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

February 10, 2014

Vice President, Operations
Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530

SUBJECT: PALISADES NUCLEAR PLANT- INTERIM STAFF EVALUATION REGARDING OVERALL INTEGRATED PLAN IN RESPONSE TO ORDER EA-12-049 (MITIGATION STRATEGIES) (TAC NO. MF0768)

Dear Sir or Madam:

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" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A736). By letter dated February 28, 2013 (ADAMS Accession No. ML13060A361), Entergy Nuclear Operations, Inc. (Entergy, the licensee) submitted its Overall Integrated Plan for Palisades Nuclear Plant in response to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13241A234), Entergy submitted a six-month update to the Overall Integrated Plan.

Based on a review of Entergy's plan, including the six-month update dated August 28, 2013, and information obtained through the mitigation strategies audit process,[1] the NRC concludes that the licensee has provided sufficient information to determine that there is reasonable assurance that the plan, when properly implemented, will meet the requirements of Order EA-12-049, at Palisades Nuclear Plant. This conclusion is based on the assumption that the licensee will implement the plan as described, including the satisfactory resolution of the open and confirmatory items detailed in the enclosed Interim Staff Evaluation (ISE) and Audit Report. As discussed in Section 4.0 of the ISE, the open item warranting the greatest attention to ensure successful implementation relates to the use of installed charging pumps, instead of portable pumps, for primary coolant system makeup.

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[1] A description of the mitigation strategies audit process may be found at ADAMS Accession No. ML13234A503.

If you have any questions, please contact Peter Bamford, Mitigating Strategies Project Manager, at 301-415-2833, or at peter.bamford@nrc.gov.

Sincerely,

Jeremy S. Bowen, Chief
Mitigating Strategies Projects Branch
Mitigating Strategies Directorate
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosures:
1. Interim Staff Evaluation
2. Technical Evaluation Report

cc w/encl: Distribution via Listserv

UNITED STATES
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INTERIM STAFF EVALUATION AND AUDIT REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO ORDER EA-12-049 MODIFYING LICENSES WITH REGARD TO REQUIREMENTS FOR MITIGATION STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS

ENTERGY NUCLEAR OPERATIONS, INC

PALISADES NUCLEAR PLANT

DOCKET NO. 50-255

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. 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. The U.S. Nuclear Regulatory Commission (NRC) determined that additional requirements needed to be imposed to mitigate beyond-design-basis external events (BDBEE). Accordingly, by letter dated 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" [Reference 1]. The 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.

By letter dated February 28, 2013 [Reference 2], Entergy Nuclear Operations, Inc. (Entergy, the licensee), provided the Overall Integrated Plan (hereafter referred to as the Integrated Plan) for compliance with Order EA-12-049 for Palisades Nuclear Plant (Palisades). The Integrated Plan describes the guidance and strategies under development for implementation by Entergy for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. As further required by the order, by letter dated August 28, 2013 [Reference 3], the licensee submitted the first six-month status report since the submittal of the Integrated Plan, describing the progress made in implementing the requirements of the order.

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's regulations and processes, and with determining if the agency should make 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 [Reference 4]. These recommendations were enhanced by the NRC staff following interactions with stakeholders. Documentation of the NRC staff's efforts is contained in SECY-11-0124, "Recommended Actions to be Taken without Delay from the Near-Term Task Force Report," dated September 9, 2011 [Reference 5] and SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011 [Reference 6].

As directed by the Commission's Staff Requirement Memorandum (SRM) for SECY-11-0093 [Reference 7], the NRC staff reviewed the NTTF recommendations within the context of the NRC's existing regulatory framework and considered the various regulatory vehicles available to the NRC to implement the recommendations. SECY-11-0124 and SECY-11-0137 established the NRC staff's prioritization of the recommendations based upon the potential safety enhancements.

After receiving the Commission's direction in SRM-SECY-11-0124 [Reference 8] and SRM-SECY-11-0137 [Reference 9], the NRC staff conducted public meetings to discuss enhanced mitigation strategies intended to maintain or restore core cooling, containment, and SFP cooling capabilities following a BDBEE. At these meetings, the industry described its proposal for a Diverse and Flexible Mitigation Capability (FLEX), as documented in the Nuclear Energy Institute's (NEI's) letter, dated December 16, 2011 [Reference 10]. FLEX was proposed as a strategy to fulfill the key safety functions of core cooling, containment integrity, and spent fuel cooling. Stakeholder input influenced the NRC staff to pursue a more performance-based approach to improve the safety of operating power reactors than envisioned in NTTF Recommendation 4.2, SECY-11-0124, and SECY-11-0137.

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," [Reference 11] to the Commission, including the proposed order to implement the enhanced mitigation strategies. As directed by SRM-SECY-12-0025 [Reference 12], the NRC staff issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" [Reference 1].

Order EA-12-049, Attachment 2,[1] 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,

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1. Attachment 3 to Order EA-12-049 provides requirements for Combined License holders.

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 operational 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 and have adequate capacity to address challenges to core cooling, containment, and SFP cooling capabilities at all units on a site subject to the 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 the Order.

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

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

On May 4, 2012, NEI submitted document 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision B [Reference 13] to provide specifications for an industry developed methodology for the development, implementation, and maintenance of guidance and strategies in response to the Mitigating Strategies order. On May 13, 2012, NEI submitted NEI 12-06, Revision B1 [Reference 14]. The guidance and strategies described in NEI 12-06 expand on those that industry developed and implemented to address the limited set of BDBEEs that involve the loss of a large area of the plant due to explosions and fire required pursuant to paragraph (hh)(2) in Section 50.54, "Conditions of licenses" of Title 10 of the *Code of Federal Regulations*.

On May 31, 2012, the NRC staff issued a draft version of the interim staff guidance (ISG) document, 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," [Reference 15] and published a notice of its availability for public comment in the *Federal Register* (77 FR 33779), with the comment period running through July 7, 2012. JLD-ISG-2012-01 proposed endorsing NEI 12-06, Revision B1, as providing an acceptable method of meeting the requirements of Order EA-12-049. The NRC staff received seven comments during this time. The NRC staff documented its analysis of these comments in "NRC Response to Public Comments, JLD-ISG-2012-01 (Docket ID NRC-2012-0068)" [Reference 16].

On July 3, 2012, NEI submitted comments on JLD-ISG-2012-01, including Revision C to NEI 12-06 [Reference 17], incorporating many of the exceptions and clarifications included in the draft version of the ISG. Following a public meeting held July 26, 2012, to discuss the remaining exceptions and clarifications, on August 21, 2012, NEI submitted Revision 0 to NEI 12-06 [Reference 18].

On August 29, 2012, the NRC staff issued the final version of JLD-ISG-2012-01, [Reference 19], endorsing NEI 12-06, Revision 0, 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.

The NRC staff determined that the overall integrated plans submitted by licensees in response to Order EA-12-049, Section IV.C.1.a should follow the guidance in NEI 12-06, Section 13, which states that:

> The Overall Integrated Plan should include a complete description of the FLEX strategies, including important operational characteristics. The level of detail generally considered adequate is consistent to the level of detail contained in the Licensee's Final Safety Analysis Report (FSAR). The plan should provide the following information:
>
> 1. Extent to which this guidance, NEI 12-06, is being followed including a description of any alternatives to the guidance, and provide a milestone schedule of planned actions.
>
> 2. Description of the strategies and guidance to be developed to meet the requirements contained in Attachment 2 or Attachment 3 of the order.
>
> 3. Description of major installed and portable FLEX components used in the strategies, the applicable reasonable protection for the FLEX portable equipment, and the applicable maintenance requirements for the portable equipment.
>
> 4. Description of the steps for the development of the necessary procedures, guidance, and training for the strategies; FLEX equipment acquisition, staging or installation, including necessary modifications.
>
> 5. Conceptual sketches, as necessary to indicate equipment which is installed or equipment hookups necessary for the strategies. (As-built piping and instrumentation diagrams (P&ID) will be available upon completion of plant modifications.)
>
> 6. Description of how the portable FLEX equipment will be available to be deployed in all modes.

By letter dated August 28, 2013 [Reference 20], the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the staff in its review, leading to the issuance of this interim staff evaluation (ISE) and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the order. Additional NRC staff review and inspection may be necessary following full implementation of those actions to verify licensees' compliance with the order.

3.0 TECHNICAL EVALUATION

The NRC staff contracted with MegaTech Services, LLC (MTS) for technical support in the evaluation of the Integrated Plan for Palisades, submitted by Entergy's letter dated February 28, 2013, as supplemented. NRC and MTS staff have reviewed the submitted information and held clarifying discussions with Entergy in evaluating the licensee's plans for addressing BDBEEs and its progress towards implementing those plans. By letter dated February 6, 2014 [Reference 21], MTS documented the interim results of that ongoing review in the attached technical evaluation report (TER). The NRC staff has reviewed this TER for consistency with NRC policy and technical accuracy and finds, in general, that it accurately reflects the state of completeness of the Integrated Plan. The NRC staff therefore adopts the findings of the TER with respect to individual aspects of the requirements of Order EA-12-049.

A simplified description of the Palisades Integrated Plan is that the licensee will remove the core decay heat by adding water to the steam generators (SGs) and releasing steam from the SGs to the atmosphere. The water will initially be added by the turbine-driven auxiliary feedwater (TDAFW) pump, taking suction from the condensate storage tank (CST), with subsequent makeup provided from other potentially available site tanks or the ultimate heat sink (UHS) (UHS, or Lake Michigan for Palisades). A portable FLEX generator will be connected to the existing plant electrical distribution system. This will allow the energizing of selected loads to implement the licensee's strategy, such as critical instrumentation and the battery chargers. Recharging the batteries will support continued operation of the direct current (dc) distribution system. Another FLEX diesel generator will power one of the installed plant charging pumps to be used for primary coolant system (PCS) makeup. If the existing volume control tank or safety injection and refueling water storage tank (SIRWT) are not available, the licensee plans to use a combination of the boric acid storage tank (BAST) water and a non-borated water source such as the UHS to provide a blended borated water supply for the charging pump. When the TDAFW pump can no longer be operated reliably due to the lowering SG pressure, a portable FLEX pump will be used to add water to the SGs. In the long-term, additional equipment, such as 4160 volt ac generators, will be delivered from one of the Regional Response Centers (RRCs) established by the nuclear power industry to provide supplemental accident mitigation equipment.

Palisades has a large dry containment building, which contains the PCS. There is limited mass and energy addition into containment under the postulated extended loss of ac power (ELAP) scenario, and thus no immediate containment cooling need is anticipated. In the long-term, restoration of containment cooling is planned with support from the RRC-supplied 4160 volt ac generators powering the existing containment air fans.

In the postulated ELAP event, the SFP may reach the boiling point. The licensee plans to initiate SFP makeup in time to ensure that sufficient water is maintained for cooling and shielding considerations. This is true for a normal (at power) decay heat level or a core offload scenario. A diesel-driven FLEX pump will be used to provide this makeup capability to the SFP, supplied from either the SIRWT, or the UHS.

4.0 OPEN AND CONFIRMATORY ITEMS

This section contains a summary of the open and confirmatory items identified as part of the technical evaluation. The NRC and MTS have assigned each review item to one of the following categories:

> Confirmatory item – an item that the NRC considers conceptually acceptable, but for which resolution may be incomplete. These items are expected to be acceptable, but will require some minimal follow up review, audit, or inspection to verify completion.
>
> Open item – an item for which the licensee has not presented a sufficient basis for the NRC to determine that the issue is on a path to resolution. The intent behind designating an issue as an open item is to document significant items that need resolution during the review process, rather than being verified after the compliance date through the inspection process.

As discussed in Section 3.0, above, the NRC staff has reviewed MTS' TER for consistency with NRC policy and technical accuracy and finds that, in general, it accurately reflects the state of completeness of the licensee's Integrated Plan. The open and confirmatory items identified in the TER are listed in the tables below, with some NRC edits made for clarity from the TER version. In addition to the editorial clarifications, Confirmatory Item 3.2.1.2.D from the TER was eliminated by combining it with Confirmatory Item 3.2.1.2.C. Confirmatory Item 3.2.4.5.A was deleted because it would be addressed by the site's existing configuration management program, in accordance with the guidance contained in Section 2.0 of the TER. Confirmatory Items 3.2.4.8 A, 3.2.4.8.B, and 3.2.4.8.C from in the TER, regarding electrical strategies, were closed because they were either addressed during the review, or will be reviewed further in conjunction with Open Item 3.2.1.9.B. Finally, Confirmatory Items 3.2.4.10.B and 3.2.4.10.C from the TER were closed because they were encompassed by Confirmatory Item 3.2.4.10.A. Further details for each open and confirmatory item listed below are provided in the corresponding sections of the TER, identified by the item number.

The NRC staff notes that for Open Item 3.2.1.8.A on boric acid mixing, the staff has now endorsed the August 2013, Pressurized Water Reactor Owners Group (PWROG) position paper, with several clarifications, which the licensee will need to address, including the assumed mixing delay time. The NRC endorsement letter is dated January 8, 2014, and is publicly available (ADAMS Accession No. ML13276A183).

Regarding Open Item 3.2.1.9.B, the NRC staff notes that the strategy of utilizing installed charging pumps is an alternate method to the provisions of NEI 12-06. The licensee proposes to use the installed power distribution system to provide power to the charging pump(s) supplied by a FLEX diesel generator. This places greater reliance on the current state of knowledge of external hazards, which are being re-examined for flooding and seismic hazards pursuant to NTTF Recommendation 2.1. Additionally, further re-evaluations will be conducted pursuant to Section 402 of Public Law 112-074, "Consolidated Appropriations Act," which requires that the NRC require licensees to reevaluate the seismic, tsunami, flooding, and other external hazards. New information from those efforts may necessitate changes in the degree of protection afforded this equipment in order to maintain the guidance and strategies required by Order EA-12-049. Also, additional information will be needed from the licensee to determine whether the proposed approach provides an equivalent level of flexibility for responding to an undefined event as would be provided through conformance with NEI 12-06. This could necessitate the provision of connection points for the use of portable pumping sources should the installed charging pumps be rendered unavailable by the initiating event, and/or alternate electrical connections for supplying power to the charging pumps that would not be dependent on the existing electrical distribution system for success of the PCS makeup strategy.

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.1.1.2.A	Evaluate the impact of potential soil liquefaction on deployment of portable FLEX equipment.	
3.1.1.2.B	Evaluate the potential need for a power source to move or deploy the equipment (e.g., to open the door from a storage location).	
3.1.1.3.A	Evaluate impacts from large internal flooding sources that are not seismically robust and the potential impact on the mitigating strategies.	
3.1.1.3.B	Evaluate the potential for ground water to impact the mitigating strategies.	
3.1.5.1.A	Evaluate the potential for high temperature hazards to impact the functionality of FLEX equipment in the FLEX storage facility.	
3.1.5.3.A	Evaluate the potential for high temperature hazards to impact the deployment of FLEX equipment.	
3.2.1.8.A	Verify resolution of the generic concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the PCS under natural circulation conditions potentially involving two-phase flow.	
3.2.1.9.B	Provide additional justification for the alternate approach to NEI 12-06 involving the use of installed charging pumps.	Significant

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.3.1.A	Confirm that the FLEX storage facility(s) will meet the plant's design-basis tornado wind speed of 300 mph or will be designed or evaluated equivalent to ASCE 7-10 using a tornado wind speed of 230 mph with separation and diversity between the storage locations. If the method of protection chosen is the later, confirm that separation and diversity is adequate.	
3.2.1.A	Confirm that the operator actions times in the first 20 minutes of the event are adequate and reasonably achievable when the associated ELAP procedures are developed and validated.	
3.2.1.B	Confirm the robustness of the charging pump control circuit or provide FLEX procedure guidance to manually operate the charging pumps by breaker operation.	

3.2.1.C	Confirm the seismic robustness of the BAST piping to support use of the BAST water as a supply source for the charging pumps.	
3.2.1.D	Confirm the availability and adequacy of a borated water supply to support the PCS makeup strategy.	
3.2.1.E	Confirm the continued functionality of the Atmospheric Dump Valves in the context of a tornado missile hazard during an ELAP in order to support a symmetric cooldown. Alternatively, address the effects of asymmetric natural circulation cooldown.	
3.2.1.F	Confirm the ability of any non-safety related equipment to function as credited in the mitigation strategies in accordance with the external event criteria described in NEI-12-06.	
3.2.1.1.A	Confirm that the use of Combustion Engineering Nuclear Transient Simulator (CENTS) in the ELAP analysis is limited to the flow conditions prior to reflux boiling initiation. This confirmation should include a description of the CENTS-calculated flow quality at the top of the SG U-tube for the condition when two-phase natural circulation ends and reflux boiling initiates.	
3.2.1.2.A	Confirm the Primary Coolant Pump (PCP) seal leakage rate assumed in the ELAP analysis is justified. Specifically, if the PCP seal leakage rate used in the plant-specific analysis is less than the upper bound expectation for the seal leakage rate (15 gpm/seal) discussed in the PWROG position paper addressing the PCP seal leakage for Combustion Engineering plants (ADAMS Accession No. ML13235A151, non-publicly available), justification should be provided.	
3.2.1.2.B	Confirm whether seal failure will occur or not when subcooling of the coolant in the PCS cold-legs is greater than 50 degrees Fahrenheit (°F). This evaluation should specify the seal leakage flow assumed for the ELAP from time zero to the timeframe when subcooling in the PCS cold-legs decreases to 50°F, and provide justification for the assumed leakage rate.	
3.2.1.2.C	If the Integrated Plan is changed to credit isolation of controlled bleed-off (CBO), confirm the assumption that the integrity of the PCP seals can be maintained, and the seal leakage rate is less than 1 gpm per PCP during an ELAP before CBO is isolated. This evaluation should provide the maximum temperature and pressure, and minimum subcooling of the coolant in the PCS cold-legs during the ELAP before CBO isolation. If CBO isolation is being assumed, justify the sequence of events (SOE) and time constraints so established.	
3.2.1.3.A	Confirm the applicability of ANS 5.1-1979 + 2 sigma decay heat curve.	

3.2.1.5.A	Confirm the containment temperature, pressure, and moisture profiles during the ELAP event, and justify the adequacy of the computer codes/methodologies, and assumptions used in the analysis.	
3.2.1.5.B	Confirm whether further instrumentation is needed based upon ongoing ELAP evaluations.	
3.2.1.6.A	Complete validation of the SOE timeline.	
3.2.1.6.B	In the audit process, the licensee has indicated that an assessment has been performed identifying potential changes to the SOE. Confirm that a final SOE has been developed incorporating any identified changes.	
3.2.1.9.A	Confirm that the ability to line up portable pumps is consistent with the times assumed in the final version of the Integrated Plan.	
3.2.2.A	Resolve the discrepancy between the licensee-determined flow rate of 100 gallons per minute (gpm) SFP spray and the 250 gpm performance attribute of NEI 12-06, Table D-3.	
3.2.3.A	Confirm the plan assumptions for containment cooling, after completion of the containment response analysis.	
3.2.4.1.A	Confirm whether supplemental cooling is required for components or systems used in the mitigating strategies plan.	
3.2.4.1.B	Confirm the connection point for the UHS FLEX Pump to the Service Water System.	
3.2.4.2.A	Confirm the adequacy of the ventilation provided in the battery room to protect the batteries from the effects of extreme high and low temperatures.	
3.2.4.2.B	Confirm the adequacy of battery room ventilation to prevent hydrogen accumulation while recharging the batteries in Phase 2 or Phase 3.	
3.2.4.3.A	Confirm whether heat tracing is required for borated water systems.	
3.2.4.4.A	Confirm that communication enhancements credited in the NRC's communication assessment (ADAMS Accession No. ML13129A219) are completed as planned.	
3.2.4.6.A	Confirm that habitability limits will be maintained and/or operator protective measures will be employed in all phases of an ELAP to ensure operators will be capable of FLEX strategy execution under adverse temperature conditions.	
3.2.4.7.A	Confirm that the evaluation of the CST and T-81 shows that the tank qualification is consistent with the strategy and the provisions of NEI 12-06.	
3.2.4.7.B	Confirm that the FLEX Support Guidelines provide clear criteria for transferring to the next preferred source of water when refilling the CST.	
3.2.4.10.A	Confirm that the load shed calculation verifies adequate battery capacity with sufficient margin throughout Phase 1 to assure the battery does not get depleted prior to charging, and the results of the analysis are properly integrated into the overall strategy.	

3.4.A	Confirm that plans for the deployment of portable equipment used to implement the response conform to the criteria of NEI 12-06, Section 12.2, with regards to considerations 2 through 10.	

5.0 SUMMARY

As required by Order EA-12-049, the licensee is developing, and will implement and maintain, guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities in the event of a BDBEE. These new requirements provide a greater mitigation capability consistent with the overall defense-in-depth philosophy, and, therefore, greater assurance that the challenges posed by BDBEEs to power reactors do not pose an undue risk to public health and safety.

The NRC's objective in preparing this ISE and audit report is to provide a finding to the licensee on whether or not their integrated plan, if implemented as described, provides a reasonable path for compliance with the order. For areas where the NRC staff has insufficient information to make this finding (identified above in Section 4.0), the staff will review these areas as they become available or address them as part of the inspection process. The staff notes that the licensee has the ability to modify their plans as stated in NEI 12-06, Section 11.8. However, additional NRC review and/or inspection may be necessary to verify compliance.

The NRC staff has reviewed the licensee's plans for additional defense-in-depth measures. Assuming a successful resolution to the items identified in Section 4.0 above, the NRC staff finds that the proposed measures, properly implemented, will meet the intent of Order EA-12-049, thereby enhancing the licensee's capability to mitigate the consequences of a BDBEE that impacts the availability of alternating current power and the ultimate heat sink. Full compliance with the order will enable the NRC to continue to have reasonable assurance of adequate protection of public health and safety. The staff will issue a safety evaluation confirming compliance with the order and may conduct inspections to verify proper implementation of the licensee's proposed measures.

6.0 REFERENCES

1. Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A736)

2. Letter from Entergy to NRC, "Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," regarding Palisades Nuclear Plant, dated February 28, 2013 (ADAMS Accession No. ML13060A361)

3. Letter from Entergy to NRC, "Palisades Nuclear Plant First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated August 28, 2013 (ADAMS Accession No. ML13241A234)

4. SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," July 12, 2011 (ADAMS Accession No. ML11186A950)

5. SECY-11-0124, "Recommended Actions to be Taken without Delay from the Near-Term Task Force Report," September 9, 2011 (ADAMS Accession No. ML11245A158)

6. SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," October 3, 2011 (ADAMS Accession No. ML11272A111)

7. SRM-SECY-11-0093, "Staff Requirements – SECY-11-0093 – Near-Term Report and Recommendations for Agency Actions following the Events in Japan," August 19, 2011 (ADAMS Accession No. ML112310021)

8. SRM-SECY-11-0124, "Staff Requirements – SECY-11-0124 – Recommended Actions to be Take without Delay from the Near-Term Task Force Report," October 18, 2011 (ADAMS Accession No. ML112911571)

9. SRM-SECY-11-0137, "Staff Requirements – SECY-11-0137- Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," December 15, 2011 (ADAMS Accession No. ML113490055)

10. Letter from Adrian Heymer (NEI) to David L. Skeen (NRC), "An Integrated, Safety-Focused Approach to Expediting Implementation of Fukushima Dai-ichi Lessons Learned," December 16, 2011 (ADAMS Accession No. ML11353A008)

11. 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," February 17, 2012 (ADAMS Accession No. ML12039A103)

12. SRM-SECY-12-0025, "Staff Requirements – 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," March 9, 2012 (ADAMS Accession No. ML120690347)

13. NEI document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision B, May 4, 2012 (ADAMS Accession No. ML12144A419)

14. NEI document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision B1, May 13, 2012 (ADAMS Accession No. ML12143A232)

15. Draft 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," May 31, 2012 (ADAMS Accession No. ML12146A014)

16. NRC Response to Public Comments, JLD-ISG-2012-01 (Docket ID NRC-2012-0068), August 29, 2012 (ADAMS Accession No. ML12229A253)

17. Nuclear Energy Institute, Comments from Adrian P. Heymer on Draft 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," July 3, 2012 (ADAMS Accession No. ML121910390)

18. Nuclear Energy Institute document 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, August 21, 2012 (ADAMS Accession No. ML12242A378)

19. Final Interim Staff Guidance, 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," August 29, 2012 (ADAMS Accession No. ML12229A174)

20. Letter from Jack R. Davis (NRC) to All Operating Reactor Licensees and Holders of Construction Permits, "Nuclear Regulatory Commission Audits of Licensee Responses to Mitigation Strategies Order EA-12-049," August 28, 2013 (ADAMS Accession No. ML13234A503)

21. Letter from John Bowen, MegaTech Services, LLC, to Eric Bowman, NRC, submitting "Technical Evaluation Report Related to Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, EA-12-049," for Palisades Nuclear Plant, Revision 1, dated February 6, 2014 (ADAMS Accession No. ML14037A160)

Principal Contributors: G. Armstrong
B. Lee
G. Singh
S. Sun
E. Bowman
P. Bamford

Date: February 10, 2014

Enclosure 2

Technical Evaluation Report

MEGA-TECH SERVICES LLC

Mega-Tech Services, LLC

Technical Evaluation Report Related to Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, EA-12-049

Revision 1

February 6, 2014

Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
Docket No. 50-255

Prepared for:

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Contract NRC-HQ-13-C-03-0039
Task Order No. NRC-HQ-13-T-03-0001
Job Code: J4672
TAC No. MF0768

Prepared by:

Mega-Tech Services, LLC
11118 Manor View Drive
Mechanicsville, Virginia 23116

1.0 BACKGROUND

Following the events at the Fukushima Dai-ichi nuclear power plant on March 11, 2011, the U.S. Nuclear Regulatory Commission (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, methodical review of NRC regulations and processes to determine 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. These recommendations were enhanced by the NRC staff following interactions with stakeholders. Documentation of the staff's efforts is contained in SECY-11-0124, "Recommended Actions to be Taken without Delay from the Near-Term Task Force Report," dated September 9, 2011, and SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011.

As directed by the Commission's staff requirement memorandum (SRM) for SECY-11-0093, the NRC staff reviewed the NTTF recommendations within the context of the NRC's existing regulatory framework and considered the various regulatory vehicles available to the NRC to implement the recommendations. SECY-11-0124 and SECY-11-0137 established the staff's prioritization of the recommendations.

After receiving the Commission's direction in SRM-SECY-11-0124 and SRM-SECY-11-0137, the NRC staff conducted public meetings to discuss enhanced mitigation strategies intended to maintain or restore core cooling, containment, and Spent Fuel Pool (SFP) cooling capabilities following beyond-design-basis external events (BDBEEs). At these meetings, the industry described its proposal for a Diverse and Flexible Mitigation Capability (FLEX), as documented in Nuclear Energy Institute's (NEI) letter, dated December 16, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11353A008). FLEX was proposed as a strategy to fulfill the key safety functions of core cooling, containment integrity, and spent fuel cooling. Stakeholder input influenced the NRC staff to pursue a more performance-based approach to improve the safety of operating power reactors relative to the approach that was envisioned in NTTF Recommendation 4.2, SECY-11-0124, and SECY-11-0137.

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," to the Commission, including the proposed order to implement the enhanced mitigation strategies. As directed by SRM-SECY-12-0025, the NRC staff issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events."

Guidance and strategies required by the Order would be available if a loss of power, motive force and normal access to the ultimate heat sink needed to prevent fuel damage in the reactor and SFP affected all units at a site simultaneously. The Order requires a three-phase approach for mitigating BDBEEs. The initial phase requires the use of installed equipment and resources to maintain or restore key safety functions including core cooling, containment, and SFP cooling. 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 offsite. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely.

NEI submitted its document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" in August 2012 (ADAMS Accession No. ML12242A378) to provide specifications for an industry-developed methodology for the development, implementation, and maintenance of guidance and strategies in response to Order EA-12-049. The guidance and strategies described in NEI 12-06 expand on those that industry developed and implemented to address the limited set of BDBEEs that involve the loss of a large area of the plant due to explosions and fire required pursuant to paragraph (hh)(2) of 10 CFR 50.54, "Conditions of licenses."

As described in 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," the NRC staff considers that the development, implementation, and maintenance of guidance and strategies in conformance with the Guidelines provided in NEI 12-06, Revision 0, subject to the clarifications in Attachment 1 of the ISG are an acceptable means of meeting the requirements of Order EA-12-049.

In response to Order EA-12-049, licensees submitted Overall Integrated Plans (hereafter, the Integrated Plan) describing their course of action for mitigation strategies that are to conform with the guidance of NEI 12-06, or provide an acceptable alternative to demonstrate compliance with the requirements of Order EA-12-049.

2.0 EVALUATION PROCESS

In accordance with the provisions of Contract NRC-HQ-13-C-03-0039, Task Order No. NRC-HQ-13-T-03-0001, Mega-Tech Services, LLC (MTS) performed an evaluation of each licensee's Integrated Plan. As part of the evaluation, MTS, in parallel with the NRC staff, reviewed the original Integrated Plan and the first 6-month status update, and conducted an audit of the licensee documents. The staff and MTS also reviewed the licensee's answers to the NRC staff's and MTS's questions as part of the audit process. The objective of the evaluation was to assess whether the proposed mitigation strategies conformed to the guidance in NEI 12-06, as endorsed by the positions stated in JLD-ISG-2012-01, or an acceptable alternative had been proposed that would satisfy the requirements of Order EA-12-049. The audit plan that describes the audit process was provided to all licensees in a letter dated August 29, 2013 from Jack R. Davis, Director, Mitigating Strategies Directorate (ADAMS Accession No. ML13234A503).

The review and evaluation of the licensee's Integrated Plan was performed in the following areas consistent with NEI 12-06 and the regulatory guidance of JLD-ISG-2012-01:

- Evaluation of External Hazards
- Phased Approach
  - Initial Response Phase
  - Transition Phase
  - Final Phase
- Core Cooling Strategies

- SFP Cooling Strategies
- Containment Function Strategies
- Programmatic Controls
    - ➢ Equipment Protection, Storage, and Deployment
    - ➢ Equipment Quality

The technical evaluation in Section 3.0 documents the results of the MTS evaluation and audit results. Section 4.0 summarizes Confirmatory Items and Open Items that require further evaluation before a conclusion can be reached that the Integrated Plan is consistent with the guidance in NEI 12-06 or an acceptable alternative has been proposed that would satisfy the requirements of Order EA-12-049. For the purpose of this evaluation, the following definitions are used for Confirmatory Item and Open Item.

> Confirmatory Item – an item that is considered conceptually acceptable, but for which resolution may be incomplete. These items are expected to be acceptable, but are expected to require some minimal follow up review or audit prior to the licensee's compliance with Order EA-12-049.
>
> Open Item – an item for which the licensee has not presented a sufficient basis to determine that the issue is on a path to resolution. The intent behind designating an issue as an Open Item is to document items that need resolution during the audit process, rather than being verified after the compliance date through the inspection process.

Additionally, for the purpose of this evaluation and the NRC staff's interim staff evaluation (ISE), licensee statements, commitments, and references to existing programs that are subject to routine NRC oversight (Updated Final Safety Analysis Report (UFSAR) program, procedure program, quality assurance program, modification configuration control program, etc.) will generally be accepted. For example, references to existing UFSAR information that supports the licensee's overall mitigating strategies plan, will be assumed to be correct, unless there is a specific reason to question its accuracy. Likewise, if a licensee states that they will generate a procedure to implement a specific mitigating strategy, assuming that the procedure would otherwise support the licensee's plan, this evaluation accepts that a proper procedure will be prepared. This philosophy for this evaluation and the ISE does not imply that there are any limits in this area to future NRC inspection activities.

3.0 <u>TECHNICAL EVALUATION</u>

By letter dated February 28, 2013 (ADAMS) Accession No. ML13060A361), and as supplemented by the first six-month status report in a letter dated August 28, 2013 (ADAMS Accession No. ML13241A234) Entergy Nuclear Operations, Inc. (the licensee or Entergy) provided Palisades Nuclear Plant's (PNP) Integrated Plan for Compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by the licensee for the maintenance of restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC staff notified all licensee and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the NRC staff in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the Order.

3.1 EVALUATION OF EXTERNAL HAZARDS

Sections 4 through 9 of NEI 12-06 provide the NRC-endorsed methodology for the determination of applicable extreme external hazards in order to identify potential complicating factors for the protection and deployment of equipment needed for mitigation of BDBEEs leading to an extended loss of all alternating current (ac) power (ELAP) and loss of normal access to the ultimate heat sink (UHS). These hazards are broadly grouped into the categories discussed below in Sections 3.1.1 through 3.1.5 of this evaluation. 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.

3.1.1 Seismic Events.

NEI 12-06, Section 5.2 states:

> All sites will address BDB [beyond-design-basis] seismic considerations in the implementation of FLEX strategies, as described below. The basis for this is that, while some sites are in areas with lower seismic activity, their design basis generally reflects that lower activity. There are large, and unavoidable, uncertainties in the seismic hazard for all U.S. plants. In order to provide an increased level of safety, the FLEX deployment strategy will address seismic hazards at all sites.
>
> These considerations will be treated in four primary areas: protection of FLEX equipment, deployment of FLEX equipment, procedural interfaces, and considerations in utilizing off-site resources.

On page 1 of the Integrated Plan, the licensee confirms that it has screened in for this external hazard. The licensee further states that per the UFSAR Section 2.4.4, the seismic criteria for Palisades includes two (2) design basis earthquake spectra: the operating basis earthquake (OBE) and the safe shutdown earthquake (SSE) and that the peak horizontal ground acceleration for the SSE is 0.2 g.

The licensee also stated that the seismic re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore was not assumed in the Integrated Plan.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to screening for seismic hazards, if these requirements are implemented as described.

3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

> 1. FLEX equipment should be stored in one or more of following three configurations:

a. In a structure that meets the plant's design basis for the Safe Shutdown Earthquake (SSE)(e.g., existing safety-related structure).

b. In a structure designed to or evaluated equivalent to [American Society of Civil Engineers] ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures.*

c. Outside a structure and evaluated for seismic interactions to ensure equipment is not damaged by non-seismically robust components or structures.

2. Large portable FLEX equipment such as pumps and power supplies should be secured as appropriate to protect them during a seismic event (i.e., Safe Shutdown Earthquake (SSE) level).

3. Stored equipment and structures should be evaluated and protected from seismic interactions to ensure that unsecured and/or non-seismic components do not damage the equipment.

On page 25 of the Integrated Plan, the licensee stated that protection of associated portable equipment from seismic hazards would be provided and that the FLEX storage facility will be designed to withstand the SSE. Two potential storage areas for FLEX portable equipment have been identified. The licensee will determine where the storage facility will be located at Palisades and communicate this information in a future six-month update.

On pages 25, 54 and 64 of the Integrated Plan, the licensee described the protection plan to determine storage requirements of portable FLEX equipment from seismic hazards, which includes that structures to provide protection of FLEX equipment, will be constructed to meet the requirements of NEI 12-06, Section 11. The schedule to construct the permanent building is contained in Attachment 2, and will satisfy the site compliance date. Procedures and programs will be developed to address storage structure requirements, haul path requirements, and FLEX equipment requirements relative to the external hazards applicable to Palisades. The reviewer considers the development of these procedures and programs as including the securing of portable equipment and the evaluation of stored equipment and structures as described in paragraphs 2 and 3 above.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to storage of FLEX equipment during seismic events, if these requirements are implemented as described.

3.1.1.2 Deployment of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.2 states:

> The baseline capability requirements already address loss of non-seismically robust equipment and tanks as well as loss of all AC. So, these seismic considerations are implicitly addressed.
>
> There are five considerations for the deployment of FLEX equipment following a

seismic event:

1. If the equipment needs to be moved from a storage location to a different point for deployment, the route to be traveled should be reviewed for potential soil liquefaction that could impede movement following a severe seismic event.

2. At least one connection point for the FLEX equipment will only require access through seismically robust structures. This includes both the connection point and any areas that plant operators will have to access to deploy or control the capability.

3. If the plant FLEX strategy relies on a water source that is not seismically robust, e.g., a downstream dam, the deployment of FLEX coping capabilities should address how water will be accessed. Most sites with this configuration have an underwater berm that retains a needed volume of water. However, accessing this water may require new or different equipment.

4. If power is required to move or deploy the equipment (e.g., to open the door from a storage location), then power supplies should be provided as part of the FLEX deployment.

5. A means to move FLEX equipment should be provided that is also reasonably protected from the event.

With respect to the movement of FLEX equipment during a seismic event, the licensee indicates on page 13 of the Integrated Plan that deployment paths from the FLEX storage building to each staging area are identified, as well as the debris removal concerns, security barriers, and lighting needs as they apply to each deployment path.

The licensee also stated that the deployment paths refer to the route from a storage location to the staging location for the pumps and generators, and routing paths refer to the route from a staging location to the point of connection to existing plant equipment for hoses and cables. To ensure the strategies can be implemented in all modes, areas adjacent to the equipment storage facilities and staging areas, as well as the deployment and hose routing paths will be kept normally accessible. These requirements will be included in an administrative program.

The licensee stated that debris removal equipment will be procured to ensure that onsite roadways are passable following a BDBEE. Offsite travel paths from the offsite response center will be assessed as part of the Regional Response Center (RRC) response dependent on post-event conditions.

The licensee also stated that for the FLEX generators and cables, the staging areas for Modes 1-4 will be either at the north side of the Turbine Building near Auxiliary Building (AB) (Staging Area 1 on Figure 3-3 in the Integrated Plan) or the on the north east side of the Containment Building. The maximum deployment path will be 2,200 feet from Storage Area 1 and 900 feet from Storage Area 2. Debris from various overheard hazards may need to be cleared; however, the expected debris can be cleared with moderately sized equipment. There are no security barriers in the deployment paths for the pumps, and the entirety of the deployment path is within the protected area.

On page 26 of the Integrated Plan, the licensee stated that the connection from both tanks T-90 and T-91 is not guaranteed to survive every event simultaneously but is the preferred source if available. Suction from Lake Michigan will survive all the events and will use a rigid suction hose to draft out of the lake to ensure its availability. The new connection to the CST will be protected by the CST missile barrier. The discharge connection for the AFW system is location inside the AB and will survive all events. The CST connection is the manway on the tank and is expected to survive the same events as the tank; all but a wind missile event. A modification to missile-protect the CST will allow this connection to survive all events.

On page 26 of the Integrated Plan, the licensee identified the connection point for the strategy to refill the condensate storage tank (CST) as being to either the manway or through a modification to the overflow line, which would not require access to a structure. The licensee also identified a connection point within the turbine building (TB) for the strategy for providing steam generator (SG) makeup using a portable pump. The licensee stated that if the TB is inaccessible, and this connection point is unavailable, a second connection point utilizes a modified Auxiliary Feedwater (AFW) system drain downstream of the motor driven AFW pump P-8C.

On pages 32 and 33 of the Integrated Plan, the licensee stated that the UHS FLEX pump will be staged along Lake Michigan. The suction hose will simply be draped into the open lake with a strainer to filter debris. The reviewer noted that the use of Lake Michigan as a water source addresses the considerations for failure of downstream dams because the nearest downstream dams are within the St. Lawrence Seaway and are sufficiently removed from the site such that a seismic initiating event would be unlikely to impact both the site and the dams. The discharge hose will be run along grade level to the Service Water Pump House, the Service Water piping adjacent to the pump house, or near the Component Cooling Water (CCW) heat exchanger in the AB where the discharge of the hose will be connected to the Service Water System. The precise location of the Service Water connection has not yet been determined, but is identified as being within the AB, which is seismically robust.

On page 53 of the Integrated Plan the licensee stated that regarding SFP cooling water sources, he available suction sources for all of the above options are the safety injection and refueling water storage tank (SIRWT) and Lake Michigan.

On pages 56 and 57 of the Integrated Plan, the licensee stated in part that for SFP cooling:

> The suction pipe for the SIRWT will be constructed to withstand all the hazards. Lake Michigan will survive all the events and will use a hardened suction hose to draft out of the lake to ensure its availability. Both discharge connections are inside the Auxiliary Building, which will survive all events. Hose will be used to get from the pumps to the connection points; this hose will be stored in the FLEX building that will be designed to withstand all events.

On page 1 of the Integrated Plan, the licensee states that soil liquefaction is not explicitly addressed in its UFSAR and identified that an evaluation is being conducted for its impact on deployment of portable FLEX equipment. This has been identified as Confirmatory Item 3.1.1.2.A in Section 4.2.

The licensee did not address potential need for a power source to move or deploy the equipment (e.g., to open the door from a storage location). This has been identified as Confirmatory Item 3.1.1.2.B in Section 4.2.

On page 65 of the Integrated Plan the licensee stated that the generators, cables, and transport vehicles will all be stored in the FLEX storage facility.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of FLEX equipment for seismic hazards, if these requirements are implemented as described.

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

> There are four procedural interface considerations that should be addressed.
>
> 1. Seismic studies have shown that even seismically qualified electrical equipment can be affected by BDB seismic events. In order to address these considerations, each plant should compile a reference source for the plant operators that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (see Section 3.2.1.10). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance should include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power.
>
> 2. Consideration should be given to the impacts from large internal flooding sources that are not seismically robust and do not require ac power (e.g., gravity drainage from lake or cooling basins for non-safety-related cooling water systems).
>
> 3. For sites that use ac power to mitigate ground water in critical locations, a strategy to remove this water will be required.
>
> 4. Additional guidance may be required to address the deployment of FLEX for those plants that could be impacted by failure of a not seismically robust downstream dam.

On page 62 of the integrated Plan the licensee stated in part that:

> Support for the safety functions is provided by continued observation of plant conditions by operators using specific instruments and coordinating activities from the Control Room. In addition, the Key Reactor Parameters can be determined from a local reading using standard I&C instruments and local indications.

The licensee did not provide information concerning impacts from large internal flooding sources that are not seismically robust and the potential impact on the mitigating strategies. This is Open Item 3.1.1.3.A in Section 4.1.

The licensee did not provide information concerning ground water mitigation requirements. This is Open Item 3.1.1.3.B in Section 4.1.

Guidance regarding downstream dams is not required as discussed in TER section 3.1.1.2 above.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Open Items, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces for seismic hazards, if these requirements are implemented as described.

3.1.1.4 Considerations in Using Offsite Resources - Seismic Hazard

NEI 12-06, Section 5.3.4 states:

> Severe seismic events can have far-reaching effects on the infrastructure in and around a plant. While nuclear power plants are designed for large seismic events, many parts of the Owner Controlled Area and surrounding infrastructure (e.g., roads, bridges, dams, etc.) may be designed to lesser standards. Obtaining off-site resources may require use of alternative transportation (such as air-lift capability) that can overcome or circumvent damage to the existing local infrastructure.
>
> 1. The FLEX strategies will need to assess the best means to obtain resources from off-site following a seismic event.

On pages 16 and 17 of the Integrated Plan, the licensee stated that the industry will establish two (2) RRCs to support utilities during beyond-design events. Each RRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when required, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local assembly area, established by the Strategic Alliance for FLEX Emergency Response (SAFER) team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 24 hours from the initial request. Entergy, for the Palisades site, will negotiate and execute a contract with SAFER that will meet the requirements of NEI 12-06, Section 12. For Palisades this will include provisions to connect the sites 2400V distribution system.

Licensee plans for use of off-site resources is not complete. The licensee has not identified the local assembly area, or provided a discussion regarding the means to be used to deliver equipment to the site. This has been identified as Confirmatory Item 3.1.1.4.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to use of off-site resources during seismic events, if these requirements are implemented as described.

3.1.2 Flooding.

NEI 12-06, Section 6.2 states:

> The evaluation of external flood-induced challenges has three parts. The first part is determining whether the site is susceptible to external flooding. The second part is the characterization of the applicable external flooding threat. The third part is the application of the flooding characterization to the protection and deployment of FLEX strategies.

NEI 12-06, Section 6.2.1 states in part:

> Susceptibility to external flooding is based on whether the site is a "dry" site, i.e., the plant is built above the design basis flood level (DBFL). For sites that are not "dry", water intrusion is prevented by barriers and there could be a potential for those barriers to be exceeded or compromised. Such sites would include those that are kept "dry" by permanently installed barriers, e.g., seawall, levees, etc., and those that install temporary barriers or rely on watertight doors to keep the design basis flood from impacting safe shutdown equipment.

On page 2 of the Integrated Plan, the licensee stated that the flood assessment for the Palisades site provided in the UFSAR considered flooding due to high levels in Lake Michigan, high rainfall, seismically-induced floods, wind-generated waves concurrent with flooding, and significant flooding in rushes called seiches. High tides, hurricane surges, and tsunamis were determined to not affect the site due to the inland location. Ground level elevation for Palisades is 590 ft. MSL. The PMF for Palisades including a seiche event is 594.1 ft. All plant equipment that will be used for FLEX is protected against a flood to a level of 594.4 ft. per UFSAR Section 2.2.

Thus, the Palisades site screens in for the external flooding hazard.

On page 2 of the Integrated Plan, the licensee further stated that, a seiche event is short in duration and is predicted to last less than 30 minutes. While the safety-related equipment is protected from the PMF, all safety-related structures are not located above this elevation and all structures are susceptible to the seiche levels. Therefore, the Palisades site is not considered a "dry" site and is susceptible to external flood. Accordingly, FLEX strategies will be developed for consideration of external flooding hazards. In addition, Palisades is also developing procedures and strategies for delivery of offsite FLEX equipment during Phase 3, which considers regional impacts from flooding. The licensee also stated that the flooding re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, had not been completed and therefore not assumed in the Integrated Plan.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to screening for flooding hazards, if these requirements are implemented as described.

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

> These considerations apply to the protection of FLEX equipment from external flood hazards:
>
> 1. The equipment should be stored in one or more of the following configurations:
>
>   a. Stored above the flood elevation from the most recent site flood analysis. The evaluation to determine the elevation for storage should be informed by flood analysis applicable to the site from early site permits, combined license applications, and/or contiguous licensed sites.
>
>   b. Stored in a structure designed to protect the equipment from the flood.
>
>   c. FLEX equipment can be stored below flood level if time is available and plant procedures/guidance address the needed actions to relocate the equipment. Based on the timing of the limiting flood scenario(s), the FLEX equipment can be relocated [footnote 2 omitted] to a position that is protected from the flood, either by barriers or by elevation, prior to the arrival of the potentially damaging flood levels. This should also consider the conditions on-site during the increasing flood levels and whether movement of the FLEX equipment will be possible before potential inundation occurs, not just the ultimate flood height.
>
> 2. Storage areas that are potentially impacted by a rapid rise of water should be avoided.

On pages 25, 55 and 64 of the Integrated Plan, the licensee stated that the FLEX storage facility will be designed to withstand flooding events to a PMF of 594.1 ft.. The equipment will be protected during a short duration seiche event and available for any standing flood event.

Similar statements were made throughout the Integrated Plan when referring to storage and protection of FLEX portable equipment with respect to flooding.

On page 24 of the Integrated Plan, the licensee stated that structures to provide protection of FLEX equipment will be constructed to meet the requirements of NEI 12-06, Section 11. Schedule to construct the permanent building is contained in Attachment 2, and will satisfy the site compliance date. Procedures and programs will be developed to address storage structure requirements, haul path requirements, and FLEX equipment requirements relative to the external hazards applicable to Palisades.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protection of FLEX equipment during flood events, if these requirements are implemented as described.

3.1.2.2 Deployment of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.2 states:

There are a number of considerations which apply to the deployment of FLEX equipment for external flood hazards:

1. For external floods with warning time, the plant may not be at power. In fact, the plant may have been shut down for a considerable time and the plant configuration could be established to optimize FLEX deployment. For example, the portable pump could be connected, tested, and readied for use prior to the arrival of the critical flood level. Further, protective actions can be taken to reduce the potential for flooding impacts, including cooldown, borating the RCS, isolating accumulators, isolating RCP seal leak off, obtaining dewatering pumps, creating temporary flood barriers, etc. These factors can be credited in considering how the baseline capability is deployed.

2. The ability to move equipment and restock supplies may be hampered during a flood, especially a flood with long persistence. Accommodations along these lines may be necessary to support successful long-term FLEX deployment.

3. Depending on plant layout, the ultimate heat sink may be one of the first functions affected by a flooding condition. Consequently, the deployment of the FLEX equipment should address the effects of LUHS, as well as ELAP.

4. Portable pumps and power supplies will require fuel that would normally be obtained from fuel oil storage tanks that could be inundated by the flood or above ground tanks that could be damaged by the flood. Steps should be considered to protect or provide alternate sources of fuel oil for flood conditions. Potential flooding impacts on access and egress should also be considered.

5. Connection points for portable equipment should be reviewed to ensure that they remain viable for the flooded condition.

6. For plants that are limited by storm-driven flooding, such as Probable Maximum Surge or Probable Maximum Hurricane (PMH), expected storm conditions should be considered in evaluating the adequacy of the baseline deployment strategies.

7. Since installed sump pumps will not be available for dewatering due to the ELAP, plants should consider the need to provide water extraction pumps capable of operating in an ELAP and hoses for rejecting accumulated water for structures required for deployment of FLEX strategies.

8. Plants relying on temporary flood barriers should assure that the storage location for barriers and related material provides reasonable assurance that the barriers could be deployed to provide the required protection.

9. A means to move FLEX equipment should be provided that is also reasonably protected from the event.

The licensee stated that debris removal equipment will be procured to ensure that onsite roadways are passable following a BDBEE. Offsite travel paths from the offsite response center will be assessed as part of the Regional Response Center (RRC) response dependent on post-event conditions.

The licensee stated that for the FLEX pumps and hoses, the staging area for Modes 1-4 will be either at the Lake Michigan suction area or near Tanks T-90 and T-91 (Staging Areas 2 and 3 on Figure 3-3 in the Integrated Plan); dependent on which suction source will be used. The staging area for Modes 5 and 6 will be either at the Lake Michigan suction area or near the Tendon Tunnel (Staging Areas 3 and 4 on Figure 3-3 in the Integrated Plan); dependent on which suction source will be used.

The licensee also explained that for the FLEX generators and cables, the staging areas for Modes 1-4 will be either at the north side of the Turbine Building near AB (Staging Area 1 on Figure 3-3 in the Integrated Plan) or the on the north east side of the Containment Building (Staging Area 5 on Figure 3-3 in the Integrated Plan).

On page 27 of the Integrated Plan, the licensee described the connection points for its strategies as described in section 3.1.1.2 above. In addition, the licensee stated that for one of its strategies, the Tendon Tunnel is below the flood elevation, therefore the hose cannot be used unless the access to the Tendon Tunnel is sealed against flooding. A pipe would have to be installed so that a FLEX portable pump would be able to connect to the Auxiliary Feed Water (AFW) system piping as an alternate strategy.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of FLEX equipment for flooding hazards, if these requirements are implemented as described.

3.1.2.3 Procedural Interfaces – Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

> The following procedural interface considerations should be addressed.
>
> 1. Many sites have external flooding procedures. The actions necessary to support the deployment considerations identified above should be incorporated into those procedures.
>
> 2. Additional guidance may be required to address the deployment of FLEX for flooded conditions (i.e., connection points may be different for flooded vs. non-flooded conditions).
>
> 3. FLEX guidance should describe the deployment of temporary flood barriers and extraction pumps necessary to support FLEX deployment.

On page 15 of the Integrated Plan, the licensee states that it is a participant in the PWROG project and will develop Functional Support Guidelines (FSGs) that supports implementation of FLEX by the Spring of 2015. The FSGs will be used to develop site-specific procedures used to cope with ELAP in a manner that is compliant with NEI 12-06. Additionally, the licensee stated that the FSGs will be implemented as necessary to maintain the key safety functions of core cooling, containment, and spent fuel pool cooling in parallel with the controlling procedure actions. The licensee stated that the FSGs would interface with controlling procedures such as Emergency Operating Procedures (EOPs), Abnormal Operating Procedures (AOPs), and Standard Operating Procedures (SOPs).

The licensee also stated that the proposed procedural interfaces used to implement the response for flooding hazards would be prepared under their internal change process.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces for flooding hazards, if these requirements are implemented as described.

3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

> Extreme external floods can have regional impacts that could have a significant impact on the transportation of offsite resources.
>
> 1. Sites should review site access routes to determine the best means to obtain resources from off-site following a flood.
> 2. Sites impacted by persistent floods should consider where equipment delivered from offsite could be staged for use on-site.

The licensee has not identified the local assembly area, or provided a discussion regarding the means to be used to deliver equipment to the site. This has been combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to use of off-site resources during flooding events, if these requirements are implemented as described.

3.1.3 High Winds

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 first part of the evaluation of high wind challenges is determining whether the site is potentially susceptible to different high wind conditions to allow characterization of the applicable high wind hazard.

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 10^{-6} per year, the site should address hazards due to extreme high winds associated with 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 10^{-6}/year probability exceeds 130 mph, the site should address hazards due to extreme high winds associated with tornadoes.

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 10^{-6}/year probability exceeds 130 mph, the site should address hazards due to extreme high winds associated with tornadoes.

On page 2 of the Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that per the UFSAR Figure 1-1, Sheet 1, the Palisades site is contained within a box with corner coordinates 42 degrees 18 minutes N, 086 degrees 18 minutes W and 42 degrees 20 minutes' N, 086 degrees 19 minutes W. Based on these coordinates, Palisades will consider a maximum wind speed of 200 mph for FLEX per NEI 12-06, Figures 7-1 and 7-2. Thus, the Palisades site screens in for the high winds hazard. The design basis tornado for Palisades uses a tangential wind speed of 300 mph per UFSAR Section 2.5.1.4. In summary, based on the available locale data and Figures 7-1 and 7-2 of NEI 12-06, Palisades is susceptible to severe storms with high winds.

The reviewer noted that a comparison of the site location to NEI 12-06, Figure 7-1 shows the site to be North and West of the contour line for a peak-gust hurricane wind speed of 130 mph with an annual exceedance probability of 10^{-6}/year; this is in the direction of diminishing peak-gust hurricane wind speeds. As a result, the site is not susceptible to hurricane conditions. The licensee's identification of a maximum wind speed of 200 mph is derived from the site location being within Region 1 of NEI 12-06, Figure 7-2, which has a recommended tornado design wind speed of 200 mph for the 10^{-6}/year probability.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to screening for high wind hazards, if these requirements are implemented as described.

3.1.3.1 Protection of FLEX Equipment - High Wind Hazard

NEI 12-06, Section 7.3.1 states:

> These considerations apply to the protection of FLEX equipment from high wind hazards:
>
> 1. For plants exposed to high wind hazards, FLEX equipment should be stored in one of the following configurations:
>
>   a. In a structure that meets the plant's design basis for high wind hazards (e.g., existing safety-related structure).
>
>   b. In storage locations designed to or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* given the limiting tornado wind speeds from Regulatory Guide 1.76 or design basis hurricane wind speeds for the site.

- Given the FLEX basis limiting tornado or hurricane wind speeds, building loads would be computed in accordance with requirements of ASCE 7-10. Acceptance criteria would be based on building serviceability requirements not strict compliance with stress or capacity limits. This would allow for some minor plastic deformation, yet assure that the building would remain functional.

- Tornado missiles and hurricane missiles will be accounted for in that the FLEX equipment will be stored in diverse locations to provide reasonable assurance that N sets of FLEX equipment will remain deployable following the high wind event. This will consider locations adjacent to existing robust structures or in lower sections of buildings that minimizes the probability that missiles will damage all mitigation equipment required from a single event by protection from adjacent buildings and limiting pathways for missiles to damage equipment.

- The axis of separation should consider the predominant path of tornados in the geographical location. In general, tornadoes travel from the West or West Southwesterly direction, diverse locations should be aligned in the North-South arrangement, where possible. Additionally, in selecting diverse FLEX storage locations, consideration should be given to the location of the diesel generators and switchyard such that the path of a single tornado would not impact all locations.

- Stored mitigation equipment exposed to the wind should be adequately tied down. Loose equipment should be in protective boxes that are adequately tied down to foundations or slabs to prevent protected equipment from being damaged or becoming airborne. (During a tornado, high winds may blow away metal siding and metal deck roof, subjecting the equipment to high wind forces.)

c. In evaluated storage locations separated by a sufficient distance that minimizes the probability that a single event would damage all FLEX mitigation equipment such that at least N sets of FLEX equipment would remain deployable following the high wind event. (This option is not applicable for hurricane conditions).

   - Consistent with configuration b., the axis of separation should consider the predominant path of tornados in the geographical location.

   - Consistent with configuration b., stored mitigation equipment should be adequately tied down.

On pages 25, 39 and 55 of the Integrated Plan, the licensee stated that the FLEX storage facility will be designed to withstand severe storms with high wind events to the magnitude discussed in the "General Integrated Plan Elements" section of the Integrated Plan. The reviewer noted that the cited portion of the Integrated Plan includes both the site design-basis tangential wind speed of 300 mph, which would be useable to conform to NEI 12-06, Section 7.3.1, Consideration 1.a., and the 200 mph wind speed derived from NEI 12-06, Figure 7-2. The use of 200 mph, which is a wind speed also discussed in the cited portion of the Integrated Plan, would fall short of the design criteria for NEI 12-06, Section 7.3.1, Consideration 1.b. This is because the Consideration 1.b. criteria for the protective structures relies on the tornado wind speeds from Regulatory Guide (RG) 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants." RG 1.76, Revision 1, which is based in part on the source document for NEI 12-06, Figure 7-2, NUREG/CR-4461, Revision 2, provides the NRC Regulatory Position that design-basis tornado parameters from RG 1.76, Table 1 should be used for defining the design-basis tornado for a nuclear power plant. Using this Regulatory Position would result in a design-basis tornado wind speed of 230 mph for PNP's site. (Use of the prior revision of RG 1.76 would result in a design-basis tornado wind speed of 360 mph.) The licensee should confirm that the structures will meet the plant's design-basis tornado wind speed of 300 mph or will be designed or evaluated equivalent to ASCE 7-10 using a tornado wind speed of 230 mph with separation and diversity between the storage locations. If the method of protection chosen is the later, the licensee should justify that the separation and diversity is adequate. This is identified as Confirmatory Item 3.1.3.1.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to storage to FLEX equipment during high wind events, if these requirements are implemented as described.

3.1.3.2 Deployment of FLEX Equipment - High Wind Hazard

NEI 12-06, Section 7.3.2 states:

> There are a number of considerations which apply to the deployment of FLEX equipment for high wind hazards:
>
> 1. For hurricane plants, the plant may not be at power prior to the simultaneous ELAP and LUHS condition. In fact, the plant may have been shut down and the plant configuration could be established to optimize FLEX deployment. For example, the portable pumps could be connected, tested, and readied for use prior to the arrival of the hurricane. Further, protective actions can be taken to reduce the potential for wind impacts. These factors can be credited in considering how the baseline capability is deployed.
>
> 2. The ultimate heat sink may be one of the first functions affected by a hurricane due to debris and storm surge considerations. Consequently, the evaluation should address the effects of ELAP/LUHS, along with any other equipment that would be damaged by the postulated storm.
>
> 3. Deployment of FLEX following a hurricane or tornado may involve the need to remove debris. Consequently, the capability to remove debris caused by these extreme wind storms should be included.
>
> 4. A means to move FLEX equipment should be provided that is also reasonably protected from the event.
>
> 5. The ability to move equipment and restock supplies may be hampered during a hurricane and should be considered in plans for deployment of FLEX

equipment.

Because PNPP is not susceptible to hurricanes, considerations 1, 2, and 5 are not applicable.

On page 15 of the Integrated Plan, the licensee states that it will develop FSGs. The FSGs will be used to develop site-specific procedures used to cope with ELAP in a manner that is compliant with NEI 12-06. The licensee stated that the FSGs would interface with controlling procedures such as EOPs, AOPs, and SOPs. The licensee states that the procedures will direct the movement of the FLEX transfer pump to the Lake Michigan access, as required so that it will be able to function by the hour 4 after the declaration of the ELAP event.

The licensee stated that debris removal equipment will be procured to ensure that onsite roadways are passable following a BDBEE. Offsite travel paths from the offsite response center will be assessed as part of the Regional Response Center (RRC) response dependent on post-event conditions. The licensee did not address a means to move FLEX equipment that is also reasonably protected from the event. This has been identified as Confirmatory Item 3.1.3.2.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of FLEX equipment during high wind events, if these requirements are implemented as described.

3.1.3.3 Procedural Interfaces - High Wind Hazard

As discussed in NEI 12-06, Section 7.3.3, the following procedural interface considerations should be addressed:

> The overall plant response strategy should be enveloped by the baseline capabilities, but procedural interfaces may need to be considered. For example, many sites have hurricane procedures. The actions necessary to support the deployment considerations identified above should be incorporated into those procedures.

On page 15 of the Integrated Plan, the licensee states that it is a participant in the PWROG project and will develop FSGs that supports implementation of FLEX by the Spring of 2015. The FSGs will be used to develop site-specific procedures used to cope with ELAP in a manner that is compliant with NEI 12-06. Further, the licensee stated that the FSGs will be implemented as necessary to maintain the key safety functions of core cooling, containment, and spent fuel pool cooling in parallel with the controlling procedure actions. The licensee stated that the FSGs would interface with controlling procedures such as EOPs, AOPs, and SOPs.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces for high wind hazards, if these requirements are implemented as described.

3.1.3.4 Considerations in Using Offsite Resources - High Wind Hazard

NEI 12-06, Section 7.3.4 states:

> Extreme storms with high winds can have regional impacts that could have a significant impact on the transportation of off-site resources.
>
> 1. Sites should review site access routes to determine the best means to obtain resources from off-site following a hurricane.
>
> 2. Sites impacted by storms with high winds should consider where equipment delivered from off-site could be staged for use on-site.

The licensee has not identified the local assembly area, or provided a discussion regarding the means to be used to deliver equipment to the site. This has been combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to use of off-site resources during high wind events, if these requirements are implemented as described.

3.1.4 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 their 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 35^{th} 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.

On page 2 of the Integrated Plan, regarding the determination of applicable extreme external hazards, the licensee stated that per the FLEX guidance all sites should consider the temperature ranges and weather conditions for their site in storing and deploying their FLEX equipment. That is, the equipment procured should be suitable for use in the anticipated range of conditions with normal design practices. The guidance provided in NEI 12-06, Section 8.2.1 states that plants above the 35th parallel must consider extreme cold and snowfall. Per the UFSAR Figure 1-1, Sheet 1, Palisades' is located between 42 degrees 18 minutes N and 42 degrees 20 minutes N, which is above the 35^{th} parallel and located in the Level 5 region for ice storms in NEI 12-06, Figure 8-2. Thus, the Palisades site screens in for the extreme cold hazard and the extreme ice storm hazard.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to screening for snow, ice and extreme cold hazards, if these requirements are implemented as described.

3.1.4.1 Protection of FLEX Equipment - Snow, Ice, and Extreme Cold Hazard

NEI 12-06, Section 8.3.1 states:

> These considerations apply to the protection of FLEX equipment from snow, ice, and extreme cold hazards:
>
> 1. For sites subject to significant snowfall and ice storms, portable FLEX equipment should be stored in one of the two configurations.
>
>   a. In a structure that meets the plant's design basis for the snow, ice and cold conditions (e.g., existing safety-related structure).
>
>   b. In a structure designed to or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* for the snow, ice, and cold conditions from the site's design basis.
>
>   c. Provided the N sets of equipment are located as described in a. or b. above, the spare (N+1) set of equipment may be stored in an evaluated storage location capable of withstanding historical extreme weather conditions such that the equipment is deployable.
>
> 2. Storage of FLEX equipment should account for the fact that the equipment will need to function in a timely manner. The equipment should be maintained at a temperature within a range to ensure its likely function when called upon. For example, by storage in a heated enclosure or by direct heating (e.g., jacket water, battery, engine block heater, etc.).

On pages 25, 39 and 55 of the Integrated Plan, the licensee stated that the FLEX storage facility will be designed to withstand snow, ice, and extreme cold events to the magnitude discussed in the "General Integrated Plan Elements" section of the Integrated Plan.

The licensee stated that the design of the FLEX storage facility is not complete. Although the licensee stated that cold temperatures, snow, and ice are conditions commonly experienced, the Integrated Plan did not specify what features would be used to ensure the functionality of FLEX equipment. During the NRC audit and review process, the licensee states that the preliminary design of the FLEX storage buildings will include considerations for harsh environment conditions by providing climate controls.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protection of equipment for snow, ice and extreme cold hazards, if these requirements are implemented as described.

3.1.4.2 Deployment of Portable Equipment – Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.2 states:

> There are a number of considerations that apply to the deployment of FLEX equipment for snow, ice, and extreme cold hazards:

1. The FLEX equipment should be procured to function in the extreme conditions applicable to the site. Normal safety-related design limits for outside conditions may be used, but consideration should also be made for any manual operations required by plant personnel in such conditions.

2. For sites exposed to extreme snowfall and ice storms, provisions should be made for snow/ice removal, as needed to obtain and transport equipment from storage to its location for deployment.

3. For some sites, the ultimate heat sink and flow path may be affected by extreme low temperatures due to ice blockage or formation of frazil ice. Consequently, the evaluation should address the effects of such a loss of the UHS on the deployment of FLEX equipment. For example, if UHS water is to be used as a makeup source, some additional measures may need to be taken to assure that the FLEX equipment can utilize the water.

On page 13 of the Integrated Plan regarding the deployment strategies of FLEX equipment in all modes, the licensee stated that deployment of FLEX equipment is described in the subsequent sections for each strategy and all modes. The broad-spectrum deployment strategies are unchanged for the different operating modes. The deployment strategies from the FLEX storage building to each staging area are identified, as well as the debris removal concerns, security barriers, and lighting needs as they apply to each deployment path.

The licensee did not address snow and ice removal from the FLEX equipment deployment paths, nor was this topic addressed in a licensee identified open item. During the NRC audit and review process, the licensee stated that the preliminary design of the FLEX storage buildings will include considerations for harsh environment conditions by providing climate controls, protecting the equipment from wind, snow and ice and having paved access to existing employee parking areas. Winter weather driven events are predictable, and Palisades routinely has snow plows mounted and road sanders prestaged prior to snow/ice events. Plowing and sanding are routine to ensure safe passage of Palisades employees with onsite salt/sand capabilities to address icing. In addition, Palisades contracts a local provider for snow removal. As part of the FLEX storage building design process, haul paths will be identified. Subsequent actions will be identified and tracked to include into Palisades procedures adverse weather preparations providing assurance FLEX equipment deployment paths will be capable of being readily cleared of snow and ice to meet FLEX strategy timelines.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of FLEX equipment for snow, ice and extreme cold hazards, if these requirements are implemented as described.

3.1.4.3 Procedural Interfaces – Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.3 states:

> The only procedural enhancements that would be expected to apply involve addressing the effects of snow and ice on transport the FLEX equipment. This includes both access to the transport path, e.g., snow removal, and appropriately equipped vehicles for moving the equipment.

As described in Section 3.1.4.2 of this TER, during the NRC audit and review process, the licensee stated that the preliminary design of the FLEX storage buildings will include considerations for harsh environment conditions by providing climate controls, protecting the equipment from wind, snow and ice and having paved access to existing employee parking areas. Winter weather driven events are predictable, and Palisades routinely has snow plows mounted and road sanders prestaged prior to snow/ice events. Plowing and sanding are routine to ensure safe passage of Palisades employees with onsite salt/sand capabilities to address icing. In addition, Palisades contracts a local provider for snow removal. As part of the FLEX storage building design process, haul paths will be identified. Subsequent actions will be identified and tracked to include into Palisades procedures adverse weather preparations providing assurance FLEX equipment deployment paths will be capable of being readily cleared of snow and ice to meet FLEX strategy timelines.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces for snow, ice and extreme cold hazards, if these requirements are implemented as planned.

3.1.4.4 Considerations in Using Offsite Resources – Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.4, states that:

> Severe snow and ice storms can affect site access and can impact staging areas for receipt of off-site material and equipment.

The licensee has not identified the local assembly area, or provided a discussion regarding the means to be used to deliver equipment to the site. This has been combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to use of off-site resources during snow, ice and extreme cold events, if these requirements are implemented as described.

3.1.5 High Temperatures

NEI 12-06, Section 9.2 states:

> All sites will address high temperatures. Virtually every state in the lower 48 contiguous United States has experienced temperatures in excess of 110°F. Many states have experienced temperatures in excess of 120°F.
>
> In this case, sites should consider the impacts of these conditions on deployment of the FLEX equipment.

On page 3 of the Integrated Plan, regarding the determination of applicable extreme external hazards, the licensee stated that due to Palisades' proximity to Lake Michigan, the site experiences cooler temperatures than most locations in their region, the 10 year maximum temperature is 95 degrees F per UFSAR Section 2.5. However, the guidance in NEI 12-06 Section 9.2 states that all sites within the continental United States will address the high temperature scenarios. Thus the Palisades site screens in for the extreme heat hazard.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to screening for high temperature hazards, if these requirements are implemented as described.

3.1.5.1 Protection of FLEX Equipment – High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

> The equipment should be maintained at a temperature within a range to ensure its likely function when called upon.

On page 25 of the Integrated Plan, regarding maintaining core cooling and heat removal, the licensee stated that the FLEX storage facility will be designed to withstand high temperature events to the magnitude discussed in the "General Integrated Plan Elements" section of the Integrated Plan. The licensee stated that the design of the FLEX storage facility is not complete. The licensee did not specify what features would be used to ensure the functionality of FLEX equipment in the presence of high temperature hazards. This is Open Item 3.1.5.1.A in Section 4.1.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Open Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protection of FLEX equipment during high temperature events, if these requirements are implemented as described.

3.1.5.2 Deployment of FLEX Equipment – High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

> The FLEX equipment should be procured to function, including the need to move the equipment, in the extreme conditions applicable to the site. The potential impact of high temperatures on the storage of equipment should also be considered, e.g., expansion of sheet metal, swollen door seals, etc. Normal safety-related design limits for outside conditions may be used, but consideration should also be made for any manual operations required by plant personnel in such conditions.

On page 13 of the Integrated Plan regarding the deployment strategies of FLEX equipment in all modes, the licensee stated that deployment of FLEX equipment is described in the subsequent sections below for each strategy and all modes. The deployment strategies from the FLEX storage building to each staging area are identified, as well as the debris removal concerns, security barriers, and lighting needs as they apply to each deployment path.

The licensee provided examples of the manual operations that are anticipated in response to an ELAP in the Integrated Plan. Such examples include manual isolation of the PCS letdown valves, breaker and switching operations, and manual control of the automatic depressurization valves (ADVs).

The licensee did not address the potential impact of high temperatures on the storage of equipment, e.g., expansion of sheet metal, or swollen door seals. This has been identified as Confirmatory Item 3.1.5.2.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of FLEX equipment during high temperature events, if these requirements are implemented as described.

3.1.5.3 Procedural Interfaces – High Temperature Hazard

NEI 12-06, Section 9.3.3 states:

> The only procedural enhancements that would be expected to apply involve addressing the effects of high temperatures on the portable equipment.

The licensee stated that the design of the FLEX storage facility is not complete. The licensee did not specify what features would be used to ensure the functionality of FLEX equipment when deployed in the presence of High Temperatures. This is Open Item 3.1.5.3.A in Section 4.1.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces for high temperature hazards, if these requirements are implemented as described.

3.2 PHASED APPROACH

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 using installed equipment and resources, followed by a transition phase using portable onsite equipment and consumables and a final phase using offsite resources.

To meet these EA-12-049 requirements, Licensees will establish a baseline coping capability to prevent fuel damage in the reactor core or SFP and to maintain containment capabilities in the context of a BDBEE that results in the loss of all ac power, with the exception of buses supplied by safety-related batteries through inverters, and loss of normal access to the UHS.

As described in NEI 12-06, Section 1.3, plant-specific analyses will determine the duration of each phase.

3.2.1 PCS Cooling and Heat Removal, and PCS Inventory Control Strategies

Note: Palisades sometimes refers to the RCS as the primary coolant system (PCS)

NEI 12-06, Table 3-2 and Appendix D summarize one acceptable approach for the reactor core cooling strategies. This approach uses the installed emergency feedwater (EFW) system to provide steam generator (SG) makeup sufficient to maintain or restore SG level in order to continue to provide core cooling for the initial phase. This approach relies on depressurization of the SGs for makeup with a portable injection source in order to provide core cooling for the transition and final phases. This approach accomplishes primary coolant system (PCS) inventory control and maintenance of long term subcriticality through the use of low leak reactor coolant pump seals and/or borated high pressure PCS makeup with a letdown path. In mode 5 (cold shutdown) and mode 6 (refueling) with SGs not available, this approach relies on an on-site pump for PCS makeup and diverse makeup connections to the PCS for long-term PCS makeup with borated water and residual heat removal from the vented RCS.

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 2.1, strategies that have a time constraint to be successful should be identified and a basis provided that the time can be reasonably met. 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 a beyond-design-basis event, 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. 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 3.2.1.4 describes boundary conditions for the reactor transient.

Acceptance criteria for the analyses serving as the technical basis for establishing the time constraints for the baseline coping capabilities described in NEI 12-06, which provide an acceptable approach, as endorsed by JLD-ISG-2012-01, to meeting the requirements of EA-12-049 for maintaining core cooling are 1) the preclusion of core damage as discussed in NEI 12-06, Section 1.3 as the purpose of FLEX; and 2) prevention of recriticality as discussed in Appendix D, Table D-1.

As described in NEI 12-06, Section 1.3, plant-specific analyses determine the duration of the phases for the mitigation strategies. In support of its mitigation strategies, the licensee performed a thermal-hydraulic analysis for an event with a simultaneous loss of all alternating current (ac) power and loss of normal access to the ultimate heat sink for an extended period (the ELAP event).

The licensee was requested to provide a discussion regarding Section 3.2 of WCAP-17601 which discusses the PWROG recommendations that cover the following subjects for consideration in developing FLEX mitigation strategies: (1) minimizing reactor coolant pump (RCP) seal leakage rates; (2) adequate shutdown margin; (3) time initiating cooldown and depressurization; (4) prevention of the RCS overfill; (5) blind feeding an SG with a portable pump; (6) nitrogen injection from SITs [safety injection tanks], and (7) asymmetric natural circulation cooldown (NCC).

During the audit process the licensee provided the following information regarding Section 3.2 of WCAP-17601:

- Item 1: The early initiation of cooldown and depressurization discussed in Item 2 reduces the seal differential pressure, further reducing seal leakage.
- Item 2: The ELAP analysis assumes at 2 hours a plant cooldown commences at approximately 75 deg F/hr using the atmospheric dump valves to approximately 350 deg

F cold leg temperatures and the plant is stabilized. During the plant cooldown the safety injection tanks (SIT) will inject borated water. Additional inventory and borated water will be required. The ELAP analysis (CN-SEE-11-13-5 (REDACTED) Rev1) concluded that a FLEX pump (which can provide at least 30 gpm at pressures up to 300 psia) started within 8 hours will maintain the primary coolant in a single phase flow condition assuming the seal leakage listed in WCAP-17601-P, Revision 1 for combustion engineering design. Furthermore, when started at 13 hours and operated for 7 hours, will provide sufficient shutdown margin at 24 hours to overcome Xe decay and maintain at least 1% shutdown margin indefinitely for hot leg temperatures of approximately 355 deg F. The Palisades FLEX pump will be an installed charging pump which exceeds the assumed capacity and discharge pressure.

- Item 3: The ELAP analysis assumes a cooldown to approximately 350 deg F cold leg temperatures. The analysis also includes considerations to prevent SIT N2 injection into the primary coolant system. Because of SIT N2 injection concerns, when developed, FLEX procedures will ensure the cooldown is secured at a primary coolant system pressure adequate to prevent SIT N2 injection. See (6) for additional details.
- Item 4: The ELAP analysis describes opening the reactor vessel upper head vent to allow refilling the upper head and provides a letdown path during the boration period. The analysis recommends that makeup flow be halted by procedure if indicated level in the pressurizer reaches its upper bound or primary coolant pressure exceeds a maximum determined by procedure. It is also recommended that the vent be shut when the makeup pump is secured, unless letdown flow is required to make room for more borated water. When developed, FLEX procedures will include guidance to mitigate primary coolant system overfill.
- Item 5: Blind feeding of a steam generator (SG) with a portable pump will not occur. Qualified SG level instrumentation remains available during the event and communications will be established between the control room and flow control locations for controlling steam generator levels.
- Item 6: The Palisades ELAP analysis determined the minimum primary coolant system pressure to ensure that SIT N2 is not injected into the primary coolant system is 136.4 psig. However, for conservatism the analysis stated the plant should not operate with an RCS pressure below143.6 psia. Therefore, when developed, FLEX procedures will ensure the cooldown is secured at a primary coolant system pressure adequate to prevent SIT N2 injection.
- Item 7: NEI 12-06 states that the ADVs operate as designed. FLEX procedures will maintain level in both SG's in the post-trip range eliminating the concern for asymmetric natural circulation cooldown.

During the audit and review process, the licensee was asked to provide information regarding action at hour 0.95 documented on page 80 of the Integrated Plan, and to discuss operator actions required within 0.95 hour prior to declaration of the ELAP and show that all the required actions can be reasonably be met.

In its response to the audit, the licensee stated that operator actions performed in the first 20 minutes of the event are associated with standard post-trip actions (EOP-1.0) and station blackout recovery (EOP-3.0). Along with main control board instrumentation and reports for the field, preliminary evaluations concluded that equipment assessments can be reasonably estimated to a degree to declare the ELAP within 0.95 hours. This information will be updated when procedures are developed and validated. The updated information regarding the required operator actions and the associated operator actions times in 20 minutes is needed from the licensee to determine whether the operator actions are adequate and reasonably achievable. This is identified as Confirmatory Item 3.2.1.A in Section 4.2.

During the NRC audit and review process, the licensee was asked to provide justification for meeting the time constraint that states that at hour 5 of the event, that deployment of the PCS makeup pump will be completed at hour 8.

In its response to the NRC audit and review process question, the licensee stated that preliminary evaluations have extended the time to deploying the FLEX generator to hour 6 that will be used to re-power an installed charging pump. This information will be updated when procedures and design for equipment storage locations are developed and validated via walkthroughs. The evaluation will also include either validating the robustness of the charging pump control circuit or provide FLEX procedure guidance to manually operate the charging pumps by breaker operation. The updated information regarding the FLEX generator deployment and operation of the charging pump is needed from the licensee to determine adequacy of use of the charging pump for PCS inventory makeup during an ELAP. This is identified as Confirmatory Item 3.2.1.B in Section 4.2.

During the NRC audit and review process, the licensee was asked to discuss the robustness of the charging pumps and the boric acid system, since they are currently part of the mitigation strategy for providing makeup to the PCS during Phase 2.

In response to the NRC audit and review process question, the licensee states that additional review of plant documentation, determined that each of these pumps is seismically robust. Evaluation of the piping from the BASTs to the pump suction identified a section of piping which requires additional evaluation. This will be resolved during the detailed design process and will be provided in a future six- month update report. The information regarding the evaluation results of seismic robustness for the BAST piping is needed from the licensee to determine the adequacy of the use of the BAST water as a supply source for the charging pumps. This is identified as Confirmatory Item 3.2.1.C in Section 4.2 below.

During the NRC audit and review process, the licensee was asked to provide information concerning the ADV modifications described in the Integrated Plan.

In response, the licensee stated that a design change is in the preliminary stages to modify the ADV backup nitrogen supply source from the High Pressure System to bottled nitrogen. The size of the source will be determined during the design process to support the SOE. Calculations will be performed to determine the volume of nitrogen required for each valve actuation, the number of actuations required, the estimated nitrogen leakage for each valve, and the overall time that nitrogen supply will be required without makeup. The ADVs and control circuit are powered from the Class 1E batteries and will not be impacted by the extended load shed that will extend battery capability for approximately 8 hours. Procedures will be written to align the nitrogen supply source to the ADVs in response to enable control room operation for stabilizing the plant following the reactor trip. No further actions will be required to enable commencing the cooldown at 2 hours.

During the NRC audit and review process, the licensee was asked, concerning the use of the Volume Control Tank (VCT) and SIRWT to provide makeup to the PCS, to provide more information about the tanks' seismic and wind missile hazard robustness. Further, the licensee was asked to provide more information about the alternate protected borated water sources as described for their usage along with the Lake Michigan water source, including other time critical actions in the event that the SIRWT and/or VCT are unavailable.

In response to the NRC audit and review process question, the licensee states that the VCT is missile protected however, the SIRWT is not. Crediting the VCT or SIRWT for a seismic event will require additional evaluations. There are no plans to credit the SIRWT or the VCT as a source of borated water. Additionally, because the SIRWT is not missile protected, the Integrated Plan includes Open Item 16 to evaluate an alternative borated water tank to supplement the water volume that may be added when Lake Michigan is the source. Evaluations are planned to provide an engineering solution that allows mixing of the BAST concentrated borated water with non-borated water. While the source of the non-borated water has not yet been determined, Lake Michigan is an available source. An installed connection to the charging pump suction already exists. Since the SIRWT and/or VCT is currently not planned to be credited, there are no time critical actions associated with unavailability. In addition, NEI 12-06 section 3.2.1.2 states that no additional failures are assumed to occur immediately prior to or during the event. This is identified as Confirmatory Item 3.2.1.D in Section 4.2 below.

During the audit, the licensee was asked to confirm that the primary ELAP strategy is to perform a symmetric cooldown using all RCS loops.

In response, the licensee states that as described above, NEI 12-06 section 3.2.1.4 states that ADVs are assumed to operate as designed. FLEX procedures will maintain level in both steam generators in the post-trip range which will eliminate the concern for asymmetric natural circulation cooldown. The licensee relies on the ADVs to release steam from the SGs to cool down the plant during an ELAP, which may be initiated from external hazards including hazards of tornado missiles. The ADVs at Palisades have two design functions, the first being that of a pressure boundary and the second being that of a control system for a vent path. The licensee should justify the continued functionality of the ADVs in the context of a tornado missile hazard resulting in an ELAP in order to support a symmetric cooldown given that the design basis operability of the ADVs appears to allow for incapacitation of individual ADVs. Alternatively, the licensee may address the effects of asymmetric natural circulation cooldown. This is identified as Confirmatory Item 3.2.1.E in Section 4.2.

During the NRC audit and review process, the licensee was asked to provide a summary of nonsafety-related equipment that is used in the mitigation strategies including a discussion of whether the equipment is qualified to survive all ELAP events. In response to the NRC audit and review process question, the licensee states that all installed equipment credited in mitigating strategies will be evaluated to verify conformance to the external event criteria described in NEI-12-06. This is identified as Confirmatory Item 3.2.1.F in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to RCS cooldown and PCS inventory strategies, if these requirements are implemented as described.

3.2.1.1 Computer Code Used for the ELAP Analysis

NEI 12-06, Section 1.3 states:

> To the extent practical, generic thermal hydraulic analyses will be developed to

support plant- specific decision-making. Justification for the duration of each phase will address the on-site availability of equipment, the resources necessary to deploy the equipment consistent with the required timeline, anticipated site conditions following the beyond-design-basis external event, and the ability of the local infrastructure to enable delivery of equipment and resources from off- site.

The licensee has provided a Sequence of Events (SOE) in their Integrated Plan, which included the time constraints and the technical basis for the site. That SOE is based on an analysis using the industry-developed Combustion Engineering Nuclear Transient Simulation (CENTS) computer code. CENTS was written to simulate the response of pressurized water reactors to non-loss of coolant accident (LOCA) transients for licensing basis safety analysis.

The licensee has decided to use the CENTS computer code for simulating the ELAP event. Although the NRC staff does acknowledge that CENTS has been reviewed and approved for performing non-LOCA transient analysis, the NRC staff has not examined its technical adequacy for simulating the ELAP transient. A generic concern associated with the use of CENTS for ELAP analysis arose because NRC staff reviews for previous applications of the CENTS code had imposed a condition limiting the code's heat transfer modeling in natural circulation to the single-phase liquid flow regime. This condition was imposed due to the lack of benchmarking for the two-phase flow models that would be LOCA scenarios. Because the postulated ELAP scenario generally includes leakage from reactor coolant pump seals and other sources, two-phase natural circulation flows may be reached prior to reestablishing primary makeup. Therefore, the NRC staff requested that the industry provide adequate basis for reliance on simulations with the CENTS code as justification for licensees' mitigation strategies.

To address the NRC staff's concern associated with the use of CENTS to simulate two-phase natural circulation flows that may occur during an ELAP for the licensee and other Combustion Engineering (CE)-designed PWRs, the PWROG submitted a position paper dated September 24, 2013, entitled "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on CENTS Code in Support of the Pressurized Water Reactor Owners Group (PWROG)" (ADAMS Accession No. ML13297A174 (Non-Publicly Available)). This position paper provided a comparison of several small-break LOCA simulations using the CENTS code to the CEFLASH-4AS code that was previously approved for analysis of design-basis small-break LOCAs. The analyses in the position paper show that the predictions of CENTS were similar or conservative relative to CEFLASH-4AS for key figures of merit for natural circulation conditions, including the predictions of loop flow rates and the timing of the transition to reflux boiling. The NRC staff further observed the fraction of the initial PCS mass remaining at the transition to reflux boiling predicted by the CENTS code for the ELAP simulations in WCAP-17601-P to be (1) in reasonable agreement with confirmatory analysis performed by the staff with the TRACE code and (2) within the range of results observed in scaled thermal-hydraulic tests that involved natural circulation (e.g., Semiscale Mod-2A, ROSA-IV large-scale test facility). After review of this position paper, the NRC staff endorsed a resolution through letter dated October 7, 2013 (ADAMS Accession No. ML13276A555 (Non-Publicly Available)). This endorsement contained one limitation on the CENTS computer code's use for simulating the ELAP event. That limitation is provided as follows:

- The use of CENTS in the ELAP analysis for CE plants is limited to the flow conditions prior to reflux boiling initiation. This is identified as Confirmatory Item 3.2.1.1.A in Section 4.2 below.

The requested information includes providing a justification for how the initiation of reflux boiling is defined. Specifically, the CENTS-calculated flow quality at the top of the SG U-tube should be provided for condition when two-phase natural circulation ends and reflux boiling initiates. Also, the licensee should discuss how the applicable ELAP analyses meet the above limitation on the use of CENTS.

On page 84 of the Integrated Plan, regarding the assumptions used in the analyses to establish the sequence of events and time constraints, the licensee stated supported by Reference G8 Table C-4, Entergy has evaluated WCAP-17601-P considering PNP site-specific parameters and determined that the conclusions of that document are applicable to PNP. Entergy has performed analysis consistent with the recommendations of the core cooling position paper. There are no deviations in the Palisades FLEX conceptual design with respect to the PWROG guidance.

In Table C-4, "Palisades Plant Specific Evaluation of Significant PWROG Generic NSSS Parameters Supporting FLEX Implementation," of Nexus Document 12-4105-03-08, Rev. 0, "Palisades FLEX Implementation Plan," February 2013, the licensee stated that the CENTS computer code was used in its plant specific analysis in order to meet WCAP-17061-P. The analysis was used in determining PCS makeup requirements and timing accounting for expected sources of PCS inventory loss and changes in PCS volume due to primary system cooldown and depressurization.

Further, in Table C-4 mentioned above, the licensee stated that a Palisades specific CENTS basedeck was not available for the analysis in PNP document CN-SEE-11-213-5, Rev. 1,"Palisades Reactor Coolant System (RCS) Inventory and Shutdown Margin Analysis to Support the Diverse and Flexible Coping Strategies (FLEX)". The St. Lucie Unit 1 CENTS basedeck was used instead. St. Lucie Unit 1 is very similar in RCS volume configuration to Palisades and therefore, the timing of key events such as flow transitions and boration rates are considered to be adequately similar. This approach is consistent with WCAP -17601-P and therefore does not constitute a deviation.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the computer codes used to perform ELAP analysis if these requirements are implemented as described.

3.2.1.2 Primary Coolant Pump (PCP) Seal Leakage Rates

NEI 12-06, Section 1.3 states:

> To the extent practical, generic thermal hydraulic analyses will be developed to support plant specific decision-making. Justification for the duration of each phase will address the on-site availability of equipment, the resources necessary to deploy the equipment consistent with the required timeline, anticipated site conditions following the beyond-design-basis external event, and the ability of the local infrastructure to enable delivery of equipment and resources from offsite.

Note: Palisades refers to reactor coolant pumps as primary coolant pumps PCPs)

During ELAP, cooling to the Reactor Coolant Pumps (RCPs) seal packages will be lost and water at high temperatures may degrade seal materials leading to excess seal leakage from the Reactor Coolant System (RCS). Without ac power available to the emergency core cooling system, inadequate core cooling may result from the leakage out of the seals. The ELAP analysis credits operator actions to align the high pressure RCS makeup sources and replenish the RCS inventory in order to ensure the core is covered with water, thus precluding inadequate core cooling. The amount of high pressure RCS makeup needed is mainly determined by the seal leakage rate, therefore the seal leakage rate is of primary importance in an ELAP analysis as greater values of the leakage rates will result in a shorter time period for the operator action to align the high pressure RCS makeup water sources.

The licensee provided a Sequence of Events (SOE) in their Integrated Plan, which included the time constraints and the technical basis for their site. The SOE is based on an analysis using specific RCP seal leakage rates. The issue of RCP seal leakage rates was identified as a Generic Concern and was addressed by the NEI in the following submittals:

- WCAP-17601-P, Revision 1, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs" dated January 2013 (ADAMS Accession Nos. ML13042A011 and ML13042A013 (Non-Publicly Available)).

- A position paper dated August 16, 2013, entitled "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Reactor Coolant Pump (RCP) Seal Leakage in Support of the Pressurized Water Reactor Owners Group (PWROG)" (ADAMS Accession No. ML13235A151 (Non-Publicly Available)).

After review of these submittals, the NRC staff has placed certain limitations for Combustion Engineering (CE) designed plants (with the exception of Palo Verde Nuclear Generating Station). Those limitations and the corresponding Confirmatory Item number for this TER are provided as follows:

1. The RCP seal initial maximum leakage rate should be greater than or equal to the upper bound expectation for the seal leakage rate for the ELAP event (15 gpm/seal) discussed in the PWROG position paper addressing the RCP seal leakage for CE plants (Reference 2). If the RCP seal leakage rate used in the plant-specific ELAP analysis is less than upper bound expectation for the seal leakage rate discussed in the position paper, justification should be provided. This is identified as Confirmatory Item 3.2.1.2.A in Section 4.2.

On page 35 of its Integrated Plan the licensee states that Palisades' strategy for coping with an ELAP includes an early cooldown to low pressure to further minimize leakage from the Primary Coolant Pump (PCP) seals. As the plant cools down and the PCS volume begins to shrink, some makeup will be required; however this will be accomplished by lowering PCS pressure below 300 psig. This action will allow the Safety Injection Tanks (SITs) to discharge to the PCS for makeup. Given the expected start time for cooldown and limiting cooldown rate, this will happen at approximately 5 hours. Additionally, boron addition will not be required to maintain adequate shutdown margin to criticality until 13 hours into the event.

On page 35 of the Integrated Plan regarding maintaining PCS inventory control during the initial phase, the licensee stated that PCS inventory control during Phase 1 is controlled by isolation of the letdown and the performance of installed PCP seals. With the successful use of these two items, the leakage from the PCS will be minimized. In the event of an ELAP, valves in the PCS letdown path automatically fail closed as a part of the containment isolation actions. In the event valves do not automatically close, operators can manually isolate the system.

The licensee did not provide a site-specific analysis to validate assumed RCP Seal Leakage Rate. The applicable cases listed in Table 4.1.2.1-1 of WCAP-17601 assumed that the RCP seal leakage commences at the pressure in the PCS at the time subcooling in the PCS cold-legs is less than 50^0F. The condition to assumes initiation of the RCP seal leakage is based on the information in Section 4.4.2 of WCAP 17601, which states that "the probability of seal failure greatly increases when there is less than 50^0F subcooling in the Cold Legs." However, the licensee did not discuss whether the seal failure will occur or not when subcooling of the coolant in the RCS cold-legs is greater than 50^0F. The licensee should specify the seal leakage flow assumed for the ELAP from the time zero to the timeframe when subcooling in the RCS cold-legs decreases to 50^0F, and provide justification for the assumed leakage rate. This has been identified as Confirmatory Item 3.2.1.2.B in Section 4.2.

The licensee further states that it is planning on changing the Integrated Plan to utilize a lower maximum RCP seal leak rate based on the plant's design capability to isolate the CBO line through both the CBO header isolation and CBO header relief valve isolation. The practice of isolating the CBO line is institutionalized through the present SBO response procedure, EOP-3.0, and will occur within the 20 minute isolation time analyzed in WCAP-16175-P. Both the CBO header and header relief isolation valves are direct current (dc) powered air operated valves capable of being remotely isolated from the main control room. The Palisades PCPs are Byron Jackson model DFSS with FlowServe N-9000 4-stage seals. WCAP 16175-P provides a failure model analysis associated with loss of seal cooling (LOSC) for CE NSSS Plants. This document provides RCP seal analysis associated with various LOSC event initiators including the SBO Event initiator. This model was used as input for the CE RCP seal leakage analysis of WCAP 17601 for the "CBO Not Isolated" case.

WCAP-17601 does not include seal leakage analysis for CE plants designed with CBO isolation capability. Therefore, while WCAP-17601 provides a bounding analysis assuming a 15 gpm/pump seal leak rate for CE plants, the basis for expected design seal leakage with CBO isolation capability (CBO Isolated Case) for CE plants is provided in WCAP-16175.
The licensee states that the NRC endorsed the model of WCAP-16175 via issuance of a Safety Evaluation Report associated with WCAP-16175-P-A (ADAMS Accession No. ML070240429). Since the Palisades operational practice for an SBO event is to isolate the CBO line completely (relief valve and common header), the RCP seal leakage analysis of WCAP-17601 is not directly applicable to model the PNP seal leakage characteristics and behavior for the ELAP event. The PNP operating practice to isolate the CBO line is predicated on an operating strategy designed to prevent the three RCP seal failure mechanisms (elastomer binding, elastomer extrusion, and seal face hydraulic instability - "pop open") described in WCAP-16175 from occurring thereby providing maximum protection against seal failure and hence seal leakage. The SBO analysis of WCAP 16175 was based on normal plant operating practice to cope with the SBO event through extended maintenance of subcooling through slow cooldown and slow depressurization. This type of coping results in extended elevated PCS temperature of approximately 350 degrees F five hours into the event. Because of this, PCS temperature will be reduced sooner in the loss of power event than that analyzed in the SBO scenario of WCAP-16175. Seal cartridge temperatures will not be maintained at elevated RCS temperature conditions as long as those analyzed in the SBO event of WCAP-16175. It is recognized that the SBO event is not equivalent to the ELAP event (SBO event is a short duration event of approximately 8 hours whereas the ELAP event is expected to last indefinitely). However, the SBO analysis of WCAP 16175 with CBO Isolated is considered applicable and binding based on

the following:

1. The analysis is specific to the CE NSSS Fleet (WCAP-16175, 1.2) – Palisades is a CE plant.
2. The analysis addresses Palisades unique RCP/Seal Combination (WCAP-16175, Table 3.1.2)
3. RCPs trip at the initiation of the SBO and ELAP event – same response characteristic
4. The loss of seal cooling is caused by loss of motive power to the cooling water pumps – same response characteristic
5. Isolation of the CBO line will occur within occur 20 minutes which is enveloped by the analysis of WCAP-16175. For the purposes of WCAP-16175 and pertinent data this time is considered "late" or "delayed" isolation and the technical data associated with the response is for the delayed or late isolation condition (e.g., Table 5.3-2a of WCAP-16175).
6. The temperature rate of rise within the seal cartridge of the SBO event with CBO isolated is bounding for the reason noted above (i.e., Palisades will conducted an early cooldown therefore temperatures within the RCS will decrease sooner in the loss of power condition than assumed in the base analysis). This preserves the analysis with respect to the elastomeric failure mechanisms which are temperature related failure modes. Temperatures are assured to not exceed those presented in the SBO event applicable to the Palisades CBO isolated condition is depicted in WCAP-16175, Table 5.3-2a, "CBO Isolated Late column." This table shows the highest temperature to be below the expected long term service conditions for the elastomers of the Palisades seal cartridge assembly (WCAP-16175, Table 3.1-1). A representative graph for the estimated Palisades seal cartridge elastomer performance at elevated temperature is shown in WCAP 16175, Figure 3.4-1 and is further discussed in Sections 3.4 and 7.3 of the report. Long term serviceability of the ethylene-propylene elastomers is expected at temperature in excess of 550 degrees F even when exposed for extended durations of greater than 8 hours. Finally, the Safety Evaluation Report 9 notes the superior performance of the tungsten carbide facing material used in the Palisades seal cartridge design to ward against "heat checking" concerns for the seal faces.
7. While the early cooldown may impact lower stage seal subcooling, maintenance of hydraulic seal face stability ("pop open" failure mode) is mitigated by two means, control of subcooling or maintenance of backpressure at greater than half the saturation pressure at the inlet temperature to prevent flashing (WCAP-16175, Section 4.2.3). When CBO is isolated, pressure across the seal faces and the "pop open" failure mode is effectively averted (WCAP-16175, Station Blackout Scenario discussion, page B-9). Additionally, the FlowServe N-9000 seals are designed such that when the seal is static, the seal faces are divergent further minimizing the potential for seal leakage (WCAP-16175, page B-42). Lastly, the rapid cooldown will assist in maintaining the RCS cold legs in a subcooled state. Maintenance of subcooling during the first 20 minutes prior to CBO isolation is bounded by the existing SBO analysis (WCAP-16175, Station Blackout Scenario discussion, pages B-9 and B-29), since there is no difference between the SBO scenario and the ELAP timeline during this period – Operator response is governed by the SBO event response procedural controls.
8. The RCPs will not be restarted for the ELAP event consistent with the assumptions within the analysis for the SBO event.
9. There are no plans for Palisades to restore seal cooling for the ELAP event at this

time. The focus of the Palisades plan is maintenance of the key safety functions for an indefinite period. It is noted that WCAP-16175 acknowledges that the FlowServe N-9000 seals are thermal shock resistant and restoration of seal cooling following an LOSC is unlikely to cause further damage.

10. The materials of the RCP seals are consistent with the analysis. The elastomers are ethylene-propylene and the seal faces are tungsten carbide (WCAP-16175, Table 3.1-1).
11. Validation of the CBO isolation capability will be via Plant Simulator as a function of finalizing the designs of the FLEX strategy to assure isolation using the existing EOP-3.0 procedural guidance can be effected by 20 minutes and that human factors requirements are appropriate to minimize the risk of human error.
12. Palisades will perform a symmetric cooldown using all loops for both steam generators.
13. Palisades will perform equipment qualification analysis as a function of finalizing the designs of the FLEX strategy for the CBO header and CBO relief valve isolation valves to ensure that they are robust for the ELAP event.
14. Consistent with the SBO event analysis; heat removal for the PCS is assured by maintenance of the key safety functions of Reactor Core Cooling and will be performed by the SGs with the TDAFW pump providing the cooling water from the CST and it's makeup source the Primary System Makeup Tank (T-81). ADVs will respond as designed. As noted earlier, a key difference from the SBO event analysis will be that a rapid cooldown of the PCS will be conducted providing additional benefit to maintaining seal cartridge temperatures lower than that analyzed for the SBO event.
15. The PWROG acknowledges that the capability to credit lower leakage values when CBO is isolated may be appropriate (LTR-FSE-13-45, Rev. 0).

The licensee further identifies that the PNP maximum PCS leak rate applied will be 1 gpm/RCP Seal + Unidentified leakage. The basis for this leakage rate is:

- Any combination of vapor stage intact or one of the three lower stages intact results in leakage values that are small or negligible. The normal vapor stage leakage is insignificant and is essentially masked by evaporation. This value is therefore conservative and bounding (WCAP-16175, 6.2.1), and,
- This value exceeds the various combinations of expected seal stage leak rates for the CE plants as depicted in the "CBO Increase" column of Table 5.2-1 of WCAP-16175 (Palisades has a nominal design CBO flow of 1.0 gpm, Reference WCAP-16175, Table 3.2-1, page 3-3), and,
- The leakage rate past individual stages during normal operation is restricted by internal pressure breakdown devices (PBD) to the nominal flow of 1 gpm (reference WCAP-16175, A.5, page A-15), and, provided at least one of three lower stage PBDs remains functional, any flow from degraded lower stages out of the seal cartridge assembly through the vapor stage would be restricted to this value, and,
- Of the industry event and testing data available, the analysis supports this value as a bounding value (WCAP-16175, page B-29), and,
- This value is consistent with input used in the RCP seal leakage generic industry modeled analysis of WCAP-17601 at the onset of the ELAP event and bounds the input used in the plant specific Palisades seal leakage analysis for when for when CBO is isolated at 20 minutes into the event (CN-SEE-II-13.5, Revision 1, page 29).
- The value utilized for Unidentified leakage is consistent with Assumption 18 of WCAP-

17601 (Section 4.2.1) and consistent with the limits of Palisades Technical Specifications

The licensee concludes that the SBO analysis provided in WCAP-16175 forms the basis for the maximum leakage rate condition for the Palisades station with CBO isolated. The SBO analysis of WCAP-16175 bounds the PNP plant equipment, operator response and plant response to the ELAP event. The combination of isolation of the CBO line coupled with the existing ELAP cool-down strategy results in optimum seal preservation strategy for the ELAP event. The practice of isolating the CBO common header and CBO common header relief valve is institutionalized through existing operational guidance and training at PNP. Isolation of the CBO line effectively mitigates the three RCP failure mechanisms from the model of WCAP-16175. Isolation of the CBO coupled with a rapid cooldown provides an effective mitigation strategy for minimizing RCP seal leakage consistent with the recommendation of WCAP-17601, Section 3.2. However, the licensee did not discuss whether the failure of the PCP seals will occur or not during an ELAP before the CBO isolation. The licensee should provide the maximum temperature and pressure, and minimum subcooling of the coolant in the RCS cold-legs during the ELAP before the CBO isolation, and justify the assumption that the integrity of the RCP seals can be maintained, and the seal leakage rate is less than 1 gpm per RCP during an ELAP before the CBO is isolated. This is identified as Confirmatory Item 3.2.1.2.C in Section 4.2.

From the licensee's Integrated Plan and the response to the audit questions discussed above, it is not clear to the reviewer whether the SOE and the associated time constraints in the licensee's finalized mitigation strategies will be based on: (1) the case discussed in WCAP-17601-P without CBO isolation, which assumes the seal leakage rate of 15 gpm per RCP, or (2) the SBO case discussed in WCAP-16175 with CBO isolation, which assumes the seal leakage rate of 1 gpm per RCP. The licensee should (1) confirm whether above Case 1 without the CBO isolation, or Case 2 with the CBO isolation is used to establish its mitigation strategies, and (2) provide and justify the updated SOE and time constraints so established. This has been identified as Confirmatory Item 3.2.1.2.D in Section 4.2.

During the audit and review process, the licensee was asked to provide additional information regarding assumption 2 on page 4-35 of WCAP-17601 which states that "Once RCP seal failure occurs, the leakage flow path characteristics remain constant for the rest of the event." The licensee was asked to address the applicability of the information in Section 4.4.2 of WCAP-17601, which states that "it has been shown that the probability of seal failure greatly increases when there is less than 50°F of subcooling in the Cold Legs."

In response to the audit, the licensee states that the analysis of WCAP-17601 applies to the case when CBO is not isolated as noted above. Assumption 2 applies directly to the analysis supporting WCAP-17601. The pressure dependent model used in support of WCAP-17601 is the CENTS model. The CENTS model applies flow modeling for any flow out of the Primary Coolant System through leaks or relief valves and is based on standard critical flow correlations. The specifics of the model are proprietary. As noted above, Palisades is planning on changing its Integrated Plan to credit a reduced PCP Seal Leak rate due to the existing practice of isolation of the CBO line that is institutionalized at the station. The applicable PCP Seal failure and leak rate analysis for the Palisades station is that associated with the SBO event of WCAP-16175 (not WCAP-17601) and specifically for the SBO scenario with CBO isolated. In the case of the CBO isolated condition, any leakage would have to be through the vapor seal and would be expected to be negligible as discussed above. While assumption 2 is not addressed by the model of WCAP-16175, the physical characteristics of the leak path for the non-modeled CBO Isolated case could be reasonably concluded to be valid because the flow path characteristics would remain constant and be influenced by the driving head of the RCS. This enables the application of fundamental engineering principles of pressure drop across a seal cartridge that is not degraded because of CBO isolation. As the plant cools down the flow would be pressure dependent and decrease with lowering primary coolant system pressure. Since the CENTS modeled case does not exist for the condition with CBO flow isolated, there is no direct flow model analysis available. Maintenance of subcooling (>50 degrees F) is one important means to mitigate the potential for the "pop-open" failure mode to prevent flashing at the seal faces when CBO line is in service. As indicated in WCAP-16175, Table 4.2-3, if the CBO line is isolated, pressures will be equalized across the seal faces removing the potential for flashing and thus removing the mechanism for the failure, as previously described above.

During the NRC audit and review process, the licensee was asked to discuss how the pressure-dependent RCP seal leakage rates are calculated with respect to the use of the equivalent size of the break area based on the initial total RCP leakage rate. Further, the licensee was asked to discuss and justify the flow rate model used and to discuss whether the size of the break area is changed or not in the analysis for the ELAP event. Additionally, the licensee was asked to provide information regarding the friction losses in the leakage flow path that are credited in the pressure-dependent leak rate calculation, including whether friction loss model is adequate for the use in the RCP Seal Leak rate calculation.

In its response to the NRC audit process, the licensee states that for PNP, no specific pressure dependent CENTS flow model is available for the case where CBO is isolated.

During the NRC audit and review process, the licensee was asked to provide a discussion regarding the applicability of WCAP-17601-P to the ELAP analysis with respect to minimizing any seal temperature excursions above 500 degrees F and the effects on the upper seal stages and the vapor seal. Additionally, the licensee was asked to discuss the Westinghouse recommendation to conduct further testing with current FlowServe N-9000 seals seal configurations in order to get a quantifiable assessment of seal function at extreme temperature conditions for periods greater than 24 hours.

In its response to the NRC audit process, the licensee states that as described above, the PNP PCP seals are FlowServe N-9000 4 stage seal assemblies. These seal assemblies contain ethylene-propylene elastomers. These types of elastomeric materials are capable of withstanding high temperatures in excess of 550 degrees F for extended duration without change in service properties. Section 6.7 of WCAP 17601 is highlighting the concern with respect to high service temperature conditions on seal properties and the potential for elastomeric failure modes associated with "thermal binding" and "extrusion" (and, concerns for "heat checking" of the seal faces). Palisades is planning a change to the submitted Integrated Plan to credit CBO full isolation capability. The net effect of the CBO isolation strategy when combined with a plant cool-down commencing at 2 hours into the event will be to reduce primary coolant system pressure and temperature, such that within approximately 5 hours following the event, the RCS will reach a temperature of approximately 350 degrees F. By so doing, the heating effects to the seal and its elastomers are significantly reduced and long term seal sustainability is optimized. Any temperature rate of rise will be gradual, will be progressive throughout the stages (lower stage heats up first) and will occur over an extended period of time. Since Palisades is expected to affect isolation of the CBO within 20 minutes, all stage temperatures are expected to be maintained below the elastomeric materials service properties of 550 degrees F. Because of the CBO isolation, the method of heat-up will be via conduction. This strategy is consistent with the protocol noted.

The licensee further states that Section 6.8 is based on the information provided in 6.6 of WCAP 17601 indicating that there is limited long term survivability testing associated with the elastomer formulations used in the RCP seals when exposed to high temperatures (in excess of approximately 550 degrees F). Since the Palisades strategy is to isolate the flow of hot RCS water through the seal cartridge and initiate RCS cool down at hour 2, the temperatures remain below 550 degrees F and therefore the recommendation is not pertinent.

During the NRC audit and review process, the licensee was asked to provide the manufacturer's name and model number for the RCPs and the RCP seals.

In response to the audit, the licensee states that as described above, the PNP PCP seals are FlowServe N-9000 seals. Further, the licensee states that the seal cartridge is described and covered by the discussion in WCAP 17601 (but, more applicably WCAP 16175 to the Palisades case where CBO is isolated). The PNP pump model number is not included in WCAP 17601, nor WCAP 16175. It is implicit in WCAP 16175 that the pump models for the CE fleet are addressed though the analysis.

The reviewer further noted that the adequacy of protection against tornado missile hazards afforded the ADVs will be subject to further separate re-evaluation pursuant to Section 402 of Public Law 112-074, "Consolidated Appropriations Act," which requires that the NRC to require licensees to reevaluate the seismic, tsunami, flooding, and other external hazards at their sites against current applicable Commission requirements and guidance for such licenses as expeditiously as possible, and thereafter when appropriate.

During the NRC audit and review process, the licensee was asked to confirm that load shed activities will not interfere with required valve positioning or operator action capability that may be credited in establishing ELAP response strategies, including specifically those actions related to isolating RCS leakage paths, including the CBO.

In response to the NRC audit and review process question, the licensee states that the preliminary battery load shed strategy evaluation includes consideration of valve positioning that validates the capability for performing CBO isolation. This is combined with Confirmatory Item 3.2.1.2.D in Section 4.2.

During the NRC audit and review process, the licensee was asked if it is intended to credit significant improvement for ELAP related to the isolation of the CBO lines, and to confirm that CBO isolation procedures, human factors requirements, and equipment qualifications are applicable to the ELAP event and are able to be achieved within the time frames described in section 5.3.1 of WCAP 16175.

In response to the NRC audit and review process question, the licensee states that it will validate CBO isolation procedures for human performance and revise them as required, to ensure conformance within the bounds for the determined isolation time frame. Further, the licensee states that the CBO isolation valves and associated components will be evaluated for robustness for the ELAP event. This is combined with Confirmatory Item 3.2.1.2.D in Section 4.2.

The current understanding of the licensee's approach, as described above, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the reactor coolant pump seal leakages rates, if these requirements are implemented as planned.

3.2.1.3 Decay Heat

NEI Section 3.2.1.2 states in part:

> The initial plant conditions are assumed to be the following:
>
> Prior to the event the reactor has been operating at 100 percent rated thermal power for at least 100 days or has just been shut down from such a power history as required by plant procedures in advance of the impending event.

On page 80, in Attachment 1A for sequence of events, the licensee indicated that the initial power evaluated for an ELAP event was 100%.

During the NRC audit and review process, the licensee was asked to address the applicability of assumption 4 on page 4-13 of WCAP 17601, to Palisades. Assumption 4 states that decay heat is per ANS 5.1-1979 + 2 sigma, or equivalent. The licensee was asked to consider initial power level, fuel enrichment, fuel burnup, effective full power operating days per fuel cycle, number of fuel cycles, if hybrid fuels are used in the core, and fuel characteristics addressing whether they are based on the beginning of the cycle, middle of the cycle, or end of the cycle.

In its response to the NRC audit and review question, the licensee states that Assumption 4 of WCAP 17601-P applies to the analyses performed for the WCAP 17601-P, of which the results of Section 5.2.3 were used in the development of the Integrated Plan. The applicability of ANS 5.1-1979 + 2 sigma decay heat curve for Palisades will be addressed in a future six-month update report. This is identified as Confirmatory Item 3.2.1.3.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to decay heat rate determination, if these requirements are implemented as described.

3.2.1.4 Initial Values for Key Plant Parameters and Assumptions

NEI 12-06, Section 3.2 provides a series of assumptions to which initial key plant parameters (core power, RCS temperature and pressure, etc.) are required to conform. When considering the code used by the licensee and its use in supporting the required event times for the SOE, it is important to ensure that the initial key plant parameters not only conform to the assumptions provided in NEI 12-06, Section 3.2, but that they also represent the starting conditions of the code used in the analyses and that they are included within the code's range of applicability.

On page 3 in the Integrated Plan, in regards to key site assumptions to implement NEI 12-06 strategies, the licensee referred to section 2.3 of Nexus Document 12-4105-03-08, Rev. 0, "Palisades FLEX Implementation Plan," February 2013.

A review was conducted of the licensee's baseline assumptions included in the Integrated Plan and the licensee's Nexus document and finds that it included all the relevant baseline assumptions assumed in NEI 12-06, Section 3.2.1.2, Section 3.2.1.3, 3.2.1.4, and 3.2.1.5, used with the baseline analyses for the determination of required times for the SOE.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to Initial Values for Key Plant Parameters and Assumptions, if these requirements are implemented as described.

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states, in part:

> The parameters selected must be able to demonstrate the success of the strategies at maintaining the key safety functions as well as indicate imminent or actual core damage to facilitate a decision to manage the response to the event within the Emergency Operating Procedures and FLEX Support Guidelines or within the SAMGs. Typically, these parameters would include the following:
>
> - SG Level
> - SG Pressure
> - RCS Pressure
> - RCS Temperature
> - Containment Pressure
> - SFP Level
>
> The plant-specific evaluation may identify additional parameters that are needed in order to support key actions identified in the plant procedures/guidance or to indicate imminent or actual core damage.

On page 19 of the Integrated Plan regarding maintaining core cooling & heat removal, the licensee listed the installed instrumentation credited for maintaining core cooling and heat removal during Phase 1 of an ELAP. They included the following parameters:

To support this function, the following instrumentation will be needed:
SG Level, SG Pressure, CST Level, T-81 Level, PCS Pressure, PCS Temperature, Pressurizer Level, Reactor Vessel Level Indication, SIRW Tank Level.

During the NRC audit and review process, the licensee was asked to discuss the analysis used to determine the containment temperature, pressure, and moisture profiles during the ELAP event and to address the adequacy of the computer codes/methodologies, and assumptions used in the analysis.

In response to the NRC audit and review question, the licensee states that a preliminary evaluation has identified the instrumentation to be used for the ELAP mitigation based on the Palisades Integrated Plan. The evaluation includes identification of instrumentation meeting Regulatory Guide 1.97 Revision 3 and instrumentation listed in the Integrated Plan requiring additional evaluation to determine robustness to support FLEX strategies. No automatic actions will be credited other than those already credited as part of the current plant design and licensing basis at the beginning of the event which are not impacted (e.g., autostart of turbine-driven auxiliary feedwater pump, auxiliary feedwater flow initiation and reactor trip) at the onset of the external event.

The licensee also states that a MAAP calculation will be performed to validate that containment profiles remain well within the containment temperature and pressure design parameters.

Results of the MAAP calculation will be utilized as an input to evaluate the robustness of key parameter instrumentation to support FLEX strategies. This is identified as Confirmatory Item 3.2.1.5.A in Section 4.2.

During the NRC audit and review process, the licensee was asked in regard to its on-going FLEX strategy evaluation, to provide the need for further instrumentation if identified by the evaluation.

In response to the NRC audit and review process question, the licensee states that a preliminary evaluation has identified the instrumentation to be used for the ELAP mitigation based on the Integrated Plan and preliminary strategy changes identified during a strategy assessment. The evaluation includes identification of instrumentation meeting Regulatory Guide 1.97, Revision 3 and instrumentation requiring additional evaluation to determine robustness to support FLEX strategies. The evaluation also identified instrumentation not previously identified in the Integrated Plan (e.g., boric acid storage tank level instrumentation) and instrumentation identified in the Integrated Plan that provides redundancy for electrical system status but are not required (e.g., battery amp-hour meters). This is identified as Confirmatory Item 3.2.1.5.B in Section 4.2.

During the audit, the licensee was requested to provide additional description of the instrumentation that will be used to monitor portable FLEX electrical power equipment including their associated measurement tolerances/accuracy to ensure that the electrical equipment remains protected from power fluctuations, and that the operator is provided with accurate information to maintain core cooling, containment, and SFP cooling. In addition, provide a discussion on the issue of portable electrical instrumentation.

During the audit the licensee stated that instrumentation to monitor portable FLEX electrical power equipment will be addressed later in the design and procedure development phase and will consider the equipment to which it will be connected. This has been combined with Confirmatory Item 3.2.1.5.B in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to instrumentation and controls for the ELAP, if these requirements are implemented as described.

3.2.1.6 Sequence of Events

NEI 12-06 discusses an event timeline and time constraints in several sections of the document, for example Section 1.3, Section 3.2.1.7 principle (4) and (6), Section 3.2.2 Guideline (1) and Section 12.1.

NEI 12-06, Section 3.2.2, in part, addresses the minimum baseline capabilities:

> Each site should establish the minimum coping capabilities consistent with unit-specific evaluation of the potential impacts and responses to an ELAP and LUHS. In general, this coping can be thought of as occurring in three phases:
>
> - Phase 1: Cope relying on installed plant equipment.

- Phase 2: Transition from installed plant equipment to on-site FLEX equipment.
- Phase 3: Obtain additional capability and redundancy from off-site equipment until power, water, and coolant injection systems are restored or commissioned.

The SOE is discussed in the integrated plan on pages 9 and 10 and in Attachment 1A on pages 81, 82, and 83.

On page 9 of the Integrated Plan, providing a sequence of events (SOE) and time constraint required for success, including the technical basis for the time constraint, the licensee stated that the sequence of events and any associated time constraints are identified for Palisades' Modes 1-4 strategies for FLEX Phase 1 through Phase 3. These actions are more bounding when compared to the Modes 5 and 6 and full core offload scenarios as they require the most personnel, actions, and time constraints. The times identified to initiate each action in this section and in Attachment 1A are based on resource loading to allow completion of all actions prior to their individual time constraints. Time critical completion times are included. Palisades' timeline is outlined in Attachment 1A. A timeline walkthrough will be completed when detailed design and site strategy is finalized.

The licensee has not completed final analysis regarding validation of the action times reported in the Sequence of Events.

During the NRC audit and review process, the licensee was asked to describe the methodology for the SOE timeline validation and to provide the results thereof, when available.

In response to the NRC audit and review process question, the licensee states that although the Integrated Plan contains the preliminary SOE timeline, an assessment has been performed identifying potential changes. The methodology and results of the SOE timeline validation will include a walk through validation. This is identified as Confirmatory Item 3.2.1.6.A in Section 4.2.

During the NRC audit and review process, the licensee was asked to provide a discussion showing the impact of injection on reactivity because WCAP-17601-P does not include PCS makeup. Additionally, the licensee was asked to describe the impact of injection on actions that take place later in the Sequence of Events, including the time to switch water sources and provide mobile boration.

In its response to the NRC audit and review process question, the licensee stated that its Integrated Plan contains a preliminary Sequence of Events timeline. A preliminary assessment has been performed identifying potential changes to the Sequence of Events. Validation methodology and results of the timeline will be provided when completed which is expected in a future six-month update report. The updated information regarding the Sequence of Events is needed from the licensee to confirm that the mitigation strategies listed in the Sequence of Events are updated and acceptable. This is identified as Confirmatory Item 3.2.1.6.B in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item(s), provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the sequence of events, if these requirements are implemented as described.

3.2.1.7 Cold Shutdown and Refueling

NEI 12-06, Table 1-1, lists the coping strategy requirements as presented in Order EA-12-049. Item (4) of that list states:

> Licensee or CP holders must be capable of implementing the strategies in all modes.

The NRC staff reviewed the licensee's Integrated Plan and determined that the Generic Concern related to shutdown and refueling requirements is applicable to the plant. This Generic Concern has been resolved generically through the NRC endorsement of NEI position paper entitled "Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514); and has been endorsed by the NRC in a letter dated September 30, 2013 (ADAMS Accession No. ML13267A382).

The position paper describes how licensees will, by procedure, maintain equipment available for deployment in shutdown and refueling modes. The NRC staff concluded that the position paper provides an acceptable approach for demonstrating that the licensees are capable of implementing mitigating strategies in all modes of operation. Entergy Nuclear Operations informed the NRC of their plan to abide by this generic The NRC staff will evaluate the licensee's resulting program through the audit and inspection process.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the analysis of an ELAP during Cold Shutdown or Refueling if these requirements are implemented as described.

3.2.1.8 Core Sub-Criticality

NEI 12-06 Table 3-2 states in part that:

> All plants provide means to provide borated RCS makeup.

On page 33 of the Integrated Plan regarding maintaining core cooling and heat removal mobile boration unit in the final phase, the licensee stated that the Mobile Boration Unit will be staged along Lake Michigan with the Water Purification Unit. The Mobile Boration Unit will have a tank where the purified water can be routed, mixed with boron, and then delivered to the desired tank. The requirements for this equipment must still be developed.

During the NRC audit and review process regarding core subcriticality, the licensee was asked to discuss the results of the Palisades ELAP analysis and show that the core will remain sub-critical during an ELAP. Further, the licensee was asked to discuss whether the uniform boron mixing model was used in its ELAP analysis and whether compliance with the recommendations discussed in a PWROG white paper the related to the boron mixing model exists.

In its response to the NRC audit and review process question, the licensee states that the results of the PNP ELAP analysis conclude that the core will remain indefinitely sub-critical during an ELAP (for RCS temperatures of 350 degrees F after xenon has decayed away.) Minimum credit is conservatively taken for SIT injection as a result of the plant cooldown. The remaining boron injection requirement is determined using the RCS FLEX pump parameters, minimum boron concentration of the injection source, and shutdown margin requirement. CENTS was used for all cases, with a St. Lucie Unit 1 base deck, modified for Palisades core parameters (St. Lucie Unit 1 is very similar in RCS volume configuration to Palisades). The analysis indicates sufficient shutdown margin from accumulator injection alone for the first 13 hours, followed by RCS boration using the FLEX pump for 7 hours to reach the required concentration to indefinitely maintain the core sub-critical at 350 degrees F. The site-specific analysis differed from the analysis described in WCAP-17601 in that it included credit for RCS makeup via the FLEX pump whereas the WCAP analysis only credited SIT injection. The analysis in WCAP 17601 additionally assumed a constant, conservative moderator temperature coefficient (MTC) though the MTC will become considerably less negative as temperature drops, as discussed on page 5-218 of WCAP-17601.

The licensee further states that a uniform boron mixing model is used in the PNP ELAP analysis. The recommendation from the August 15, 2013 PWROG position paper (OG-13-284) referenced in the question, is to allow 60 minutes for assuming complete mixing. The position paper also indicates this is actually conservative since the boron concentration may actually be higher in the core than the rest of the RCS over that time period due to the flow from the cold leg injection into the core. The PNP strategy has sufficient margin between the time boration needs to begin (task begins at hour 8, time critical at hour 10) and finish (for subcriticality, start at hour 13, inject for 7 hours, must complete before 24 hours) to ensure adequate shutdown margin, additionally makeup will occur beyond this time period to account for RCS leakage and to ensure single phase natural circulation is maintained.

The NRC staff reviewed the licensee's Integrated Plan and determined that the Generic Concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the reactor coolant system (PCS) under natural circulation conditions potentially involving two-phase flow was applicable to Palisades.

The Pressurized Water Reactor Owners Group submitted a position paper, dated August 15, 2013 (withheld from public disclosure due to proprietary content), which provides test data regarding boric acid mixing under single-phase natural circulation conditions and outlined applicability conditions intended to ensure that boric acid addition and mixing would occur under conditions similar to those for which boric acid mixing data is available. During the audit process, the licensee informed the NRC staff of its intent to abide by the generic approach discussed above. In an endorsement letter dated January 8, 2014, ADAMS Accession No. ML13276A183, the NRC staff concluded that the August 15, 2013, position paper constitutes an acceptable approach for addressing boric acid mixing under natural circulation during an ELAP event, provided that the following additional conditions are satisfied:

(1) The required timing for providing borated makeup to the primary system should consider conditions with no reactor coolant system leakage and with the highest applicable leakage rate for the reactor coolant pump seals and unidentified reactor coolant system leakage.

(2) For the condition associated with the highest applicable reactor coolant system leakage rate, two approaches have been identified, either of which is acceptable to the staff:

   a. Adequate borated makeup should be provided such that the loop flow rate in two-phase natural circulation does not decrease below the loop flow rate corresponding to single-phase natural circulation.

b. If loop flow during two-phase natural circulation has decreased below the single-phase natural circulation flow rate, then the mixing of any borated primary makeup added to the reactor coolant system is not to be credited until one hour after the flow in all loops has been restored to a flow rate that is greater than or equal to the single-phase natural circulation flow rate.

(3) In all cases, credit for increases in the reactor coolant system boron concentration should be delayed to account for the mixing of the borated primary makeup with the reactor coolant system inventory. Provided that the flow in all loops is greater than or equal to the corresponding single-phase natural circulation flow rate, the staff considers a mixing delay period of one hour following the addition of the targeted quantity of boric acid to the reactor coolant system to be appropriate.

At the time the audit was conducted, the licensee had neither (1) committed to abide by the generic approach discussed above, including the additional conditions specified in the NRC's endorsement letter, nor (2) identified an acceptable alternate approach for justifying the boric acid mixing assumptions in the analyses supporting its mitigating strategy. To satisfactorily resolve this issue, the licensee should confirm its compliance with the conditions specified in the NRC endorsement letter discussed above. Alternatively, the licensee may identify an acceptable alternate approach for justifying the boric acid mixing assumptions in the subcriticality analyses. This is identified as Open Item 3.2.1.8.A in Section 4.1.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01 and subject to the successful closure of issues related to the Open Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to boron mixing, if these requirements are implemented as described.

3.2.1.9 Use of Portable Pumps

NEI 12-06, Section 3.2.2, Guideline (13), states in part:

> Regardless of installed coping capability, all plants will include the ability to use portable pumps to provide RPV/RCS/SG makeup as a means to provide diverse capability beyond installed equipment. The use of portable pumps to provide RCS/SG makeup requires a transition and interaction with installed systems. For example, transitioning ... to a portable pump for SG makeup may require cooldown and depressurization of the SGs in advance of using the portable pump connections. Guidance should address both the proactive transition from installed equipment to portable and reactive transitions in the event installed equipment degrades or fails. Preparations for reactive use of portable equipment should not distract site resources from establishing the primary coping strategy. In some cases, in order to meet the time-sensitive required actions of the site-specific strategies, the FLEX equipment may need to be stored in its deployed position.
>
> The fuel necessary to operate the FLEX equipment needs to be assessed in the plant specific analysis to ensure sufficient quantities are available as well as to address delivery capabilities.

NEI 12-06 Section 11.2 states in part:

> Design requirements and supporting analysis should be developed for portable equipment that directly performs a FLEX mitigation strategy for core, containment, and SFP that provides the inputs, assumptions, and documented analysis that the mitigation strategy and support equipment will perform as intended.

On page 71 of the Integrated Plan, discussing the safety function support regarding portable equipment for use during the transition phase, the licensee provides the following information:

> Portable SG Makeup Pump – 300 gpm, 780 ft.
> Portable SFP Makeup Pump – 300 gpm, 164 ft.

On page 73 of the Integrated Plan, discussing the safety function support regarding portable equipment for use during the final phase, the licensee provides the following information:

> Ultimate Heat Sink Pump – 6,000 gpm
> Containment Cooling Pump

On page 73 of the Integrated Plan, discussing the safety function support regarding portable equipment for use during the final phase, the licensee states that there is a Large Fuel Truck (also outfitted for debris removal).

During the audit, the licensee was asked provide information on the portable pumps required for ELAP mitigation, (the Phase 2 SG makeup pumps, Phase 3 ultimate heat sink pump, and containment cooling pump). The licensee is requested to discuss any time constraints for the operator to deploy and start each of the portable pumps noted above. Additionally, the licensee was asked to discuss how the required capacity of the each of the listed pumps is determined with respect to maintaining core cooling and sub-criticality during Phases 2 and 3 of the ELAP.

In its response to the NRC audit and review question, the licensee states that the timing requirements for connecting the pumps for Modes 1-4 are discussed in the sequence of events timeline and the relevant sections of the Integrated Plan. Due to a revision in the strategy, the limiting time constraint for deployment of portable pumps is 8 hours for CST makeup. Procedures have not been developed at this time, but validation of the procedures will confirm the timing. Per the white paper on shutdown modes (ADAMS Accession No. ML13267A382) specific time lines are not required to be addressed for Modes 5 and 6. Times for phase 3 actions are contained in the Integrated Plan. With respect to the flow and heads identified in the Phase 2 and Phase 3 portable equipment tables, the flow rates and required heads are generally valid however, the design process is not yet complete. Calculations are currently being prepared and the values may change slightly when the calculations are finalized. The flow rates for pumps supporting core cooling and sub-criticality are consistent with or bound WCAP-17601 and the plant specific CN-SEE-II-13-5 analyses. Required total developed head (TDH) is determined by hand calculations using standard methods (e.g., Crane 410). The licensee should provide verification that the procedures will line up with the estimated time for deployment of the portable pumps. This has been identified as Confirmatory Item 3.2.1.9.A in Section 4.2.

During the NRC audit and review process, the licensee was asked for a description of the FLEX pump that can be used for both SFP makeup and CST refill along with detailed information on how the flow requirements for both functions will be met during the ELAP event.

In response to the NRC audit and review process question, the licensee states that as shown in figure 3-2 in the Integrated Plan, either the SFP makeup FLEX pump or CST Refill pump (FLEX transfer pump) may be utilized to provide flow for the SFP makeup and CST refill functions from a common source. Multiple pumps are available in order to allow the flexibility for multiple water sources to be utilized simultaneously. The SFP makeup FLEX pump and CST Refill pump (FLEX transfer pump) will be sized adequately to meet the requirements of providing flow to both SFP makeup and CST refill from a common water source.

The licensee stated that in order to provide makeup to the PCS, Palisades will utilize two of its three installed positive displacement charging pumps. Additionally the licensee stated that In order to utilize the installed charging pumps an evaluation of the charging system robustness must be performed. The proposed use of portable generators to repower installed charging pumps is an alternative approach to NEI 12-06. This places greater reliance on the current state of knowledge of external hazards, which are being re-examined pursuant to NTTF Recommendation 2.1. New information from that effort may necessitate changes in the degree of protection afforded the pre-staged generators and associated equipment in order to maintain the guidance and strategies required by EA-12-049. Additional information is needed from the licensee to determine whether the proposed approach provides an equivalent level of flexibility for responding to an undefined event as would be provided through conformance with NEI 12-06, including provision of connection points for the use of portable pumping sources from off-site should the installed equipment be rendered unavailable by the initiating event. The Staff approval of this approach has been identified as Open Item 3.2.1.9.B in Section 4.1.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01 and subject to the successful closure of issues related to the Confirmatory and Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to use of portable pumps, if these requirements are implemented as described.

3.2.2 Spent Fuel Pool Cooling Strategies

NEI 12-06, Table 3-2 and Appendix D summarize one acceptable approach for the SFP cooling strategies. This approach uses a portable injection source to provide: 1) makeup via hoses on the refuel deck/floor capable of exceeding the boil-off rate for the design basis heat load; 2) makeup via connection to spent fuel pool cooling piping or other alternate location capable of exceeding the boil-off rate for the design basis heat load; and alternatively 3) spray via portable monitor nozzles from the refueling deck/floor capable of providing a minimum of 200 gallons per minute (gpm) per unit (250 gpm to account for overspray). This approach will also provide a vent pathway for steam and condensate from the SFP.

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 2.1, strategies that have a time constraint to be successful should be identified and a basis provided that the time can be reasonably met. 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 a beyond-design-basis event, 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 assume to operate at nominal setpoints and capacities. 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.

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 described in NEI 12-06, which provide an acceptable approach to meeting the requirements of EA-12-049 for maintaining SFP cooling. This criterion is keeping the fuel in the SFP covered.

On pages 51 of the Integrated Plan, in regards to maintaining SFP cooling during the initial phase, the licensee stated that under non-outage conditions, the maximum SFP heat load is 4.405 MW. Loss of SFP cooling with this heat load and an initial SFP temperature of 140 degrees F results in a time to boil of 5.63 hours. This does not include the amount of time it takes to reach the top of active fuel once the boiling initiates. Palisades will use a safety margin of 15 feet above the top of the spent fuel, which will be reached after 20.93 hours; therefore, completing the equipment line-up for initiating SFP make-up at 18 hours is conservative.

The licensee stated that the worst case SFP heat load during an outage is 9.02 MW. Loss of SFP cooling with this heat load and an initial SFP temperature of 140 degrees F results in a time to boil of 3.28 hours. With the entire core being located in the SFP, manpower resources normally allocated to core cooling along with the operations outage shift manpower can be allocated to aligning SFP make-up which ensures the system alignment can be established prior to the point at which SFP conditions become challenged. Palisades will use a safety margin of 15 feet above the top of the spent fuel, which will occur after 11.28 hours; therefore, completing the equipment line-up for initiating SFP make-up at 9 hours is conservative.

The licensee stated that given the time available before makeup is necessary, there are no activities required to support SFP cooling during Phase 1; however, SFP area vent is established during inspection of SFP conditions by actions such as opening doors or wall louvers. Palisades will determine the optimal method of established ventilation.

On pages 53 of the Integrated Plan, the licensee stated that the transition to Phase 2 strategies will be as the inventory in the SFP slowly declines due to boiling. It has been determined that the SFP makeup with an intact pool is not required until 20.93 hours for a normal decay heat load, and 11.28 hours for a maximum decay heat load. SFP cooling through makeup and spray will be provided by using the SFP makeup FLEX pump. For makeup, the primary method for maintaining Spent Fuel Pool makeup is to modify a flanged connection in the Spent Fuel Pool Cooling System so that it can be fed by a portable pump.

The licensee stated that the secondary method is a hose connection in the SFP Cooling System fed by a portable pump. A method of providing SFP spray must also be established in the event the SFP area becomes uninhabitable. The method for this function will be to use an existing monitor nozzle in the SFP Room fed from a hose and pump. The portable pump is required to deliver 100 gpm at 28 psi to perform the SFP Cooling function.

The licensee stated that these connections are both located in the SFP Heat Exchanger Room on the 590' Level. The primary connection is an existing flange that must be fitted with a hose connection. The secondary connection is an existing hose connection.

The licensee stated that if SFP spray is necessary, a monitor nozzle will be attached to the discharge hose of the SFP makeup FLEX pump. The hose will then be routed to the top of the SFP level on the 649' Level. The monitor nozzle will be staged in the SFP Room early in the event, before the area becomes uninhabitable. Palisades will use existing pumps to fulfill this requirement. The monitor nozzle discharges 100 gpm at a pressure of 30 – 50 psi. The available suction sources for all of the above options are the SIRWT and Lake Michigan. NEI 12-6 Table D-3, SFP cooling section, specifies that a flow rate minimum of 200 gpm per unit to the pool or 250 gpm per unit if overspray occurs consistent with 10 CFR 50.54(hh)(2). Resolution of the discrepancy between the licensee flow rate of 100 gpm spray and the NEI 12-06 specified 250 gpm for spray is required This has been identified as Confirmatory Item 3.2.2.A in Section 4.2.

The licensee stated that two diesel engine driven pumps will be stored to support this requirement. The pump will be sized to provide the bounding hydraulic requirements for all spent fuel pool cooling alignments. Since the SFP makeup and CST refill both have relatively low pressure and flow requirements the same pump may be used to provide flow to both when they are using the same suction source.

On pages 58 of the Integrated Plan, in regards to maintaining SFP cooling during the final phase, the licensee stated that the strategies to maintain SFP cooling from Phase 2 can continue as long as there is sufficient inventory available to feed the strategies.

The licensee stated that for long term cooling of the SFP, Palisades will repower one train of normal SFP cooling equipment. The Phase 3 medium voltage 2 MW FLEX Generator from the RRC will be used to repower the equipment for SFP cooling. To remove heat, the RRC will have supplied a UHS FLEX pump connected as described in the Phase 3 portion of the Core Cooling and Heat Removal section of the Integrated Plan.

During the NRC audit and review process, the licensee was asked to describe how SFP instrumentation would be maintained operational until off-site power is restored and during all 3 Phases of the event.

In response to the NRC audit and review process question, the licensee states that in accordance to its response to RAI for Order EA-12-051 (ADAMS Accession No. ML13231A126), the instrument configuration is planned to be established for a sample rate when under battery power consistent with seven days continuous operation. External connections will be provided to permit powering the system from any portable 9-36VDC source, 24VDC nominal. Procedures will be developed to include guidance to either replace the onboard batteries or provide an external power supply to the instrumentation prior to exhaustion of the onboard battery.

On page 51 of the Integrated Plan, regarding determination of baseline coping capability during the transitional phase for the SFP, the licensee stated that given the time available before makeup is necessary, there are no activities required to support SFP cooling during Phase 1; however, SFP area vent is established during inspection of SFP conditions by actions such as opening doors or wall louvers. Palisades will determine the optimal method of establishing ventilation.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of the issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to SFP cooling strategies, if these requirements are implemented as described.

3.2.3 Containment Functions Strategies

NEI 12-06, Table 3-2 and Appendix D provide 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. For example: Containment pressure control/heat removal utilizing containment spray or repowering hydrogen igniters for ice condenser containments.

On page 45 of the Integrated Plan, regarding maintaining containment in the initial phase, the licensee stated:

> Containment pressure and temperature are expected to increase during an ELAP due to loss of containment cooling and mass and energy transfer from the PCS to containment. The Palisades Containment design pressure is 55 psig and the design temperature is 283 degrees F. The Containment Liner has been analyzed for temperatures up to 410 degrees F for a design basis accident.
>
> A containment evaluation has been performed consistent with the boundary conditions described in Section 2 of NEI 12-06. Based on the performance of installed PCP seals, pressure and temperature of containment are not expected to rise significantly. Analysis done in support of the IER 11-4 response demonstrated that as long as cooling water was restored to the SGs prior to fuel damage there would not be any structural concerns with containment for this event. Therefore there are no specific Phase 1 actions required at this time. However, the FSGs will include steps to monitor containment conditions.
>
> Additional strategies to maintain containment during conditions outside those described in Section 2 of NEI 12-06 have not been determined.

On pages 47 and 49 of the Integrated Plan, regarding maintaining containment in the transition and final phases, the licensee stated a containment evaluation will be performed based on the boundary conditions described in Section 2 of NEI 12-06. Based on the results of this evaluation, required actions to ensure maintenance of containment integrity and required instrument function will be developed, if needed. In the NRC audit process, the licensee stated that the analysis will be provided in a future six-month update. This is identified as Confirmatory Item 3.2.3.A in Section 4.2.

To provide long term support of containment, Palisades will use the medium voltage 2 MW FLEX generator from the RRC to repower the installed containment air fans. Palisades has a 2400V system and the RRC generator will be 4160V, a transformer will be required to make the two compatible.

During the NRC audit and review process, the licensee was asked whether water hammer is considered when establishing flow through the containment air cooling fans after they are re-powered.

In response to the NRC audit and review process question, the licensee states that the detailed design work is in progress. The Engineering Change process requires engineers to evaluate any adverse effects to systems, structures, and components including the potential for water hammer.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to containment functions strategies, if these requirements are implemented as described.

3.2.4 Support Functions

3.2.4.1 Equipment Cooling - Support Functions

NEI 12-06, Section 3.2.2, Guideline (3) states:

> *Plant procedures/guidance should specify actions necessary to assure that equipment functionality can be maintained (including support systems or alternate method) in an ELAP/LUHS or can perform without ac power or normal access to the UHS.*
>
> Cooling functions provided by such systems as auxiliary building cooling water, service water, or component cooling water may normally be used in order for equipment to perform their function. It may be necessary to provide an alternate means for support systems that require ac power or normal access to the UHS, or provide a technical justification for continued functionality without the support system.

The licensee did not provide any information regarding the need for systems such as closed cooling water systems of service water that me be necessary to cool plant components that are credited in the ELAP mitigating strategies. The licensee will use the TDAFW pump and the positive displacement charging pumps, Additionally information is required to determined is supplemental cooling is required for these components or components or any others not noted here. This is identified as Open Item 3.2.4.1.A in Section 4.1.

On page 30 of the Integrated Plan regarding maintaining core cooling and heat removal in the final phase, the licensee stated that as Phase 3 continues, the RRC will provide a large 2 MW medium voltage generator, which will supply power to installed equipment used to bring the plant to cold shutdown. The RRC will additionally provide a large, diesel-driven UHS FLEX pump. This pump will provide Service Water flow, as it is assumed the Service Water Pumps or intake structure are unrecoverable. PNP still needs to determine the connection point for the UHS FLEX Pump to the Service Water System. This has been identified as Confirmatory Item 3.2.4.1.B in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to equipment cooling support functions if these requirements are implemented as described.

3.2.4.2 Ventilation – Equipment Cooling

NEI 12-06, Section 3.2.2, Guideline (10) states, in part:

> *Plant procedures/guidance should consider loss of ventilation effects on specific energized equipment necessary for shutdown (e.g., those containing internal*

> *electrical power supplies or other local heat sources that may be energized or present in an ELAP.*
>
> ELAP procedures/guidance should identify specific actions to be taken to ensure that equipment failure does not occur as a result of a loss of forced ventilation/cooling. Actions should be tied to either the ELAP/LUHS or upon reaching certain temperatures in the plant. Plant areas requiring additional air flow are likely to be locations containing shutdown instrumentation and power supplies, turbine-driven decay heat removal equipment, and in the vicinity of the inverters. These areas include: steam driven AFW pump room, … the control room, and logic cabinets. Air flow may be accomplished by opening doors to rooms and electronic and relay cabinets, and/or providing supplemental air flow.
>
> Air temperatures may be monitored during an ELAP/LUHS event through operator observation, portable instrumentation, or the use of locally mounted thermometers inside cabinets and in plant areas where cooling may be needed. Alternatively, procedures/guidance may direct the operator to take action to provide for alternate air flow in the event normal cooling is lost. Upon loss of these systems, or indication of temperatures outside the maximum normal range of values, the procedures/guidance should direct supplemental air flow be provided to the affected cabinet or area, and/or designate alternate means for monitoring system functions.
>
> For the limited cooling requirements of a cabinet containing power supplies for instrumentation, simply opening the back doors is effective. For larger cooling loads, such as … AFW pump rooms, portable engine-driven blowers may be considered during the transient to augment the natural circulation provided by opening doors. The necessary rate of air supply to these rooms may be estimated on the basis of rapidly turning over the room's air volume.
>
> Actuation setpoints for fire protection systems are typically at 165-180°F. It is expected that temperature rises due to loss of ventilation/cooling during an ELAP/LUHS will not be sufficiently high to initiate actuation of fire protection systems. If lower fire protection system setpoints are used or temperatures are expected to exceed these temperatures during an ELAP/LUHS, procedures/guidance should identify actions to avoid such inadvertent actuations or the plant should ensure that actuation does not impact long term operation of the equipment.

On page 21 of the Integrated Plan, regarding maintaining core cooling and heat removal during the transitional phase, the licensee stated that ventilation for the TDAFWP spaces will not be required during Phase 2; however, if time is available, temporary fans can be staged ahead of time to prepare for high temperatures.

During the audit, the licensee was asked to provide a detailed summary of the analysis and/or technical evaluation performed to demonstrate the adequacy of the ventilation provided in the TDAFW pump room to support equipment operation throughout all phases of an ELAP.

In response to the audit, the licensee states that a GOTHIC analysis was performed to determine a conservative temperature profile over time in the auxiliary feedwater pump room. This analysis accounted for the maximum design basis ambient conditions and assumed leakage from a steam trap in the room. The only credited cooling was that via natural circulation through the ceiling vent pipe. Analysis assumptions include: loss of offsite power, no active room ventilation, the turbine building temperature is 110 degrees F, initial AFW room temperature is 104 degrees F, and no credit for heat sinks from the insulated AFW piping in the room. The analysis determined that the maximum temperature of the room was 159 degrees F after 5 days. The TDAFW pump is supported through all phases of an ELAP.

On page 60 of the Integrated Plan, regarding determination of baseline coping capability, the licensee stated that the instrumentation functionality and Control Room accessibility are supported by establishing Control Room ventilation per existing coping for a licensed SBO event. Per EOP-3.0, the SBO procedure, the operators are directed to open the Control Room doors to provide some natural ventilation. Portable fans are added to increase the air circulation if opening the door proves to be insufficient.

On page 62 of the Integrated Plan, regarding safety function support in the transition phase, the licensee stated that during Phase 2, two portable 480 V, 100 kW FLEX diesel generators will be used to maintain power to critical instrumentation, as well as recharging the vital batteries and SBO battery loads. The generators will also be used to power existing battery room ventilation and emergency lighting or, where necessary, portable lighting and portable ventilation can be powered by smaller ac generators.

During the NRC audit and review process, the licensee was asked to provide information on the adequacy of the ventilation provided in the battery room to protect the batteries from the effects of extreme high and low temperatures and to prevent hydrogen accumulation while recharging the batteries in Phase 2 or 3.

In response to the NRC audit and review process question, the licensee states that during battery charging operations in Phases 2 and 3 in support of maintaining power to instrumentation and controls for core cooling, containment, and SFP cooling functions, ventilation may be required in the battery rooms and associated dc equipment rooms for cooling the rooms. If necessary due to extreme heat conditions, the doors will be manually propped open and forced ventilation can then be established using portable fans.

The licensee also stated that, for extreme cold temperatures, the battery rooms would be at their normal operating temperature at the onset of the event and the temperature of the electrolyte in the cells would build up due to the heat generated by the batteries discharging and during re-charging. Higher temperatures have a positive impact on battery life. The battery rooms are located internal to the plant leading to a long time frame required for outside temperatures to cause the electrolyte in the cells to drop to a limiting temperature. Therefore, it is reasonable to assume that the room will remain near its pre-event temperature during the relatively short period of time until the FLEX generators are deployed and have energized the battery chargers. Once the battery charger is re-energized and is charging the battery, the charger is carrying the dc loads during Phase 2 and 3. A calculation is being prepared to evaluate the temperature profile of the battery and dc equipment rooms and determine whether additional forced air flow for cooling is required. Additional details on adequacy of battery room ventilation for extreme temperature protection will be available later in the design / procedure development process. This is identified as Confirmatory Item 3.2.4.2.A in Section 4.2.

The licensee further stated that preliminary analysis indicates battery room ventilation will need to be established less than 1.5 hours after charging has been started to prevent hydrogen accumulation to less than 2% concentration. The AB heating ventilation air conditioning (HVAC) system exhaust path is neither seismically designed nor tornado missile protected. As such, the ventilation will likely be provided by a portable ventilation fan, exhausting through the open door into the cable spreading room. The exact strategy will be finalized during the design phase. The capability to minimize hydrogen buildup in the cable spreading room and battery room will be addressed in the final strategy. This information will be provided in a future update. This is identified as Confirmatory Item 3.2.4.2.B in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to providing ventilation and equipment cooling, if these requirements are implemented as described.

3.2.4.3 Heat Tracing

NEI 12-06, Section 3.2.2, Guideline (12) states:

> *Plant procedures/guidance should consider loss of heat tracing effects for equipment required to cope with an ELAP. Alternate steps, if needed, should be identified to supplement planned action.*
>
> Heat tracing is used at some plants to ensure cold weather conditions do not result in freezing important piping and instrumentation systems with small diameter piping. Procedures/guidance should be reviewed to identify if any heat traced systems are relied upon to cope with an ELAP. For example, additional condensate makeup may be supplied from a system exposed to cold weather where heat tracing is needed to ensure control systems are available. If any such systems are identified, additional backup sources of water not dependent on heat tracing should be identified.

During the NRC audit and review process, the licensee was asked to provide a discussion concerning the use of heat tracing for freeze protection and prevention of boric acid precipitation on equipment used for ELAP response and to address instrument and sensing lines as well as piping.

In its response to the NRC audit and review process question the licensee states that a preliminary evaluation has determined that freeze protection heat tracing for installed piping that has continuing or frequent flow (e.g. CST and turbine driven auxiliary feedwater pump suction piping) is not required. The evaluation also identified that further analysis to determine heat tracing requirements for borated water systems (e.g., boric acid storage tank and associated discharge lines) because of the potential for precipitation of boric acid. The current Palisades level indication design does not have installed heat tracing; however, the lines are frequently blown-down to prevent precipitation. This common practice will continue and the current frequency will be evaluated for adequacy. The sensing line has been considered and is blown down every shift. Walkdowns will be conducted to identify additional areas heat tracing for freeze protection and boric acid precipitation may be required. Results of the walkdowns and precipitation evaluation will be included in FLEX procedures. This is identified as Confirmatory Item 3.2.4.3.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to heat tracing and component cold weather protection, if these requirements are implemented as described.

3.2.4.4 Accessibility – Lighting and Communications

NEI 12-06, Section 3.2.2, Guideline (8) states:

> *Plant procedures/guidance should identify the portable lighting (e.g., flashlights or headlamps) and communications systems necessary for ingress and egress to plant areas required for deployment of FLEX strategies.*
>
> Areas requiring access for instrumentation monitoring or equipment operation may require portable lighting as necessary to perform essential functions.
>
> Normal communications may be lost or hampered during an ELAP. Consequently, in some cases, portable communication devices may be required to support interaction between personnel in the plant and those providing overall command and control.

On page 13 of the Integrated Plan, the licensee stated that prior to hour 2 in the Sequence of Events, emergency lighting is being provided by Appendix R lighting, emergency dc lighting, and emergency lighting from the 100 kW FLEX generators. Once time critical steps are completed additional temporary lighting can be strategically placed in several vital areas (e.g. Control Room, AB, Cable Spreading room, etc.). This lighting will be powered by smaller cart FLEX generators noted in the table on Page 71 of the Integrated Plan. The licensee provided two 8kW generators in the Phase 2 equipment table on Page 71.

On page 63 of the Integrated Plan, the licensee stated smaller diesel generators loaded on carts, will be used as necessary to power communications equipment, portable fans, and portable lighting.

On page 71 of the Integrated Plan in the Table of portable equipment during the transition phase, the licensee identified that a portable cell tower would be deployed.

The NRC staff has reviewed the licensee communications assessment (ML12305A540 and ML13053A080) in response to the March 12, 2012 50.54(f) request for information letter for Palisades and, as documented in the staff analysis (ML13129A219) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2 (8) regarding communications capabilities during an ELAP. Verification that these communication enhancements are made is identified as Confirmatory Item 3.2.4.4.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to Accessibility – Lighting and Communications, if these requirements are implemented as described.

3.2.4.5 Protected and Internal Locked Area Access

NEI 12-06, Section 3.2.2, Guideline (9) states:

> *Plant procedures/guidance should consider the effects of ac power loss on area access, as well as the need to gain entry to the Protected Area and internal locked areas where remote equipment operation is necessary.*
>
> At some plants, the security system may be adversely affected by the loss of the preferred or Class 1E power supplies in an ELAP. In such cases, manual actions specified in ELAP response procedures/guidance may require additional actions to obtain access.

On page 7 of the Integrated Plan, in the section regarding sequence of events, the licensee stated that exceptions to the site security plan or other (license/site specific) requirements of a nature requiring NRC approval will be communicated in a future six-month update following identification. This is identified as Confirmatory Item 3.2.4.5.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protected and internal locked area access, if these requirements are implemented as described.

3.2.4.6 Personnel Habitability – Elevated Temperature

NEI 12-06, Section 3.2.2, Guideline (11), states:

> *Plant procedures/guidance should consider accessibility requirements at locations where operators will be required to perform local manual operations.*
>
> Due to elevated temperatures and humidity in some locations where local operator actions are required (e.g., manual valve manipulations, equipment connections, etc.), procedures/guidance should identify the protective clothing or other equipment or actions necessary to protect the operator, as appropriate.
>
> FLEX strategies must be capable of execution under the adverse conditions (unavailability of installed plant lighting, ventilation, etc.) expected following a BDBE resulting in an ELAP/LUHS. Accessibility of equipment, tooling, connection points, and plant components shall be accounted for in the development of the FLEX strategies. The use of appropriate human performance aids (e.g., component marking, connection schematics, installation sketches, photographs, etc.) shall be included in the FLEX guidance implementing the FLEX strategies.

NEI 12-06 Section 9.2 states:

> Virtually every state in the lower 48 contiguous United States has experienced temperatures in excess of 110°F. Many states have experienced temperatures in excess of 120°F.

The licensee's plan on personnel habitability/accessibility in an elevated temperature environment lacked information to determine that the habitability limits will be maintained and/or operator protective measures will be employed in all phases of an ELAP to ensure operators will be capable of FLEX strategy execution under adverse temperature conditions. Examples of areas of concern are the control room, TDAFW pump room, SFP area, and charging pump room. This is identified as Confirmatory Item 3.2.4.6.A in Section 4.2 below.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to access and personnel habitability, if these requirements are implemented as described.

3.2.4.7 Water Sources

NEI 12-06, Section 3.2.2, Guideline (5) states:

> *Plant procedures/guidance should ensure that a flow path is promptly established for makeup flow to the steam generator/nuclear boiler and identify backup water sources in order of intended use. Additionally, plant procedures/guidance should specify clear criteria for transferring to the next preferred source of water.*
>
> Under certain beyond-design-basis conditions, the integrity of some water sources may be challenged. Coping with an ELAP/LUHS may require water supplies for multiple days. Guidance should address alternate water sources and water delivery systems to support the extended coping duration. Cooling and makeup water inventories contained in systems or structures with designs that are robust with respect to seismic events, floods, and high winds, and associated missiles are assumed to be available in an ELAP/LUHS at their nominal capacities. Water in robust UHS piping may also be available for use but would need to be evaluated to ensure adequate NPSH can be demonstrated and, for example, that the water does not gravity drain back to the UHS. Alternate water delivery systems can be considered available on a case-by-case basis. In general, all CSTs should be used first if available. If the normal source of makeup water (e.g., CST) fails or becomes exhausted as a result of the hazard, then robust demineralized, raw, or borated water tanks may be used as appropriate.
>
> Finally, when all other preferred water sources have been depleted, lower water quality sources may be pumped as makeup flow using available equipment (e.g., a diesel driven fire pump or a portable pump drawing from a raw water source). Procedures/guidance should clearly specify the conditions when the operator is expected to resort to increasingly impure water sources.

On page 21 of the Integrated Plan, in the section regarding maintaining core cooling and heat removal during the transition phase, the licensee stated that the primary strategy for core cooling uses a portable FLEX transfer pump to refill the CST to prolong the use of the TDAFWP. Potentially available suction sources for refilling the CST are T-90, T-91, and Lake Michigan. The pump will be placed near the suction source and hose will be routed to the CST. This action must be completed before the inventory in the CST and T-81 deplete, which occurs in approximately 4 hours.

On page 12 of the Integrated Plan, initiated at hour 24.0, the mobile water purification unit should be received from the RRC, and deployment into the site. This equipment will support the effective heat removal from the PCS by providing pure, demineralized water to makeup to the CST. Although the quality of the water in Lake Michigan may be acceptable to feed the SGs, higher quality water is preferred.

During the NRC audit and review process, the licensee was asked to provide an estimated completion date for the T-81 and CST seismic and wind missile hazard evaluation and a description of any modifications necessary.

In response to the NRC audit and review process question, the licensee stated that a preliminary strategy assessment has been conducted to identify options for seismic upgrade and missile protection of T-81. Minor modifications of the anchorage may be required however, the evaluation is not yet complete. The evaluation for the CST is not yet complete however, the results will be provided at a future date. This is identified as Confirmatory Item 3.2.4.7.A in Section 4.2 below.

During the NRC audit and review process, the licensee was asked to provide information concerning the capacity of tanks T-80, CST, T-90, and T-91 for use as water sources and the means to connect portable pumps to refill the CST. In addition, the licensee was asked whether there was a priority in the source of water from T-90, T-91, and Lake Michigan.

In response to the NRC audit and review process question, the licensee states that an assessment has been conducted and because tanks T-90 and T-91 are non-seismic, non-missile protected and have not been evaluated to withstand the effects of a design basis flood. They are not planned on being credited.

In addition the licensee states that for Phase 2, CST makeup will be from Lake Michigan using a portable FLEX pump. Currently, the portable FLEX pump will be staged on the west side of the Intake Structure. Removable grating adjacent to the Intake Structure provides access to Lake Michigan via the intake canal using a suction hose. Flexible discharge hoses will be routed to a tee connection prior to depletion of combined CST and T-81 inventory. A design is being developed to install the tee connection on the CST overflow line.

The licensee did not identify whether the FSGs would provide clear criteria for transferring to the next preferred source of water. This is identified as Confirmatory Item 3.2.4.7.B in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to makeup water sources, if these requirements are implemented as described.

3.2.4.8 Electrical Power Sources/Isolations and Interactions

NEI 12-06, Section 3.2.2, Guideline (13) states in part:

> The use of portable equipment to charge batteries or locally energize equipment may be needed under ELAP/LUHS conditions. Appropriate electrical isolations and interactions should be addressed in procedures/guidance.

The licensee provided no information on the procedures used to describe electrical isolations and interactions, however, on page 65 of the Integrated Plan, in the section that describes safety function support for portable equipment during the transition phase, the licensee stated that it would modify spare breakers on necessary buses. The breakers will need to be replaced with breakers large enough to support the load from the generator. Additionally, the face of the breaker will need to be modified to have external female connectors, capable of receiving power from the FLEX generators. Four (4) female connectors will be required for 480 V distribution centers, one for each phase (A, B, C) and one to ground the generator to the bus. The connectors will be quick-electrical connections that require little to no electrical training to marry the connection. Two (2) breakers on LC-19 will require this modification. A spare breaker on both Bus 11 and Bus 12 will also need this modification.

During the NRC audit and review process, the licensee was asked to provide information concerning the proposed breaker modifications described above.

In response to the NRC audit and review process question, the licensee states that 480 Volt Load Control Centers (LCC) EB-11, EB-12, EB-19, and EB-20 are being modified to receive power from the 480 VAC Phase 2 portable FLEX generators. A new breaker will be installed for each load control center. A permanent cable will be installed to connect to newly installed breaker with a newly mounted quick disconnect box near the LCC. This is identified as Confirmatory Item 3.2.4.8.A in Section 4.2 below.

During the NRC audit and process review, the licensee was asked to provide a summary of the sizing calculation for the FLEX generators to show that they can supply the loads assumed in Phases 2 and 3.

In response to the NRC audit and review process question, the licensee states that the loading calculation for the 480V Generators for Phase 2 and 4160V Generator(s) to power the 2400V loads (via 4160V/2400V stepdown transformer) for Phase 3 has not been completed at this time. However, the calculation will develop conservative estimates for the electrical loading requirements for both the 480V and 4160V portable generators for electrical loads that supply key safety functions and other support loads in support of the Phase 2 and Phase 3 FLEX strategies. Nexus Document 12-4105-03-08 "Palisades FLEX Implementation Plan", Section 8.6.2.2, Description of Procedures / Strategies / Guidelines, lists the expected loads on the Phase 2 FLEX DG and Section 8.6.3.2, Description of Procedures / Strategies / Guidelines, describes the 2400V equipment that will be repowered by the RRC FLEX 4160 generators.

The licensee also stated that the calculation will generate the critical performance characteristics (kW, KVAR, and kVA demands for starting, stopping, and maintaining loads with margin) that must be met by the portable generators. For RRC provided Phase 3 portable generators, the calculation will verify the equipment to be furnished will be capable of repowering the Station's required electrical loads to support the strategies. These calculations are being developed in accordance with approved design processes that utilize appropriate design inputs for calculating electrical loads and the necessary considerations for use in sizing generators and their drivers (e.g., load starting requirement, voltage and frequency recovery requirements between applied loads, etc.). Loading and unloading of the generators will be controlled by procedure, based on vendor recommendations, to prevent overloading or tripping of generators.

The licensee needs to finalize the loading and sizing calculations for the 480V flex generators and the 4160V flex generators. This is identified as Confirmatory Item 3.2.4.8.B in Section 4.2 below.

During the NRC audit and review process, the licensee was asked to provide Single Line Diagrams showing the proposed connections of Phase 2 and 3 electrical equipment. Additionally, show protection information (breaker, relay etc.) and rating of the equipment on the Single Line Diagrams and the connection points for the 2 MW Generator with the 2400V switchgear.

In response to the NRC audit and review process question, the licensee states that preliminary Single Line Diagrams showing the proposed connections of Phase 2 (480V Bus 11, 480V Bus 12, and 480V bus 19) and a preliminary Single Line Diagram (2400V Bus 1C/1D) for Phase 3 electrical equipment are provided. The finalized Single Line Diagrams will be available in a future six-month update report.

During the NRC audit and review process, the licensee was asked to discuss how the charging pumps are going to be repowered with regard to their use as described in the Integrated Plan.

In response to the NRC audit and review process question, the licensee states that either P-55B or P-55C will be used as the motive force to provide makeup to the PCS. The selected pump will be powered from FLEX Generator 2 through either Bus 11 or Bus 12. A portable generator will be used to power Bus 11 or Bus 12 through the use of cables and a modified breaker with quick disconnects.

During the NRC audit and review process, the licensee was asked to describe how electrical isolation will be maintained such that Class 1E equipment is protected from faults in portable/FLEX equipment and how multiple sources do not attempt to power electrical buses.

In response to the NRC audit and review process question, the licensee states that appropriate controls for the equipment will be implemented in procedures to ensure compliance with NEI 12-06 section 3.2.2.13. However, the primary goal of FLEX generators is to power components credited in the FLEX strategy and not to protect Class 1E equipment. Further, the licensee explained that at the onset of the ELAP, Class 1E emergency diesel generators are assumed to be unavailable to supply the Class 1E buses. Portable generators are used in response to an ELAP in FLEX strategies for Phases 2 and 3. At the point when ELAP mitigation activities require tie-in of FLEX generators, in addition to existing electrical interlocks, procedural controls, such as inhibiting EDG start circuits and breaker rack-outs (e.g., EDG breakers, offsite feeder breakers, etc.), will be employed to prevent simultaneous connection of both the FLEX generators and Class 1E EDGs to the same ac distribution system or component. Additionally, repowering the Class 1E electrical buses from either FLEX generators or subsequently the Class 1E EDGs (should they become available) will be accomplished manually and controlled by procedure; no automatic sequencing or automatic repowering of the buses will be utilized. FLEX strategies, including the transition from installed sources to (and vice versa), will be addressed in the FLEX procedures and guidance which are in the development stage. This is identified as Confirmatory Item 3.2.4.8.C in Section 4.2 below.

During the NRC audit and review process, the licensee was asked to discuss which components change state when loads are shed and actions required to mitigate resultant hazards such as allowing hydrogen release from the main generator and disabling credited equipment via interlocks.

In response to the NRC audit and review process question, the licensee states that existing procedures address the issue of venting the main generator . For the interaction of components that may change state during load shed operations, PNP is evaluating a deeper load shed strategy of non-essential loads beyond that required by the EOP to obtain longer battery life for the ELAP event. The results of this evaluation will yield a procedure for extended load shed.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to electrical power sources/Isolations and interactions, if these requirements are implemented as described.

3.2.4.9 Portable Equipment Fuel

NEI 12-06, Section 3.2.2, consideration (13) states in part:

> The fuel necessary to operate the FLEX equipment needs to be assessed in the plant specific analysis to ensure sufficient quantities are available as well as to address delivery capabilities.

NEI 12-06, Section 3.2.1.3, initial condition (5) states:

> Fuel for FLEX equipment stored in structures with designs which are robust with respect to seismic events, floods and high winds and associated missiles, remains available.

On page 67 of the Integrated Plan, regarding portable equipment during the transition phase, the licensee stated that refueling operations in Phase 3 will be similar to that of Phase 2, using a diesel fuel tank loaded on a truck. Additional fuel supplies can be brought by the RRC when on-site supplies are diminished.

During the NRC audit and review process, the licensee was asked to describe plans for supplying fuel oil to FLEX equipment (i.e., fuel oil storage tank volume, supply pathway, etc.). Additionally, the licensee was asked to describe how fuel quality will be assured if stored for extended periods of time.

In response to the NRC audit and review process question, the licensee states that underground diesel fuel oil storage tank T-10A is the source to refuel FLEX equipment. This tank contains approximately 30,000 gallons of fuel. Fuel from T-10A will be transferred to a portable tank mounted on a trailer or truck and then transported to the diesel driven components for refueling as necessary. Existing plant procedures provide guidance for manually transferring fuel oil from T-10A with a manual pump and hoses. Provisions will be made to ensure the equipment required to manually transfer fuel oil from T-10A will be available. The portable tank will use the same path that for deployment of the FLEX equipment. The diesel fuel can be gravity drained from the portable tank or transferred using a FLEX fuel transfer pump. The quality of the diesel fuel in T-10A is maintained under the Diesel Fuel Monitoring and Storage Program in accordance with the guidelines of the ASTM Standards D 1796, D 2276, D 2709, and D 4057. The quality of the diesel fuel in stored FLEX equipment will be maintained under the site's Preventative Maintenance program according to the manufacturer's guidance and existing site maintenance practices.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to portable equipment fuel, if these requirements are implemented as described.

3.2.4.10 Load Reduction to Conserve DC Power

NEI 12-06, Section 3.2.2, consideration (6) provides that:

> *Plant procedures/guidance should identify loads that need to be stripped from the plant dc buses (both Class 1E and non-Class 1E) for the purpose of conserving dc power.*
>
> DC power is needed in an ELAP for such loads as shutdown system instrumentation, control systems, and dc backed AOVs and MOVs. Emergency lighting may also be powered by safety-related batteries. However, for many plants, this lighting may have been supplemented by Appendix R and security lights, thereby allowing the emergency lighting load to be eliminated. ELAP procedures/guidance should direct operators to conserve dc power during the event by stripping nonessential loads as soon as practical. Early load stripping can significantly extend the availability of the unit's Class 1E batteries. In certain circumstances, AFW/HPCI /RCIC operation may be extended by throttling flow to a constant rate, rather than by stroking valves in open-shut cycles.
>
> Given the beyond-design-basis nature of these conditions, it is acceptable to strip loads down to the minimum equipment necessary and one set of instrument channels for required indications. Credit for load-shedding actions should consider the other concurrent actions that may be required in such a condition.

During the NRC audit and review process, the licensee was asked to provide the direct current load profile with the required loads for the mitigating strategies to maintain core cooling, containment, and SFP cooling.

In response to the audit, the licensee states that the load profile for Station Blackout load shedding activities is developed in calculation EA-ELEC-LDTAB-009. Preliminary evaluation identified additional load shedding activities to extend battery coping time will be required. A calculation will be completed to determine the dc load profile for the extended load shedding activities.

During the audit, the licensee was asked to provide a detailed discussion on the loads that will be shed from the dc bus, the equipment location (or location where the required action needs to be taken), and the required operator actions needed to be performed and the time to complete each action. The licensee was further asked to explain which functions are lost as a result of shedding each load and discuss any impact on defense in depth and redundancy.

In response to the audit, the licensee states that a preliminary strategy has been drafted identifying a success path for extending the battery coping time to approximately eight hours to support FLEX strategies. The preliminary evaluation identified a deeper load shed than identified in the current Palisades station blackout response while providing the acceptable minimum equipment necessary per NEI 12-06 Section 3.2.2. The extended load shed does not include any fuse or lead manipulations and breakers are located in the AB and the diesel generator 1-2 room. The potential impacts are being evaluated.

The licensee needs to complete the load shed calculation to confirm adequate battery capacity with sufficient margin throughout Phase 1 to assure the battery does not get depleted prior to charging. This is noted as Confirmatory Item 3.2.4.10.A in Section 4.2.

Additionally, the licensee states that any non-essential loads that are included in the extended load shed will not be credited for ELAP and will be available to be repowered once the battery chargers are energized. The preliminary strategy evaluation includes actions to determine the time frame to complete the proposed load shed including walkthroughs. Walkthrough results will be utilized in the battery coping methodology.

During the NRC audit and review process, the licensee was asked to provide the basis for the minimum dc bus voltage that is required to ensure proper operation of all required electrical equipment.

In response to the NRC audit and review process question, the licensee states that the basis for the existing minimum dc bus voltage is the Technical Specifications minimum battery voltage of 105 V at the terminals. Calculation EA-ELEC-VOLT-052 determines the minimum required voltages at each breaker which will be utilized to determine the minimum dc bus voltage required during extended load shedding.

In response to the NRC audit and review process question, the licensee states that the initial coping strategy during Phase 1 relies on installed instrumentation to monitor critical parameters. All essential instrumentation required to monitor core, containment, and spent fuel safety parameters are provided with power from the batteries. The present battery coping time is approximately 4 hours per the current Palisades SBO procedure, EOP-3.0. A preliminary strategy evaluation has been drafted to extend the battery coping time to approximately eight hours at which point portable power will be required to power the battery chargers during Phase 2. This is identified as Confirmatory Item 3.2.4.10.B in Section 4.2.

During the NRC audit, the licensee was asked to clarify if margin was provided in establishing a 4 hour battery duty cycle.

In response to the NRC audit, the licensee states that at present, battery coping time is approximately 4 hours per the current SBO procedures. A preliminary strategy evaluation has been drafted to extend the battery coping time to approximately 8 hours. The preliminary evaluation includes actions to determine the time frame to complete the proposed load shed including walkthroughs and battery run-time calculations. The licensee confirms that the station battery run-time will be calculated in accordance with the IEEE-485 methodology using manufacturer discharge test data applicable to the FLEX strategy as outlined in the NEI white paper on Extended Battery Duty Cycles. The detailed PNP calculations, supporting vendor discharge data, FLEX strategy battery load profile, and other inputs/initial conditions required by IEEE-485 will be available in a future 6-month update report. This is identified as Confirmatory Item 3.2.4.10.C in Section 4.2 below.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01 and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to load reduction to conserve power, if these requirements are implemented as described.

3.3 PROGRAMMATIC CONTROLS

3.3.1 Equipment Maintenance and Testing

NEI 12-06, Section 3.2.2, the paragraph following Guideline (15) states in part:

> In order to assure reliability and availability of the FLEX equipment required to meet these capabilities, 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. Thus, a two-unit site would nominally have at least three portable pumps, three sets of portable ac/dc power supplies, three sets of hoses & cables, etc. 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 (e.g., two separate means to repower instrumentation). In this case the equipment associated with each strategy does not require N+1. The existing 50.54(hh)(2) pump and supplies can be counted toward the N+1, provided it meets the functional and storage requirements outlined in this guide. The N+1 capability applies to the portable FLEX equipment described in Tables 3-1 and 3-2 (i.e., that equipment that directly supports maintenance of the key safety functions). Other FLEX support equipment only requires an N capability.

NEI 12-06, Section 11.5 states:

1. FLEX mitigation equipment should be initially tested or other reasonable means used to verify performance conforms to the limiting FLEX requirements. Validation of source manufacturer quality is not required.

2. Portable equipment that directly performs a FLEX mitigation strategy for the core, containment, or SFP should be subject to maintenance and testing guidance provided in INPO AP 913, Equipment Reliability Process, to verify proper function. The maintenance program should ensure that the FLEX equipment reliability is being achieved. Standard industry templates (e.g., EPRI) and associated bases will be developed to define specific maintenance and testing including the following:

    a. Periodic testing and frequency should be determined based on equipment type and expected use. Testing should be done to verify design requirements and/or basis. The basis should be documented and deviations from vendor recommendations and applicable standards should be justified.

    b. Preventive maintenance should be determined based on equipment type and expected use. The basis should be documented and deviations from vendor recommendations and applicable standards should be justified.

c. Existing work control processes may be used to control maintenance and testing. (e.g., PM Program, Surveillance Program, Vendor Contracts, and work orders).

3. The unavailability of equipment and applicable connections that directly performs a FLEX mitigation strategy for core, containment, and SFP should be managed such that risk to mitigating strategy capability is minimized.

   a. The unavailability of installed plant equipment is controlled by existing plant processes such as the Technical Specifications. When installed plant equipment which supports FLEX strategies becomes unavailable, then the FLEX strategy affected by this unavailability does not need to be maintained during the unavailability.

   b. Portable equipment may be unavailable for 90 days provided that the site FLEX capability (N) is available.

   c. Connections to permanent equipment required for FLEX strategies can be unavailable for 90 days provided alternate capabilities remain functional.

   d. Portable equipment that is expected to be unavailable for more than 90 days or expected to be unavailable during forecast site specific external events (e.g., hurricane) should be supplemented with alternate suitable equipment.

   e. The short duration of equipment unavailability, discussed above, does not constitute a loss of reasonable protection from a diverse storage location protection strategy perspective.

   f. If portable equipment becomes unavailable such that the site FLEX capability (N) is not maintained, initiate actions within 24 hours to restore the site FLEX capability (N) and implement compensatory measures (e.g., use of alternate suitable equipment or supplemental personnel) within 72 hours.

Information regarding the specific storage areas for FLEX equipment is described in section 3.1, above.

The NRC staff reviewed the licensee's Integrated Plan and determined that the Generic Concern related to maintenance and testing of FLEX equipment is applicable to the plant. This Generic Concern has been resolved generically through the NRC endorsement of the Electric Power Research Institute (EPRI) technical report on preventative maintenance of FLEX equipment, submitted by NEI by letter dated October 3, 2013 (ADAMS Accession No. ML13276A573). The NRC staff's endorsement letter is dated October 7, 2013 (ADAMS Accession No. ML13276A224)

This Generic Concern involves clarification of how licenses would maintain FLEX equipment such that it would be readily available for use. The technical report provided sufficient basis to resolve this concern by describing a database that licensee could use to develop preventive maintenance programs for FLEX equipment. The database describes maintenance tasks and maintenance intervals that have been evaluated as sufficient to provide for the readiness of the FLEX equipment. The NRC staff has determined that the technical report provides an acceptable approach for developing a program for maintaining FLEX equipment in a ready-to-use status. During the NRC audit and review process, the licensee informed the NRC of their plans to abide by this generic resolution. The NRC staff will review the resulting program during the audit and inspection process.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to maintenance and testing, if these requirements are implemented as described.

3.3.2 Configuration Control

NEI 12-06, Section 11.8 states:

1. The FLEX strategies and basis will be maintained in an overall program document. This program document will also contain a historical record of previous strategies and the basis for changes. The document will also contain the basis for the ongoing maintenance and testing programs chosen for the FLEX equipment.

2. Existing plant configuration control procedures will be modified to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.

3. Changes to FLEX strategies may be made without prior NRC approval provided:

    a) The revised FLEX strategy meets the requirements of this guideline.

    b) An engineering basis is documented that ensures that the change in FLEX strategy continues to ensure the key safety functions (core and SFP cooling, containment integrity) are met.

In the Integrated Plan, the licensee stated, that the unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy will be managed using plant equipment control guidelines developed in accordance with NEI 12-06 Section 11.5. Programs and controls will be established to assure personnel proficiency in the mitigation of beyond-design- basis events is developed and maintained in accordance with NEI 12-06 Section 11.6. The FLEX strategies and basis will be maintained in an overall program document. Existing plant configuration control procedures will be modified to ensure that changes to the plant design, physical plant layout, road, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies in accordance with NEI 12-06, Section 11.8.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to configuration control, if these requirements are implemented as described.

3.3.3 Training

NEI 12-06, Section 11.6 states:

1. Programs and controls should be established to assure personnel proficiency in the mitigation of beyond-design-basis events is developed and maintained. These programs and controls should be implemented in accordance with an accepted training process.

2. Periodic training should be provided to site emergency response leaders7 on beyond design-basis emergency response strategies and implementing guidelines. Operator training for beyond-design-basis event accident mitigation should not be given undue weight in comparison with other training requirements. The testing/evaluation of Operator knowledge and skills in this area should be similarly weighted.

3. Personnel assigned to direct the execution of mitigation strategies for beyond-design basis events will receive necessary training to ensure familiarity with the associated tasks, considering available job aids, instructions, and mitigating strategy time constraints.

4. "ANSI/ANS 3.5, Nuclear Power Plant Simulators for use in Operator Training" certification of simulator fidelity (if used) is considered to be sufficient for the initial stages of the beyond-design-basis external event scenario until the current capability of the simulator model is exceeded. Full scope simulator models will not be upgraded to accommodate FLEX training or drills.

5. Where appropriate, the integrated FLEX drills should be organized on a team or crew basis and conducted periodically; with all time-sensitive actions to be evaluated over a period of not more than eight years. It is not the intent to connect to or operate permanently installed equipment during these drills and demonstrations.

On page 16 of the Integrated Plan, in regards to training, the licensee stated that the training materials for FLEX will be developed for all station staff involved in implementing FLEX strategies. For accredited training programs, the Systematic Approach to Training will be used to determine training needs. For other station staff, a training overview will be developed and communicated. Training for FLEX implementation will be done in accordance with NEI 12-06, Section 11.6 and will be conducted prior to design implementation.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to training, if these requirements are implemented as described.

3.4 OFFSITE RESOURCES

NEI 12-06, Section 12.2 lists the following minimum capabilities for offsite resources for which each licensee should establish the availability of:

1) A capability to obtain equipment and commodities to sustain and backup the site's coping strategies.

2) Off-site equipment procurement, maintenance, testing, calibration, storage, and control.

3) A provision to inspect and audit the contractual agreements to reasonably assure the capabilities to deploy the FLEX strategies including unannounced random inspections by the Nuclear Regulatory Commission.

4) Provisions to ensure that no single external event will preclude the capability to supply the needed resources to the plant site.

5) Provisions to ensure that the off-site capability can be maintained for the life of the plant.

6) Provisions to revise the required supplied equipment due to changes in the FLEX strategies or plant equipment or equipment obsolescence.

7) The appropriate standard mechanical and electrical connections need to be specified.

8) Provisions to ensure that the periodic maintenance, periodic maintenance schedule, testing, and calibration of off-site equipment are comparable/consistent with that of similar on-site FLEX equipment.

9) Provisions to ensure that equipment determined to be unavailable/non-operational during maintenance or testing is either restored to operational status or replaced with appropriate alternative equipment within 90 days.

10) Provision to ensure that reasonable supplies of spare parts for the off-site equipment are readily available if needed. The intent of this provision is to reduce the likelihood of extended equipment maintenance (requiring in excess of 90 days for returning the equipment to operational status).

The licensee identified that Entergy, for the Palisades site, will negotiate and execute a contract with SAFER that will meet the requirements of NEI 12-06, Section 12.

A review was conducted of the licensee's plans for the deployment of portable equipment used to implement the response for all hazards and finds that more information was needed in order to conclude that the plan would conform to the criteria of NEI 12-06 with regards to considerations 2 through 10. This is Confirmatory Item 3.4.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to off-site resources, if these requirements are implemented as described.

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.1.1.2.A	In the Integrated Plan, the licensee stated that soil liquefaction is not explicitly addressed in its UFSAR and identified that an evaluation is being conducted for its impact on deployment of portable FLEX equipment.	
3.1.1.2.B	The licensee should address potential need for a power source to move or deploy the equipment (e.g., to open the door from a storage location).	
3.1.1.3.A	The licensee did not provide information concerning impacts from large internal flooding sources that are not seismically robust and the potential impact on the mitigating strategies.	
3.1.1.3.B	The licensee did not provide information concerning ground water mitigation.	
3.1.5.1.A	The licensee did not specify what features would be used to ensure the functionality of FLEX equipment in the presence of high temperature hazards.	
3.1.5.3.A	The licensee stated did not specify what features would be used to ensure the functionality of FLEX equipment when deployed in the presence of high temperatures.	
3.2.1.8.A	At the time the audit was conducted, the licensee had neither (1) committed to abide by the generic approach discussed above, including the additional conditions specified in the NRC's endorsement letter, nor (2) identified an acceptable alternate approach for justifying the boric acid mixing assumptions in the analyses supporting its mitigating strategy. To satisfactorily resolve this issue, the licensee should confirm its compliance with the conditions specified in the NRC endorsement letter discussed above. Alternatively, the licensee may identify an acceptable alternate approach for justifying the boric acid mixing assumptions in the subcriticality analyses.	
3.2.1.9.B	The proposed use of portable generators to repower installed charging pumps is an alternative approach to NEI 12-06. The NRC staff notes that this places greater reliance on the current state of knowledge of external hazards, which are being re-examined pursuant to NTTF Recommendation 2.1. New information from that effort may necessitate changes in the degree of protection afforded the pre-staged generators and associated equipment in order to maintain the guidance and strategies required by EA-12-049. Additional information is needed from the licensee to determine whether the proposed approach provides an equivalent level of flexibility for responding to an undefined event as would be provided through conformance with NEI 12-06, including provision of connection points for the use of portable pumping sources from off-site should the installed equipment be rendered unavailable by the initiating event.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.3.1.A	The licensee should confirm that the structures will meet the plant's design-basis tornado wind speed of 300 mph or will be designed or evaluated equivalent to ASCE 7-10 using a tornado wind speed of 230 mph with separation and diversity between the storage locations. If the method of protection chosen is the later, the licensee should justify that the separation and diversity is adequate.	
3.2.1.A	The licensee stated that operator actions performed in the first 20 minutes of the event are associated with standard post-trip actions (EOP-1.0) and station blackout recovery (EOP-3.0). Along with main control board instrumentation and reports for the field, preliminary evaluations concluded that equipment assessments can be reasonably estimated to a degree to declare the ELAP within 0.95 hours. This information will be updated when procedures are developed and validated. The updated information regarding the required operator actions and the associated operator actions times in 20 minutes is needed from the licensee to determine whether the operator actions are adequate and reasonably achievable.	
3.2.1.B	The evaluation will also include either validating the robustness of the charging pump control circuit or provide FLEX procedure guidance to manually operate the charging pumps by breaker operation. The updated information regarding the FLEX generator deployment and operation of the charging pump is needed from the licensee to determine the adequacy of use of the charging pump for RCS inventory makeup during an ELAP.	
3.2.1.C	Evaluation of the piping from the BASTs to the pump suction identified a section of piping which requires additional evaluation. This will be resolved during the detailed design process and will be provided in a future six- month update report. The information regarding the evaluation results of seismic robustness for the BAST piping is needed from the licensee to determine the adequacy of the use of the BAST water as a supply source for the charging pumps.	
3.2.1.D	The Integrated Plan includes Open Item 16 to evaluate an alternative borated water tank to supplement the water volume that may be added when Lake Michigan is the source. Evaluations are planned to provide an engineering solution that allows mixing of the BAST concentrated borated water with non-borated water. While the source of the non-borated water has not yet been determined, Lake Michigan is an available source. An installed connection to the charging pump suction already exists. Since the SIRWT and/or VCT is currently not planned to be credited, there are no time critical actions associated with unavailability. In addition, NEI 12-06 section 3.2.1.2 states that no additional failures are assumed to occur immediately prior to or during the event.	

3.2.1.E	The licensee should justify the continued functionality of the ADVs in the context of a tornado missile hazard resulting in an ELAP in order to support a symmetric cooldown given that the design basis operability of the ADVs appears to allow for incapacitation of individual ADVs. Alternatively, the licensee may address the effects of asymmetric natural circulation cooldown.	
3.2.1.F	The licensee was asked to provide a summary of nonsafety-related equipment that is used in the mitigation strategies including a discussion of whether the equipment is qualified to survive all ELAP events. In response to the NRC audit and review process question, the licensee states that all installed equipment credited in mitigating strategies will be evaluated to verify conformance to the external event criteria described in NEI-12-06. Review of this evaluation is needed.	
3.2.1.1.A	The use of CENTS in the ELAP analysis for CE plants is limited to the flow conditions prior to reflux boiling initiation. Specifically, the CENTS-calculated flow quality at the top of the SG U-tube should be provided for condition when two-phase natural circulation ends and reflux boiling initiates. Also, the licensee should discuss how the applicable ELAP analyses meet the above limitation on the use of CENTS.	
3.2.1.2.A	The RCP seal initial maximum leakage rate should be greater than or equal to the upper bound expectation for the seal leakage rate for the ELAP event (15 gpm/seal) discussed in the PWROG position paper addressing the RCP seal leakage for CE plants (Reference 2). If the RCP seal leakage rate used in the plant-specific ELAP analysis is less than upper bound expectation for the seal leakage rate discussed in the position paper, justification should be provided.	
3.2.1.2.B	The licensee did not discuss whether the seal failure will occur or not when subcooling of the coolant in the RCS cold-legs is greater than 50^0F. The licensee should specify the seal leakage flow assumed for the ELAP from the time zero to the timeframe when subcooling in the RCS cold-legs decreases to 50^0F, and provide justification for the assumed leakage rate.	
3.2.1.2.C	The licensee should provide the maximum temperature and pressure, and minimum subcooling of the coolant in the RCS cold-legs during the ELAP before the CBO isolation, and justify the assumption that the integrity of the RCP seals can be maintained, and the seal leakage rate is less than 1 gpm per RCP during an ELAP before the CBO is isolated.	
3.2.1.2.D	The licensee should (1) confirm whether above Case 1 without the CBO isolation, or Case 2 with the CBO isolation is used to establish its mitigation strategies, and (2) provide and justify the updated SOE and time constraints so established.	
3.2.1.3.A	The applicability of ANS 5.1-1979 + 2 sigma decay heat curve for PNP will be addressed in a future six-month update report.	
3.2.1.5.A	The licensee was asked to discuss the analysis used to determine the containment temperature, pressure, and moisture profiles during the ELAP event and to address the adequacy of the	

	computer codes/methodologies, and assumptions used in the analysis.	
3.2.1.5.B	The licensee was asked in regard to its on-going FLEX strategy evaluation, to provide the need for further instrumentation if identified by the evaluation.	
3.2.1.6.A	The licensee was asked to describe the methodology for the SOE timeline validation and to provide the results thereof, when available.	
3.2.1.6.B	The licensee stated that its Integrated Plan contains a preliminary Sequence of Events timeline. A preliminary assessment has been performed identifying potential changes to the Sequence of Events. Validation methodology and results of the timeline will be provided when completed which is expected in a future six-month update report. The updated information regarding the Sequence of Events is needed from the licensee to confirm that the mitigation strategies listed in the Sequence of Events are updated and acceptable.	
3.2.1.9.A	The flow rates for pumps supporting core cooling and sub-criticality are consistent with or bound the WACP 17601 and the plant specific CN-SEE-II-13-5 analyses. Required total developed head (TDH) is determined by hand calculations using standard methods (e.g., Crane 410). The licensee should provide verification that the procedures will line up with the estimated time for deployment of the portable pumps.	
3.2.2.A	The monitor nozzle discharges 100 gpm at a pressure of 30 to 50 psi. The available suction sources for all of the above options are the SIRWT and Lake Michigan. NEI 12-6 Table D-3, SFP cooling section, specifies that a flow rate minimum of 200 gpm per unit to the pool or 250 gpm per unit if overspray occurs consistent with 10 CFR 50.54(hh)(2). Resolution of the discrepancy between the licensee flow rate of 100 gpm spray and the NEI 12-06 specified 250 gpm for spray is required.	
3.2.3.A	The licensee should provide the results of containment response analysis.	
3.2.4.1.A	The licensee did not provide any information regarding the need for systems such as closed cooling water systems of service water that me be necessary to cool plant components that are credited in the ELAP mitigating strategies. The licensee will use the TDAFW pump and the positive displacement charging pumps, Information is required to determined is supplemental cooling is required for these components or systems or any other not noted here.	
3.2.4.1.B	The RRC will additionally provide a large, diesel-driven UHS FLEX pump. This pump will provide Service Water flow, as it is assumed the Service Water Pumps or intake structure are unrecoverable. PNP still needs to determine the connection point for the UHS FLEX Pump to the Service Water System.	
3.2.4.2.A	The licensee was asked to provide information on the adequacy of the ventilation provided in the battery room to protect the batteries from the effects of extreme high and low temperatures.	

3.2.4.2.B	The licensee was asked to provide a discussion of battery room ventilation to prevent hydrogen accumulation while recharging the batteries in Phase 2 or Phase 3	
3.2.4.3.A	Complete heat tracing analysis for borated water systems.	
3.2.4.4.A	Verification that completed communication enhancements is needed to confirm acceptability.	
3.2.4.5.A	Exceptions to the site security plan or other (license/site specific) requirements of a nature requiring NRC approval will be communicated in a future six-month update following identification	
3.2.4.6.A	The licensee's plan on personnel habitability/accessibility in an elevated temperature environment lacked information to determine that the habitability limits will be maintained and/or operator protective measures will be employed in all phases of an ELAP to ensure operators will be capable of FLEX strategy execution under adverse temperature conditions. Examples of areas of concern are the control room, TDAFW pump room, SFP area, and charging pump room.	
3.2.4.7.A	The licensee stated that a preliminary strategy assessment has been conducted to identify options for seismic upgrade and missile protection of T-81. Minor modifications of the anchorage may be required however, the evaluation is not yet complete. The evaluation for the CST is not yet complete however, the results will be provided at a future date	
3.2.4.7.B	CST makeup will be from Lake Michigan using a portable FLEX pump. Currently, the portable FLEX pump will be staged on the west side of the Intake Structure. Flexible discharge hoses will be routed to a tee connection prior to depletion of combined CST and T-81 inventory. A design is being developed to install the tee connection on the CST overflow line. The licensee did not identify whether the FSGs would provide clear criteria for transferring to the next preferred source of water.	
3.2.4.8.A	The 480 Volt Load Control Centers (LCC) EB-11, EB-12, EB-19, and EB-20 are being modified to receive power from the 480 VAC Phase 2 portable FLEX generators. A new breaker will be installed for each load control center. A permanent cable will be installed to connect to newly installed breaker with a newly mounted quick disconnect box near the LCC. The licensee should provide information concerning the proposed breaker modifications.	
3.2.4.8.B	The licensee was asked to describe how electrical isolation will be maintained such that Class 1E equipment is protected from faults in portable/FLEX equipment and how multiple sources do not attempt to power electrical buses.	
3.2.4.8.C	Repowering the Class 1E electrical buses from either FLEX generators or subsequently the Class 1E EDGs (should they become available) will be accomplished manually and controlled by procedure; no automatic sequencing or automatic repowering of the buses will be utilized. FLEX strategies, including the transition from installed sources to (and vice versa), will be addressed in the FLEX procedures and guidance which are in the	

	development stage.	
3.2.4.10.A	The licensee confirms that the FLEX strategy station battery run-time will be calculated in accordance with the IEEE-485 methodology using manufacturer discharge test data applicable to the FLEX strategy as outlined in the NEI white paper on Extended Battery Duty Cycles. The detailed Palisades calculations, supporting vendor discharge data, FLEX strategy battery load profile, and other inputs/initial conditions required by IEEE-485 will be available in a future 6-month update report.	
3.2.4.10.B	The present battery coping time is approximately 4 hours per the current Palisades SBO procedure, EOP-3.0. A preliminary strategy evaluation has been drafted to extend the battery coping time to approximately eight hours at which point portable power will be required to power the battery chargers during Phase 2.	
3.2.4.10.C	The licensee confirms that the FLEX strategy station battery run-time will be calculated in accordance with the IEEE-485 methodology using manufacturer discharge test data applicable to the FLEX strategy as outlined in the NEI white paper on Extended Battery Duty Cycles. The detailed Palisades calculations, supporting vendor discharge data, FLEX strategy battery load profile, and other inputs/initial conditions required by IEEE-485 will be available in a future 6-month update report.	
3.4.A	The licensee's plans for the deployment of portable equipment used to implement the response for all hazards is not complete. More information was needed in order to conclude that the plan would conform to the criteria of NEI 12-06 with regards to considerations 2 through 10.	

If you have any questions, please contact Peter Bamford, Mitigating Strategies Project Manager, at 301-415-2833, or at peter.bamford@nrc.gov.

Sincerely,

/RA/

Jeremy S. Bowen, Chief
Mitigating Strategies Projects Branch
Mitigating Strategies Directorate
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosures:
1. Interim Staff Evaluation
2. Technical Evaluation Report

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DATE	02/06/14	02/06/14	02/06/14	2/6/14
OFFICE	NRR/MSD/MESB/BC	NRR/MSD/MRSB/BC	NRR/MSD/D	NRR/MSD/MSPB/BC
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