, and surveillance of the SFP level instrumentation, including the approach to identify the population to be trained, appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.3.2 Programmatic Controls: Procedures

During the onsite audit, the staff reviewed procedure N1-IPM-054-003 which included calibration procedures. The staff also sampled other procedures provided by the licensee during the audit to confirm they were updated. The licensee provided a list of the updated procedures with descriptions in RAI response 16 in its letter dated February 19, 2015.

Based on the above, the NRC staff concludes that the licensee's procedure development appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to address the requirements of the order.

4.3.3 Programmatic Controls: Testing and Calibration

The staff reviewed parts of the programmatic controls in the ISE dated November 15, 2013, and requested additional information to complete the evaluation (RAI 17 and 18).

The licensee provided the following description of the key elements of its programmatic control for the SFP level instrument as part of the response to RAI 17 in its letter dated February 19, 2015.

> Programmatic controls will be established to ensure the performance of periodic checks of the SFP level transmitters and indications, calibration of loop power supplies and current repeaters/isolators, and verification of system response. Procedure N1-IPM-054-003 provides the instructions for calibration checks/functional checks of SFP level instrumentation channels. Procedure N1-PM-S1 directs the shift operator to perform electronic rounds and the SFP wide range levels are listed in the electronic rounds database and are recorded once per twelve hour shift. Minimum and maximum SFP level values are identified for operator action in procedure N1-SOP-6.1. The plant process computer system has alarms to notify control room operators when levels indicate off normal values.

The licensee also provided a detailed response regarding compensatory action for one or both instruments out of service in part of the response to RAI 17 in letter dated February 19, 2015.

The licensee also described the in-situ calibration process in response to RAI 18 in its letter dated February 19, 2015.

> The in-situ calibration process at the SFP location utilizes the capability to rotate the waveguide horn assembly from its normal downward-pointing position so that it can be pointed at a target that is moved along the radar beam path. By placing the moveable target at known distances from the horn, the instrument output can be checked at each target location. In the event that the as-found values are not within acceptance criteria, the measurement range can be shifted up or down to calibrate the instrument to within the required tolerance. Calibration is only required when functional or channel check identifies that the instrument requires

calibration. Functional verification can be achieved using cross channel checks and functional checks per the vendor manual.

The staff reviewed the previously provided information in the OIP and RAI response dated July 5, 2013, together with the RAI responses provided above. The staff also reviewed the procedures noted in the RAI response 17 during the onsite audit and found the test and calibration approach meets the criteria of NEI 12-02.

Based on the above, the NRC staff concludes that the licensee's proposed testing and calibration plan appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.4 Conclusions for Order EA-12-051

In its letter dated June 8, 2015 (ADAMS Accession No. ML15159A385), the licensee stated that they would meet the requirements of Order EA-12-051 by following the guidelines of NEI 12-02, as endorsed by JLD-ISG-2012-03. In the evaluation above, the NRC staff concludes that, if implemented appropriately, the licensee has conformed to the guidance in NEI 12-02, as endorsed by JLD-ISG-2012-03. In addition, the NRC staff concludes that if the SFP level instrumentation is installed at Nine Mile Point, Unit 1 according to the licensee's proposed design, it should adequately address the requirements of Order EA-12-051.

5.0 CONCLUSION

In August 2013 the NRC staff started audits of the licensee's progress on Orders EA-12-049 and EA-12-051. The staff conducted an onsite audit in November 2014 (ADAMS Accession No. ML15110A026). The licensee reached its final compliance date for Unit 1 on June 8, 2015. The purpose of this SE is to document the strategies and implementation features that the licensee has committed to. Based on the evaluations above, the NRC staff concludes that the licensee has developed guidance and proposed designs that if implemented appropriately should adequately address the requirements of Orders EA-12-049 and EA-12-051. The NRC staff will conduct an onsite inspection to verify that the licensee has implemented the strategies and equipment to demonstrate compliance with the orders.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO ORDERS EA-12-049 AND EA-12-051

EXELON GENERATION COMPANY, INC.

NINE MILE POINT NUCLEAR STATION, UNIT 2

DOCKET NO. 50-410

1.0 INTRODUCTION

The earthquake and tsunami at the Fukushima Dai-ichi nuclear power plant in March 2011 highlighted the possibility that extreme natural phenomena could challenge the prevention, mitigation and emergency preparedness defense-in-depth layers already in place in nuclear power plants in the United States. At Fukushima, limitations in time and unpredictable conditions associated with the accident significantly challenged attempts by the responders to preclude core damage and containment failure. During the events in Fukushima, the challenges faced by the operators were beyond any faced previously at a commercial nuclear reactor and beyond the anticipated design-basis of the plants. The U.S. Nuclear Regulatory Commission (NRC) determined that additional requirements needed to be imposed at U.S. commercial power reactors to mitigate such beyond-design-basis external events (BDBEEs).

On March 12, 2012, the NRC issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A736). This order directed licensees to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities in the event of a BDBEE. Order EA-12-049 applies to all power reactor licensees and all holders of construction permits for power reactors.

On March 12, 2012, the NRC also issued Order EA-12-051, "Order Modifying Licenses With Regard to Reliable Spent Fuel Pool Instrumentation" (ADAMS Accession No. ML12054A679). This order directed licensees to install reliable SFP level instrumentation with a primary channel and a backup channel, and with independent power supplies that are independent of the plant alternating current (ac) and direct current (dc) power distribution systems. Order EA-12-051 applies to all power reactor licensees and all holders of construction permits for power reactors.

2.0 REGULATORY EVALUATION

Following the events at the Fukushima Dai-ichi nuclear power plant on March 11, 2011, the NRC established a senior-level agency task force referred to as the Near-Term Task Force

(NTTF). The NTTF was tasked with conducting a systematic and methodical review of the NRC regulations and processes and determining if the agency should make additional improvements to these programs in light of the events at Fukushima Dai-ichi. As a result of this review, the NTTF developed a comprehensive set of recommendations, documented in SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011 (ADAMS Accession No. ML11186A950). Following interactions with stakeholders, these recommendations were enhanced by the NRC staff and presented to the Commission.

On February 17, 2012, the NRC staff provided SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," (ADAMS Accession No. ML12039A103) to the Commission. This paper included a proposal to order licensees to implement enhanced BDBEE mitigation strategies. As directed by the Commission in staff requirements memorandum (SRM)-SECY-12-0025 (ADAMS Accession No. ML120690347), the NRC staff issued Orders EA-12-049 and EA-12-051.

2.1 Order EA-12-049

Order EA-12-049, Attachment 2 (ADAMS Accession No. ML12054A736), requires that operating power reactor licensees and construction permit holders use a three-phase approach for mitigating BDBEEs. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment and SFP cooling capabilities. The transition phase requires providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. Specific requirements of the order are listed below:

1) Licensees or construction permit (CP) holders shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities following a beyond-design-basis external event.

2) These strategies must be capable of mitigating a simultaneous loss of all alternating current (ac) power and loss of normal access to the ultimate heat sink [UHS] and have adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to this Order.

3) Licensees or CP holders must provide reasonable protection for the associated equipment from external events. Such protection must demonstrate that there is adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to this Order.

4) Licensees or CP holders must be capable of implementing the strategies in all modes of operation.

5) Full compliance shall include procedures, guidance, training, and acquisition, staging, or installing of equipment needed for the strategies.

On August 21, 2012, following several submittals and discussions in public meetings with NRC staff, the Nuclear Energy Institute (NEI) submitted document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0 (ADAMS Accession No. ML12242A378) to the NRC to provide specifications for an industry-developed methodology for the development, implementation, and maintenance of guidance and strategies in response to the Mitigation Strategies order. The NRC staff reviewed NEI 12-06 and on August 29, 2012, issued its final version of Japan Lessons-Learned Directorate (JLD) Interim Staff Guidance (ISG) JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12229A174), endorsing NEI 12-06, Revision 0, with comments, as an acceptable means of meeting the requirements of Order EA-12-049, and published a notice of its availability in the *Federal Register* (77 FR 55230).

2.2 Order EA-12-051

Order EA-12-051, Attachment 2 (ADAMS Accession No. ML12054A679), requires that operating power reactor licensees and construction permit holders install reliable SFP level instrumentation. Specific requirements of the order are listed below:

> All licensees identified in Attachment 1 to the order shall have a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system, (2) level that is adequate to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.
>
> 1. The spent fuel pool level instrumentation shall include the following design features:
>
> 1.1 Instruments: The instrumentation shall consist of a permanent, fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor spent fuel pool water level under conditions that restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or heat and humidity from a boiling pool.
>
> 1.2 Arrangement: The spent fuel pool level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the spent fuel pool. This protection may be provided by locating the primary instrument channel and fixed portions of the backup instrument channel, if applicable, to maintain instrument channel separation within the spent fuel pool area, and to utilize inherent shielding

from missiles provided by existing recesses and corners in the spent fuel pool structure.

1.3 Mounting: Installed instrument channel equipment within the spent fuel pool shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the spent fuel pool structure.

1.4 Qualification: The primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period. This reliability shall be established through use of an augmented quality assurance process (e.g., a process similar to that applied to the site fire protection program).

1.5 Independence: The primary instrument channel shall be independent of the backup instrument channel.

1.6 Power supplies: Permanently installed instrumentation channels shall each be powered by a separate power supply. Permanently installed and portable instrumentation channels shall provide for power connections from sources independent of the plant ac and dc power distribution systems, such as portable generators or replaceable batteries. Onsite generators used as an alternate power source and replaceable batteries used for instrument channel power shall have sufficient capacity to maintain the level indication function until offsite resource availability is reasonably assured.

1.7 Accuracy: The instrument channels shall maintain their designed accuracy following a power interruption or change in power source without recalibration.

1.8 Testing: The instrument channel design shall provide for routine testing and calibration.

1.9 Display: Trained personnel shall be able to monitor the spent fuel pool water level from the control room, alternate shutdown panel, or other appropriate and accessible location. The display shall provide on-demand or continuous indication of spent fuel pool water level.

2. The spent fuel pool instrumentation shall be maintained available and reliable through appropriate development and implementation of the following programs:

2.1 Training: Personnel shall be trained in the use and the provision of alternate power to the primary and backup instrument channels.

2.2 Procedures: Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels.

2.3 Testing and Calibration: Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup spent fuel pool level instrument channels to maintain the instrument channels at the design accuracy.

On August 24, 2012, following several NEI submittals and discussions in public meetings with NRC staff, the NEI submitted document NEI 12-02, "Industry Guidance for Compliance With NRC Order EA-12-051, To Modify Licenses With Regard to Reliable Spent Fuel Pool Instrumentation," Revision 1 (ADAMS Accession No. ML12240A307) to the NRC to provide specifications for an industry-developed methodology for compliance with Order EA-12-051. On August 29, 2012, the NRC staff issued its final version of JLD-ISG-2012-03, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation" (ADAMS Accession No. ML12221A339), endorsing NEI 12-02, Revision 1, as an acceptable means of meeting the requirements of Order EA-12-051 with certain clarifications and exceptions, and published a notice of its availability in the *Federal Register* (77 FR 55232).

3.0 TECHNICAL EVALUATION OF ORDER EA-12-049

By letter dated February 28, 2013 (ADAMS Accession No. ML13066A171), Exelon Generation Company, Inc.(Exelon, the licensee), previously as Constellation Energy Nuclear Group, LLC submitted its OIP for Nine Mile Point Nuclear Station, Units 1 and 2 (Nine Mile Point, NMP1 and NMP2) in response to Order EA-12-049. By letter dated March 8, 2013 (ADAMS Accession No. ML13074A056), Exelon submitted a complete revision of the OIP for Nine Mile Point. By letters dated August 27, 2013 (ADAMS Accession No. ML13254A278), February 27, 2014 (ADAMS Accession No. ML14069A318), August 26, 2014 (ADAMS Accession No. ML14241A380), February 19, 2015 (ADAMS Accession No. ML15062A036), August 28, 2015 (ADAMS Accession No. ML15243A085), and February 26, 2016 (ADAMS Accession No. ML16057A007), the licensee submitted six-month updates to the OIP. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049 in accordance with NRC Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, "Regulatory Audits" (ADAMS Accession No. ML082900195). By letters dated December 19, 2013 (ADAMS Accession No. ML13225A584), April 28, 2015 (ADAMS Accession No. ML15110A026), and February 4, 2016 (ADAMS Accession No. ML16006A213), the NRC issued an Interim Staff Evaluation (ISE) and audit reports, respectively, on the licensee's progress. By letters dated July 1, 2016 (ADAMS Accession Nos. ML16188A265 and ML16188A271), Exelon submitted a compliance letter and Final Integrated Plan (FIP) in response to Order EA-12-049 for Nine Mile Point, Unit 2. The compliance letter stated that the licensee had achieved full compliance with Order EA-12-049.

3.1 Overall Mitigation Strategy

Attachment 2 to Order EA-12-049 describes the three-phase approach required for mitigating BDBEEs in order to maintain or restore core cooling, containment, and SFP cooling capabilities. The phases consist of an initial phase (Phase 1) using installed equipment and resources, followed by a transition phase (Phase 2) in which portable onsite equipment is placed in service, and a final phase (Phase 3) in which offsite resources may be placed in service. The timing of when to transition to the next phase is determined by plant-specific analyses.

While the initiating event is undefined, it is assumed to result in an extended loss of ac power (ELAP) with a loss of normal access to the UHS. Thus, the ELAP with loss of normal access to the UHS is used as a surrogate for a BDBEE. The initial conditions and assumptions for the analyses are stated in NEI 12-06, Section 3.2.1, and include the following:

1. The reactor is assumed to have safely shut down with all rods inserted (subcritical).
2. The dc power supplied by the plant batteries is initially available, as is the ac power from inverters supplied by those batteries; however, over time the batteries may be depleted.
3. There is no core damage initially.
4. There is no assumption of any concurrent event.
5. Because the loss of ac power presupposes random failures of safety-related equipment (emergency power sources), there is no requirement to consider further random failures.

Nine Mile Point, Unit 2 is a General Electric boiling-water reactor (BWR) Model 5 with a Mark II containment. The licensee's three-phase approach to mitigate a postulated ELAP event, as described in the FIP, is summarized below.

At the onset of an ELAP the reactor is assumed to trip from full power. The main condenser is unavailable due to the loss of circulating water. The licensee performs a cooldown of the RCS by controlling the safety relief valves (SRVs). Decay heat is removed when the SRVs open on high pressure and dump steam from the reactor pressure vessel (RPV) to the suppression pool located in the containment. Makeup to the RPV is provided by the reactor core isolation cooling (RCIC) turbine-driven pump. If available, the RCIC pump will take suction from the condensate storage tank (CST) to pump into the core. If the CST is not available, the RCIC pump suction will be re-aligned to the suppression pool. The SRVs are controlled to minimize the cycling to preserve the batteries until ac power to the chargers is restored. The cooldown of the primary system is stopped when reactor pressure reaches 200 psig to ensure sufficient steam pressure to operate the RCIC pump. When the suppression pool heats up to a predetermined setpoint, the vent to atmosphere is opened to mitigate the temperature rise and allow the RCIC system to continue to function. The RPV makeup will continue to be provided from the RCIC system until the gradual reduction in RPV pressure resulting from diminishing decay heat requires a transition to Phase 2 methods. The RCIC injection source will be maintained for as long as possible, since it is a closed loop system using relatively clean suppression pool water.

When the RCIC system is no longer available, the preferred RPV makeup supply in Phase 2 comes from a portable FLEX diesel-driven pump, which will be deployed approximately 4 hours after the initiation of the ELAP event. To ensure proper flow from the pump to the RPV, depressurization of the core will continue until pressure reaches less than 100 psig. The FLEX pump's suction source is from Lake Ontario via dry hydrants or hose dropped into an opening upstream of the intake trash rakes and discharges to either the residual heat removal (RHR) 'A' or RHR 'B' systems, for RPV and SFP makeup.

Nine Mile Point, Unit 2 has a Mark II containment. The licensee performed a containment evaluation and determined that opening the suppression pool vent to atmosphere will allow containment temperature and pressure to stay within acceptable levels until equipment from the NSRC can be set up for cooling of the suppression pool.

The Unit 2 SFP is in the reactor building. To maintain SFP cooling capabilities, the licensee stated that the required action is to establish the water injection lineup before the environment on the SFP operating deck degrades due to boiling in the pool so that personnel can access the refuel floor to accomplish the coping strategies. The pool will initially heat up due to the unavailability of the normal cooling system. The licensee has calculated that, depending on the spent fuel loading in the pool, boiling could start as soon as 5.4 hours for the maximum design heat load (outage condition, full core offload, SFP gates installed), and for non-outage conditions, the time to boiling in the pool is greater than 24 hours. The pool water level would drop to the top of the fuel racks in approximately 30 hours (maximum heat load). The portable FLEX pump is staged within 16 hours after declaration of an ELAP to restore and maintain normal SFP level.

To makeup to the SFP, the licensee has a primary and alternate strategy based on the condition of the pool. The portable FLEX Pump will take suction from Lake Ontario at the Unit 2 service water system intake bay to a distribution manifold in the reactor building. The SFP makeup hoses are routed from the FLEX distribution manifold to a hard-pipe connection (not requiring refueling floor access) on either RHR 'A' or RHR 'B', or additional hoses are routed to the refuel floor to provide direct makeup to the pool or provide spray flow through portable nozzles as contingency, using a second FLEX pump.

The operators will perform dc bus load stripping within the initial 4 hours following event initiation to ensure safety-related battery life is extended up to 12 hours. Following dc load stripping and prior to battery depletion, one 450 kilowatt (kW), 600 volt alternating current (Vac) generator will be deployed from a FLEX storage building (FSB). These portable generators will be used to repower essential battery chargers within 6 hours of ELAP initiation.

In addition, a National Strategic Alliance of FLEX Emergency Response (SAFER) Response Center (NSRC) will provide high capacity pumps and large turbine-driven diesel generators (DGs), which could be used to backup the Phase 2 portable equipment or repower existing plant systems, if necessary. There are two NSRCs in the United States.

Below are specific details on the licensee's strategies to restore or maintain core cooling, containment, and SFP cooling capabilities in the event of a BDBEE and the results of the staff's review of these strategies. The NRC staff evaluated the licensee's strategies against the endorsed NEI 12-06, Revision 0, guidance.

3.2 Reactor Core Cooling Strategies

Order EA-12-049 requires licensees to maintain or restore cooling to the reactor core in the event of an ELAP concurrent with a loss of normal access to the UHS. Although the ELAP results in an immediate trip of the reactor, sufficient core cooling must be provided to account for fission product decay and other sources of residual heat. Consistent with endorsed guidance from NEI 12-06, Phase 1 of the licensee's core cooling strategy credits installed equipment (other than that presumed lost to the ELAP with loss of normal access to the UHS) that is robust in accordance with the guidance in NEI 12-06. In Phase 2, robust installed equipment is supplemented by onsite FLEX equipment, which is used to cool the core either directly (e.g., pumps and hoses) or indirectly (e.g., FLEX electrical generators and cables repowering robust installed equipment). The equipment available onsite for Phases 1 and 2 is further supplemented in Phase 3 by equipment transported from the NSRCs.

As reviewed in this section, the licensee's core cooling analysis for the ELAP with loss of normal access to the UHS event presumes that, per endorsed guidance from NEI 12-06, the unit would have been operating at full power prior to the event. Therefore, the suppression pool may be credited as the heat sink for core cooling during the ELAP with loss of normal access to the UHS event. Maintenance of sufficient RPV inventory, despite steam release from the SRVs and ongoing system leakage expected under ELAP conditions, is accomplished through a combination of installed systems and FLEX equipment. The specific means used by the licensee to accomplish adequate core cooling during the ELAP with loss of normal access to the UHS event are discussed in further detail below. The licensee's strategy for ensuring compliance with Order EA-12-049 for conditions where one or more units are shut down or being refueled is reviewed separately in Section 3.11 of this evaluation.

3.2.1 Core Cooling Strategy and RPV Makeup

3.2.1.1 Phase 1

For RPV makeup, FIP Section 2.3.1.1 states that at the initiation of the BDBEE, main steam isolation valves (MSIVs) automatically close, feed water flow to the reactor is lost, and SRVs automatically cycle to control pressure, causing reactor water level to decrease. The RCIC automatically initiates on the low-low reactor water level indication. The licensee indicated that the RCIC function can provide RPV makeup for about 8 hours after an ELAP is declared.

Phase 1 of core cooling relies on the use of installed plant equipment. Injection of cooling water into the RPV will be accomplished through the RCIC system. The RCIC system is initially lined up to the CST and will pump water into the core from the CST if the CST is available. If the CST is not available, the RCIC pump suction will be re-aligned to the suppression pool.

The RCIC pump is designed to automatically start when the RPV reaches low-low reactor water level initiation signal. In the event that the RCIC does not automatically start, procedural guidance is given for the operators to manually initiate the pump from the control room or to locally start the pump from the RCIC room. The RCIC discharges into the RCIC/head spray into the RPV. The RCIC system valves are powered by the 125 Vdc bus and are used to control the cooling flow to the RPV balancing it with the steam that is flowing through the SRVs to the suppression pool.

Pressure control of the RPV comes from the SRVs. Operators take manual control of the SRVs to minimize cycling, which helps to preserve the batteries until ac power to the chargers is restored, and to cool the RCS at a controlled rate of a maximum 100°F per hour. The operators will then stabilize the reactor at around 200 psig to continue to provide steam to the RCIC turbine for operation.

3.2.1.2 Phase 2

In the FIP, Sections 2.3.1.1 and 2.3.2 state that deployment of Phase 2 portable equipment will begin when it is recognized a station blackout (SBO)/ELAP condition exists (within 1 hour) in

Phase 1. At approximately 4 hours after the initiation of the ELAP event, the portable diesel-driven pump will be available to back up RCIC. The suction hose will be attached to the dry hydrant on the North side of the Unit 2 screenwell building, which ties into the circulating water tempering line for the intake tunnel providing for an indefinite supply of water for make up to the RPV (and the SFP). An alternate staging area for the portable FLEX pump is the Northeast side of the Unit 2 screenwell building in the event the North side screenwell area is not accessible, and the suction hose will draw water directly from the intake bay. Discharge hoses from the portable FLEX pump will be connected to a portable distribution manifold in the reactor building to inject to the RPV through the 'A' or 'B' RHR system. Per analysis, the FLEX pump would need to inject at a maximum 180 gallons per minute (gpm) into the RPV to ensure the core remains covered throughout the event. The makeup water from Lake Ontario via the FLEX pump can be directed to the RPV, suppression pool, and SFP.

In its FIP, the licensee states that RCIC will continue to be used for RPV makeup, and to assist the SRVs with RPV pressure control for as long as RCIC operation is viable. To support this operation, a FLEX DG will be utilized to allow for repowering of systems ensuring that dc powered components in the RCIC system will continue to have power. Additionally, the battery chargers will provide dc power to critical instrumentation. In order to maintain the continued use of the SRV's, the licensee will utilize a portable, FLEX air compressor. The compressor will be deployed to replenish the air receivers and accumulators associated with the automatic depressurization sytem and the SRVs.

3.2.1.3 Phase 3

The licensee stated in FIP Section 2.3.3, that the Phase 3 strategy is to use the Phase 2 connections, both mechanical and electrical, but supply water using Phase 3 portable pumps and ac power using Phase 3 portable generators, if necessary. The Phase 3 equipment will act as backup or redundant equipment to the Phase 2 portable equipment and is deployed from an off-site facility. The off-site facility supplying this equipment is the NSRC.

The usage of Lake Ontario will provide an indefinite volume for the core cooling strategy, but this water is not reactor grade water and the licensee is not receiving a water filtration skid from the NSRC. The licensee provided information for the use of raw water in the core that included generic work by the BWR Owners Group (BWROG) that referenced PWR steam generator degradation with raw water. In addition, the licensee evaluated the use of raw water and concluded that using Lake Ontario water is acceptable to inject into the RPV to maintain level above the top of active fuel (TAF) during an ELAP event.

3.2.2 Staff Evaluations

3.2.2.1 Availability of Structures, Systems, and Components (SSCs)

Guidance document NEI 12-06 provides guidance that the baseline assumptions have been established on the presumption that other than the loss of the ac power sources and normal access to the UHS, installed equipment that is designed to be robust with respect to design basis external events is assumed to be fully available. Installed equipment that is not robust is assumed to be unavailable. Below are the baseline assumptions for the availability of SSCs for core cooling during an ELAP caused by a BDBEE.

3.2.2.1.1 Plant SSCs

The RCIC system includes one turbine-driven pump, one gland seal system dc powered air compressor, automatic valves, control devices for this equipment, and sensors and logic circuitry. Cooling water for the RCIC system turbine lube oil cooler is supplied from the RCIC pump discharge. Following isolation, the reactor pressure will rise causing SRVs to cycle to control reactor pressure below safety valve set points. The licensee described that the RCIC is placed into operation automatically by opening the steam admission valve by signals from RCIC logic on low-low reactor water level and directing steam from the 'B' main steam line to drive a turbine-driven pump. The steam then exhausts to the suppression pool. The turbine-driven pump is supplied water from either the CSTs, if available, or the suppression pool and is capable of delivering 600 gpm to the RPV through the RCIC/head spray nozzle located inside the RPV head. The RCIC system is located in the reactor building, which is a seismic Class I structure and is protected from all applicable external hazards as defined in NEI 12-06. The suppression pool is the credited protected water source for the RCIC system, but the CST will be used if it is available. Based on the safety-related classification and function of the RCIC system, the NRC staff concludes that the RCIC system is robust and is expected to be available at the start of an ELAP event and its use is consistent with NEI 12-06, Section 3.2.1.3.

3.2.2.1.2 Plant Instrumentation

The Nine Mile Point, Unit 2 plan includes monitoring instrumentation in the control room. The instrumentation will be powered by batteries and will be maintained for indefinite coping via battery chargers powered by the FLEX DGs. A more detailed evaluation of the instrumentation power supply is contained in Section 3.2.2.6 of this safety evaluation (SE).

As described in the licensee's FIP for Unit 2, instrumentation for the following parameters is credited for all phases of core cooling and RPV inventory control:

- RPV Level
- RPV Pressure
- RCIC Flow
- Suppression Pool Temperature
- Suppression Pool Water Level
- Suppression Chamber Pressure
- Drywell Ambient Temperature
- Drywell Pressure

The instrumentation identified by the licensee to support its core cooling strategy is consistent with the recommendations specified in the endorsed guidance of NEI 12-06.

The instrumentation is available both prior to and after load shedding of dc busses during Phase 1. The 125 Vdc battery charges for station batteries will be repowered by FLEX portable DGs to maintain availability of instrumentation during Phases 2 and 3. In addition, the instrument indications would be continuously accessible throughout the ELAP event.

In accordance with NEI 12-06 Section 5.3.3.1, guidelines for obtaining critical parameters locally are provided in a Flex Support Guideline (FSG). Should it be required, the licensee will use guidance that provides a list of key parameters, locations, and equipment needed to obtain local readings of key parameters. Procedure N2-SOP-78A "EOP Key Parameter-Alternate Instrumentation," was reviewed during the audit to verify this plan, and it provides alternate methods for obtaining critical parameters if key parameter instrumentation is unavailable. The SFP level instruments are discussed in Section 4 below.

3.2.2.2 Thermal-Hydraulic Analyses

The licensee based its mitigating strategy for reactor core cooling on thermal-hydraulic analysis performed using Version 4 of the Modular Accident Analysis Program (MAAP4). Because the thermal-hydraulic analysis for the reactor core and containment during an ELAP event are closely intertwined, as is typical of BWRs, the licensee has addressed both in a single, and coupled calculation. This dependency notwithstanding, the NRC staff's discussion in this section of the SE solely focuses on the licensee's analysis of reactor core cooling. The review of the licensee's analysis of containment thermal-hydraulic behavior is provided in Section 3.4.4.2 of this evaluation.

MAAP is an industry-developed, general-purpose thermal-hydraulic computer code that has been used to simulate the progression of a variety of light water reactor accident sequences, including severe accidents such as the Fukushima Dai-ichi event. Initial code development began in the early 1980s, with the objective of supporting an improved understanding of and predictive capability for severe accidents involving core overheating and degradation in the wake of the accident at Three Mile Island Nuclear Station, Unit 2. Currently, maintenance and development of the code is carried out under the direction of the Electric Power Research Institute (EPRI).

To provide analytical justification for their mitigating strategies in response to Order EA-12-049, a number of licensees for BWRs and pressurized-water reactors (PWRs) completed analysis of the ELAP event using MAAP4. Although MAAP4 and predecessor code versions have been used by industry for a range of applications, such as the analysis of severe accident scenarios and probabilistic risk analysis (PRA) evaluations, the NRC staff had not previously examined the code's technical adequacy for performing best-estimate simulations of the ELAP event. In particular, due to the breadth and complexity of the physical phenomena within the code's calculation domain, as well as its intended capability for rapidly simulating a variety of accident scenarios to support PRA evaluations, the NRC staff observed that the MAAP code makes use of a number of simplified correlations and approximations that should be evaluated for their applicability to the ELAP event. Therefore, in support of the reviews of licensees' strategies for ELAP mitigation, the NRC staff audited the capability of the MAAP4 code for performing thermal-hydraulic analysis of the ELAP event for both BWRs and PWRs. The NRC staff's audit review involved a limited review of key code models, as well as confirmatory analysis with the TRACE code to obtain an independent assessment of the predictions of the MAAP4 code.

To support the NRC staff's review of the use of MAAP4 for ELAP analyses, in June 2013 EPRI issued a technical report entitled "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications." The document provided general information concerning the code and its development, as well as an overview of its physical models, modeling guidelines, validation, and quality assurance procedures.

Based on the NRC staff's review of EPRI's June 2013 technical report, as supplemented by further discussion with the code vendor, audit review of key sections of the MAAP code documentation, and confirmation of acceptable agreement with NRC staff simulations using the TRACE code, the NRC staff concluded that, under certain conditions, the MAAP4 code may be used for best-estimate prediction of the ELAP event sequence for BWRs.

The NRC staff issued an endorsement letter dated October 3, 2013, which documented these conclusions and identified specific limitations that BWR licensees should address to justify the applicability of simulations using the MAAP4 code for demonstrating that the requirements of Order EA-12-049 have been satisfied.

During the audit process, the NRC staff verified that the licensee's MAAP calculation addressed the limitations from the NRC staff's endorsement letter. The licensee utilized the generic roadmap and response template that had been developed by EPRI to support consistency in individual licensee's responses to the limitations from the endorsement letter. In particular, based upon review of the MAAP calculation documentation, the staff concluded that appropriate inputs and modeling options had been selected for the code parameters expected to have dominant influence for the ELAP event. The NRC staff further observed that the limitations imposed in the endorsement letter, particularly those concerning the RPV collapsed liquid level being maintained above the reactor core and the primary system cooldown rate being maintained within technical specification limits, were satisfied. By maintaining the reactor core fully covered with water, adequate core cooling is assured for this event. Additionally, Unit 2's fulfillment of the endorsement letter condition regarding the primary system cooldown rate signifies that thermally induced volumetric contraction and other changes in primary system thermal-hydraulic conditions should proceed relatively slowly with time, which supports the NRC staff's confidence in the predictions of the MAAP code.

Therefore, based on the evaluation above, the NRC staff concludes that the licensee's analytical approach should appropriately determine the sequence of events for reactor core cooling, including time-sensitive operator actions, and evaluate the required equipment to mitigate the analyzed ELAP event, including pump sizing and cooling water capacity.

3.2.2.3 Recirculation Pump Seals

An ELAP event would result in the interruption of cooling to the recirculation pump seals, potentially resulting in increased leakage due to the distortion or failure of the seals, elastomeric O-rings, or other components. Sufficient primary make-up must be provided to offset recirculation pump seal leakage and other expected sources of primary leakage, in addition to removing decay heat from the reactor core.

The licensee's calculations for Unit 2 assumed a seal leakage rate at normal RPV operating pressure of 61 gpm. This leakage rate includes 18 gpm per recirculation pump seal. In addition, the licensee's calculation assumed an additional primary system leakage rate equal to the technical specification limit of 25 gpm. Thus, between the two recirculation pumps and the additional primary system leakage, the total primary leakage rate assumed for Unit 2 during the ELAP event was 61 gpm at normal operating reactor pressure.

As the RPV is depressurized the seal leakage rate is reduced. The Unit 2 analysis concluded that the RPV water level continued to be above the TAF throughout the simulation period.

During the audit, the NRC staff discussed recirculation pump seal leakage with the licensee and requested that the licensee justify the applicability of the assumed leakage rate to the ELAP event. The licensee has Model RV-875B-2 recirculation pump seals that were manufactured by Sultzer Bingham.

The NRC staff concludes that the leakage rate assumed for Unit 2 is reasonable based on the testing and analysis that was performed to resolve issues related to Generic Letter 91-07. The staff further notes that gross seal failures are not anticipated to occur during the postulated ELAP event. As is typical of the majority of U.S. BWRs, Nine Mile Point, Unit 2 has an installed steam-driven pump (i.e., RCIC) capable of injecting into the primary system at a flow rate well in excess of the primary system leakage rate expected during an ELAP, and the other pumps used for core cooling in its FLEX strategy have a similar functional capability.

Based upon the discussion above, the NRC staff concludes that the recirculation pump seal leakage rates assumed in the licensee's thermal-hydraulic analysis may be applied to the beyond-design basis ELAP event for the site.

3.2.2.4 Shutdown Margin Analyses

As described in its updated final safety analysis report (UFSAR), Unit 2's design is such that the control rods provide adequate shutdown margin under all anticipated plant conditions, with the assumption that the highest-worth control rod remains fully withdrawn. The Unit 2 Technical Specification Section 1.1 further clarifies that shutdown margin is to be calculated for a cold, xenon-free condition to ensure that the most reactive core conditions are bounded.

Based on the NRC staff's audit review, the licensee's ELAP mitigating strategy maintains the reactor within the envelope of conditions analyzed by the licensee's existing shutdown margin calculation. Furthermore, the existing calculation retains conservatism because the guidance in NEI 12-06 permits analyses of the beyond-design-basis (BDB) ELAP event to assume that all control rods fully insert into the reactor core.

Therefore, based on the evaluation above, the NRC staff concludes that the sequence of events in the proposed mitigating strategy should result in acceptable shutdown margin for the analyzed ELAP event.

3.2.2.5 FLEX Pumps and Water Supplies

The licensee's FLEX strategy relies on one portable FLEX pump during Phase 2 to provide makeup to the spent fuel pool and RPV. The FLEX pump is a Power Prime model 3419MX rated at 770 gpm (at 363 psid). The FLEX pump is a trailer-mounted, diesel-driven engine centrifugal pump that is stored in the robust FLEX Storage Building (FSB). The licensee has an additional portable FLEX pump stored in the FSB as the N+1 backup to the portable FLEX pumps for Unit 1 and Unit 2. In Table 4 of its FIP, the licensee identified the performance criteria (e.g., flow rate, discharge pressure) for its Phase 2 portable FLEX pump. The NRC staff noted that the performance criteria for the FLEX Phase 3 portable pump is consistent or exceeds those of the FLEX Phase 2 portable FLEX pump capacities.

The licensee described in FIP Section 2.3.9 that a hydraulic calculation was performed to verify the capability of the portable FLEX pump and piping/hose system to deliver the required amount of water to each required location in the plant. For RPV makeup, calculation A10.1-A-016, "NMP2 Hydraulic Analysis of NMP2 FLEX Water makeup to the RPV and SFP," Revision 0, conservatively determined an RPV makeup flowrate of 180 gpm was required with an assumed constant RPV leakage rate of 61 gpm makeup to account for RPV level shrink. Calculation A10.1-A-016 also verified that the FLEX pump net positive suction head (NPSH) available is greater than the NPSH required for the FLEX strategy flowrates being implemented. Additionally, the MAAP analysis N2-2014-004, "MAAP 4.0.6 Analysis of Nine Mile Point Unit 2 Loss of All AC Power Scenario with Successful FLEX Short Term," Revision 3, conservatively used a RPV makeup rate of 180 gpm to verify that the RPV water level stays above TAF, assuming that assuming RCIC fails at 240°F suppression pool temperature and RPV emergency depressurization occurs in conjunction with alternate RPV injection from FLEX portable pumps at the time of RCIC failure.

The NRC staff reviewed the flow rates and pressures evaluated in the hydraulic analyses and confirmed that the equipment is capable of providing the needed flow rates. During the onsite audit, the NRC staff conducted a walk down of the hose deployment routes for the above FLEX pump to confirm the evaluations of the pump staging locations, hose distance runs, and connection points, as described in the above hydraulic analyses and FIP.

Based on the NRC staff's review of the FLEX pumping capabilities at Unit 2, as described in the above hydraulic analyses and the FIP, the licensee has demonstrated that its portable FLEX pump should perform as intended to support RPV makeup during an ELAP caused by an ELAP, consistent with NEI 12-06, Section 11.2.

3.2.2.6 Electrical Analyses

The licensee's electrical strategies provide power to the equipment and instrumentation used to mitigate the ELAP and LUHS. The electrical strategies described in the FIP are practically identical for maintaining or restoring core cooling, containment, and SFP cooling, except as noted in Sections 3.3.4.4 and 3.4.4.4 of this SE.

The NRC staff reviewed the licensee's FIP, conceptual electrical single-line diagrams, the summary of calculations for sizing the FLEX generators and station batteries. The staff also reviewed the licensee's evaluations that addressed the effects of temperature on the electrical equipment credited in the FIP as a result of the loss of heating, ventilation, and air conditioning (HVAC) caused by the event.

According to the licensee's FIP, ELAP entry conditions can be verified by control room staff. As stated in the FIP, a transition to procedure N2-SOP-01, "Station Blackout/Extended Loss of AC Power," will be made upon the diagnosis of the total loss of ac power. Procedures N2-SOP-01 and N2-SOP-02, "Station Blackout/Extended Loss of AC Power Support Procedure," and N2-DRP-FLEX-ELEC, "Emergency Damage Repair - BOB/FLEX Generator Deployment Strategy," provide guidance on isolation of primary containment systems, reduction of dc loads on the station Class 1E batteries, and establishes electrical equipment alignment in preparation for eventual power restoration.

The NRC staff reviewed the electrical portion of the mitigation strategy for a BDBEE condition and performed a walk-down of the licensee's strategies during an onsite audit that was conducted on November 3 – 7, 2014. During the walk-down, the NRC staff focused on the areas where the FLEX portable electrical equipment will be located, the connection points to the electrical distribution system, battery load shedding, and the cable runs from the staged and deployed FLEX generators to the installed equipment.

The Unit 2 Phase 1 FLEX strategy involves relying on installed plant equipment and onsite resources such as installed Class 1E station batteries and switchgear. The installed equipment is located within safety-related Class 1 structures. The Class 1E station batteries will provide power to system instrumentation, control systems, and other required loads. Operators will strip or shed unnecessary loads to extend the battery life until backup power is available. The plant operators would commence load shedding of the non-essential loads within 60 minutes and complete load shedding within 4 hours from the onset of an ELAP event.

The Unit 2 Division I and Division II Class 1E station batteries (2BYS*BAT2A and 2BYS*BAT2B) were manufactured by Exide Technologies, Model GNB NCN-35, contain 60 cells each, and have a capacity of 2552 ampere hours each.

The NRC staff reviewed the summary of the licensee's dc system analyses in EC-203 "Battery 2BYS*BAT2A and 2BYS*BAT2B Load Shed Coping Time for ELAP Event," Revision 0, which verified adequacy and capability of the dc system to supply power to the required Phase 1 loads. The licensee's calculation EC-203 modeled the Unit 2 Division I battery 2BYS*BAT2A because loading on this battery bounds the loading on battery 2BYS*BAT2B. Battery 2BYS*BAT2A includes RCIC loads and battery 2BYS*BAT2B does not. These safety-related batteries will provide sufficient power to all the required plant instruments and electrical controls for a maximum of 12 hours (power is expected to be restored to the battery charger by this time). The licensee's analysis identified the required loads and their associated ratings (amperage and minimum voltage). The FSG procedure N2-SOP-02, "Station Blackout Support Procedure," provides guidance to operations to load shed non-essential loads from Class 1E batteries to extend battery coping time. According to the licensee's FIP, the FLEX DG is expected to be deployed and connected to restore power to the 600 Vac battery charger at approximately 6 hours, well within the time frame before the batteries deplete below the minimum acceptable voltage (12 hours).

Because the licensee is crediting the station batteries for more than 8 hours in Phase 1, NEI white paper regarding battery duty cycles, "EA-12-049 Mitigating Strategies Resolution of Extended Battery Duty Cycles Generic Concern," dated August 27, 2013, which was endorsed by the NRC (ADAMS Accession No. ML13241A188), is applicable to Nine Mile Point, Unit 2. This white paper describes the industry's evaluation of extended battery cycles. In addition to the white paper, the NRC sponsored testing at Brookhaven National Laboratory that resulted in the issuance of NUREG/CR-7188, "Testing to Evaluate Extended battery Operation in Nuclear Power Plants," in May of 2015. The purpose of this testing was to examine whether existing vented lead acid batteries can function beyond their defined design-basis duty cycles (or beyond-design-basis duty cycles if existing SBO coping analyses were utilized) in order to support the necessary safety functions during an ELAP. The study evaluated battery performance availability and capability to supply the necessary dc loads for extended period of time.

The testing provided an indication of the amount of time available (depending on the actual load profile) for batteries to continue to supply dc power to the core-cooling equipment beyond the original duty cycles for a representative plant. The testing also demonstrated that battery availability can be significantly extended using load shedding techniques to allow more time to recover ac power. The testing further demonstrated that battery performance is consistent with battery manufacturing performance data. According to the NUREG, the projected availability of a battery can be accurately calculated using the Institute of Electrical and Electronics Engineers (IEEE) Standard 485-2010, "IEEE Recommended Practice for Sizing Lead-Acid batteries for Stationary Applications," or using an empirical algorithm described in the report.

Based on the staff's review of the licensee's analysis and procedures, and information from the battery vendor, the NRC staff concludes that the Unit 2 dc systems should have adequate capacity and capability to power the loads required to mitigate the consequences during Phase 1 of an ELAP as a result of a BDBEE provided that necessary load shedding is completed within the times assumed in the licensee's analysis.

According to the licensee's FIP, the Phase 2 strategy is to deploy, stage, and connect a FLEX 600 Volt alternating current (Vac) DG to repower 600 Vac buses to ensure power is available to the battery chargers prior to depletion of the station batteries. In the FIP, the licensee noted that the installed battery chargers can be energized by the 600 Vac FLEX DG within 6 hours after initiation of an ELAP event and before the station battery depletes to the minimum acceptable voltage. The licensee has developed a primary and alternate strategies for supplying power. The strategy relies on one of the two trailer mounted 600 Vac, 450 kilowatt (kW)/ 563 kilovolt ampere (kVA) DGs stored in a robust FLEX storage facility. Only one 450 kW/563 kVA PDG is needed to support Phase 2 loads which includes one safety-related 600 Vac/125 Vdc battery charger, battery room exhaust fans, essential instruments, an RHR motor operated valve, and other required loads. Two 600 Vac FLEX DGs provide N+1 capability to meet NEI 12-06 criteria. The NRC staff reviewed licensee calculation EC-206, "600VAC FLEX Phase II Portable 450 kW Diesel Generator Sizing Calculation," Revision 00, which indicated that the total estimated Phase 2 continuous loads would be approximately 453 kVA which is well within the 563 KVA rating of the Phase 2 600 Vac DGs.

During the audit process, the NRC staff reviewed key licensee electrical documents including: calculations, licensee evaluations, single line electrical diagrams, and FLEX procedures. The staff review considered the locations of stored, staged and deployed FLEX portable DG (PDGs), protection and diversity of the power supply pathways, separation and isolation of the deployed FLEX 600 Vac DGs from the Class 1E emergency DGs, and availability of procedures to direct operators how to align, connect, and protect associated systems and components. Based on its review, the NRC staff concludes that the FLEX 600 Vac DGs should have sufficient capacity and capability to supply the necessary loads following a BDBEE.

For Phase 3, the licensee plans to continue the Phase 2 coping strategy with additional assistance provided from offsite equipment/resources. Off-site equipment from an NSRC is expected to arrive on site within 24 hours to support Phase 3 operation, as necessary. The NSRC supplied combustion turbine generators (CTGs) come with the same size connectors as the onsite Phase 2 FLEX 600 Vac DGs and bus connection devices (BCDs). The offsite resources that will be provided by an NSRC include two 1-megawatt (MW) 4160 Vac CTGs (2 per unit), a distribution panel (1 per unit) (including cables and connectors), a step up transformer 480/600 Vac (1 per unit), and a 480 Vac, 1100 kW CTG (1 per unit). In its FIP, the licensee stated that the NSRC supplied 1.1 MW CTGs, 480 Vac with 480/600 Vac step up transformer is a backup to the onsite Phase 2 equipment. The NSRC supplied 1.1 MW 480 Vac CTG capacity exceeds, and therefore, envelopes the onsite Phase 2 600 Vac DG capacity (450 kW). The licensee expects that these CTGs would be available within 24 hours after the initiation of the ELAP event. The proposed onsite staging locations, cable pathways, and connections are the same as those used for the connections of the Phase 2 equipment as discussed in procedure N2-DRP-FLEX-ELEC. Based on its review of this evaluation, the NRC staff concludes that the Phase 3 CTGs should have adequate capacity to supply the required loads to maintain or restore core cooling, SFP cooling, and containment indefinitely following an ELAP.

Based on its review, the NRC staff concludes that the station batteries used in the strategy should have sufficient capacity to support the licensee's Phase 1 strategy, and that the Phase 2 FLEX DGs and NSRC supplied CTGs that the licensee plans to use should have sufficient capacity and capability to supply the necessary loads during an ELAP event.

3.2.3 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that should maintain or restore core cooling and RCS inventory during an ELAP event consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.3 Spent Fuel Pool Cooling Strategies

In NEI 12-06, Table 3-1 and Appendix C summarize an acceptable approach consisting of three separate capabilities for the SFP cooling strategies. This approach uses a portable injection source to provide the capability for 1) makeup via hoses on the refueling floor capable of exceeding the boil-off rate for the design-basis heat load; 2) makeup via connection to SFP cooling piping or other alternate location capable of exceeding the boil-off rate for the design basis heat load; and 3) spray via portable monitor nozzles from the refueling floor using a portable pump capable of providing a minimum of 200 gpm per unit (250 gpm if overspray occurs). During the event, the licensee selects the method to use based on plant conditions. This approach also requires a strategy to mitigate the effects of steam from the SFP, such as venting.

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 1.1, strategies that must be completed within a certain period should be identified and a basis that the time can be reasonably met should be provided. In NEI 12-06, Section 3 provides the performance attributes, general criteria, and baseline assumptions to be used in developing the technical basis for the time constraints. Since the event is beyond-design-basis, the analysis used to provide the technical basis for time constraints for the mitigation strategies may use nominal initial values (without uncertainties) for plant parameters, and best-estimate physics data. All equipment used for consequence mitigation may be assumed to operate at nominal setpoints and capacities. In NEI 12-06, Section 3.2.1.2 describes the initial plant conditions for the at-power mode of operation; Section 3.2.1.3 describes the initial conditions; and Section 3.2.1.6 describes SFP initial conditions.

In NEI 12-06, Section 3.2.1.1 provides the acceptance criterion for the analyses serving as the technical basis for establishing the time constraints for the baseline coping capabilities to maintain SFP cooling. This criterion is keeping the fuel in the SFP covered with water.

The ELAP causes a loss of cooling in the SFP. As a result, the pool water will heat up and eventually boil off. The licensee's response is to provide makeup water. The timing of operator actions and the required makeup rates depend on the decay heat level of the fuel assemblies in the SFP. The sections below address the response during operating, pre-fuel transfer or post-fuel transfer operations. The effects of an ELAP with full core offload to the SFP is addressed in Section 3.11 below.

3.3.1 Phase 1

In the FIP, Section 2.5 indicates that the water in the SFP will gradually heat up and evaporate from decay heat following a loss of SFP cooling and that no operator actions are required during an ELAP for Phase 1. Specifically, the licensee stated that at the SFP maximum design heat load (outage condition, full core offload, SFP gates installed), the SFP will reach 212°F in approximately 5.4 hours and during non-outage conditions, the time to boiling in the pool is greater than 24 hours. Additionally, the boil off to a level of 10 ft. above the top of the fuel in outage, full core offload conditions is about 30 hours from declaration of an ELAP. Adequate SFP inventory exists to provide radiation shielding for personnel well beyond the time of boiling. During Phase 1, operators will establish ventilation pathways in the Unit 2 reactor building and monitor level using the SFP level instrumentation installed per Order EA-12-051. The portable FLEX pump is staged within 16 hours after declaration of an ELAP to restore and maintain normal SFP level in Phase 2.

3.3.2 Phase 2

During Phase 2, FIP Section 2.5 states that operators will deploy a portable FLEX pump to supply water from Lake Ontario at the Unit 2 service water system intake bay to a distribution manifold in the reactor building. The connection is made to the RHR 'B' loop using a 2 inch SFP makeup hose of 200 ft. The SFP makeup hoses are routed from the FLEX distribution manifold to a hard-pipe connection (not requiring refueling floor access) on RHR 'B'. Additional hoses are routed to the refuel floor at the 353 ft. elevation to provide direct makeup to the pool or provide spray flow through portable nozzles, as a contingency, using the second FLEX pump.

3.3.3 Phase 3

The licensee stated in FIP Section 2.5, that the Phase 3 strategy is to continue with the Phase 2 methodologies using the FLEX pump and that additional high capacity pumps will be available from the NSRC as a backup to the onsite portable FLEX pumps.

3.3.4 Staff Evaluations

3.3.4.1 Availability of Structures, Systems, and Components

3.3.4.1.1 Plant SSCs

Condition 6 of NEI 12-06, Section 3.2.1.3, states that permanent plant equipment contained in structures with designs that are robust with respect to seismic events, floods, and high winds, and associated missiles, are available. In addition, Section 3.2.1.6 states that the initial SFP conditions are: 1) all boundaries of the SFP are intact, including the liner, gates, transfer canals, etc., 2) although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the refueling deck around the pool and 3) SFP cooling system is intact, including attached piping.

The NRC staff reviewed the licensee's calculation on habitability on the SFP refuel floor. This calculation and the FIP indicate that boiling begins at greater than 24 hours during a normal, non-outage situation. The NRC staff noted that the licensee's sequence of events timeline in the FIP indicates that operators will deploy hoses and spray nozzles as a contingency for SFP makeup within 7 hours from event initiation to ensure the SFP area remains habitable for personnel entry, which is well in advance of the expected time for bulk boiling in the SFP.

As described in the licensee's FIP, the licensee's Phase 1 SFP cooling strategy does not require any operator actions. However, the licensee does establish a ventilation path to cope with temperature, humidity and condensation from evaporation and/or boiling of the SFP. The operators are directed to initiate passive cooling and ventilation in the Unit 2 reactor building by opening specified doors in the reactor building at grade level and on the reactor building roof within 8 hours of the event onset.

The licensee's Phase 2 and Phase 3 SFP cooling strategy involves the use of the portable FLEX pump or NSRC supplied pump for Phase 3, with suction from Lake Ontario, to supply water to the SFP. The NRC staff's evaluation of the robustness and availability of FLEX connections points for the portable FLEX pump is discussed in Section 3.7.3.1 below. Furthermore, the NRC staff's evaluation of the robustness and availability of Lake Ontario for an ELAP event is discussed in Section 3.10.

3.3.4.1.2 Plant Instrumentation

In its FIP, the licensee stated that the instrumentation for SFP level will meet the requirements of Order EA-12-051. Furthermore, the licensee stated that these instruments will have initial local battery power with the capability to be powered from the FLEX DGs. The NRC staff's review of the SFP level instrumentation, including the primary and back-up channels, the display to monitor the SFP water level and environmental qualifications to operate reliably for an extended period are discussed in Section 4 of this SE.

3.3.4.2 Thermal-Hydraulic Analyses

The licensee stated in its FIP, that for Nine Mile Point, Unit 2, the normal SFP water level at the event initiation is approximately 23 ft. over the top of the spent fuel in the storage racks and that maintaining the SFP full of water at all times during the ELAP event is not required. The licensee explained that its FLEX strategy is to maintain the SFP level at least 10 ft. above the spent fuel in the fuel racks.

As described in FIP Section 2.5, the SFP will boil in approximately 5.4 hours and boil off to a level 10 ft. above the top of fuel in 30 hours from initiation of the event with no operator action at the maximum design basis heat load. In the FIP, Section 2.5.6 states that the bounding scenario used for its FLEX strategy is the maximum normal/emergency refueling heat load, which includes a full core offload, requires a make-up rate of 73 gpm.

Therefore, the licensee conservatively determined that a SFP makeup flow rate of at least 73 gpm will maintain adequate SFP level at least 10 ft. above the top of fuel for an ELAP occurring during normal power operation. In NEI 12-06, Section 3.2.1.6 states that the SFP heat load assumes the maximum design-basis heat load for the site as one of the initial SFP conditions. Consistent with this guidance in NEI 12-06, Section 3.2.1.6, the NRC staff concludes that the licensee has considered the maximum design-basis SFP heat load.

The licensee explained that SFP cooling will be established in Phase 2 utilizing the FLEX pump to makeup to the SFP in order to keep the spent fuel covered. Phase 2 actions to have the pump connected and available for makeup are targeted to occur at less than or equal to 16 hours which, by then, SFP water level should only have lowered by about 8 ft. The NRC staff concludes that the licensee's strategy for normal non-outage scenarios conservative because the timelines are based on a full-core offload during a refueling outage. In addition, the licensee's actions to deploy and stage hoses and the portable FLEX pump are in advance of this conservative full-core offload timeline.

3.3.4.3 FLEX Pumps and Water Supplies

As described in the FIP, the SFP cooling strategy relies on one portable FLEX pump to provide SFP makeup during Phase 2. In the FIP, Section 2.5 described the hydraulic performance criteria (e.g., flow rate, discharge pressure) for the FLEX pump. Specifically, the portable FLEX pump is a trailer-mounted Power Prime model 3419MX (diesel-driven engine centrifugal pump) rated at 770 gpm (at 363 psid), which is stored in the robust FSB. A hydraulic calculation was performed to verify the capability of the portable FLEX pump and piping/hose system to deliver the required amount of water to each required location in the plant. The NRC staff noted that the hydraulic calculation accounts for one portable FLEX pump providing makeup to the RPV and SFP simultaneously. The licensee explained in its FIP the capability of 250 gpm of SFP spray is identified in NEI 12-06 in the event of a crack in the pool or other means of unforeseen leakage. The 250 gpm is inclusive of the 73 gpm boil off rate; therefore, 250 gpm was established as the SFP makeup in the hydraulic calculation. A second portable FLEX pump is available and will have to be used if the maximum SFP makeup flow of 250 gpm is required while the first pump is supplying maximum make up to the RPV.

The NRC staff noted that the performance criteria of a portable FLEX pump supplied from an NSRC for Phase 3 would allow the NSRC pump to fulfill the mission of the onsite portable FLEX pump, if needed. As stated above, the SFP makeup rate of 73 gpm and SFP spray rate of 250 gpm both meet or exceed the maximum SFP makeup requirements. Furthermore, the NRC staff concludes that the analysis above is consistent with NEI 12-06, Section 11.2 and the FLEX equipment is capable of supporting the SFP cooling strategy and is expected to be available during an ELAP event.

3.3.4.4 Electrical Analyses

The licensee's FIP defined strategies capable of mitigating a simultaneous loss of all ac power and LUHS, resulting from a BDBEE, by providing the capability to maintain or restore SFP cooling at the NMP2 site.

The NRC staff review of the Unit 2 FIP indicated that the licensee credits the power supplies to the SFP level instruments that were installed for Order EA-12-051. These instruments are addressed in Section 4 of this SE.

In the compliance letter for NRC Order EA-12-051, the licensee stated that the power control panel for the primary level instrument will be powered from two independent uninterruptible power supply (UPS), which will be fed from a selected Division I dc switchgear or a selected Division I 600 Vac switchgear. Similarly, the power panel for the backup level instrument will be powered from two independent UPS which will be fed from a selected Division II 125 Vdc switchgear or a selected Division II 600 Vac switchgear. Each power control panel has its own independent battery. During Phase 1, SFP level instrument will be powered by Class 1E batteries through safety-related UPS. The staff reviewed the licensee's calculation EC-203 in Section 3.2.3.6 of this SE and concluded that the Class 1E batteries should have adequate capacity to repower SFP instruments. For Phase 2, the FLEX DG will supply power to the SFP level instruments through Class 1E battery chargers, 125 Vdc switchgears, and UPS. The NRC staff reviewed the licensee's FLEX DG sizing calculation (EC-206), and concluded that the FLEX DGs should have sufficient capacity and capability to supply these loads, if necessary. For Phase 3, the SFP instruments and panels can be repowered from the NSRC supplied 480 Vac, 1.1 MW CTG which is a back up to the FLEX DG, if required, and through a selected Class 1E battery charger, 125 Vdc switchgear, and UPS. Since the NSRC supplied CTG has higher capacity than the capacity of the FLEX DG, the NRC staff concludes that the NSRC CTG will have sufficient capacity to supply to the SFP instruments and panels.

Based on its review of the summary of the licensee's calculation, the NRC staff concludes that the Class 1E battery, FLEX 600 Vac DG and 480 Vac CTGs and 480/600 Vac step up transformer being supplied from the NSRC should have sufficient capacity and capability to supply the required SFP instrument loads.

3.3.5 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that if implemented appropriately should maintain or restore SFP cooling following an ELAP consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.4 Containment Function Strategies

The industry guidance document, NEI 12-06, Table 3-1, provides some examples of acceptable approaches for demonstrating the baseline capability of the containment strategies to effectively maintain containment functions during all phases of an ELAP event. One such approach is for a licensee to perform an analysis demonstrating that containment pressure control is not challenged. Nine Mile Point, Unit 2 is a General Electric BWR with a Mark 2 containment.

The licensee performed a containment evaluation, N2-2014-004, "MAAP 4.0.6 Analysis of Nine Mile Point Unit 2 Loss of All AC Power Scenario with Successful FLEX Short Term – Cases 1F19a, 1F20a, and 1F23a," Revision 0, which was based on the boundary conditions described in Section 2 of NEI 12-06. The calculation analyzed the strategy of monitoring key parameters and venting the suppression chamber to maintain a 10 psig suppression chamber pressure and concluded that the containment parameters of pressure and temperature remain well below the respective UFSAR Section 6.2.1 design limits of 45 psig and 293°F for the drywell and 45 psig for the suppression chamber for more than 72 hours. The suppression chamber will exceed its temperature design structural temperature of 212°F. The licensee's review of exceeding the suppression chamber temperature design parameter is covered in Section 3.4.4.2 below. From its review of the evaluation, the NRC staff noted that the required actions to maintain containment integrity and required instrumentation functions have been developed, and are summarized below.

3.4.1 Phase 1

The FIP identifies the Phase 1 strategy, which is to maintain containment integrity through normal design features of the containment, such as the containment isolation valves. The suppression pool will be vented, as directed by procedure N2-EOP-PC "Primary Containment Control," when the containment pressure reaches 10 psig to support RCIC operation. Venting is expected to occur approximately 7 hours into the event.

3.4.2 Phase 2

The Phase 2 strategy is to maintain the Phase 1 actions of venting the suppression pool to maintain a containment pressure of 10 psig to support RCIC operation. Containment temperature and pressure will be monitored in the control room via installed plant instrumentation. FLEX portable generators will be used to maintain the uninterruptable power supplies to the instrumentation.

3.4.3 Phase 3

The Phase 3 strategy is the continuation of the Phase 2 strategy of venting the suppression pool. Additional Phase 3 actions to reduce containment temperature and pressure and to ensure continued functionality of key parameters will utilize existing plant systems and those systems restored by offsite equipment and resources. Makeup to the suppression pool will continue to be provided by Phase 2 portable equipment, backed up by the NSRC equipment. Procedure S-DRP-OPS-005, "Use of FLEX Phase 3 SAFER Equipment," provides guidance for utilization of Phase 3 SAFER equipment. Existing plant procedures will be used to operate plant systems.

3.4.4 Staff Evaluations

3.4.4.1 Availability of Structures, Systems, and Components

Guidance document NEI 12-06 baseline assumptions have been established on the presumption that other than the loss of the ac power sources and normal access to the UHS, installed equipment that is designed to be robust with respect to design-basis external events is assumed to be fully available. Installed equipment that is not robust is assumed to be unavailable. Below are the baseline assumptions for the availability of SSCs for maintaining containment functions during an ELAP.

3.4.4.1.1 Plant SSCs

Containment/Suppression Chamber

The primary containment structure of Unit 2 consists of the drywell, the pressure suppression chamber, and the drywell floor which separates the drywell and suppression chamber. The drywell is a steel-lined reinforced concrete vessel in the shape of a frustum of a cone, closed by a dome with a torispherical head. The pressure suppression chamber is a cylindrical stainless steel clad steel-lined reinforced concrete vessel located below the drywell. The pressure suppression chamber stores a large volume of water (approximately 145,000 cubic foot minimum water volume). The primary containment structure houses the reactor vessel, the reactor recirculation system, and other branch connections of the reactor coolant pressure boundary.

In the UFSAR, Section 6.2.1 identifies the containment design parameters as 45 psig internal design pressure, 340°F environmental design temperature, and 293°F structural design temperature for the drywell. For the suppression chamber it is 45 psig internal design pressure, 270°F environmental design temperature, and 212°F structural design temperature.

The licensee performed an analysis, 2015-1099, Appendix D, "Containment Suppression Chamber Structural Evaluation," Revision 0, to evaluate the impact of the temperatures, pressures, and water level on structures and components (e.g.: liner embedment plates, suppression pool liner anchorage system, containment penetrations, base ring T-Joint) within the containment suppression chamber during FLEX conditions. The licensee concluded that there is sufficient capacity of the containment structures at beyond-design-basis conditions.

Hardened Containment Vent System

The FIP indicates that the hardened containment vent system (HCVS) is designed and installed to meet the operational requirements of NRC Order EA-13-109. The HCVS is operated by first manually bursting a rupture disc with the associated argon purge system and then opening three valves: 2CPS* AOV109, * AOV111 and -AOV134. Only air operated valve (AOV)134 will be closed to isolate the vent. The HCVS system can be operated from either the main control room via new panel 2CEC-PNL801 or from the remote operating station (ROS), located in the reactor building track bay. Pneumatic supply to valves and dc power for instrumentation and controls are provided by nitrogen bottles and a HCVS battery located in the reactor building track bay. Both are sized to be capable of supporting system operation for at least 24 hours without replenishment.

Reactor Core Isolation Cooling (RCIC)

Calculation 2015-01099, "RCIC Equipment Survivability Review," Revision 0, evaluated the RCIC system under ELAP conditions. The evaluation looked at postulated room environmental conditions along with the compensatory actions. The RCIC pump/turbine was reviewed for operation with suppression pool temperature at 240°F. The pump/turbine review included bearing material, lubrication, and governor performance.

Calculation 2015-01099 identified that operating the HCVS at 10 psig containment pressure reduces the challenges to RCIC operation caused by elevated suppression pool temperatures. With the suppression pool and chamber at saturated conditions lowering pressure will provide for lower suppression pool temperature. The evaluation estimated that the lower suppression pool temperature also extends RCIC operation from 9 hours to 15 hours prior to failure while controlling containment heatup and pressurization. Appendix C of calculation 2015-01099 reviewed the survivability of those portions of the RCIC system subject to elevated temperatures above the original design conditions.

Appendix B of calculation 2015-01099 determined the environmental conditions in the RCIC pump room following an ELAP event. The evaluation identified compensatory actions to maintain acceptable conditions.

The licensee determined that with the compensatory actions the RCIC system will operate for its required mission time. The minimum mission time is 4-hours. Once the transition to the FLEX pumps occurs, the licensee plans to perform an emergency RPV depressurization by opening 7 SRVs to support RPV injection with FLEX portable pumps. Containment pressure is controlled to maintain pressure less than the primary containment pressure limit (PCPL) in accordance with EOPs.

During the audit, the licensee noted that Unit 2 has procedures in place that direct the bypass of RCIC high temperature isolations and provide for the local control of RCIC following the loss of ac/dc power.

3.4.4.1.2 Plant Instrumentation

In NEI 12-06, Table 3-1, specifies that containment pressure, suppression pool level, and suppression pool temperature are key containment parameters which should be monitored by repowering the appropriate instruments. The licensee's FIP states that control room instrumentation would be available due to the coping capability of the station batteries and associated inverters in Phase 1, or the portable DGs deployed in Phase 2. If no ac or dc power is available, the FIP states that key credited plant parameters, including these containment parameters, would be available using alternate methods.

Instrumentation providing the following key parameters credited for all phases of the containment Integrity strategy include:

- Suppression Pool Temperature: 2CMS*TI174 (alternate), 2CMS*TI 175 (primary)
- Suppression Pool Level: 2CMS*LI9A (primary), 2CMS*LR9B (alternate), 2CMS*LI11A (primary), 2CMS*LI11 B (alternate)
- Suppression Chamber Pressure: 2CMS*PI7A (primary), 2CMS*PR7B (alternate)

- Drywell Ambient Temperature: 2CMS*TRX130 (primary), 2CMS*TRX140 (alternate)
- Drywell Pressure: 2CMS*PI2A (primary), 2CMS*PR2B (alternate)

In the unlikely event that the Division I or Division II safety related battery bus infrastructures or supporting equipment is damaged and non-functional rendering key parameter instrumentation unavailable in the Unit 2 main control room, alternate methods for obtaining the critical parameters locally is provided in procedure N2-SOP-78A, "EOP Key Parameter-Alternate Instrumentation."

3.4.4.2 Thermal-Hydraulic Analyses

Calculation N2-2014-004, "MAAP 4.0.6 Analysis of Nine Mile Point Unit 2 Loss of All AC Power Scenario with Successful FLEX Short Term – Cases 1F19a, 1F20a, and 1F23a," Revision 0, was performed to understand the overall accident of the containment (drywell and wetwell) thermal-hydraulic behavior. The calculation used the MAAP 4.0.6 to model the plant response for 72 hours. RCS leakage was assumed to be 61 gpm from recirculation pump seal leakage and technical specification allowable leakage. The RCIC was assumed to fail at a suppression pool water temperature of 240°F. Suppression chamber venting was assumed to occur at 45 psig to maintain containment integrity. Suppression chamber venting was required twice during the 72 hour period. The drywell temperature peaks at approximately 270°F. The peak wetwell pool temperature was approximately 280°F.

Venting the suppression chamber maintains containment below the design limit of 45 psig. The drywell remains below the design limit of 293°F. The suppression chamber temperature exceeds its design limit of 212°F as indicated in UFSAR Section 6.2.1. The licensee performed an analysis, 2015-1099, Appendix D, "Containment Suppression Chamber Structural Evaluation" Revision 0, to evaluate the impact of the temperatures, pressures, and water level on structures and components (e.g.: liner embedment plates, containment penetrations, base ring T-Joint) within the containment suppression chamber during FLEX conditions. The licensee concluded that there is sufficient capacity of the Containment structures at beyond-design-basis conditions.

3.4.4.3 FLEX Pumps and Water Supplies

No FLEX pumps or water supplies are directly credited for mitigating actions to maintain containment function. Water added to the suppression pool is from water added to the reactor as part of the mitigating actions to remove decay heat from the reactor core and is discussed above in Section 3.2.2.5, "FLEX Pumps and Water Supplies."

3.4.4.4 Electrical Analyses

The licensee has performed a containment analysis based on the boundary conditions described in Section 2 of NEI 12-06. Based on the results of this analysis, the licensee evaluated whether actions would be required to ensure maintenance of containment integrity and instrumentation functions.

Primary Containment

According to the FIP, the licensee will maintain primary containment integrity by normal design features of the containment, such as the containment isolation valves during Phases 1 and 2. SRVs would cycle automatically or manually to control reactor pressure until RCIC is placed into service. The RCIC may automatically start and inject to the RPV on low-low RPV level following the ELAP event onset. Containment temperature and pressure will be maintained by using the HCVS when the Suppression Chamber reaches 10 psig. In N2-2014-004, "MAAP 4.0.6 Analysis of Nine Mile Point Unit 2 Loss of All AC Power Scenario with Successful FLEX Short Term - Cases 1F19a, 1F20a, and, 1F23a," Revision 3, the licensee stated that the HCVS will be opened when containment pressure reaches 10 psig (approximately 7 hours into the event) and remain open to control containment pressure and temperature to support continued operation of RCIC for core cooling.

Containment pressure and temperature will be monitored in the control room via installed plant instrumentation powered by the safety-related batteries and safety-related UPS. The safety-related batteries, and subsequently the UPSs, are maintained in Phase 2 by deployment of the FLEX 600 Vac DGs within 6 hours of an ELAP event that would repower battery chargers. Once the RCIC is no longer required to support core cooling when the transition to portable pumps is complete, emergency RPV depressurization is performed by opening SRVs and the HCVS vent path is closed because venting is no longer required to maintain RCIC operation. Containment pressure is then controlled to maintain pressure within the PCPL per EOPs (N2-EOP-6.21, "Containment Venting: Revision 001, N2-EOP-PC, "Primary Containment Control," Revision 014). Based on the NRC staff's review of the FLEX 600 Vac DGs capacity in Section 3.2.2.6 of this SE, a single Phase 2 FLEX 600 Vac DG should have sufficient capacity and capability to supply power to the battery chargers, critical instruments and other required loads to ensure plant parameter monitoring.

In its FIP, the licensee stated that during Phase 3, RPV makeup will continue to be provided by the Phase 2 portable equipment and backed up by the NSRC supplied diesel pumps to ensure containment makeup and containment temperature and pressure monitoring. As such, no additional loads are expected to be on the Phase 2 600 Vac DG and it can continue supplying power to the required loads indefinitely backed up by NSRC supplied CTGs. The NSRC supplied 1.1 MW 480 Vac CTG capacity exceeds the Phase 2 FLEX DG, and therefore, envelopes the onsite Phase 2 DG size (450 kW). Based on the above, the NRC staff concludes that the Phase 3 supplied NSRC CTG should provide adequate capacity and capability to supply power to the required loads to maintain or restore containment indefinitely following an ELAP as a result of a BDBEE.

Secondary Containment (Reactor Building)

The NRC staff review of the FIP indicated that the only electrical equipment the licensee has credited for secondary containment cooling are the required critical instruments located in the reactor building area. In the licensee's Gothic Model calculation ES-289, "NMP2 Reactor Building Thermal Response Following an Extended Loss of AC Power," Revision 01.00, under ECP-13-000652-Appendix A, the licensee determined that the expected peak temperature at reactor building elevation 328 ft., where the reliable wide range SFP water level instrumentation is located, and required per NRC Order EA-12-051, is expected to reach 150°F, which is below the 176°F limiting temperature for the water level sensing devices.

In calculation (ES-289), the licensee evaluated all critical instruments in the reactor building area and found that they are acceptable and will remain functional during an ELAP event. For example, all required transmitters located in the reactor building are design qualified to at least 203°F for 25 days per environmental qualification (EQ) documents and the design qualification temperature (203°F) of the above transmitters envelop the maximum expected temperature of 150°F. Suppression pool instruments are design qualified to 340°F per Unit 2 EQ documents and envelopes the maximum expected temperature of 150°F. Calculation ES-289, and procedures N2-SOP-01and N2-SOP-02 describe the licensee's strategy to implement passive cooling and ventilation that will limit the reactor building temperature to below the design qualification limits of the credited equipment and instruments.

Based on its review of the summary of calculations ES-289, N2-2014-004, and the licensee's mitigation strategy in the FIP, and procedure N2-SOP-01 to monitor containment pressure and temperature, the NRC staff concludes that the electrical equipment should have sufficient capacity and capability to supply power to the required loads to reduce containment temperature and pressure, if necessary, to ensure that containment function is maintained and that key instruments remain functional.

3.4.5 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should maintain or restore containment functions following an ELAP event consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.5 Characterization of External Hazards

Sections 4 through 9 of NEI 12-06 provide the methodology to identify and characterize the applicable BDBEEs for each site. In addition, NEI 12-06 provides a process to identify potential complicating factors for the protection and deployment of equipment needed for mitigation of applicable site-specific external hazards leading to an ELAP and loss of normal access to the UHS.

Characterization of the applicable hazards for a specific site includes the identification of realistic timelines for the hazard, characterization of the functional threats due to the hazard, development of a strategy for responding to events with warning, and development of a strategy for responding to events without warning.

The licensee reviewed the plant site against NEI 12-06 and determined that FLEX equipment should be protected from the following hazards: seismic; external flooding; severe storms with high winds; snow, ice and extreme cold; and extreme high temperatures.

References to external hazards within the licensee's mitigating strategies and this SE are consistent with the guidance in NEI-12-06 and the related NRC endorsement of NEI 12-06 in JLD-ISG-2012-01. Guidance document NEI 12-06 directed licensees to proceed with evaluating external hazards based on currently available information. For most licensees, this meant that the OIP used the current design-basis information for hazard evaluation. Coincident with the issuance of Order EA-12-049, on March 12, 2012, the NRC staff issued a Request for Information pursuant to Title 10 of the *Code of Federal Regulations* Part 50, Section 50.54(f)

(ADAMS Accession No. ML12053A340) (hereafter referred to as the 50.54(f) letter), which requested that licensees reevaluate the seismic and flooding hazards at their sites using updated hazard information and current regulatory guidance and methodologies. Due to the time needed to reevaluate the hazards, and for the NRC to review and approve them, the reevaluated hazards were generally not available until after the mitigation strategies had been developed. The NRC staff has developed a proposed rule, titled "Mitigation of Beyond-Design-Basis Events," hereafter called the MBDBE rule, which was published for comment in the *Federal Register* on November 13, 2015 (80 FR70610). The proposed MBDBE rule would make the intent of Orders EA-12-049 and EA-12-051 generically applicable to all present and future power reactor licensees, while also requiring that licensees consider the reevaluated hazard information developed in response to the 50.54(f) letter.

The NRC staff requested Commission guidance related to the relationship between the reevaluated flooding hazards provided in response to the 50.54(f) letter and the requirements for Order EA-12-049 and the MBDBE rulemaking (see COMSECY-14-0037, Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards" (ADAMS Accession No. ML14309A256). The Commission provided guidance in an SRM to COMSECY-14-0037 (ADAMS Accession No. ML15089A236). The Commission approved the staff's recommendations that licensees would need to address the reevaluated flooding hazards within their mitigating strategies for BDBEEs, and that licensees may need to address some specific flooding scenarios that could significantly damage the power plant site by developing scenario-specific mitigating strategies, possibly including unconventional measures, to prevent fuel damage in reactor cores or SFPs. The NRC staff did not request that the Commission consider making a requirement for mitigating strategies capable of addressing the reevaluated flooding hazards be immediately imposed, and the Commission did not require immediate imposition. In a letter to licensees dated September 1, 2015 (ADAMS Accession No. ML15174A257), the NRC staff informed the licensees that the implementation of mitigation strategies should continue as described in licensee's OIPs, and that the NRC SEs and inspections related to Order EA-12-049 will rely on the guidance provided in JLD-ISG-2012-01, Revision 0, and the related industry guidance in NEI 12-06, Revision 0. The hazard reevaluations may also identify issues to be entered into the licensee's corrective action program consistent with the OIPs submitted in accordance with Order EA-12-049.

As discussed above, licensees are reevaluating the site seismic and flood hazards as requested in the NRC's 50.54(f) letter. After the NRC staff approves the reevaluated hazards, licensees will use this information to perform flood and seismic mitigating strategies assessments (MSAs) per the guidance in NEI 12-06, Revision 2, Appendices G and H (ADAMS Accession No. ML16005A625). The NRC staff endorsed Revision 2 of NEI 12-06 in JLD-ISG-2012-01, Revision 1 (ADAMS Accession No. ML15357A163). The licensee's MSAs will evaluate the mitigating strategies described in this SE using the revised seismic hazard information and, if necessary, make changes to the strategies or equipment. Licensees will submit the MSAs for NRC staff review.

The licensee developed its OIP for mitigation strategies by considering the guidance in NEI 12-06 and the site's design-basis hazards. Therefore, this SE makes a determination based on the licensee's OIP and FIP. The characterization of the applicable external hazards for the plant site is discussed below.

3.5.1 Seismic

In its FIP, the licensee described the current design-basis seismic hazard, the safe shutdown earthquake (SSE). As part of design and licensing for Unit 2, the maximum earthquake potential was represented by a modified mercalli intensity VI earthquake adjacent to Nine Mile Point, Unit 2, resulting in a peak horizontal ground motion of 0.07g. However, the licensee adopted a very conservative value for the Unit 2 licensing basis. As described in UFSAR Sections 2.5.2.6 and 2.5.2.7, the SSE seismic criteria for Unit 2 is 0.15g. It should be noted that the actual seismic hazard involves a spectral graph of the acceleration versus the frequency of the motion. Peak acceleration in a certain frequency range, such as the numbers above, is often used as a shortened way to describe the hazard. .

As the licensee's seismic reevaluation activities are completed, the licensee is expected to assess the mitigation strategies to ensure they can be implemented under the reevaluated hazard conditions as will potentially be required by the proposed MBDBE rulemaking. The licensee has appropriately screened in this external hazard and identified the hazard levels to be evaluated.

3.5.2 Flooding

In its FIP, the licensee stated that Unit 2 was designed to satisfy the requirements stated in the NRC standard review plan, NUREG-0800 for external floods. In addition, the design-basis floods for Unit 2 are in accordance with NRC Regulatory Guide 1.59, "Design Basis Floods." Based on analyses, the worst flood height for Unit 2 is 262.5 ft caused from a local propable maximum precipitation (PMP) event.

As the licensee's flooding reevaluation activities are completed, the licensee is expected to assess the mitigation strategies to ensure they can be implemented under the reevaluated hazard conditions as will potentially be required by the proposed MBDBE rulemaking. The licensee has appropriately screened in this external hazard and identified the hazard levels to be evaluated.

3.5.3 High Winds

In NEI 12-06, Section 7, provides the NRC-endorsed screening process for evaluation of high wind hazards. This screening process considers the hazard due to hurricanes and tornadoes.

The screening for high wind hazards associated with hurricanes should be accomplished by comparing the site location to NEI 12-06, Figure 7-1 (Figure 3-1 of U.S. NRC, "Technical Basis for Regulatory Guidance on Design Basis Hurricane Wind Speeds for Nuclear Power Plants," NUREG/CR-7005, December, 2009); if the resulting frequency of recurrence of hurricanes with wind speeds in excess of 130 mph exceeds 1E-6 per year, the site should address hazards due to extreme high winds associated with hurricanes using the current licensing basis for hurricanes.

The screening for high wind hazard associated with tornadoes should be accomplished by comparing the site location to NEI 12-06, Figure 7-2, from U.S. NRC, "Tornado Climatology of the Contiguous United States," NUREG/CR-4461, Rev. 2, February 2007; if the recommended tornado design wind speed for a 1E-6/year probability exceeds 130 mph, the site should address hazards due to extreme high winds associated with tornadoes using the current licensing basis for tornados or Regulatory Guide 1.76, Revision 1.

In its FIP, regarding the determination of applicable extreme external hazards, the licensee stated that the site is located at 43° 31' 17" North latitude and 76° 24' 36" West longitude. Per NEI 12-06, Figure 7-1, Nine Mile Point has a 1 in 1 million chance per year of a hurricane induced peak-gust wind speed of greater than120 mph. Thus, Nine Mile Point does not need to address high straight wind hazards. However, NEI 12-06, Figure 7-2 indicates that the site is in Region 1, where the tornado design wind speed exceeds 130 mph. Therefore, the plant screens in for an assessment for high winds, and tornados, including missiles produced by these events.

Therefore, high-wind hazards are applicable to the plant site. The licensee has appropriately screened in the high wind hazard and characterized the hazard in terms of wind velocities and wind-borne missiles.

3.5.4 Snow, Ice, and Extreme Cold

As discussed in NEI 12-06, Section 8.2.1, all sites should consider the temperature ranges and weather conditions for their site in storing and deploying FLEX equipment consistent with normal design practices. All sites outside of Southern California, Arizona, the Gulf Coast and Florida are expected to address deployment for conditions of snow, ice, and extreme cold. All sites located north of the 35th Parallel should provide the capability to address extreme snowfall with snow removal equipment. Finally, all sites except for those within Level 1 and 2 of the maximum ice storm severity map contained in Figure 8-2 should address the impact of ice storms.

In its FIP, regarding the determination of applicable extreme external hazards, the licensee stated that the site is located at 43° 31' 17" North latitude and 76° 24' 36" West longitude. The lowest recorded temperature at or near the site was -26°F in 1979. In addition, the site is located within the region characterized by EPRI as ice severity Level 5 (NEI 12-06, Figure 8-2, Maximum Ice Storm Severity Maps). Consequently, the site is subject to severe icing conditions that could cause severe damage to electrical transmission lines. The licensee concludes that the plant screens in for an assessment for snow, ice, and extreme cold hazard.

In summary, based on the available local data and Figures 8-1 and 8-2 of NEI 12-06, the plant site does experience significant amounts of snow, ice, and extreme cold temperatures; therefore, the hazard is screened in. The licensee has appropriately screened in the hazard and characterized the hazard in terms of expected temperatures.

3.5.5 Extreme Heat

In the section of its FIP regarding the determination of applicable extreme external hazards, the licensee stated that, as per NEI 12-06 Section 9.2, all sites are required to consider the impact of extreme high temperatures. The licensee stated that the maximum temperature referenced in the Unit 2 UFSAR, Section 2.3.1.2.2, Climatological Normals and Extremes, is 102°F. The plant site screens in for an assessment for extreme high temperature hazard.

In summary, based on the available local data and the guidance in Section 9 of NEI 12-06, the plant site does experience extreme high temperatures. The licensee has appropriately screened in the high temperature hazard and characterized the hazard in terms of expected temperatures.

3.5.6 Conclusions

Based on the evaluation above, the NRC staff concludes that the licensee has developed a characterization of external hazards that is consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order in regard to the characterization of external hazards.

3.6 Planned Protection of FLEX Equipment

3.6.1 Protection from External Hazards

In its FIP, the licensee stated that Nine Mile Point has constructed a single hardened FLEX storage structure of approximately 8,400 square feet that will meet the requirements for the external events identified in NEI 12-06, such as earthquakes, external floods, storms (high winds, and tornadoes), extreme snow, ice, extreme heat, and cold temperature conditions. The FSB is located inside the protected area fence on the West side of Unit 1, South of the sewage treatment plant and North of the independent spent fuel storage installation (ISFSI) area. In addition, the licensee stated that additional credited FLEX equipment will be stored in existing seismically qualified structures. Specifically, the Unit 2 reactor building, control building, and screenwell building.

Below are additional details on how FLEX equipment is protected from each of the applicable external hazards.

3.6.1.1 Seismic

In its FIP, the licensee stated that the FSB is designated as a seismic Category I and QA Category II structure (non-safety related) structure. The building design is based on SDC-1, "Structural Design Criteria," Revision 07, and the Unit 2 SSC current licensing basis for external hazards. In addition, the licensee stated that large FLEX portable equipment such as pumps, generators, portable battery charger, fuel trailers, pay loader, tractor, and trucks are secured with tie-down straps to floor anchors inside the FSB to protect them from seismic interactions from other components during an event. The FSB anchors are integrated into the floor slab.

3.6.1.2 Flooding

As stated above, the limiting flood mechanism at Nine Mile Point, Unit 2 is the PMP event, which produces a flood height of 262.5 ft. In its FIP, the licensee stated that the top of the floor elevation of the FSB is 263.3 ft., which is above the design-basis flood hazard elevation. Also, the licensee indicated that the FSB was designed and constructed to prevent water intrusion. Lastly, the Lake Ontario shoreline adjacent to Nine Mile Point is protected by a 1,000 ft. long rock dike adjacent to Unit 1 transitioning to a revetment ditch adjacent to Unit 2, both with a top elevation of 263 ft.

3.6.1.3 High Winds

In its FIP, the licensee stated that the FLEX portable N and N+1 equipment is stored in the tornado and tornado missile proof FSB. Deployment pathways blocked by tornado debris can be cleared using the FLEX pay loader and other debris removal tools such as chainsaws, disaster saws, tow chains, etc., which are also stored in the FSB.

3.6.1.4 Snow, Ice, Extreme Cold and Extreme Heat

The licensee has evaluated and procured FLEX equipment (i.e., pumps, DGs, etc.) that is capable of operating in extreme temperatures. In its FIP, the licensee stated that the FLEX generators are rated for full load operation at temperatures as low as -25°F. Freeze protection for FLEX pumps and hoses is provided by maintaining flow in the pump/hose through the use of a minimum flow line controlled at the FLEX distribution manifold by the operator. Diesel fuel for FLEX equipment is treated with a fuel additive during cold weather conditions to prevent gelling.

Regarding extreme high temperatures, the FLEX generators vendor manual shows a maximum ambient temperature of 158°F for the control unit and 122°F for the cooling system. The FLEX pumps are capable of operating in temperatures up to 132°F.

In addition, the FSB has its own heating and ventilation system. Per the building design, the maximum predicted temperature of 105.34°F inside the building is based on a maximum outdoor temperature of 103°F. This 105.34°F temperature does not challenge the FLEX portable equipment capabilities.

3.6.2 Reliability of FLEX Equipment

Section 3.2.2 of NEI 12-06 states, in part, that in order to assure reliability and availability of the FLEX equipment, the site should have sufficient equipment to address all functions at all units onsite, plus one additional spare (i.e., an N+1 capability, where "N" is the number of units on site). It is also acceptable to have a single resource that is sized to support the required functions for multiple units at a site (e.g., a single pump capable of all water supply functions for a dual unit site). In this case, the N+1 could simply involve a second pump of equivalent capability. In addition, it is also acceptable to have multiple strategies to accomplish a function, in which case the equipment associated with each strategy does not require an additional spare.

Based on the number of portable FLEX pumps, FLEX DGs, and support equipment identified in the FIP and during the audit review, the NRC staff concludes that, if implemented appropriately, the licensee's FLEX strategies include a sufficient number of portable FLEX pumps, FLEX DGs, and equipment for RPV makeup and core cooling, SFP makeup, and maintaining containment consistent with the N+1 recommendation in Section 3.2.2 of NEI 12-06.

3.6.3 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should protect the FLEX equipment during a BDBEE consistent with NEI 12-06 guidance as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.7 Planned Deployment of FLEX Equipment

The licensee stated in its FIP that pre-determined, preferred haul paths have been identified and documented in procedures N2-DRP-FLEX-MECH and N2-DRP-FLEX-ELEC. Figure 3 of the FIP shows the haul paths from the FSB to the various deployment locations. These haul paths have been reviewed for potential soil liquefaction and have been determined that the impact to be minimal following a seismic event.

3.7.1 Means of Deployment

The deployment of onsite FLEX equipment to implement coping strategies beyond the initial plant capabilities (Phase 1) requires that pathways between the FSB and various deployment locations be clear of debris resulting from seismic, high wind (tornado), excessive snow/ice, or flooding events. The stored FLEX equipment includes debris removal equipment, including tractors with the capability to remove snow. In addition, FLEX debris removal hand held tools (e.g., tow chains, chains, etc.) are available. All equipment is stored in the FSB.

The licensee may need to open doors and gates that rely on electric power for opening and/or locking mechanisms. The licensee has contingencies for access upon loss of all ac/dc power as part of the security plan. Access to the owner-controlled area, the plant protected area, and areas within the plant structures will be controlled under this access contingency.

Phase 3 of the FLEX strategies involves the receipt of equipment from offsite sources including the NSRC and various commodities such as fuel and supplies. Transportation of this equipment can be through airlift or via ground transportation. Debris removal for the pathway between staging areas 'A' and the NSRC receiving location staging area 'B' and from the various plant access routes may be required based on conditions present. The same debris removal equipment used for onsite pathways will be used to support debris removal to facilitate road access to the site.

3.7.2 Deployment Strategies

In its FIP, the licensee stated that the haul paths were reviewed for potential soil liquefaction. The licensee evaluated the primary and alternate routes using original site borings, the extensive borings conducted for the installation of the ISFSI and the associate heavy haul path, and the recent soil borings for the design of the new FSB. The licensee concluded that the soil liquefaction potential for the primary and alternate deployment paths is considered minimal. During the onsite audit, the NRC staff reviewed the licensee's evaluation to verify the licensee's conclusions and the NRC staff believes that liquefaction should not inhibit the necessary equipment deployment after an earthquake.

For the makeup water supply strategy, the licensee will deploy portable FLEX pumps from the FSB to a location near the selected water source. The primary staging location and suction source is from the North side of the screenwell. An alternate staging area for the FLEX pump and suction hose is available from the Northeast side of the screenwell in the event the North side screenwell area is not accessible.

For RPV and SFP makeup, the primary strategy utilizes a manifold, mounted on a push cart, located in the Unit 2 reactor building track bay. The manifold will receive water from the portable FLEX pump staged at the screenwell building. When not in use, the manifold and cart are stored locally in the reactor building.

For the electrical strategy, the primary strategy is to deploy the FLEX portable generator to the east side of the Unit 2 control building. The alternate strategy is to deploy the FLEX portable generator to the east side of the Unit 2 115 kV switchyard.

3.7.3 Connection Points

3.7.3.1 Mechanical Connection Points

Makeup Water Supply

In the FIP, Section 2.9.1 indicated that Lake Ontario will be used as the primary water source to support makeup strategies at Nine Mile Point, Unit 2. The suction of the portable FLEX pump is connected to the dry hydrants, which tap into the intake water tempering line located in the Unit 2 service water system intake tunnels upstream of the trash rakes at elevation 228 ft., 15 feet below the minimum lake level. The dry hydrant connections are located on the north side of the screenwell building in a missile protected enclosure. The intake tunnels where the tempering line is located are seismic Class I structures. The FIP described the alternate makeup water connection for the portable FLEX pump and suction hose as being located on the west side of the screenwell building. The portable FLEX pump suction hose will be installed in an opening upstream of the intake trash rakes. The 6 inch suction hose will then be routed from the portable FLEX pump suction to the service water system intake bay where water will be drawn through a strainer to limit solid debris. The makeup water strategy only calls for one portable FLEX pump. The N+1 portable FLEX pump is stored in the FSB, which is robust and protected from all applicable external hazards as defined in NEI 12-06.

RPV Makeup Strategy

In NEI 12-06, Table C-1, states, in part, that the performance attributes for make-up for core cooling with a portable pump should include primary and alternate injection points to establish the capability to inject through separate divisions/trains, i.e., should not have both connections in one division/train. In its FIP, Section 2.9.2, the licensee stated that the primary RPV makeup will be provided through a manifold, which is mounted on a push cart, located in the Unit 2 reactor building track bay. The portable FLEX pump will deliver water through the manifold valve using a 3 inch hose that runs 800 ft. The push cart with the manifold will be stored in the Unit 2 reactor building, which is a seismic Category I structure and protected from all applicable external hazards as defined in NEI 12-06. Primary RPV make up consists of 200 ft. of 2 inch hose routed from the manifold valve, through the East side reactor building hoisted up to reactor building 289 ft. elevation to the tie-in at RHR 'A', and interfaces with a flanged FLEX hose connection. An elevated platform is provided for access to the flange connection at RHR 'A'. The hose is stored near the RHR FLEX hose connections in boxes located on elevation 289 ft. of the reactor building. The alternate RPV makeup is described in the FIP as using RHR 'B'. A hose connection is also installed at a blank flange in the cross-tie between condensate transfer system (CNS) piping and RHS 'B' piping on reactor building 289 ft. elevation. The 2 inch hose is routed from the FLEX manifold discharge to this hose connection through the reactor building East side hoist well. The flanged hose connection and 200 ft. of 2 inch hose are stored in boxes near the RHR hose connection flanges. This hose connection is located close to floor level and no special equipment is needed for access.

SFP Makeup Strategy

In NEI 12-06, Table C-3, states, in part, that the baseline capabilities for SFP cooling include makeup via hoses on refuel floor, spray capability via portable monitor nozzles from refueling floor and makeup via connection to SFP cooling piping or other alternate location. In the FIP, Section 2.9.3 stated that the primary SFP makeup strategy utilized the same hose connection from the portable distribution manifold to a permanent hose connection point on reactor building 289 ft. elevation that will supply makeup water to the SFP on reactor building elevation 353 ft. The RHR 'B' loop will be utilized for SFP makeup after valve manipulation and the makeup water is delivered to the SFP cooling system. The manifold valve is throttled to 32 percent open to allow for simultaneous delivery to both RHR 'A' and RHR 'B' connections for the RPV and SFP makeup, respectively. The alternate SFP make-up strategy uses a flanged hose connection point on reactor building 289 ft. elevation at RHR 'A' loop via the FLEX manifold for a FLEX pump to supply lake water to the SFP. The backup to the primary and alternate SFP makeup strategies involves routing hose from the second portable FLEX pump discharge into the reactor building and up the stairs to elevation 328 ft. On reactor building elevation 328 ft., a valve hose splitter is used to create two hose paths to the SFP, one route to the side of the SFP and connected to an oscillating spray nozzle (Ozzi), and the other is tied down to the SFP railing on the side of the pool for direct SFP makeup. The oscillating spray nozzle can be used to provide spray flow over the SFP for cooling, if the pool's integrity has been compromised.

Given the design and location of the primary and alternate connection points, as described in the above paragraphs, the NRC staff concludes that at least one of the connection points should be available to support RPV makeup and SFP makeup through a portable FLEX pump during an ELAP caused by an external event, consistent with NEI 12-06 Section 3.2.2. Furthermore, the NRC staff concludes that the licensee's capability to provide makeup to the RPV through a primary and alternate injection point that is through separate divisions/trains is consistent with the provisions provided in NEI 12-06, Table C-1. In addition, the NRC staff concludes that the available connection points and strategies to provide SFP make-up and cooling are consistent with NEI 12-06, Table C-3.

3.7.3.2 Electrical Connection Points

In its FIP, the licensee stated that the Phase 2 strategies use installed and portable onsite equipment that will be deployed to plant locations to provide for continued RPV makeup and SFP cooling, as well as power to the FLEX pumps and vital 600 Vac buses. Portable FLEX 600 Vac DGs will provide power to all necessary loads. The electrical equipment will be relied upon throughout Phase 2 and be supplemented by NSRC supplied equipment in Phase 3. As described in the FIP, all electrical connection points are located in the control building; thus all connections are within seismic Category I structures and are protected from all postulated external hazards as defined in NEI 12-06.

During Phase 2, one 600 Vac DG will be deployed to connect to the Division I 600 Vac switchgear via a BCD. Division I is preferred due to the RCIC system dc power. Alternately, a portable FLEX 600 Vac DG could be deployed to connect to the Division II 600 Vac switchgear via a BCD.

In its FIP, the licensee stated that the FLEX PDG is deployed from the FSB to the East side of the Unit 2 control building near the equipment access door, in which the temporary cables will be routed. The alternate route for connecting the FLEX DG to a selected unit substation is to deploy to the East side of the Unit 2 115 KV switchyard and route temporary cables through a selected access door located on the West side of the control building. The licensee strategy uses a 600 Vac, 450 kW FLEX DG to power one of the existing safety-related 600 Vac unit substations. This enables 600 Vac power restoration to key FLEX related loads and 600 Vac /125 Vdc battery chargers in either Division I or Division II, in order to maintain vital dc loads necessary to support FLEX strategy implementation. In accordance with the Nine Mile Point engineering change package ECP-13-001068, "Unit 2 FLEX Fukushima FLEX Phase 2 Electrical Generator Connections," Revision 0, the connection between the portable FLEX DG and the 600Vac Division I or Division II unit substation is via temporary cables with quick connect fittings to BCDs located in the Division I or Division II unit substation. These unit substations are the normal 600 Vac power supply to the vital battery chargers. The BCDs are stored in place in the selected unit substations. The BCD is racked-in to seismically restrain it, but is not connected to the bus. The electrical cables are stored on reels in a hallway closet located just south of the emergency switchgear rooms near their intended use. Procedure N2-DRP-FLEX-ELEC, "Emergency Damage Repair – BDB/FLEX Generator Deployment Strategy," Revision 0, provides guidance for operation and deployment of the BDB/FLEX 600 Vac DGs to supply 600 Vac power to keep safety-related battery voltage adequate to supply power to the selected division loads.

In its FIP, the licensee stated that the NSRC will supply two Turbine Marine 1100 kW 480 Vac 3 phase CTGs with 480/600 Vac step up transformer (1 per unit). This NSRC equipment is a backup to onsite Phase 2 equipment. The NSRC generators come with the same size connectors as the onsite Phase 2 FLEX generators and BCDs. As such, the proposed onsite staging locations, cable pathways, and connections are the same as those used for connections of the Phase 2 equipment. The electrical connections for the NSRC supplied equipment and Unit 2 FLEX equipment are identical and the NSRC generator phase rotation is verified, as described in procedure S-DRP-OPS-005.

Based on its review of conceptual single line electrical diagrams and station procedures, the NRC staff concludes that the licensee's approach is acceptable given the protection and diversity of the power supply pathways, the separation and isolation of the FLEX DGs from the Class 1E emergency DGs, and availability of procedures to direct operators how to align, connect, and protect associated systems and components.

3.7.4 Accessibility and Lighting

During the onsite audit, the licensee stated that the potential impairments to required access are: 1) doors and gates, and 2) site debris blocking personnel or equipment access. The coping strategy to maintain site accessibility through doors and gates is applicable to all phases of the FLEX coping strategies, and is immediately required as part of the immediate activities required during Phase 1. Doors and gates serve a variety of barrier functions on the site. One primary function is security and is discussed below. However, other barrier functions include fire, flood, radiation, ventilation, tornado, and high energy line break. As barriers, these doors and gates are typically administratively controlled to maintain their function as barriers during normal operations.

The licensee noted that following a BDBEE and subsequent ELAP event, FLEX coping strategies require the routing of hoses and cables to be run through various barriers in order to connect BDB equipment to station fluid and electric systems or require the ability to provide ventilation. For this reason, certain barriers (gates and doors) will be opened and remain open. This deviation of normal administrative controls is acknowledged and is acceptable during the implementation of FLEX coping strategies. The ability to open doors for ingress and egress, ventilation, or temporary cables/hoses routing is necessary to implement the FLEX coping strategies.

Regarding lighting, the licensee evaluated the tasks to be performed and the available lighting in the designated task areas to validate the adequacy of supplemental lighting and the adequacy and practicality of using portable lighting to perform FLEX strategy actions. The licensee determined that the battery powered Appendix R emergency lights provide adequate lighting for all primary FLEX connection points in the FLEX strategies including the illumination for all interior travel pathways needed to access the connection points. These emergency lights provide a minimum of eight hours of lighting with no external ac power sources. However, this lighting may not be available following a seismic event.

A supply of flashlights, headlights, batteries and other lighting tools are routinely used by operators. These supplies are stored in different locations throughout the site, including the control room. In addition, the licensee recognized that there are no emergency lighting fixtures in the outside areas of the protected area to provide necessary lighting in those areas where portable FLEX equipment is to be deployed. Therefore, the tow vehicles for the FLEX portable pump and generator carry hand held flash lights and head lamps that can be used while deploying the pump and hoses, generator and cables. Also, the FSB contains flashlights and batteries, head lamps and batteries, and battle lanterns.

3.7.5 Access to Protected and Vital Areas

During the audit process, the licensee provided information describing that access to protected areas will not be hindered. The licensee has contingencies in place to provide access to areas required for the ELAP response if the normal access control systems are without power.

3.7.6 Fueling of FLEX Equipment

In the FIP, Section 2.9.5 states that the coping strategy for supplying fuel oil to diesel-driven portable equipment during an ELAP event is to draw fuel oil out of the Unit 2 emergency DG fuel oil storage tanks. The licensee explained in its FIP, that the Unit 1 emergency DG fuel oil storage tanks are below grade and the tank access ports will not be accessible based on the reevaluated flood hazard. Calculations associated with fuel oil consumption were performed assuming the equipment required for full implementation of mitigation strategies at both units are in operation simultaneously. For conservatism, the licensee assumed that only two of the three Unit 2 emergency diesel generator fuel oil storage tanks will be available, which equates to a capacity of greater than 85,000 gallons. Fuel consumption for portable equipment operating at full load for both units to support FLEX (4 diesel-driven portable pumps, 2 diesel-driven portable generators and 1 diesel-driven portable air compressor) is approximately 130 gallons per hour. Based on the fuel oil consumption of the FLEX equipment from both units operating at full load, the NRC staff noted that the available fuel oil in two of the robust Unit 2 emergency diesel generator fuel oil storage tanks would support the FLEX strategies for over 25 days of continuous operation. The licensee indicated that it expects the emergency response organization can ensure delivery of replenishment fuel as required within 25 days from the initiation of the ELAP event. Based on the safety-related classification and location of the Unit 2 emergency diesel generator fuel oil storage tanks, the NRC staff concludes that the Unit 2 tanks are robust and the fuel oil contents should be available to support the licensee's FLEX strategies during an ELAP event and the quantity available is sufficient until offsite resources can provide fuel oil replenishment to the site.

In the FIP, Section 2.9.5 states that the site has two 528 gallon fuel tanks mounted on separate trailers equipped dc-powered fuel transfer pump, which are stored in the FSB, to support FLEX equipment refueling. These tankers will be filled by using portable fuel oil transfer pumps, stored in the FSB, taking suction from the Unit 2 emergency DG fuel oil storage tanks. The portable transfer pumps are capable of providing over 31 gpm flowrate and the on-board transfer pumps on the trailers are capable of providing approximately 20 gpm. Based on the available protected equipment to support refueling operation, the available run-time and fuel oil consumption rate on each piece of FLEX equipment, the NRC staff concludes that the diesel-powered FLEX equipment can be adequately refueled to ensure uninterrupted operation to support the licensee's FLEX strategies.

In the FIP, Section 2.18.6 states that a fleet procedure has been developed to address preventative maintenance using EPRI templates or manufacturer provided information and recommendations. Preventative Maintenance templates for the major FLEX equipment including the portable diesel pumps and generators have also been issued and include activities such as fluid analyses. Since the Unit 1 and Unit 2 FLEX equipment relies on the Unit 2 emergency diesel generator fuel oil storage tanks, the NRC staff noted that the technical specifications for Unit 2 (surveillance requirement SR 3.8.3.3) require that fuel oil properties of new and stored fuel oil are tested in accordance with, and maintained within the limits of, the diesel fuel oil testing program. Based on the licensee's technical specification requirements and preventative maintenance activities for FLEX equipment, the NRC staff concludes that the licensee has addressed management of fuel oil in the emergency DG fuel oil storage tanks and portable FLEX equipment to ensure FLEX equipment will be supplied with quality fuel oil during an ELAP event.

3.7.7 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should allow deploying the FLEX equipment following a BDBEE consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.8 Considerations in Using Offsite Resources

3.8.1 Nine Mile Point SAFER Plan

The industry has collectively established the needed off-site capabilities to support FLEX Phase 3 equipment needs via the SAFER Team. The SAFER Team consists of the Pooled Equipment Inventory Company (PEICo) and AREVA Inc. and provides FLEX Phase 3 management and deployment plans through contractual agreements with every commercial nuclear operating company in the United States.

There are two NSRCs located near Memphis, Tennessee and Phoenix, Arizona, established to support nuclear power plants in the event of a BDBEE. Each NSRC holds five sets of equipment, four of which will be able to be fully deployed to the plant when requested. The fifth set allows removal of equipment from availability to conduct maintenance cycles. In addition, the plant's FLEX equipment hose and cable end fittings are standardized with the equipment supplied from the NSRC.

By letter dated September 26, 2014 (ADAMS Accession No. ML14265A107), the NRC staff issued its assessment of the NSRCs established in response to Order EA-12-049. In its assessment, the staff concluded that SAFER has procured equipment, implemented appropriate processes to maintain the equipment, and developed plans to deliver the equipment needed to support site responses to BDBEEs, consistent with NEI 12-06 guidance; therefore, the staff concluded in its assessment that licensees can reference the SAFER program and implement their SAFER Response Plans to meet the Phase 3 requirements of Order EA-12-049.

The NRC staff noted that the licensee's SAFER Response Plan contains (1) SAFER control center procedures, (2) NSRC procedures, (3) logistics and transportation procedures, (4) staging area procedures, which include travel routes between staging areas to the site, (5) guidance for site interface procedure development, and (6) a listing of site-specific equipment (generic and non-generic) to be deployed for FLEX Phase 3.

3.8.2 Staging Areas

In general, up to four staging areas for NSRC supplied Phase 3 equipment are identified in the SAFER Plans for each reactor site. These are a Primary (Area C) and an Alternate (Area D), if available, which are offsite areas (within about 25 miles of the plant) utilized for receipt of ground transported or airlifted equipment from the NSRCs. From Staging Areas C and/or D, the SAFER team will transport the Phase 3 equipment to the on-site Staging Area B for interim staging prior to it being transported to the final location in the plant (Staging Area A) for use in Phase 3. For Nine Mile Point Staging Area C is the Syracuse Hancock International Airport. Staging Area B is the parking lot located south of the P-building and the overflow parking lot on the east side of the warehouse access road. Staging Area A for the NSRC pumps is the north side of Unit 2 screenwell building at the FLEX dry hydrants and Staging Area A for the NSRC portable generators is the Unit 2 courtyard east of the Unit 2 control building. Procedure S-DRP-OPS-005, "Use of FLEX Phase 3 SAFER Equipment," provides a map depicting these 'A' and 'B' Staging Areas.

Use of helicopters to transport equipment from Staging Area C to Staging Area B is recognized as a potential need within the Nine Mile Point SAFER Plan.

3.8.3 Conclusions

Based on this evaluation, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should allow utilization of offsite resources following a BDBEE consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.9 Habitability and Operations

3.9.1 Equipment Operating Conditions

3.9.1.1 Loss of Ventilation and Cooling

Following a BDBEE and subsequent ELAP event, plant HVAC in occupied areas and areas containing permanent plant and FLEX mitigation strategy equipment will be lost. Per NEI 12-06, FLEX mitigation strategies must be capable of execution under the adverse conditions (unavailability of normal plant lighting, ventilation, etc.) expected following a BDBEE resulting in an ELAP and a loss of normal access to the UHS. The primary concern with regard to ventilation is the heat buildup, which occurs with the loss of forced ventilation in areas that continue to have heat loads.

The areas identified for all phases of execution of the FLEX mitigation strategy activities are the control room, RCIC pump room, standby switchgear rooms, Class 1E station battery rooms, reactor building, computer and relay room, and containment. The licensee evaluated these areas to determine the temperature profiles following an ELAP and a loss of normal access to the UHS event.

Control Room

The NRC staff reviewed the licensee's evaluation of the effect of higher temperatures on the electrical and electronic equipment installed in the control room. The licensee's evaluation in calculation ES-198, "Control Building Station Blackout Analysis," Revision 1, indicated that the control room temperature is expected to reach 100°F at 1.6 hours. This peak temperature then starts decreasing and stays constantly less than 100°F throughout the event. Procedure N2-SOP-01 provides guidance to the operators to block open certain doors and panels for additional cooling within the first 30 minutes after ventilation is lost. When selected electrical loads in the control room are restored following the deployment of the FLEX 600 Vac DG in Phase 2, one of the control room air conditioning fans may be restored, if determined necessary. Outside air (1500 CFM) will also be available through either the Division I or Division II special filter train to provide air circulation and makeup air from outside. The above strategies (opening doors, restoring control room air conditioning fans, and establishing outside air circulations etc.) should maintain control room temperature within acceptable limits. The fan loads for the control room ventilation are within the FLEX 600 Vac DG load capability.

Based on the control room temperature (100°F) remaining below 120°F (the temperature limit, as identified in NUMARC-87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," Revision 1, for most of the equipment to be able to survive indefinitely) and the licensee's mitigating actions in Procedure N2-SOP-01, such as monitoring control room temperature and opening doors within 30 minutes, the NRC staff concludes that it is reasonable to assume that the equipment in the control room will not be adversely impacted by the loss of ventilation as a result of an ELAP event.

RCIC Pump Room

The licensee evaluation 2015-01099 (Appendix B), "RCIC Equipment Survivability Review," Revision 0, stated that the only electrical equipment in the RCIC pump/turbine room are the cable trays, and the cables in the cable trays are not powered during an ELAP event. As such, the NRC staff concludes that there is no electrical equipment in the RCIC pump/turbine room that could be adversely impacted due to a loss of ventilation during an ELAP event. At Unit 2, the electronic governor module (EGM) is installed in a panel that is installed in a different room on the North exterior wall of the reactor building auxiliary bay. As such, the elevated temperature in the RCIC pump room has no impact on functioning of the electronic components and controls of the EGM.

Emergency Switchgear Rooms for Switchgears, DC equipment and Battery Charger/Inverter) (Control Building El. 261')

The NRC staff reviewed the licensee's evaluation of the effect of higher temperatures in the standby switchgear rooms. At Nine Mile Point, Unit 2, switchgears, dc equipment and battery chargers are located in separate Division I and Division II emergency switchgear rooms within the control building. In calculation HVC-083, "Temperature Evaluation In NMP2 Emergency Switchgear Rooms during ELAP," Revision 01.00, and licensee evaluation 2-057, "Tracking Form for NRC Audit Related Questions or Document Request," dated November 19, 2015, the licensee stated that the maximum room temperature in the switchgear rooms during an ELAP is expected to be 106°F and remains constant for the remainder of the event. This temperature is 2°F higher than the room design temperature. However, based on room temperatures remaining below 120°F (the temperature limit, as identified in NUMARC-87-00, for most of the equipment to be able to survive indefinitely), the NRC staff concludes that it is reasonable to assume that the equipment in the emergency switchgear rooms in the control building will not be adversely impacted by the loss of ventilation as a result of an ELAP event.

Class 1E Station Battery Rooms

The NRC staff reviewed licensee evaluation 2-052, "Tracking Form for NRC Audit Related Questions or Document Request," dated October 30, 2015, on the effects of higher temperatures in the Class 1E Division I battery rooms. The NRC staff also reviewed the licensee's station blackout calculation ES-198, "Control Building Station Blackout Analysis," Revision 1, which showed that the maximum expected temperature in the Division I station battery room would reach 99°F in 8 hours with an initial room temperature of 85°F. Calculation ES-198 further showed that room temperature would continue to rise after 8 hours with no actions. In its FIP, the licensee stated that during Phase 2 operation, the Unit 2 strategy in procedure N2-DRP-FLEX-ELEC requires restoration of battery room exhaust fans within 8 hours that should cool the room temperature and maintain below room design limit of 104°F per calculation HVC-064 "Heat Gain & Cooling Requirement for Standby Switchgear Room Control Building Elevation 261 Foot 6 Inch," Revision 03.00, with a maximum outdoor ambient design temperature of 93°F.

The concrete walls, floors and ceiling in the safety-related battery rooms function as a large heat sink following loss of ventilation. Heat loads in and around the vital battery rooms following an ELAP are minimal (lighting, dc-powered loads) compared to normal operating loads such as large transformers and breakers, battery chargers, and motors. Additionally, following an ELAP, plant operators would strip loads from the station's safety-related batteries to prolong the life of the batteries. The heat load from batteries during discharge and charging is a function of the internal resistance and the square of the current. Since the licensee expects load shedding to be completed approximately 240 minutes from the onset of an ELAP event, the heat generated in the battery will be minimized due to the lower current draw, and the rate of release into the room will be slow due to the large mass of electrolyte. Furthermore, the heat sinks in the vital battery rooms minimize the rate of temperature increase or decrease in the battery room, regardless of the outside ambient temperature.

Procedure N2-DRP-FLEX-ELEC requires monitoring the battery conditions including electrolyte levels, and obtaining support, as necessary, to mitigate adverse environmental conditions in the battery rooms.

Based on the above, the NRC staff concludes that the licensee's ventilation strategy, in combination with the effect of the heat sinks in and around the vital battery rooms, will maintain the battery room temperature below the maximum temperature limit (120°F) of the NCN batteries, as specified by the battery manufacturer (Exide Technologies). Therefore, the NRC staff concludes that the Unit 2 vital batteries should perform their required functions at the expected temperatures as a result of loss of ventilation during an ELAP event.

Computer and Relay Room

The NRC staff reviewed the licensee's evaluation of the effects of higher temperatures in the computer and relay rooms. The licensee's evaluation in calculation ES-198 stated that the maximum expected temperature in the computer and relay rooms would reach 106°F peak at approximately 1.67 hours, then lowers to 102°F and appear to remain steady state thereafter. Based on room temperatures remaining below 120°F (the temperature limit, as identified in NUMARC-87-00, for electronic equipment to be able to survive indefinitely), the NRC staff concludes that it is reasonable to assume that the equipment in the computer and relay rooms will not be adversely impacted by the loss of ventilation as a result of an ELAP event.

Containment (Primary Containment)

In calculation N2-2014-004, the licensee determined that the drywell peak temperature and pressure following an ELAP are expected to be approximately 272°F and 45 psig and suppression pool peak temperature and pressure are expected to be 280°F and 45 psig. The critical equipment that the operators will rely on during an ELAP are the RPV SRVs located in the primary containment. The SRV solenoid valves have solenoid coils that will be exposed to the primary containment temperature and pressure. The Unit 2 EQ document 2EQDP-SOV011 shows that the SRV solenoid coil would operate at above 325°F for up to 100 days. As such, no adverse impact is expected on the SRV solenoid coils due to the higher temperatures during an ELAP event. The licensee stated that no other critical monitoring instruments required for the ELAP event are located in the primary containment.

Secondary Containment (Reactor Building)

See Section 3.4.4.4 of this SE for the NRC staff's evaluation of the licensee's mitigating strategy for maintaining secondary containment temperature within design limit of credited instrumentation and equipment.

3.9.1.2 Loss of Heating

In the FIP, Section 2.11.3 described that the FLEX equipment is stored in the FSB, which is designed and protected from snow, ice, and extreme cold in accordance with NEI 12-06, and is temperature controlled. Major components for FLEX strategies such as tow vehicles and generators are provided with cold weather packages. The FIP also described that the FLEX connection points are located inside seismically-qualified structures, which are temperature-controlled and do not require heat tracing. The FLEX dry hydrants are enclosed in a missile protected structure, which contains a radiant heater to protect the pipes within from freezing when the hydrants are not in use. The equipment and tools used to make the FLEX connections are stored in areas immediately adjacent to the deployment connections. The FLEX manifold located in the reactor building track bay has an additional connection to allow water to flow from the portable FLEX pump, into the manifold and back out through the valve. A hose attached at this location is to be routed back out of the reactor building and towards Lake Ontario. The licensee indicated that the hose will allow the portable FLEX pump to continue to operate and flow water during low or zero system demand in order to meet minimum pump flow requirements, as well as to aid in freeze protection.

The Nine Mile Point, Unit 2 battery rooms are located within control building at ground elevation. The battery walls are not exposed to outside weather conditions, and are in the interior of the control complex. The safety-related batteries are located in the interior of the control building such that outside air temperature would not impact battery performance and battery rooms are normally maintained at approximately 77°F. In addition, during battery discharge, the battery will be producing heat which will keep electrolyte temperature above the room temperature. Procedure N2-DRP-FLEX-ELEC includes a note to monitor battery conditions including electrolyte levels, and obtain support, as necessary, to mitigate adverse environmental conditions in the battery rooms. Based on its review of the licensee's battery room assessment and procedure, the NRC staff concludes that the Unit 2 safety-related batteries should perform their required functions as a result of loss of heating during an ELAP event.

3.9.1.3 Hydrogen Gas Control in Vital Battery Rooms

An additional ventilation concern that is applicable to Phases 2 and 3 is the potential buildup of hydrogen in the battery rooms as a result of loss of ventilation during an ELAP event. Off-gassing of hydrogen from batteries is only a concern when the batteries are charging.

In licensee calculation HVC-64, "Unit 2 Battery Room Hydrogen Generation and Negative Pressure," Revision 03, the licensee evaluated the required air flow to remove sufficient hydrogen generated by the batteries during recharging and maintain hydrogen concentration level in the battery rooms below combustible limits. The licensee determined that the flow rate required to maintain hydrogen concentration level from the battery rooms is low compared to the flow rate required to maintain negative pressure in the battery rooms as required by the Unit 2 UFSAR. As such, the air flow from the battery room exhaust fans 2HVC*FN4A/B and Unit Coolers 2HVC*UC101A/B will remove sufficient hydrogen from the battery rooms and will maintain hydrogen concentration levels below the hydrogen combustible limit (4 percent). Furthermore, the licensee stated in its FIP that procedure N2-DRP-FLEX-ELEC requires battery room exhaust fans to be restored for ventilation prior to energizing the battery chargers.

Based on its review of the licensee's FIP and hydrogen generation analysis, the NRC staff concludes that it is reasonable that hydrogen accumulation in the 125 Vdc safety-related battery rooms will not reach the combustibility limit for hydrogen (4 percent) during an ELAP event as a result of a BDBEE since power will be restored to the vital battery room HVAC system prior to restoring the battery chargers and recharging the batteries during Phase 2 and Phase 3.

3.9.2 Personnel Habitability

The licensee described in FIP Section 2.11.2, the various personnel equipment (gloves, coats, rain gear, etc.) to address bad weather conditions when performing FLEX deployment actions.

The licensee also indicated that portable heaters and shelters are available for deployment when outside actions during adverse weather conditions are needed for extended periods. All the above equipment is stored in the FSB.

3.9.2.1 Main Control Room

Calculation ES-198, "Control Building Station Blackout Analysis," Revision 1, was originally performed to address SBO requirements. The calculation uses the THREED computer program. The calculation shows that the control room will remain below 100°F for 8-hours. The calculation showed the control room steady state temperature would be approximately 98°F. During the onsite audit, the NRC staff asked if the heat loads in the control room could change when the Phase 2 portable generators were placed in service. The licensee responded that when electrical loads are restored in the control room following the deployment of the FLEX generator, one of the control room air conditioning units may be available through one of the special filter trains. The licensee indicated that the fan loads are within the FLEX generator load capability. Procedure N2-SOP-01, "Station Blackout/Extended Loss of AC Power," provides guidance to monitor temperature and restore HVAC, if needed.

3.9.2.2 Spent Fuel Pool Area

Calculation ES-289, Revision 0, was performed to determine the environmental conditions for the new SFP water level sensing instrumentation. The calculation used the GOTHIC thermal hydraulic computer code, Version 8.0. The calculation determined that the refueling floor remains below 120°F until boiling occurs in the SFP (at roughly 23 hours). Procedure N2-SOP-01 requires operator actions to be completed within the first 8 hours of the ELAP. Once SFP boiling starts, the area temperature will be roughly 150°F with selected doors opened and venting at the roof level. Plant guidance document N2-DRP-FLEX-MECH, "Emergency Damage Repair – BDB/FLEX Pump Deployment Strategy," Section 6.8 addresses establishing the natural ventilation flow path.

3.9.2.3 Other Plant Areas

RCIC Pump Room

Evaluation 2015-01099, Appendix B, Revision 0, addressed the RCIC pump room environmental condition subsequent to an ELAP. The calculation used the GOTHIC thermal hydraulic computer program, version 8.1. Three cases were ran. Case 1 assuming the suppression pool is being vented at 45 psig. Case 2 assuming the suppression pool is being vented at 10 psig. Case 3 with the suppression pool being vented at 10 psig and no RCIC pump seal leakage. The calculation determined the room conditions with selected doors opened at 2 hours and additional doors opened at 8 hours subsequent to an ELAP. The room temperature will rapidly rise to 140°F by 2 hours. Once the door is opened, the room temperature will drop to roughly 125°F. The room temperature will continue to rise and will approach 140°F at roughly 10 hours. The room temperature will peak at roughly 215°F at 20 hours into the event when pump seal leakage is assumed. When pump seal leakage is assumed to be zero, the room approaches 140°F at 10 hours and exceeds 160°F at 50 hours following the onset of an ELAP. The licensee has determined that protective equipment may be necessary for personnel needing to access the room.

The FLEX pump is anticipated to be deployed and available after 4 hours into the event. Once suppression pool temperatures approach 240°F, 9 to 15 hours into the event, RCIC is assumed to fail and the FLEX pump will be operated. Once the FLEX pump is operating, access to the RCIC room will not be required.

3.9.3 Conclusions

The NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should maintain or restore equipment and personnel habitability conditions following a BDBEE consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.10 Water Sources

In the FIP, Section 2.9.15 states Lake Ontario provides an indefinite supply of water as make-up to the screen house inlet structure, specifically the water will be drawn from the service water system intake tunnel. The NRC staff noted that Lake Ontario will be used as the water source for make up to the RPV and SFP during Phase 2 and 3, and for containment cooling during Phase 3. The licensee confirmed that the intake and discharge tunnels are seismic Class I structures (see UFSAR Section III). Furthermore, there are diverse locations for the deployment of the FLEX pump (i.e., North side or Northeast side of the screen house); thus, the NRC staff concludes that it is reasonable that a BDBEE would not impact the ability of the FLEX pump to take suction from Lake Ontario from at least one of the screenhouse locations.

The portable FLEX pump takes suction from the Unit 2 service water system intake tunnel upstream of the trash rakes and the licensee explained that at the required FLEX pump flow rates, intake water will be flowing at a very low velocity such that it is not expected that significant debris will be carried into the area where the FLEX ump will be taking their suction. The licensee also described in its FIP, that the suction end of the barrel strainer will be located below the low level elevation of the lake at least 4 ft. below the water surface (marked line on suction hose), but well above the floor of the intake tunnel, preventing any debris that may have settled on the bottom of the tunnel to be lifted into the suction hose.

Consistent with NEI 12-06 Section 3.2.2.5, the NRC staff concludes that Lake Ontario (through the service water system intake tunnel) is a robust and indefinite water source that should be available during an ELAP to support the FLEX mitigation strategy for RPV and SFP makeup.

Based on the evaluation above, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should maintain satisfactory water sources following a BDBEE consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.11 Shutdown and Refueling Analyses

Order EA-12-049 requires that licensees must be capable of implementing the mitigation strategies in all modes. In general, the discussion above focuses on an ELAP occurring during power operations. This is appropriate, as plants typically operate at power for 90 percent or more of the year. When the ELAP occurs with the plant at power, the mitigation strategy initially focuses on the use of the steam-driven RCIC pump to provide the water initially needed for decay heat removal. If the plant has been shut down and all or most of the fuel has been removed from the RPV and placed in the SFP, there may be a shorter timeline to implement the makeup of water to the SFP. However, this is balanced by the fact that if immediate cooling is not required for the fuel in the reactor vessel, the operators can concentrate on providing makeup to the SFP. The licensee's analysis shows that following a full core offload to the SFP, about 30 hours are available to implement makeup before boil-off results in the water level in the SFP dropping far enough to uncover fuel assemblies, and the licensee has stated that they have the ability to implement makeup to the SFP within that time.

When a plant is in a shutdown mode in which steam is not available to operate a steam-powered pump such as RCIC (which typically occurs when the RPV has been cooled below about 300°F), another strategy must be used for decay heat removal. On September 18, 2013, NEI submitted to the NRC a position paper entitled "Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514), which described methods to ensure plant safety in those shutdown modes. By letter dated September 30, 2013 (ADAMS Accession No. ML13267A382), the NRC staff endorsed this position paper as a means of meeting the requirements of the order.

The position paper provides guidance to licensees for reducing shutdown risk by incorporating FLEX equipment in the shutdown risk process and procedures. Considerations in the shutdown risk assessment process include maintaining necessary FLEX equipment readily available and potentially pre-deploying or pre-staging equipment to support maintaining or restoring key safety functions in the event of a loss of shutdown cooling. The NRC staff concludes that the position paper provides an acceptable approach for demonstrating that the licensees are capable of implementing mitigating strategies in shutdown and refueling modes of operation. In its FIP, the licensee informed the NRC staff of its plans to follow the guidance in this position paper. During the audit process, the NRC staff observed that the licensee had made progress in implementing this guidance.

Based on the licensee's incorporation of the use of FLEX equipment in the shutdown risk process and procedures, the NRC staff concludes that the licensee has developed guidance that, if implemented appropriately, should maintain or restore core cooling, SFP cooling, and containment following a BDBEE in shutdown and refueling modes consistent with NEI 12-06 guidance, as endorsed by JLD-ISG-2012-01, and appears to adequately address the requirements of the order.

3.12 Procedures and Training

3.12.1 Procedures

Regarding procedures, the licensee stated in its FIP that the inability to predict actual plant conditions that require the use of BDB equipment makes it impossible to provide specific procedural guidance. As such, the FSGs will provide guidance that can be employed for a variety of conditions. Clear criteria for entry into FSGs will ensure that FLEX strategies are used only as directed for BDBEE conditions, and are not used inappropriately in lieu of existing procedures. When BDB equipment is needed to supplement emergency operating procedures (EOPs or abnormal/special operating procedures (SOPs) strategies, the EOP or SOP, severe accident mitigation guidelines (SAMGs, or extreme damage mitigation guidelines (EDMGs will direct the entry into and exit from the appropriate FSG procedure.

FLEX strategy support guidelines have been developed in accordance with BWROG guidelines. FSGs will provide available, preplanned FLEX strategies for accomplishing specific tasks in the EOPs or SOPs. The FSGs will be used to supplement (not replace) the existing procedure structure that establishes command and control for the event. Procedural interfaces have been incorporated into N2-SOP-01, "Station Blackout/ELAP," to the extent necessary to include appropriate reference to FSGs and provide command and control for the ELAP. Additionally, procedural interfaces have been incorporated to include appropriate reference to FSGs:

- N2-SOP-02, Station Blackout/Extended Loss of AC Power Support Procedure
- N2-SOP-78A, EOP Key Parameter-Alternate Instrumentation
- N2-OP-102, Meteorological Monitoring

The licensee also stated in the FIP that changes to FSGs are controlled by Exelon fleet procedure AD-AA-101, "Processing of Procedures and T&RMs." The FSG changes will be reviewed and validated by the involved groups to the extent necessary to ensure the strategy remains feasible. Validation for existing FSGs has been accomplished in accordance with the guidelines provided in NEI APC14-17, "FLEX Validation Process," issued July 18, 2014.

3.12.2 Training

In its FIP, the licensee stated that the Nine Mile Point nuclear training program has been revised to assure response leaders proficiency on beyond-design-basis emergency response strategies and implementing guidelines. In addition, personnel assigned to the direct execution of mitigation strategies for BDBEEs have received the necessary training to ensure familiarity with the associated tasks, instructions, and mitigating strategy time constraints. The training plan development was done in accordance with Nine Mile Point's procedures using the Systematic Approach to Training (SAT) process.

Based on the description provided above, the NRC staff concludes that, as described, the licensee's established procedural guidance meets the provisions of NEI 12-06, Section 11.4 (Procedure Guidance). Similarly, the NRC staff concludes that the training plan, including use of the SAT for the groups most directly impacted by the FLEX program, meets the provisions of NEI 12-06, Section 11.6 (Training).

3.13 Maintenance and Testing of FLEX Equipment

As a generic issue, NEI submitted a letter to the NRC dated October 3, 2013 (ADAMS Accession No. ML13276A573), which included EPRI Technical Report 3002000623, "Nuclear Maintenance Applications Center: Preventive Maintenance Basis for FLEX Equipment." By letter dated October 7, 2013 (ADAMS Accession No. ML13276A224), the NRC endorsed the use of the EPRI report and the EPRI database as providing a useful input for licensees to use in developing their maintenance and testing programs. In its FIP, the licensee stated that they would conduct maintenance and testing of the FLEX equipment in accordance with the industry letter.

In its FIP, the licensee stated that Nine Mile Point followed the EPRI generic industry guidance program for maintenance and testing of FLEX equipment or manufacturer provided information/recommendations, equipment testing, and the unavailability of equipment. The licensee states in its FIP, that preventive maintenance procedures and intervals have been established to ensure FLEX equipment is reliably maintained per manufacturer recommendations. The EPRI templates are used for equipment where applicable. However, in those cases where EPRI templates were not available, preventative maintenance actions were developed based on manufacturer provided information/recommendations and Exelon fleet procedure ER-AA-200, "Preventive Maintenance Program."

The NRC staff concludes that the licensee has adequately addressed equipment maintenance and testing activities associated with FLEX equipment because a maintenance and testing program has been established in accordance with NEI 12-06, Section 11.5.

3.14 Conclusions for Order EA-12-049

Based on the evaluations above, the NRC staff concludes that the licensee has developed guidance to maintain or restore core cooling, SFP cooling, and containment following a BDBEE which, if implemented appropriately, and appears to adequately address the requirements of Order EA-12-049.

4.0 TECHNICAL EVALUATION OF ORDER EA-12-051

By letters dated February 28, 2013 (ADAMS Accession No. ML13066A172) and March 8, 2013 (ADAMS Accession No. ML13073A155), the licensee submitted its OIP for Nine Mile Point in response to Order EA-12-051. By letter dated June 5, 2013 (ADAMS Accession No. ML13154A399), the NRC staff sent a request for additional information (RAI) to the licensee. The licensee provided a response by letter dated July 5, 2013 (ADAMS Accession No. ML13197A220). By letter dated November 15, 2013 (ADAMS Accession No. ML13281A205), the NRC staff issued an ISE and RAI to the licensee.

By letters dated August 27, 2013 (ADAMS Accession No. ML13254A279), February 24, 2014 (ADAMS Accession No. ML14069A180), August 26, 2014 (ADAMS Accession No. ML14241A016), February 19, 2015 (ADAMS Accession No. ML15062A035), August 28, 2015 (ADAMS Accession No. ML15243A093), and February 26, 2016 (ADAMS Accession No.

ML16057A003), the licensee submitted status reports for the integrated plan. The integrated plan describes the strategies and guidance to be implemented by the licensee for the installation of reliable SFP level instrumentation which will function following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-051. By letter dated June 14, 2016 (ADAMS Accession No. ML16167A172), the licensee reported that full compliance with the requirements of Order EA-12-051 was achieved.

The licensee has installed a SFP level instrumentation system designed by Areva. The NRC staff reviewed the vendor's SFP level instrumentation system design specifications, calculations and analyses, test plans, and test reports. The staff issued an audit report on October 9, 2014 (ADAMS Accession No. ML14241A454).

The staff performed an onsite audit to review the implementation of SFP level instrumentation related to Order EA-12-051. The scope of the audit included verification of (a) site's seismic and environmental conditions enveloped by the equipment qualifications, (b) equipment installation met the requirements and vendor's recommendations, and (c) program features met the requirements. By letter dated April 28, 2015 (ADAMS Accession No. ML15110A026), the NRC issued an audit report on the licensee's progress. Refer to Section 2.2 above for the regulatory background for this section.

4.1 Levels of Required Monitoring

Nine Mile Point, Unit 2 Level 1 is at elevation 352 ft. 7.5 inches (in.). The NRC staff evaluated Level 1 in the ISE as being the higher of two points for operation of the SFP cooling system and determined that it met the NEI 12-02 criteria.

Level 2 was changed to elevation 339 ft. 11.9 in as documented in the fourth six-month update. The NRC staff confirmed that this elevation is 10 ft. above the fuel rack and meets the criteria of NEI-12-02. In its OIP, the licensee declared Level 2 at a lower elevation based on a dose rate calculation. The new level is higher, provides more shielding at the edge of the pool deck, and, per the NEI 12-02 guidance, no longer requires the support of a dose rate calculation.

Level 3 is at elevation 329 ft. 11.9 in. The NRC staff confirmed in the ISE that Level 3 corresponds to the highest point (+/- 1 ft.) of any fuel rack seated in the SFP based on a sketch provided in the licensee's July 5, 2013, RAI response.

Based on the above, the NRC staff concludes that the licensee's proposed Levels 1, 2 and 3 appear to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2 Evaluation of Design Features

Order EA-12-051 required that the SFP level instrumentation shall include specific design features, including specifications on the instruments, arrangement, mounting, qualification, independence, power supplies, accuracy, testing, and display. Refer to Section 2.2 above for the requirements of the order in regards to the design features. Below is the staff's assessment of the design features of the SFP level instrumentation.

4.2.1 Design Features: Instruments

In its OIP, the licensee stated, in part, that it intends to implement one permanent fixed primary and one permanent fixed backup level instrument for the Unit 2 SFP. These instruments would be permanently located and mounted in the SFP. For Unit 2, each instrument channel will be capable of monitoring SFP water level from the top of the fuel racks (329ft. 11.9 in. elevation) to above the normal water level in the pool (352 ft. 10 in. elevation), for a minimum range of about 24 ft.

The NRC confirmed the design configuration in a sketch provided with the February 28, 2013, OIP and during the onsite audit SFP walkdowns.

Based on the above, the NRC staff concludes that the licensee's design, with respect to the number of channels and measurement range for its SFP, appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.2 Design Features: Arrangement

In its OIP, the licensee stated that the primary instrument channel level sensing components would be located in the Northeast corner of the SFP; and the backup would be located near the Northwest corner of the SFP at elevation 353 ft. 10 in. The OIP includes a plan view of Unit 2 showing the proposed location for both the primary and the backup instruments. The licensee also stated that the transmitter would be located in the reactor building at elevation 328 ft. 10 in. directly below the SFP operating floor. According to the licensee, these locations would provide protection against missiles without interfering with SFP activities. Cabling for power supplies and indications for each channel would be routed in separate conduits from cabling from other channels; and separation between cables for the primary and backup channels would be maintained.

In its letter dated July 5, 2013, the licensee stated that it intends to implement the fixed primary level instrument in the Northeast corner of the Unit 2 SFP and the backup level instrument in the Northwest corner. The licensee also provided a plan view of Unit 2 SFP depicting the proposed sensor placements. This figure also depicts the horns and waveguides cantilevered over the pool edge, above the water surface in the corners described above. The licensee also stated that the waveguides are routed through a core bore in the refueling floor to the sensor in the reactor building 328 ft. elevation below. Finally, the licensee stated that the electronics and display units will be mounted in the Unit 2 main control room.

The NRC staff notes that the separation between the sensors appears to be the longer, North side of the pool with a dimension of approximately 44 ft. In addition, the staff notes that the licensee modified the locations of the displays that were identified in its OIP. The displays are located in the East and West cable chase rooms below the main control room.

The NRC staff observed that there is sufficient channel separation within the SFP area between the primary and back-up level instruments to provide protection against loss of indication of SFP level due to missiles that may result from damage to the structure over the SFP. The staff also observed that the display locations in control building elevation 288 ft. East and West cable chase rooms are promptly accessible from the Unit 2 main control room. Although the display location change was not publicly documented under the RAI 2 response in the February 19, 2015, update letter, the display locations were reviewed by the NRC staff in the RAI responses provided during the onsite audit and confirmed later via a Nine Mile Point electronic reading room. In addition, the NRC staff observed the equipment locations during plant walkdowns as part of the onsite audit.

Based on the above, the NRC staff concludes that, if implemented appropriately, the licensee's proposed arrangement for the SFP level instrumentation appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.3 Design Features: Mounting

In its OIP, the licensee stated, for Nine Mile Point, Unit 2, in part, that mounting will be on seismic Class I structures.

In its letter dated July 5, 2013, the licensee provided a sketch and description stating that it intends to mount the SFP level instrument sensing element to the refueling floor just outside the SFP. The design for this mounting will apply the seismic design criteria applicable to the design-basis maximum for the plant, capable of withstanding all active and passive loads, including the effects of pool sloshing during a seismic event. The licensee also stated that the design loading considerations for the mounting hardware include the static weight loads and dynamic weight loads of the horn antenna, waveguide assembly, and attached waveguide pipe up to the nearest pipe support. The dynamic loading on the mounting bracket consists of the design-basis maximum seismic loading on the bracket and mounted components, along with the hydrodynamic loads produced by impinging surface waves caused by seismically-induced pool sloshing. The methodology for ensuring that the mounting bracket and attached equipment can withstand the seismic dynamic forces will be by analysis and/or test of the combined maximum seismic and hydrodynamic forces on the cantilevered portion of the waveguide assembly and horn antenna exposed to potential seismically induced wave action. In addition to the analysis described above, seismic qualification testing will be performed to seismic response spectra that envelope the maximum seismic ground motion for the installed location.

During the onsite audit, the NRC staff reviewed hydrodynamic loading analysis for Unit 2, calculation EM3.241 and confirmed the combined hydrodynamic and seismic loading to be within the tested limits of the equipment.

During the vendor audit, the NRC reviewed qualification testing for the Areva product, including the seismic testing. The Areva vendor audit report is documented as part of the McGuire Nuclear Station Mitigating Strategies onsite audit report dated October 9, 2014.

Based on the above, the NRC staff concludes that the licensee's proposed mounting design appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.4 Design Features: Qualification

4.2.4.1 Augmented Quality Process

Appendix A-1 of the guidance in NEI 12 02 describes a quality assurance process for non-safety systems and equipment that are not already covered by existing quality assurance requirements. In JLD-ISG-2012-03, the NRC staff found the use of this quality assurance process to be an acceptable means of meeting the augmented quality requirements of Order EA 12 051.

By letter dated February 28, 2013, the licensee stated that instrument channel reliability shall be established by use of an augmented quality assurance process similar to that described in NEI 12-02.

Based on the above, the NRC staff concludes that, if implemented appropriately, this approach appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.4.2 Instrument Channel Reliability

Section 3.4 of NEI 12-02 states, in part:

> The instrument channel reliability shall be demonstrated via an appropriate combination of design, analyses, operating experience, and/or testing of channel components for the following sets of parameters, as described in the paragraphs below:
>
> - conditions in the area of instrument channel component use for all instrument components,
> - effects of shock and vibration on instrument channel components used during any applicable event for only installed components, and
> - seismic effects on instrument channel components used during and following a potential seismic event for only installed components.

Equipment reliability performance testing was performed to (1) demonstrate that the SFP instrumentation will not experience failures during BDB conditions of temperature, humidity, emissions, surge, and radiation, and (2) to verify those tests envelope the plant-specific requirements.

The NRC staff reviewed vendor qualification testing and results during the vendor audit which is documented in letter dated October 9, 2014. The Unit 2 configuration has just the horns and waveguides in the SFP area. These components contain no electronics devices. The sensor electronics are seismic Category I mounted to concrete walls outside the SFP area on a lower elevation than the pool deck. The display electronics are seismic Category I mounted to concrete walls near each of the control rooms.

During the onsite audit, the NRC staff reviewed calculation H21C112 and confirmed the anticipated radiological conditions for each installed location of the electronics units is less than

1E3 rad. The NRC staff notes that the passive horn and waveguide devices in the SFP area contain no active components and their performance are not susceptible to the anticipated radiological conditions. Shielding provided by the concrete walls for the electronic components outside the SFP area limited exposure to less than 1E3 rad. In its letter dated February 19, 2015, the licensee provided a summary of the analysis in RAI 7 response.

Temperature and humidity conditions in the pool area, per NEI 12-02, are assumed to be 212°F condensing. Areva testing confirms temperature does not impact the performance of the passive horn and waveguide. The condensing steam conditions, however, may have minor impact the instrument accuracy, but as determined in the vendor audit, the impact is less than the accuracy criteria in NEI 12-02.

During the audit, the NRC staff reviewed Gothic analysis ECP-13-001035-MU-010 ES-289 and confirmed the anticipated temperature and humidity conditions for the sensor electronics units is 150°F, 100% RH and within the operating characteristics determined by Areva testing. The licensee also provided a response to RAIs 5 and 6 in its letter dated February 19, 2015.

Seismic qualification was discussed in the mounting Section 4.2.3 above. The licensee also provided a seismic testing summary of the Areva equipment in RAI 12 response in letter dated February 19, 2015. During the onsite audit, the staff reviewed calculation ECP-13-000652-MU-011 MS-3011-NA to confirm the structural analysis of the level sensor and panels and ECP-13-000651-MU-015 S54TB261PANL001-N/A to confirm structural analysis of supports in the auxiliary control room. The latter pertains specifically to Unit 1, but is taken as representative of effort to qualify the remote indicators.

Based on walk downs of the partially installed instruments during the onsite audit, the NRC concluded that the as-installed configuration is consistent with the guidance for shock and vibration.

Based on the above, the NRC staff concludes that the licensee's proposed instrument qualification process appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.5 Design Features: Independence

Primary and backup channels maintain approximately 44 ft. of separation in the area of the SFP. The waveguides for each maintain separation leaving the pool edge toward refueling floor core bores a short distance away. The NRC staff observed the installed configuration of the waveguides during the onsite audit and confirmed the separation.

Changes to the electrical supply were provided with the June 14, 2016, compliance letter in RAI response 13, which details the final electrical supply configuration. The NRC staff confirmed in the final configuration that the primary and backup instruments are supplied by separate electrical busses in accordance with NEI 12-02.

Based on the above, the NRC staff concludes that the licensee's proposed design, with respect to instrument channel independence, appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.6 Design Features: Power Supplies

In its OIP, the licensee stated, in part, that the primary and backup power supplies would be independent. The NRC staff reviewed drawing EE-009GY to confirm the proposed power supplies were independent during the onsite audit. The final electrical supply configuration was provided with the June 14, 2016, compliance letter in RAI response 13. The NRC staff confirmed in the final configuration that the primary and backup instruments are supplied by separate electrical busses in accordance with NEI 12-02.

Fixed aspects of the Areva system such as the on-board battery backup capabilities were reviewed and confirmed during the vendor audit and are documented in report dated October 9, 2014.

Based on the above, the NRC staff concludes that the licensee's proposed power supply design appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.7 Design Features: Accuracy

Accuracy of the Areva system was reviewed and confirmed to meet the criteria of NEI 12-02 during the vendor audit and is documented in report dated October 9, 2014.

Based on the above, the NRC staff concludes that the licensee's proposed instrument accuracy appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.8 Design Features: Testing

The Areva system uses an articulating horn that can be turned up away from the SFP toward a fixed object of known distance (e.g. a wall) for calibration testing. The NRC staff assessed the testability of the Areva system during the vendor audit and is documented in report dated October 9, 2014.

During the onsite audit, the NRC staff reviewed procedure N2-IPM-SFC-001 which included calibration procedures. The NRC staff also sampled other procedures provided by the licensee during the audit to confirm they were updated. The licensee provided a list of the updated procedures with descriptions in RAI response 16 in its letter dated February 19, 2015.

Based on the above, the NRC staff concludes that the licensee's proposed SFP instrumentation design allows for testing consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.2.9 Design Features: Display

Aspects of the display design and operation were reviewed and confirmed to meet the criteria of NEI 12-02 during the vendor audit and are documented in report dated October 9, 2014.

The primary and backup display locations were described in the OIP as being in the control room. However, the design was changed. The primary display is located in the East cable chase room. The backup display is located in the West cable chase room. Both locations are one floor below the main control room and are promptly accessible. The NRC staff confirmed accessibility on walkdowns during the onsite audit.

Based on the above, the NRC staff concludes that the licensee's proposed location and design of the SFP instrumentation displays appear to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.3 Evaluation of Programmatic Controls

Order EA-12-051 specified that the SFP instrumentation shall be maintained available and reliable through appropriate development and implementation programmatic controls, including training, procedures, and testing and calibration. Below is the NRC staff's assessment of the programmatic controls for the SFP instrumentation.

4.3.1 Programmatic Controls: Training

In its OIP, the licensee stated, for Nine Mile Point, Unit 2, in part, that the SAT process will be used to identify the population to be trained and to determine both the initial and continuing elements of the required training. Training will be completed prior to placing the instrumentation in service.

In its compliance letter for Unit 2 dated June 14, 2016, the licensee stated, in part, training for Nine Mile Point Nuclear Station, Unit 2 has been completed in accordance with an accepted training process as recommended in NEI 12-02, Section 4.1.

Based on the above, the NRC staff concludes that the licensee's plan to train personnel in the operation, maintenance, calibration, and surveillance of the SFP level instrumentation, including the approach to identify the population to be trained, appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.3.2 Programmatic Controls: Procedures

During the onsite audit, the NRC staff reviewed procedure N2-IPM-SFC-001, which included calibration procedures. The NRC staff also sampled other procedures provided by the licensee during the audit to confirm they were updated. The licensee provided a list of the updated procedures with descriptions in RAI response 16 in its letter dated February 19, 2015.
Based on the above, the NRC staff concludes that the licensee's procedure development appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.3.3 Programmatic Controls: Testing and Calibration

The NRC staff reviewed parts of the programmatic controls in the ISE dated November 15, 2013 and requested additional information to complete the evaluation (RAIs 17 and 18).

The licensee provided the following description of the key elements of its programmatic control for the SFP level instrument as part of the response to RAI 17 in its letter dated February 19, 2015.

> Programmatic controls will be established to ensure the performance of periodic checks of the SFP level transmitters and indications, calibration of loop power supplies and current repeaters/isolators, and verification of system response. Procedure N1-IPM- 054-003 provides the instructions for calibration checks/functional checks of SFP level instrumentation channels. Procedure N2-PM-014 directs the shift operator to perform electronic rounds and the SFP wide range levels are listed in the electronic rounds database and are recorded once per twelve hour shift. Minimum and maximum SFP level values are identified for operator action in procedure N2-SOP-38. The plant process computer system has alarms to notify control room operators when levels indicate off-normal values.

The licensee also provided a detailed response regarding compensatory actions for one or both instruments out of service as part of its response to RAI 17 in letter dated February 19, 2015.

The licensee also described the in-situ calibration process in response to RAI 18 in letter dated February 19, 2015.

> The in-situ calibration process at the SFP location utilizes the capability to rotate the waveguide horn assembly from its normal downward-pointing position so that it can be pointed at a target that is moved along the radar beam path. By placing the moveable target at known distances from the horn, the instrument output can be checked at each target location. In the event that the as-found values are not within acceptance criteria, the measurement range can be shifted up or down to calibrate the instrument to within the required tolerance. Calibration is only required when functional or channel check identifies that the instrument requires calibration. Functional verification can be achieved using cross channel checks and functional checks per the vendor manual.

The staff reviewed the previously provided information in the OIP and RAI response dated July 5, 2013 together with the RAI responses provided above. The staff also reviewed the procedures noted in the RAI response 17 during the onsite audit and found the test and calibration approach meets the criteria of NEI 12-02.

Based on the above, the NRC staff concludes that the licensee's proposed testing and calibration plan appears to be consistent with NEI 12-02 guidance, as endorsed by JLD-ISG-2012-03, and appears to adequately address the requirements of the order.

4.4 Conclusions for Order EA-12-051

In its letter dated February 28, 2013, the licensee stated that they would meet the requirements of Order EA-12-051 by following the guidelines of NEI 12-02, as endorsed by JLD-ISG-2012-03. In the evaluation above, the NRC staff concludes that, if implemented appropriately, the licensee has conformed to the guidance in NEI 12-02, as endorsed by JLD-ISG-2012-03. In addition, the NRC staff concludes that if the SFP level instrumentation is installed at Nine Mile Point, Unit 2 according to the licensee's proposed design, it should adequately address the requirements of Order EA-12-051.

5.0 CONCLUSION

In August 2013 the NRC staff started audits of the licensee's progress on Orders EA-12-049 and EA-12-051. The staff conducted onsite audits in November 2014 and November 2015 (ADAMS Accession Nos. ML15110A026 and ML16006A213, respectively) . The licensee reached its final compliance date on July 1, 2016, and has declared that both of the reactors are in compliance with the orders. The purpose of this safety evaluation is to document the strategies and implementation features that the licensee has committed to. Based on the evaluations above, the NRC staff concludes that the licensee has developed guidance and proposed designs that if implemented appropriately should adequately address the requirements of Orders EA-12-049 and EA-12-051. The NRC staff will conduct an onsite inspection to verify that the licensee has implemented the strategies and equipment to demonstrate compliance with the orders.

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NINE MILE POINT NUCLEAR STATION, UNITS 1 AND 2 – SAFETY EVALUATION REGARDING IMPLEMENTATION OF MITIGATING STRATEGIES AND RELIABLE SPENT FUEL POOL INSTRUMENTATION RELATED TO ORDERS EA-12-049 AND EA-12-051 DATED January 31, 2016

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NAME	JPaige	SLent	SBailey*	MHalter
DATE	1/26/17	1/11/17	1/23/17	1/31/17

OFFICIAL AGENCY RECORD