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

November 22, 2013

Mr. George T. Hamrick, Vice President
Brunswick Steam Electric Plant
Carolina Power & Light Company
P.O. Box 10429
Southport, NC 28461

SUBJECT: BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2 - INTERIM STAFF EVALUATION RELATING TO OVERALL INTEGRATED PLAN IN RESPONSE TO ORDER EA-12-049 (MITIGATION STRATEGIES) (TAC NOS. MF0975 AND MF0976)

Dear Mr. Hamrick:

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. ML13071A559) Carolina Power and Light Company, submitted its Overall Integrated Plan for Brunswick Steam Electric Plant, Units 1 and 2 (Brunswick) in response to Order EA-12-049. By letter dated August 20, 2013 (ADAMS Accession No. ML13248A447), Duke Energy Progress, Inc., (Duke, the licensee), formerly known as Carolina Power and Light Company, submitted a six-month update to the overall integrated plan for Brunswick.

Based on a review of Duke's plan, including the six-month update dated August 20, 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 Brunswick. 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 and Audit Report. As identified in Section 4.0 of the enclosed report, the open items warranting the greatest attention to ensure successful implementation are the following:

1.) Recirculation Pump Leakage
2.) Extended Loss of Alternating Current Power, Containment Analysis
3.) Generic Concern Regarding Boiling Water Reactor Owners Group Emergency Procedure Guidelines/Severe Accident Guidelines, Revision 3

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 Nos. 50-325 and 50-324

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

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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

DUKE ENERGY PROGRESS, INC.

BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2

DOCKET NOS. 50-325 and 50-324

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 Nuclear Regulatory Commission (NRC) determined that additional requirements needed to be imposed to mitigate beyond-design-basis external events. 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 beyond-design-basis external event.

By letter dated February 28, 2013 [Reference 2], Carolina Power and Light Company (CP&L), provided the Overall Integrated Plan for compliance with Order EA-12-049 for Brunswick Steam Electric Plant, Units 1 and 2 (Brunswick) (hereafter referred to as the Integrated Plan). The Integrated Plan describes the guidance and strategies under development for implementation by the licensee 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 20, 2013 [Reference 3], Duke Energy Progress, Inc., (Duke, the licensee), formerly known as CP&L, 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 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 beyond-design-basis external events. 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

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

requires providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. Specific 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 beyond-design-basis external events 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, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" [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 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 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 Brunswick, submitted by CP&L's letter dated February 28, 2013, as supplemented. NRC and MTS staff have reviewed the submitted information and held clarifying discussions with Duke in evaluating the licensee's plans for addressing beyond-design-basis external events and its progress towards implementing those plans. By letter dated November 20, 2013 [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 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 Brunswick Integrated Plan to mitigate the postulated extended loss of ac power event is that the licensee will initially remove the core decay heat by using the Reactor Core Isolation Cooling (RCIC) system. The steam-driven RCIC pump will initially supply water to the reactor from the condensate storage tank or the suppression pool, depending on availability. Steam from the reactor will then be vented through the Safety Relief Valves to the suppression pool. The suction source for RCIC will eventually be switched to the clean water tank, which is a new supply of water being constructed for this scenario. A FLEX generator will be used to reenergize selected 480 volt ac load centers. This will allow energizing selected motor control centers so that power is available to critical loads such as required motor-operated valves, direct current (dc) components through the installed battery chargers, and desired ac instrumentation. In the long-term, additional equipment, such as 4160 volt ac generators, will be delivered from the Regional Response Center to provide supplemental accident mitigation equipment.

In the postulated extended loss of ac power event, the SFP will initially heat up due to the unavailability of the normal cooling system. A FLEX pump supplied from the clean water storage tank will be aligned and used to add water to the SFP to maintain level as the pool boils. This will maintain a sufficient amount of water above the top of the fuel assemblies for cooling and shielding purposes.

Brunswick plans to use containment venting to maintain containment pressure and temperature within acceptable values. The exact timing and strategy for venting is still under evaluation by the licensee.

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:

A. Acceptable item – an item that the NRC considers resolved, consistent with the endorsed guidance, or otherwise acceptable to the staff. No further NRC review is required, but licensee implementation may be subject to inspection.

B. 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.

C. Open item – an item for which the licensee has not presented a sufficient basis for 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 NRC staff therefore adopts the open and confirmatory items identified in the TER, with one exception regarding TER Open Item 3.2.4.6.A, Habitability of Response Locations. In the audit process, the licensee stated that the use of passive cooling technologies for response personnel were being evaluated and that GOTHIC analyses were being performed to determine if other mitigating strategies will be required. The results of these will be provided to the NRC staff in a future six-month update. The licensee has committed to performing calculations and evaluations which will inform their plant-specific strategy for maintaining personnel habitability in all areas which require critical actions following an ELAP event. The licensee's approach, as currently understood, is not complete; however, the NRC staff considers their stated path to resolution to be conceptually acceptable and consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01. For this reason, the NRC staff has decided to classify Open Item 3.2.4.6.A of the TER as Confirmatory Item 3.2.4.6.A. In addition to this technical item, the NRC staff has edited some portions of the TER Open and Confirmatory Item Listing for clarity. Therefore, the tables in Section 4.0 of this ISE represent the NRC's assessment of the open and confirmatory items for Brunswick. These summary tables provide a brief description of the issue of concern. Further details for each open and confirmatory item are provided in the corresponding sections of the TER, identified by the item number.

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.1.1.C	The licensee has indicated that programs are being developed to address storage structure requirements, but insufficient information was provided regarding seismic considerations.	

3.1.1.2.B	The licensee identified that they plan to construct a clean water tank to supply RCIC and High Pressure Coolant Injection with water of acceptable quality. However, the licensee did not identify the design considerations for the clean water tank regarding its ability to withstand all hazards. Therefore, there is not sufficient information to confirm that the clean water tank will be "robust" in accordance with NEI 12-06 such that it can be credited for all events or whether other water sources are required.	
3.1.1.3.B	The licensee did not discuss hazards associated with large internal flooding sources that are not seismically robust and do not require ac power and the use of ac power to mitigate ground water in critical locations.	
3.2.1.1.F	MAAP - The Modular Accident Analysis Program (MAAP) analysis uses an initial wetwell liquid volume that requires additional justification or provide a revised analysis of the coping time available under ELAP conditions that incorporates an initial wetwell water volume and level that is representative of Brunswick.	
3.2.1.2.A	A review was conducted of the licensee's integrated plan and it was determined that there is insufficient information provided to determine the adequacy of the determination of recirculation pump seal or other sources of leakage used in the ELAP analysis.	SIGNIFICANT
3.2.1.3.A	The licensee has not provided information to support the reliability of the HPCI switchover function from the CST [condensate storage tank] to the suppression pool, similar to the information provided for the RCIC switchover function.	
3.2.1.3.B	The integrated plan is not consistent between the discussions in the Maintain Containment section and the timeline regarding RPV pressure.	
3.2.1.3.C	Information was not provided to determine if RCIC will be started automatically or at a time required by analysis following the initiation of the event, if any elapsed time constraint exists for this action, if pressure and temperature conditions in the containment predicted in NEDC-33711P Rev 1, have been considered, and net positive suction head for RCIC.	
3.2.1.3.F	The timeline identifies that at 19.5 hours, the containment is vented via the Hardened Containment Vent System (HVCS). This timeframe does not appear consistent with the results presented in NEDC-33771P, Revision 1.	
3.2.1.4.A	Regarding the use of portable pumps to provide RPV injection, the licensee did not provide technical basis or supporting analyses for the pump capabilities for the primary and alternate flow paths.	

3.2.1.8.A	The licensee has not provided information related to whether a booster pump is needed between the CWST and the RCIC pump.	
3.2.3.A	The licensee has not provided plant-specific analysis information, commensurate with the level of detail contained in NEDC-33771P, to demonstrate that containment functions will be maintained in all phases of an ELAP.	SIGNIFICANT
3.2.3.B	The NRC staff considers the adoption of Revision 3 to the BWROG Emergency Procedure Guidelines (EPG)/Severe Accident Guidelines (SAG) by licensees to be a Generic Concern (and thus an open item for the licensee) because the BWROG has not addressed the potential for the revised venting strategy to increase (relative to currently accepted venting strategies) the likelihood of detrimental effects on containment response for events in which the venting strategy is invoked.	SIGNIFICANT
3.2.4.2.A	The licensee's response did not address maintaining battery room ventilation. A discussion on the hydrogen gas exhaust path for each strategy is needed, and a discussion of the accumulation of hydrogen when the batteries are being recharged during Phase 2 and 3.	
3.2.4.2.B	The licensee did not provide sufficient information regarding the effect of elevated temperatures on electrical equipment being credited as part of ELAP strategies.	
3.2.4.2.C	The licensee did not discuss the extreme low temperatures effects of the batteries capability to perform its function for the duration of the ELAP event.	
3.2.4.3.A	The licensee did not discuss the effects of loss of power to heat tracing.	
3.2.4.4.A	The licensee has not discussed their coping strategies for portable and emergency lighting necessary to facilitate personnel access into plant locations to implement mitigating strategies.	
3.2.4.5.A	The licensee provided no information regarding local access to the protected areas under ELAP.	
3.2.4.8.A	The licensee did not provide any information or strategy regarding electrical isolation of the FLEX DGs from installed plant equipment to prevent simultaneously supplying power to the same Class 1E bus.	
3.2.4.8.B	The licensee did not provide sufficient information on the instrumentation that will be used to monitor portable/FLEX electrical power equipment.	
3.2.4.9.A	The licensee did not provide sufficient information on the amount or the expected usage rates of fuel that would be necessary to support Phase 2 equipment.	

3.2.4.9.B	The licensee did not to discuss the diesel fuel oil supply pathway for the diesel driven FLEX pumps and the permanently pre-staged FLEX DGs. The primary concern is flooded conditions.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.1.A	The licensee is planning on constructing a FLEX Equipment Storage Building (FESB) that meets the requirements of NEI 12-06 Section 11, but has not discussed the specific protection requirements described in NEI 12-06 for the applicable hazard. During the audit process, the licensee provided a description of the design considerations for the FESB however their considerations were not inclusive of all applicable hazards.	
3.1.1.1.B	The licensee updated methodologies and processes associated with the HCVS that will be incorporated into the response to Order EA-13-109, and the BSEP Units 1 and 2 will be modified for these processes in accordance with the requirements of Order EA-13-109. Any applicable Phase 2 FLEX equipment required for the modification/process to facilitate the venting practices (HCVS) will need to be stored and/or protected for all hazards.	
3.1.1.2.A	The licensee identified two vehicles as a means to deploy equipment, provide fuel replenishment, etc., and four flatbed trailers as a means to store and transport hoses, strainers, cables, and miscellaneous equipment, but omitted discussion of the protection to be afforded these vehicles/trainers from seismic hazards.	
3.1.1.3.A	The licensee did not provide sufficient information concerning coping strategies for the failure of seismically qualified electrical equipment that can be affected by beyond-design-basis seismic events as discussed in NEI 12-06, Section 5.3.3 consideration 1. The licensee determined that a local process for local vital indications would be developed to support BSEP's FLEX response.	
3.1.1.4.A	The licensee has not identified local staging areas and method(s) of transportation of SAFER equipment.	
3.1.2.A	While the licensee has identified the limiting source of flooding as the Probable Maximum Hurricane, the applicable flooding hazard was not characterized in terms of warning time and persistence.	
3.1.2.2.A	There was no discussion of the considerations for movement of equipment and restocking of supplies in the context of a flood with long persistence.	

3.1.3.2.A	The licensee has not provided sufficient information with regard to the deployment of FLEX equipment. The licensee stated that strategies and movement of equipment during hurricanes will be incorporated into the Flex Support Guidelines to ensure successful deployment without endangering personnel. Due to hurricanes providing days of forewarning, strategies may include pre-staging or certain equipment in robust structures other than the permanent FLEX storage building. These strategies are still under development.	
3.1.4.2.A	The licensee stated that the deployment of debris removal equipment (including ice removal) has not been finalized.	
3.1.5.3.A	The licensee did not provide a discussion of the potential effects of high temperatures at the location where the portable equipment would actually operate during a high temperature hazard. The licensee stated that the equipment would be purchased with the requirements to operate during a high temperature hazard and that the FLEX DGs and structure will be purchased/designed to ensure proper operation at elevated temperatures.	
3.2.1.1.A	From the June 2013 position paper, benchmarks must be identified and discussed which demonstrate that MAAP4 is an appropriate code for the simulation of an ELAP event at Brunswick.	
3.2.1.1.B	The collapsed level must remain above Top of Active Fuel (TAF) and the cool down rate must be within technical specification limits.	
3.2.1.1.C	MAAP4 must be used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper.	
3.2.1.1.D	In using MAAP4, the licensee must identify and justify the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236). This should include response at a plant-specific level regarding specific modeling options and parameter choices for key models that would be expected to substantially affect the ELAP analysis performed for that licensee's plant. Although some suggested key phenomena are identified below, other parameters considered important in the simulation of the ELAP event by the vendor / licensee should also be included. Nodalization General two-phase flow modeling Modeling of heat transfer and losses Choked flow	

	Vent line pressure losses Decay heat (fission products / actinides / etc.)	
3.2.1.1.E	The specific MAAP4 analysis case that was used to validate the timing of mitigating strategies in the integrated plan must be identified and should be available on the ePortal for NRC staff to view. Alternately, a comparable level of information may be included in the supplemental response. In either case, the analysis should include a plot of the collapsed vessel level to confirm that TAF is not reached (the elevation of the TAF should be provided) and a plot of the temperature cool down to confirm that the cool down is within tech spec limits.	
3.2.1.3.D	The SOE identifies that at 15 minutes, SBO is declared and battery load shedding begins. At approximately 1 hour and 15 minutes the dc deep load shedding is complete (if both SAMA diesel generators fail to start). During the audit process, the licensee stated that the deep load shedding decision point is at 1 hour 15 minutes into the event and would occur if both FLEX DGs failed to start. Clarification is needed relative to the completion timing of deep load shedding.	
3.2.1.3.E	On page 10 of their Integrated Plan, the licensee stated that SRVs provide RPV pressure control during an ELAP. However, the licensee did not provide information regarding what was needed to support SRV actuation (dc power or pneumatics) or how long those support systems would be available. In addition, depending on primary containment environmental conditions during the event, SRV actuation may require a higher than nominal dc voltage to actuate the SRVs. The SRV pilot solenoid coil electrical resistance would increase due to a higher containment temperature with a longer duration event than an existing SBO coping time. In subsequent discussions with the licensee during the audit process, information was provided that included a plant modification for additional nitrogen bottles to ensure SRV pneumatics would be available for 24 hours into the event and an evaluation/qualification of the SRV solenoid voltage during thermal testing. Completion of the nitrogen supply modification and associated testing will be confirmed.	
3.2.3.C	The licensee has not demonstrated that the calculated drywell temperature will not exceed the limits of penetration seals or other equipment.	
3.2.4.4.B	The licensee described, and the staff accepted, upgrades to the site's communications systems (ADAMS Accession Nos. ML12311A299 and ML1309A341, respectively). The staff will confirm these upgrades have been completed.	
3.2.4.6.A	The licensee indicated in the audit process that Control Room long term habitability will be assured by monitoring of	

	Control Room conditions, heat stress countermeasures, and rotation of personnel to the extent feasible and that the FLEX Support Guidelines will provide guidance for control room staff to evaluate the control room temperature and take actions as necessary. Further, Brunswick is evaluating the use of passive cooling technologies to be used for response personnel and is performing GOTHIC analysis for the Reactor Building (including RCIC area and refuel floor). Completion of these evaluations and confirmation of implementation needs to be performed.	
3.2.4.7.A	The licensee created a new Open Item 21 in their system to track development of a new process for long-term makeup to the CWST.	
3.2.4.8.C	The licensee provided updated information as part of the audit process regarding sizing of the Phase 2 and 3 generators. The licensee has not finalized their load sizing analysis for the Phase 2 and 3 DGs.	
3.2.4.10.A	The Generic Concern related to extended battery duty cycles is applicable to this plant. The Generic Concern related to extended battery duty cycles has been resolved generically through the NRC endorsement of Nuclear Energy Institute (NEI) position paper entitled "Battery Life Issue" (ADAMS Accession no ML13241A186 (NRC endorsement letter) and ML13241A188 (NEI position paper)) The NRC staff will evaluate a licensee's application of the guidance (calculations and supporting data) in its development of the final Safety Evaluation documenting compliance with NRC Order EA-12-049.	
3.2.4.10.B	The licensee has not finalized their battery depletion analysis.	
3.3.2.A	There is insufficient information to conclude that configuration control of equipment and connections will be controlled in conformance with the guidance of NEI 12-06, Section 11.8, Items 1 and 3 regarding a program documentation and change control process.	
3.4.A	The licensee's plans for off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2 Consideration 1; however, the licensee did not address Considerations 2 through 10 regarding the functionality of the equipment.	

Based on a review of Duke's plan, including the six-month update dated August 20, 2013, and information obtained through the mitigation strategies audit process, 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 Brunswick. 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. As identified above, the open items warranting the greatest attention to ensure successful implementation are the following:

1.) Recirculation Pump Leakage
2.) Extended Loss of Alternating Current Power, Containment Analysis
3.) Generic Concern Regarding Boiling Water Reactor Owners Group Emergency Procedure Guidelines/Severe Accident Guidelines, Revision 3

5.0 SUMMARY

As required by Order EA-12-049, the licensee is developing, and will implement and maintain, guidance and strategies to restore or maintain core cooling, containment, and SFP cooling capabilities in the event of a beyond-design-basis external event. 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 beyond-design-basis external events to power reactors do not pose an undue risk to public health and safety.

The NRC's objective in preparing this interim staff evaluation 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. Contingent upon resolution of the issues identified above, the 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 beyond-design-basis external event that impacts the availability of ac 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 Carolina Power and Light Company to NRC, "Overall Integrated Plan for 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)," Brunswick Steam Electric Plant, Unit Nos. 1 and 2, dated February 28, 2013 (ADAMS Accession No. ML13071A559)

3. Letter from Duke Energy Progress, Inc. to NRC, "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 20, 2013 (ADAMS Accession No. ML13248A447)

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

14. Nuclear Energy Institute document 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 on Draft JLD-ISG-2012 and document 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision C, 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. 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 the Brunswick Steam Electric Plant, Units 1 and 2, dated November 20, 2013 (ADAMS Accession No. ML13324B140)

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Date: November 22, 2013

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

November 20, 2013

Duke Energy Progress, Inc.
Brunswick Steam Electric Plant, Units 1 and 2
Docket Nos. 50-325 and 324

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
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Technical Evaluation Report

Brunswick Steam Electric Plant, Units 1 and 2
Order EA-12-049 Evaluation

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 (TE) 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 review 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 TECHNICAL EVALUATION

By letter dated February 28, 2013, (ADAMS Accession No. ML13071A559), and as supplemented by the first six-month status report in letter dated August 20, 2013 (ADAMS Accession No. ML13248A447), Duke Energy Progress, Inc. (the licensee or Duke) provided Brunswick Steam Electric Plant's (BSEP) Unit 1 and 2 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 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. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. 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.

In their integrated plan, the licensee identified the Design Basis Earthquake (DBE) to be 0.16g horizontal ground acceleration, which is consistent with their USFAR, section 2.5.2.5. The licensee confirmed on page 1 of their Integrated Plan that the BSEP site screens in for an assessment for the seismic hazard. In addition, the licensee stated, on page 4 of their Integrated Plan, that the reevaluation of the seismic hazard, as required by 10CFR50.54(f), has not yet been completed and therefore was not assumed in their Integrated Plan

The licensee's screening for seismic hazards as presented in their Integrated Plan has appropriately screened this external hazard and identified the hazard levels for reasonable protection of the portable equipment.

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 pages 13, 20, 25, and 32 of the Integrated Plan regarding the strategies for maintaining core cooling, containment, SFP cooling and for Safety Systems Support, respectively, the licensee stated that protection of associated portable equipment from seismic hazards in the transition phase (Phase 2) would be provided by constructing a FLEX Equipment Storage Building (FESB) that meet the requirements of NEI 12-06 Section 11. Section 11 provides general storage design guidance but does not provide the details for protection from the seismic hazards as delineated in NEI 12-06, Section 5.3.1. Each section of the Integrated Plan describing storage protection from hazards makes reference to Section 11 rather than to the specific protection requirements described in NEI 12-06 for the applicable hazard. In discussions with the licensee during the audit process, the licensee provided a description of the design considerations for the FESB however their considerations were not inclusive of all applicable hazards. This has been identified as Confirmatory Item 3.1.1.1.A in Section 4.2.

On page 20, the licensee described that the Hardened Containment Vent System (HCVS) will meet the design requirements as specified for reasonable protection per NEI 12-06. Subsequent discussions with the licensee provided that the initial HCVS strategy required ac power and pneumatic power 24 hours into the BDBEE. However, NRC Order EA-13-109 has superseded NRC Order EA-12-050. In the licensee's August 20, 2013 update to their Integrated Plan, section 4 entitled "Changes to Compliance Method," item 1 provided a description of updated methodologies and processes associated with the HCVS that will be incorporated into the response to EA-13-109 and the BSEP Units 1 and 2 will be modified for these processes in accordance with the requirements of EA-13-109. The licensee closed Open Item 13 identified in their Integrated Plan and added a new Open Item 20 to track a new modification/process to facilitate the venting practices. This change, as a result of the 6-month update, created Confirmatory Item 3.1.1.1.B in Section 4.2 and is relative to any applicable Phase 2 FLEX equipment required for the modification/process to facilitate the venting practices (HCVS) will need to be stored and/or protected for all hazards.

The licensee has indicated that procedures and programs are being developed to address storage structure requirements, but insufficient information was provided to ascertain that these procedures and programs will provide for securing large portable equipment to protect them during a seismic event or to ensure unsecured and/or non-seismic components do not damage the equipment as is specified in NEI 12-06, Section 5.3.1, considerations 2 and 3. Item 2 specifies that large portable equipment should be secured as appropriate to protect it during a seismic event. Item 3 specifies that 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. This has been identified as Open Item 3.1.1.1.C. 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/Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the storage of FLEX equipment from seismic hazards 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.

On page 1 of the Integrated Plan, the licensee stated that analysis has shown that soil liquefaction will not occur at the site under dynamic loadings of the DBE. Therefore, soil liquefaction was screened out for the BSEP site.

The licensee's plans for protection and accessibility of the connection points were reviewed. These plans imply, but do not state that the connection points for the modifications will be missile protected and enclosed within a Seismic Category 1 structure, which will inherently protect it from local hazards such as vehicle impact. During the audit process, the licensee stated that the only connection point that was not in a seismic category 1 structure was located in a turbine building controlled access corridor. The licensee stated that based on a 1993 seismic evaluation of this area, that the controlled access corridor is structurally adequate for seismic loads.

A review was made of the licensee's plans for implementation of the strategies to deploy portable/FLEX equipment during a seismic hazard including the means and power requirements to deploy portable/FLEX equipment. The licensee discussed deployment of portable/FLEX equipment on page 6 of the Integrated Plan. The licensee specified that programs and procedures, including administrative controls, will be employed to ensure that deployment of the portable/FLEX equipment remains possible in all modes but are still under development.

On page 36 of their Integrated Plan, the licensee identified two vehicles as a means to deploy equipment, provide fuel replenishment, etc., and four flatbed trailers as a means to store and transport hoses, strainers, cables, and miscellaneous equipment but omitted discussion of the protection to be afforded these vehicles/trainers from seismic hazards. This has been identified as Confirmatory Item 3.1.1.2.A in Section 4.2.

In reviewing the site's FSAR, there are no downstream dams related to the site. Therefore, consideration 3 of NEI 12-06, Section 5.3.2 is not applicable.

The licensee identified on page 13 of their Integrated Plan, that they plan to construct a clean water tank to supply Reactor Core Isolation Cooling (RCIC) and High Pressure Coolant Injection (HPCI) with water of acceptable quality for RCIC/HPCI injection into the reactor pressure vessel (RPV) or the SFP. However, the licensee did not identify the design specifications for the clean water tank or state that the clean water tank would be designed to withstand all hazards. This is identified as Open Item 3.1.1.2.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/Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the deployment of FLEX equipment following a seismic event 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 11 of their Integrated Plan, the licensee identified that instrumentation relative to RPV level, RPV pressure, drywell pressure, suppression pool level, suppression pool temperature, drywell temperature and suppression chamber air temperature would be available during the event since this instrumentation is powered from station batteries.

The licensee's plans for the development of the mitigating strategies were reviewed and the reviewer was unable to conclude that they address determination of necessary instrument readings to support the implementation of the mitigating strategies in the event that seismically qualified electrical equipment is affected by beyond-design-basis seismic events. In addition, there was no discussion of the use portable instrumentation to measure process variables. The submittal does not specify the location of the instrumentation identified above.

The licensee is requested to provide additional information concerning coping strategies for the failure of seismically qualified electrical equipment that can be affected by beyond-design-basis seismic events as discussed in NEI 12-06, Section 5.3.3 consideration 1. That section specifies that each plant should compile a reference source for the plant operators that provide approaches to obtaining necessary instrument readings to support the implementation of the coping strategy. 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. In addition, NEI 12-06, Section 5.3.3 consideration 1 specifies that guidance should include critical actions to perform until alternate indications can be connected. Finally, it also specifies that the guidance to plant operators include instructions on how to control critical equipment without associated control power. In the licensee's 6-month update to their Integrated Plan, Section 4, item 6 described that the initial Integrated Plan did not address the need to develop guidance for obtaining local vital indications during an extended loss of alternating current (ac) power (ELAP). The licensee determined that a local process for local vital indications would be developed to support BSEP's FLEX response. This has been identified as Confirmatory Item 3.1.1.3.A. in Section 4.2.

The licensee did not provide a discussion in their Integrated Plan regarding implementation of the mitigating strategies with respect to the procedural interface considerations for seismic hazards associated with large internal flooding sources that are not seismically robust and do not require ac power and the use of ac power to mitigate ground water in critical locations. Therefore, there is not sufficient information to address NEI 12-06 Section 5.3.3 considerations 2 and 3. This has been identified as Open Item 3.1.1.3.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/Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces for coping with a seismic hazard 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 4 and 9 of their Integrated Plan, the licensee provided information regarding the use of the offsite resources through the industry Strategic Alliance for FLEX Emergency Response (SAFER) program, but has not identified local staging areas and method(s) of transportation per the guidance of NEI 12-06, Section 5.3.4, consideration 1, Section 6.2.3.4, considerations 1 and 2, Section 7.3.4, considerations 1 and 2, and Section 8.3.4. Provide a discussion of the effects of these considerations on the ELAP strategies being developed for all hazards. 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 following 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 1 of their Integrated Plan, the licensee stated that the Probable Maximum Hurricane (PMH) defines the Probable Maximum Flood (PMF) for BSEP. The most severe flood conditions are associated with a PMH coinciding with peak local astronomical tides. In the intake canal, the still water level is expected to reach 22.0 feet Mean Sea Level (MSL). With a nominal plant grade of 20 feet MSL, this results in two feet of water depth surrounding the plant during maximum surge conditions. Therefore, BSEP is not a dry site because site grade is below the maximum probable flood level and screens in for external flooding hazards. Safety-related structures are waterproofed to elevation 22 feet MSL. The wave action on structures on the ground will depend on the overland water depth caused by flooding. This depth being 2.0 feet maximum, the highest wave that can be sustained would be 1.6 feet high. Larger waves over 1.6 feet coming from any overland direction will break when they reach the 2-foot depth overland. Wave run-up on a vertical wall associated with 1.6-foot waves is about 3.6 feet. Thus, the maximum instantaneous water elevation on any building is 25.6 feet MSL.

On page 4 of their Integrated Plan, the licensee 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 was not assumed in their Integrated Plan. The licensee also stated that as the re-evaluations are completed, appropriate issues would be entered into the corrective action program and addressed.

While the licensee has identified the limiting source of flooding as the PMH, the applicable flooding hazard was not characterized in terms of warning time and persistence. The lack of characterization of the applicable flooding hazard in terms of warning time and persistence has been identified as Confirmatory Item 3.1.2.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 evaluation of the flooding hazard 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 page 14 of its Integrated Plan, the licensee stated that protection of associated portable equipment from flooding hazards in the transition phase (Phase 2) would be provided by constructing a FESB that meet the requirements of NEI 12-06 Section 11. As described in Section 3.1.1.1, Section 11 provides general storage design guidance but not the hazard specific details for protection as delineated in NEI 12-06, Section 6.2.3.1 for flooding. This has been combined with Confirmatory Item 3.1.1.1.A in Section 4.2.

The licensee, for all hazards, provided similar verbiage regarding the HCVS. Refer to Section 3.1.1.1 above for the evaluation.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2013-01, 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 storage and protection of portable equipment during a flooding hazard 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 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.

A review was made of the licensee's plans for implementation of the strategies to deploy portable/FLEX equipment during the flood hazard. The licensee discussed deployment of portable/FLEX equipment on page 6 of the Integrated Plan. As stated on page 2 in the Integrated Plan, the licensee has not yet defined deployment routes for portable/FLEX equipment. Also, as discussed in Section 3.1.2, above, the licensee has not provided a characterization of the persistence of the external flooding hazard. There was no discussion of the considerations for movement of equipment and restocking of supplies per consideration 2 in the context of a flood with long persistence. This is has been identified as Confirmatory Item 3.1.2.2.A. in Section 4.2.

On page 36 of their Integrated Plan, in the section listing BWR Portable Equipment for Phase 2, the licensee identified two vehicles as a means to deploy equipment, provide fuel replenishment, etc., and four flatbed trailers as a means to store and transport hoses, strainers, cables, and miscellaneous equipment but omitted discussion of the protection to be afforded these vehicles/trainers from flooding hazards. This has been combined with Confirmatory Item 3.1.1.2.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 Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of portable equipment during a flooding hazard 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.

A review was made of the licensee's plans for the development of the mitigating strategies. The licensee has described the framework for their administrative program for FLEX on pages 6 and 8 of the Integrated Plan. However, there was no discussion of the deployment of portable/FLEX equipment during the flood hazard and no discussion of the need for and deployment of temporary flood barriers. Therefore, there is insufficient information to conclude that procedural interfaces for the flood hazard will conform to the considerations of NEI 12-06, Section 6.2.3.3. This issue has been combined with Confirmatory Item 3.1.2.2.A in Section 4.2 regarding the deployment of portable/FLEX equipment during the flooding 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 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 procedural interfaces coping with the flooding hazard 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 off-site 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 off-site could be staged for use on-site.

On pages 4 and 9 of their Integrated Plan, the licensee provided information regarding the use of the offsite resources through the industry Strategic Alliance for FLEX Emergency Response (SAFER) program, but has not identified local staging areas and method(s) of transportation per the guidance of NEI 12-06, Section 6.2.3.4, considerations 1 and 2. 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 a flooding hazard 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.

On page 2 of their Integrated Plan the licensee determined that the site has the potential to experience damaging winds caused by a hurricane up to 210 mph. The site was also determined to be within Tornado Region 1, where the recommended maximum tornado wind speed design is 200 mph. For the site, using NEI 12-06 guidance, hurricane wind speeds exceed those of tornadoes. Therefore, high wind hazards are applicable to the BSEP site. The BSEP site screens in to high wind hazards (hurricanes and tornadoes).

A review was made of the licensee's screening for high wind hazards and it was determined that the licensee has appropriately screened this external hazard and identified the hazard levels for reasonable protection of the portable equipment for high winds from both hurricanes and tornadoes.

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 the severe storms with high winds hazard if these requirements are implemented as described.

3.1.3.1 Protection of FLEX Equipment - High Winds 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 page 14 of its Integrated Plan, the licensee stated that protection of associated portable equipment in the transition phase (Phase 2) would be provided by constructing a FESB that meet the requirements of NEI 12-06 Section 11. As described in Section 3.1.1.1 above, Section 11 provides general storage design guidance but not the hazard specific details for protection as delineated in NEI 12-06, Section 7.3.1 for high winds. This has been combined with Confirmatory Item 3.1.1.1.A in Section 4.2.

The licensee, for all hazards, provided similar verbiage regarding the HCVS. Refer to Section 3.1.1.1 above for the evaluation.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2013-01, 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 and protection of portable equipment during a high wind hazard 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.

In the integrated plan, there was insufficient information with regard to the guidelines identified in NEI 12-06 Section 7.3.2, considerations 2, 4 and 5. Subsequent discussions with the licensee were held during the audit process regarding considerations 2, 4 and 5. During those discussions, the licensee described:

- For consideration 2, the Phase 2 strategy does not include any equipment in, or around the UHS so the effects of high wind will not effect deployment of FLEX equipment. Phase 2 on-site equipment (including debris removal, deployment equipment, etc.) credited in the FLEX strategy will be stored in the robust/hardened FLEX structure or permanently pre-staged in a robust/hardened structure other than the intake structure.
- For consideration 4, debris removal and tow equipment will be purchased that is suitable to move all equipment from the FLEX structure to deployment areas with high winds taken into consideration. Prior to the event, the debris removal and deployment equipment will be stored in the robust/hardened FLEX structure to protect it from external hazards, including high winds.
- For consideration 5, prior to the hurricane, portable FLEX equipment, including debris removal and deployment equipment, will be stored in the robust/hardened FLEX structure (except for those permanently staged pieces of equipment that will be protected from hurricanes in their location). Strategies and movement of equipment during hurricanes will be incorporated into the Flex Support Guidelines to ensure successful deployment without endangering personnel. Due to hurricanes providing days of forewarning, strategies may include pre-staging or certain equipment in robust structures other than the permanent FLEX storage building. These strategies are still under development.

Based on the information provided during the audit process, 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 portable equipment during a severe storm high winds hazard if these requirements are implemented as described.

3.1.3.3 Procedural Interfaces – High Wind Hazard

NEI 12-06, Section 7.3.3, states:

> 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.

A review was made of the licensee's plans for the development of procedures and programs regarding the deployment of portable equipment during severe storms with high wind hazard. The licensee discussed deployment considerations on page 6 of the Integrated Plan. There was no specific discussion of procedural interfaces for portable/FLEX equipment deployment and hurricane, tornado and severe weather procedures. The licensee's plan to incorporate deployment considerations into procedures was also reviewed in Section 3.1.3.2, above. This has been combined with 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 procedural interfaces for coping with the severe storm with high wind hazard 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.

On pages 4 and 9 of their Integrated Plan, the licensee provided information regarding the use of the offsite resources through the industry Strategic Alliance for FLEX Emergency Response (SAFER) program, but has not identified local staging areas and method(s) of transportation per the guidance of NEI 12-06, Section 7.3.4, considerations 1 and 2. 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 the use of offsite resources during a severe storm with high winds hazard 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.

A review was made of the licensee's screening for snow, ice, and extreme cold hazard. The licensee discussed their screening of the hazard on page 2 of the Integrated Plan. They stated that the site is below the 35th parallel; therefore, FLEX strategies are not required to consider the impedances caused by extreme snowfall with snow removal equipment. Because the same basic trend applies to extreme low temperatures, per NEI 12-06, FLEX strategies are not required to address extreme low temperatures.

BSEP is a Level 4 region as defined by Figure 8-2 of NEI 12-06. Since the BSEP site is not in a Level 1 or Level 2 region, FLEX strategies must consider the impedances caused by ice storms. Therefore, the site screens in for impact of ice storms.

The licensee has appropriately screened for snow, ice, and extreme cold hazard and has identified the hazard levels for reasonable protection of the portable equipment.

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 the snow, ice and extreme cold hazard 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 N+1 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 page 14 of its Integrated Plan, the licensee stated that protection of associated portable equipment in the transition phase (Phase 2) would be provided by constructing a FESB that meet the requirements of NEI 12-06 Section 11. As described in Section 3.1.1.1 above, Section 11 provides general storage design guidance but not the hazard specific details for protection as delineated in NEI 12-06, Section 8.3.1. This has been combined with Confirmatory Item 3.1.1.1.A in Section 4.2.

The licensee, for all hazards, provided similar verbiage regarding the HCVS. Refer to Section 3.1.1.1 above for the evaluation.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2013-01, 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 and protection of portable equipment from snow, ice and extreme cold hazard if these requirements are implemented as described.

3.1.4.2 Deployment of FLEX 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 FLEX 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 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 6 of their integrated plan, the licensee provided a description of how the strategies would be deployed in all modes. On page 8 of their Integrated Plan regarding programmatic controls, the licensee stated that portable/FLEX equipment will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control as outlined in NEI 12-06 section 11.1.

The licensee's Integrated Plan for implementation of the strategies to deploy portable equipment in the context of snow, ice, and extreme cold did not provide sufficient information to conclude that the administrative program elements to ensure the pathways were clear would include ice removal. In subsequent discussions with the licensee during the audit process, they have described that the deployment of debris removal equipment (including ice removal) has not been finalized. The licensee has also stated that ice removal would be considered in the selection process. In addition, applicable equipment credited for FLEX strategies would be stored in the FLEX structure or permanently pre-staged in a robust/hardened structure. Based upon the licensee's description during the audit process, this has been identified as Confirmatory Item 3.1.4.2.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-2013-01, 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 portable equipment from snow, ice and extreme cold hazard 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.

A review was made of the licensee's plans for procedural enhancements that address the effects of snow and ice on transportation equipment. As discussed in Section 3.1.4.2, there was insufficient to conclude that the guidance of NEI 12-06, Section 8.3.2 concerning equipment deployment and the administrative program elements to ensure the pathways are clear would include ice removal are sufficient. This has been combined with Confirmatory Item 3.1.4.2.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 procedural enhancements that address the effects of snow and ice on transport equipment, including snow and ice removal during a snow, ice and extreme cold hazard if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.4, states:

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

On pages 4 and 9 of their Integrated Plan, the licensee provided information regarding the use of the offsite resources through the industry Strategic Alliance for FLEX Emergency Response (SAFER) program, but has not identified local staging areas and method(s) of transportation per the guidance of NEI 12-06, Section 7.3.4, considerations 1 and 2. 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 using offsite resources during a snow, ice and extreme cold hazard if these requirements are implemented as described.

3.1.5 High Temperatures

NEI 12-06, Section 9 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.

A review was made of the licensee's screening the high temperature hazard that was discussed on page 2 of the Integrated Plan. The licensee stated that NEI 12-06, Section 9.2 described that virtually every state in the lower 48 contiguous United States has experienced temperatures in excess of 110 degrees Fahrenheit and many in excess of degrees Fahrenheit. In addition, NEI 12-06 states that all sites will address high temperatures. Therefore, the licensee stated that the site screens in for extreme high temperatures.

The licensee has appropriately screened for high temperature hazard and has identified the hazard levels for reasonable protection of the portable equipment.

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 the high temperature hazard 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 14 of its Integrated Plan, the licensee stated that protection of associated portable equipment in the transition phase (Phase 2) would be provided by constructing a FESB that meet the requirements of NEI 12-06 Section 11. As described in Section 3.1.1.1 above, Section 11 provides general storage design guidance but not the hazard specific details for protection as delineated in NEI 12-06, Section 8.3.1. This has been combined with Confirmatory Item 3.1.1.1.A in Section 4.2.

The licensee, for all hazards, provided similar verbiage regarding the HCVS. Refer to Section 3.1.1.1 above for the evaluation.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2013-01, 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 storage and protection of portable equipment from a high temperature hazard 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.

A review was made of the licensee's plans for implementation of the strategies to deploy portable equipment during a high temperature hazard. The licensee discussed equipment deployment on page 6 of the Integrated Plan. On page 8 of their Integrated Plan regarding programmatic controls, the licensee stated that portable/FLEX equipment would be procured as commercial equipment with design, storage, maintenance, testing, and configuration control as outlined in NEI 12-06 section 11.1. The licensee did not discuss the impact of high temperatures on the deployment strategies. Information obtained from the Weather Service Office for Southport, North Carolina showed that the highest recorded temperature was 103 degrees Fahrenheit on June 26, 1952. Normal work practices would support deployment of portable/FLEX equipment in this temperature range and that normal maintenance actions would support correcting issues that delay the deployment.

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 equipment during a high temperature hazard 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 FLEX equipment.

The licensee's plans for the procedural interfaces associated with the effects of high temperatures on portable equipment did not provide reasonable assurance that the requirements of Order EA-12-049 with regard to the use of portable equipment in the context of high temperatures. The effects of high temperatures on the storage of equipment was addressed in Section 3.1.5.1 and there was information presented on the heat up of a variety of rooms and enclosures in the integrated plans, but there is no discussion of the potential effects of high temperatures at the location where the portable equipment would actually operate during a high temperature hazard. Subsequent discussions with the licensee during the audit process provided additional guidance. That guidance included that the majority of the FLEX equipment would be deployed to an outside location. The equipment would be purchased with the requirements to operate during a high temperature hazard. The only exception is the FLEX diesel generators (DGs) (identified as SAMA DG in their Integrated Plan) that would be permanently pre-staged in their own robust/hardened structure. The FLEX DGs and structure will be purchased/designed to ensure proper operation at elevated temperatures. Based upon the additional information obtained during the audit process, this has been identified as Confirmatory Item 3.1.5.3.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-2013-01, 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 procedural interfaces from a high temperature hazard 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, "[p]lant-specific analyses will determine the duration of each phase." This baseline coping capability is supplemented by the ability to use portable pumps to provide reactor pressure vessel (RPV)/reactor makeup in order to restore core or SFP capabilities as described in NEI 12-06, Section 3.2.2, Guideline (13). This approach is endorsed in NEI 12-06, Section 3, by JLD-ISG-2012-01.

3.2.1 Reactor Core Cooling, Heat Removal, and Inventory Control Strategies

NEI 12-06, Table 3-1 and Appendix C summarize one acceptable approach for the reactor core cooling strategies. This approach uses the installed reactor core isolation cooling (RCIC) system, or the high pressure coolant injection (HPCI) system to provide core cooling with installed equipment for the initial phase. This approach relies on depressurization of the RPV for injection with a portable injection source with diverse injection points established to inject through separate divisions/trains for the transition and final phases. This approach also provides for manual initiation of RCIC/HPCI/IC as a contingency for further degradation of installed SSCs as a result of the beyond-design-basis initiating event.

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) the performance attributes as discussed in Appendix C.

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 should perform 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).

3.2.1.1. Computer Code Used for ELAP Analysis.

NEI 12-06, Section 1.3 states in part:

> 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.

The licensee provided a sequence of events (SOE) identifying time constraints and their technical basis for the BSEP site. The licensee indicated on page 6 of their Integrated Plan that within the SOE, time constraints pertaining to maintaining reactor core cooling and containment integrity are based on analyses performed using the industry-developed Modular Accident Analysis Program (MAAP) Version 4 computer code. MAAP4 was written to simulate the response of both current and advanced light water reactors to LOCA and non-LOCA transients for probabilistic risk analyses as well as severe accident sequences. The code has been used to evaluate a wide range of severe accident phenomena, such as hydrogen generation and combustion, steam formation, and containment heating and pressurization.

The licensee has decided to use the MAAP4 computer code for simulating the Extended Loss of ac Power (ELAP) event. While the NRC staff does acknowledge that MAAP4 has been used many times over the years and in a variety of forums for severe and beyond design basis analysis, MAAP4 is not an NRC approved code, and the NRC staff has not examined its technical adequacy for performing thermal hydraulic analyses. Therefore, during the review of the Integrated Plan, the issue of using MAAP4 was raised as a Generic Concern and was addressed by the Nuclear Energy Institute (NEI) in their position paper dated June 2013, entitled "Use of Modular Accident Analysis Program (MAAP4) in Support of Post-Fukushima Applications" (ADAMS Accession No. ML13190A201). After review of this position paper, the NRC staff endorsed a resolution through letter dated October 3, 2013 (ADAMS Accession No. ML13275A318). This endorsement contained five limitations on the MAAP4 computer code's use for simulating the ELAP event for Boiling Water Rectors (BWRs). Those limitations and their corresponding Confirmatory Item numbers for this TER are provided as follows:

(1) From the June 2013 position paper, benchmarks must be identified and discussed which demonstrate that MAAP4 is an appropriate code for the simulation of an ELAP event at your facility. This has been identified as Confirmatory Item 3.2.1.1.A in Section 4.2.

(2) The collapsed level must remain above Top of Active Fuel (TAF) and the cool down rate must be within technical specification limits. This has been identified as Confirmatory Item 3.2.1.1.B in Section 4.2.

(3) MAAP4 must be used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper. This has been identified as Confirmatory Item 3.2.1.1.C in Section 4.2.

(4) In using MAAP4, the licensee must identify and justify the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236). This should include response at a plant-specific level regarding specific modeling options and parameter choices for key models that would be expected to substantially affect the ELAP analysis performed for that licensee's plant. Although some suggested key phenomena are identified below, other parameters considered important in the simulation of the ELAP event by the vendor / licensee should also be included.

    a. Nodalization
    b. General two-phase flow modeling
    c. Modeling of heat transfer and losses
    d. Choked flow
    e. Vent line pressure losses
    f. Decay heat (fission products / actinides / etc.)

    This has been identified as Confirmatory Item 3.2.1.1.D in Section 4.2.

(5) The specific MAAP4 analysis case that was used to validate the timing of mitigating strategies in the integrated plan must be identified and should be available on the ePortal for NRC staff to view. Alternately, a comparable level of information may be included in the supplemental response. In either case, the analysis should include a plot of the collapsed vessel level to confirm that TAF is not reached (the elevation of the TAF should be provided) and a plot of the temperature cool down to confirm that the cool down is within tech spec limits. This has been identified as Confirmatory Item 3.2.1.1.E in Section 4.2.

The MAAP analysis report addressing coping time under ELAP conditions acknowledges that the initial wetwell liquid volume assumed in the MAAP analysis is approximately 25% greater than the actual liquid volume specified in the Brunswick final safety analysis report (reference Table 4-1 in calculation note CN-AEO-13-0001). The MAAP analysis report attempted to justify this discrepancy by stating that the basis for the reduced water volume in the final safety analysis report was a modification to the suction strainers for the emergency core cooling system that are located in the wetwell. The MAAP analysis report further presumed that the consequent reduction to the wetwell initial water volume resulted solely from the displaced volume of the new strainers, ultimately reasoning that the MAAP analysis with the overestimated wetwell liquid volume remains valid because the product of the density and specific heat capacity of the metal strainers would be similar (e.g., estimates to within roughly

15%) to that of the displaced water volume.

However, the reasoning presented in the MAAP analysis report appears questionable firstly because the suction strainers are not solid structures (i.e., it is not clear that a substantial part of what the MAAP analysis report presumes to be "displaced volume" is not in fact wetwell liquid that has passed through perforations and filled the interior volume of the strainers). Secondly, displacing a water volume of approximately 20,000 ft^3 solely with stainless steel would require a mass of steel (i.e., roughly 5000 tons) that is significantly larger than expected for wetwell suction strainers.

In addition to the above concerns, since the wetwell water volume is actually 20,000 ft^3 less than indicated in the MAAP analysis report, there is a concern over how accurately the initial water level value of 11.84 ft and the rate of water level decrease are represented within the analyses; a lower initial water level or a more rapid decrease in water level could result in inadequate RCIC NPSH when compared to the current analyses. In light of these issues, either provide adequate documentation to substantiate the assumptions and calculations in the MAAP analysis report, or else provide a revised analysis of the coping time available under ELAP conditions that incorporates an initial wetwell water volume and level that is representative of Brunswick. This has been identified as Open Item 3.2.1.1.F 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/Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the computer code used for ELAP analysis if these requirements are implemented as described.

3.2.1.2. Recirculation Pump Seal Leakage Models.

Conformance with the guidance of NEI 12-06, Section 3.2.1.5, Paragraph (4) includes consideration of recirculation pump seal leakage. When determining time constraints and the ability to maintain core cooling, it is important to consider losses to the RCS inventory as this can have a significant impact on the SOE. Special attention is paid to the recirculation pump seals because these can fail in a SBO event and contribute to beyond normal system leakage.

The licensee did not Identify or provide justification for the assumptions made regarding primary system leakage from the recirculation pump seals and other sources that addresses the following items:

a. The assumed leakage rate and its predicted pressure dependence relative to test data.
b. Clarification of whether the leakage was determined or assumed to be single-phase liquid, two-phase mixture, or steam at the donor cell.
c. Comparison of design-specific seal leakage testing conditions to code-predicted thermal hydraulic conditions (temperature, void fraction) during an ELAP and justification if predicted conditions are not bounded by testing.
d. Discussion of how mixing of the leakage flow with the drywell atmosphere is modeled.

A review was conducted of the licensee's integrated plan and it was determined that there is insufficient information provided to determine the adequacy of the recirculation pump seals leakage and other sources of leakage used in the ELAP analysis. This has been identified as Open Item 3.2.1.2.A in Section 4.1.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that the Integrated Plan is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to recirculation pump seal leakage models and other sources of RCS leakage. This concern is Open Item 3.2.1.2.A above and in Section 4.1.

3.2.1.3 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 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.

In order to support the objective of an indefinite coping capability, each plant will be expected to establish capabilities consistent with Table 3-1 (BWRs). Additional explanation of these functions and capabilities are provided in NEI 12-06 Appendix C, "Approach to BWR Functions."

In its integrated plan, the licensee provided a sequence of events (SOE) identifying the time constraints and their applicability. Many of the time constraints were listed as preliminary. As noted above in section 3.2.1.1, the computer code analysis used in ELAP analysis, the licensee did not provide consistent information regarding how MAAP was used in establishing an SOE time line, nor provide a technical basis with the results of the MAAP analysis.

NEDC-33771P/NEDO-33771, "GEH Evaluation of FLEX Implementation Guidelines," Revision 1 (hereinafter NEDC-33771P, ADAMS Accession No. ML130370742), specifies the beginning of the sequence for SBO for BWR/3/4 with Mark 1 Containment as follows:

> BWRs that have RCIC will respond to an SBO with the initiation of RCIC to inject water into the reactor vessel. High Pressure Coolant Injection (HPCI) may respond if RCIC is not available. RCIC and HPCI utilize reactor steam for motive force, exhausting this steam to the suppression pool. This exhaust steam transfers decay heat from the reactor vessel to the suppression pool. In addition to the RCIC steam supply, the [safety-relief valves] SRVs may open automatically to relieve pressure. Also some SRVs under operator control may be manually opened to maintain a reactor pressure band while there is sufficient direct current (dc) power and pneumatic supply. For both cases, SRV steam flow

will remove additional reactor decay heat.

The RCIC system is proposed as the primary means by which the licensee will remove decay heat during an ELAP event. The RCIC system consists of a steam-driven turbine pump unit and associated valves and piping capable of delivering makeup water to the reactor vessel. The steam supply to the turbine comes from the reactor vessel. The steam exhaust from the turbine dumps to the torus. The pump can take suction from the demineralized water in the condensate storage tank or from the torus. Following any reactor shutdown, steam generation continues due to heat produced by the radioactive decay of fission products. The steam normally flows to the main condenser through the turbine bypass or if the condenser is isolated, through the relief valves to the torus. The RCIC system turbine pump unit either starts automatically upon a receipt of a reactor vessel low-low water level signal or is started by the operator from the Control Room by remote manual controls. The RCIC system delivers its design flow within 30 seconds after actuation. To limit the amount of fluid leaving the reactor vessel, the reactor vessel low-low water level signal also actuates the closure of the main steam isolation valves. The RCIC system has a makeup capacity sufficient to prevent the reactor vessel water level from decreasing to the level where the core is uncovered without the use of core standby cooling systems.

On page 10 of the Integrated Plan, the licensee specified that during an ELAP, with only dc power available, the main method of RPV level control is RCIC, with HPCI as a backup. RCIC takes suction from either the CST or the Suppression Pool and pumps water into the RPV. The CST is the preferred source of feed to the RPV for makeup, since it is not subject to heat-up like the Suppression Pool. It also is the normally aligned suction source to RCIC and HPCI. However, if the CST is unavailable, RCIC takes suction from the Suppression Pool.

In subsequent discussions with the licensee during the audit process, information was requested regarding HPCI CST to suppression pool switchover instrumentation such that HPCI would remain operational with injection to the RPV uninterrupted if, during the ELAP event, the CST is damaged and no longer available. The discussion was to include whether the switchover function is automatic or fail-safe and whether function logic and hardware, related piping, valves, systems, structures, and components (SSCs) to support the switchover function are of safety grade and are qualified for all criteria including tornado/high winds. If not, then justify how switchover from CST to Suppression Pool will be assured in ELAP conditions if the CSTs are unavailable. The licensee described the above information for RCIC but not HPCI as requested. This has been identified as Open Item 3.2.1.3.A in Section 4.1.

The following SOE of the ELAP was provided by the licensee in the description of the strategy to maintain core cooling, maintain containment and in attachment 1A of their Integrated Plan. The event starts with the plant at 100% power when the initiating event of an instantaneous loss of all ac power is assumed. Upon the event initiation, with only dc power available, the main method of RPV level control is RCIC, with High Pressure Coolant Injection System (HPCI) as a backup. RCIC takes suction from either the CST (Attachment 1A states that the CST is lost during the BDBEE) or the Suppression Pool and pumps water into the RPV. With the RCIC taking suction off of the Suppression Pool, the Suppression Pool will reach 200°F in 5.4 hours. At this point, RCIC must be aligned to the clean water tank, which is a new water storage tank.

RPV pressure is maintained using SRVs during the ELAP/FLEX event. The RPV is depressurized to 450 psia at 1 hour into the event. The RPV is depressurized to 200 psia at 2 hours into the event. RPV pressure is maintained around 200 psia using SRVs for the remainder of the event. The RPV is not fully depressurized for the duration of the event.

On page 41 of the Integrated Plan, Action Item 3 describes the depressurization of the RPV to 150 – 300 psig within 1 hour. The Integrated Plan is not consistent between the discussions in the Maintain Containment section on page 17 and the SOE timeline regarding RPV pressure. Additional information relative to the appropriate RPV pressures during the BDBEE is needed that includes a description of the impact of not attaining these pressure in the required times. This has been identified as Open Item 3.2.1.3.B in Section 4.1.

Information was not provided to determine if; RCIC will be started automatically or at a time required by analysis following the initiation of the event, if any elapsed time constraint exists for this action or if pressure and temperature conditions in the containment predicted in NEDC-33711P, Rev 1 have been considered. In addition, the required net positive suction head required for RCIC to be operable during an ELAP has not been discussed. This has been identified as Open Item 3.2.1.3.C in Section 4.1.

The SOE identifies that at 15 minutes, SBO is declared and load shedding begins. At approximately 1 hour and 15 minutes the dc deep load shedding is complete (if both SAMA diesel generators fail to start). During subsequent discussions with the licensee during the audit process, additional information was provided that stated that the deep load shedding decision point is at 1 hour 15 minutes into the event and would occur if both FLEX DGs failed to start. Clarification is needed relative to the completion timing of deep load shedding. This has been identified as Confirmatory Item 3.2.1.3.D in Section 4.2.

On page 10 of their Integrated Plan, the licensee stated that SRVs provide RPV pressure control during an ELAP. However, the licensee did not provide information regarding what was needed to support SRV actuation (dc power or pneumatics) or how long those support systems would be available. In addition, depending on primary containment environmental conditions during the event, SRV actuation may require a higher than nominal dc voltage to actuate the SRVs. The SRV pilot solenoid coil electrical resistance would increase due to a higher containment temperature with a longer duration event than an existing SBO coping time. In subsequent discussions with the licensee during the audit process, information was provided that included a plant modification for additional nitrogen bottles to ensure SRV pneumatics would be available for 24 hours into the event and an evaluation/qualification of the SRV solenoid voltage during thermal testing. This has been identified as Confirmatory Item 3.2.1.3.E in Section 4.2.

The SOE timeline on page 42 of 57 identifies that at 19.5 hours, the Action is to vent containment via HCVS. The Remarks/Applicability section states that primary containment pressure is assumed based on MAAP run. It also identifies that the venting must take place prior to exceeding the Primary Containment Pressure Limit (PCPL-A) of 70 psia. In a review of NEDC-33771P, Revision 1, starting to vent containment via the HCVS at 19.5 hours does not appear to be supported when compared to the analysis presented in Appendix B, "BWR/4 Mark I Containment Response Plots (No Venting, Suction from Suppression Pool)" or Appendix C, "BWR/4 Mark I Containment Response Plots (No Venting, Suction from CST)." Please provide justification that 19.5 hours is appropriate. This has been identified as Open Item 3.2.1.3.F 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/Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the sequence of events timeline, if these requirements are implemented as described.

3.2.1.4 Systems and Components for Consequence Mitigation

NEI 12-06, Section 11 provides details on the equipment quality attributes and design for the implementation of FLEX strategies. It states:

> Equipment associated with these strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control as outlined in this section [Section 11]. If the equipment is credited for other functions (e.g., fire protection), then the quality attributes of the other functions apply.

And,

> 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.

NEI 12-06, Section 3.2.1.12 states:

> Equipment relied upon to support FLEX implementation does not need to be qualified to all extreme environments that may be posed, but some basis should be provided for the capability of the equipment to continue to function.

On page 9 of the integrated plan, the licensee specified that FLEX equipment would be procured as commercial equipment with design, storage, maintenance, testing, and configuration control in accordance with NEI 12-06, Section 11.1.

On page 14 of the integrated plan regarding Portable Equipment to Maintain Core Cooling, the licensee describes the use of portable pumps to provide RPV injection. No technical basis or a supporting analysis was provided for the diesel-driven FLEX pump capabilities considering the pressure within the RPV and the loss of pressure along with details regarding the FLEX pump supply line routes, length of hoses runs, connecting fittings, elevation changes to show that the pump is capable of injecting water into the RPV with a sufficient rate to maintain and recover core inventory for both the primary and alternate flow paths. This has been identified as Open Item 3.2.1.4.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 systems and components for consequence mitigation, if these requirements are implemented as described.

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 provides information regarding instrumentation and controls necessary for the success of the coping strategies. NEI 12-06 provides the following guidance:

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:

- RPV Level
- RPV Pressure
- Containment Pressure
- Suppression Pool Level
- Suppression Pool Temperature
- 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 pages 11, and 19 of their Integrated Plan, the licensee listed the installed instrumentation that would be available with the loss of all ac power and the uninterruptible power supply (UPS) de-energized for all phases. For Phase 1, station batteries would supply the following instruments:

Instrument	Parameter
C32-LI-R606A (NO04A) C32-LI-R606B (NO04B) C32-LI-R606C (NO04C) B21-LI-R604BX (N026B) B21-LI-610 (N036) B21-LI-3331 (3331) B21-LI-5977 (5977)	RPV Level
B21-PI-R605A B21-PI-R605B	RPV Pressure
CAC-PI-3341	Drywell Pressure
CAC-LI-3342	Suppression Pool Level
CAC-TR-778 PT 6 CAC-TR-778 PT 7	Suppression Pool Temperature
CAC-TR-778 PT 1,3,4	Drywell Temperature
CAC-TR-778 PT 5	Suppression Chamber Air Temperature

For Phase 2, the licensee noted that the instrumentation credited was the same as that for Phase 1.

The licensee defined the appropriate instrumentation specified by NEI 12-06 Section 3.2.1.10 to support key actions. On page 24 of the Integrated Plan, the licensee noted that new SFP level instrumentation would be addressed under EA-12-051.

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 plant instrumentation credited in the ELAP mitigation strategies, if these requirements are implemented as described.

3.2.1.6 Motive Power, Valve Controls and Motive Air System

NEI 12-06, Section 12.1 provides guidance regarding the scope of equipment that will be needed from off-site resources to support coping strategies. NEI 12-06, Section 12.1 states that:

> Arrangements will need to be established by each site addressing the scope of equipment that will be required for the off-site phase, as well as the maintenance and delivery provisions for such equipment.

And,

> Table 12-1 provides a sample list of the equipment expected to be provided to each site from off-site within 24 hours. The actual list will be specified by each site as part of the site-specific analysis.

Table 12-1 includes "Portable air compressor or nitrogen bottles & regulators (if required by plant strategy).

The primary method of pressure control for the RPV during the ELAP is the SRVs. The pneumatic system and applicable backup system required to operate SRVs were not described in the Integrated Plan. This information was discussed with the licensee during the audit process and has been combined with Confirmatory Item 3.2.1.3.E. in Section 4.2.

On page 20 of their Integrated Plan, the licensee stated that containment integrity is maintained by permanently installed equipment. In addition, restoration of power is required to operate the hardened wetwell vent in excess of 24 hours. On page 38 of their plan, the licensee identifies a three to four megawatt electric DG as part of the Phase 3 requested equipment.

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 motive power, valve controls and motive air system, 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 licensee's Integrated Plan did not discuss providing core cooling if an ELAP occurs during Cold Shutdown or Refueling, Modes 5 and 6.

A review of the Integrated Plan for BSEP revealed 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.

The licensee informed the NRC of their plans to abide by this generic resolution.

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 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 RPV/RCS/SG makeup requires a transition and interaction with installed systems. For example, transitioning from RCIC to a portable FLEX pump as the source for RPV makeup requires appropriate controls on the depressurization of the RPV and injection rates to avoid extended core uncovery. Similarly, transition 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.

Phase 2 of the plan includes coping strategies using on-site portable equipment and modifications to maintain core cooling. The licensee proposed multiple ways of continuing to cool the reactor core during Phase 2.

On pages 14 and 17 of their Integrated Plan, the licensee specified that the strategy for Phase 2 Core Cooling will rely on RCIC and the Torus with venting through the HCVS for as long as possible. Once RCIC operation is no longer possible, the reactor will be fully depressurized using SRVs, and core cooling makeup will be provided by a FLEX portable diesel driven pump. The dc powered equipment will be supported by a FLEX portable diesel driven generator. Details of this strategy are outlined below.

The FLEX pump will take suction from either the CST (if available) or the new clean water storage tank and provide water to the RPV via two flow paths:

- Flexible hose connected to the Integrated Leak Rate Test (ILRT) piping going to RHR Loop B injection.
- Flexible hose connected to an Auxiliary Steam Supply Line inside the Turbine Building Heater Drain Pump Rooms and an Auxiliary Steam Supply line to RCIC piping interconnection for injection into the RPV.

No technical basis or a supporting analysis was provided for the diesel-driven FLEX pump capabilities considering the pressure within the RPV and the loss of pressure along with details regarding the FLEX pump supply line routes, length of hoses runs, connecting fittings, elevation changes to show that the pump is capable of injecting water into the RPV with a sufficient rate to maintain and recover core inventory for both the primary and alternate flow paths. This has been combined with Open Item 3.2.1.4.A in Section 4.1.

On page 50 of the Integrated Plan, the licensee provided Sketch 4, "Flow Diagram for FLEX Strategies." Note 5 states that a booster pump between the CWST and the RCIC pump suction will be dependent on the final design. However, no evaluation to determine if a booster pump is needed and a description of any changes has been provided. This has been 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-2012-0, and subject to the successful closure of issues related to the Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to use of portable equipment if these requirements are implemented as described.

3.2.2 Spent Fuel Pool Cooling Strategies

NEI 12-06, Table 3-1 and Appendix C summarize one acceptable approach for the SFP cooling strategies for BWRs. 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 SFP 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 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 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.

NEI 12-06, Section 3.2.1.6 provides the initial boundary conditions for SFP cooling.

1. All boundaries of the SFP are intact, including the liner, gates, transfer canals, etc.
2. Although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the refueling deck around the pool.
3. SFP cooling system is intact, including attached piping.
4. SFP heat load assumes the maximum design basis heat load for the site.

On page 24 of their Integrated Plan, the licensee provided a discussion of SFP cooling. During Phase 1, there would be no equipment capable of providing SFP cooling. Also, during Phase 1, the SFP will heat up to boiling temperature at five hours [UFSAR Section 9.1.2.3.2.4.2.2] and begin to lose inventory at a rate of 65 gpm [UFSAR Section 9.1.2.3.2.4.2.2] due to boil-off.

On page 25 of their Integrated Plan, the licensee stated that in Phase 2, the FLEX pump would be utilized taking suction from the clean water tank to provide SFP inventory. The primary connection point for SFP makeup is the Auxiliary Steam Supply to Residual Heat Removal (RHR) B Loop to Fuel Pool Cooling Assist connection. The alternate connection point for SFP makeup is Supplemental Spent Fuel Pool Cooling (SSFPC) piping to the Alternate Decay Heat Removal (ADHR) flange via portable hose. In addition, the FLEX pump would be used to provide 250 gallons per minute spray to the SFP via portable monitor nozzles from the refueling deck.

The SOE timeline provided by the licensee on page 41 of their Integrated Plan states that within five hours site personnel need to perform and complete manual actions on the 117- foot elevation of the Reactor Building for SFP spray and Reactor Building natural circulation.

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 SFP cooling strategies, if these requirements are implemented as described.

3.2.3 Containment Functions Strategies

NEI 12-06, Table 3-1 and Appendix C provide a description of the safety functions and performance attributes for BWR containments which are to be maintained during an ELAP as defined by Order EA-12-049. The safety function applicable to a BWR with a Mark I containment listed in Table 3-1 is Containment Pressure Control/Heat Removal, and the method cited for accomplishing this safety function is Containment Venting or Alternative Containment

Heat Removal. Furthermore, the performance attributes listed in Table C-2 denote the containment's function is to provide a reliable means to assure containment heat removal. JLD-ISG-2012-01, Section 5.1 is aligned with this position stating, in part, that the goal of this strategy is to relieve pressure from the containment.

On page 17 of their Integrated Plan, the licensee stated that after reactor scram during an ELAP event, the RPV is depressurized using SRVs, per technical specifications of 100 degrees Fahrenheit per hour. RCIC aligned to the Suppression Pool is used for RPV makeup, and RPV pressure is maintained using SRVs during the ELAP/FLEX event. Suppression Pool water temperature is a limiting factor for implementation of the FLEX strategy. RCIC initially takes suction off the Suppression Pool, and at 5.4 hours, the Suppression Pool water temperature reaches 200 degrees Fahrenheit. At this time, RCIC suction is switched to the clean water tank. The maximum Suppression Pool temperature is 290.6 degrees Fahrenheit and this occurs at 19.6 hours into the event.

It is not expected to reach containment pressure limits during the ELAP event because the HCVS is opened prior to exceeding any containment pressure limits. The HCVS is opened at 19.5 hours into the coping time analysis. Containment pressure will be maintained below Primary Containment Pressure Limit (PCPL-A) as directed by procedure OEOP-02-PCCP, Primary Containment Control Procedure, utilizing hardened wetwell vent as modified to comply with NRC Order EA-13-109.

The information cited above and the SOE timeline on page 42 of 57 identifies that at 19.5 hours, the Action is to vent containment via HCVS. The Remarks/Applicability section states that primary containment pressure is assumed based on MAAP run. It also identifies that the venting must take place prior to exceeding the Primary Containment Pressure Limit (PCPL-A) of 70 psia. In a review of NEDC-33771P, Revision 1, starting to vent containment via the HCVS at 19.5 hours does not appear to be supported when compared to the analysis presented in Appendix B, "BWR/4 Mark I Containment Response Plots (No Venting, Suction from Suppression Pool)" or Appendix C, "BWR/4 Mark I Containment Response Plots (No Venting, Suction from CST)." Furthermore, for any instance in which the NEDC was used as the basis document for technical justification, the staff requested an explanation of any plant-specific analyses which were performed to support the applicability of the NEDC document to Duke's integrated plan. The licensee not identify each instance where a plant parameter or time constraint for their integrated plan was based on the data and/or analyses from the subject NEDC document and did not provide a technical justification for its applicability to BSEP. This has been combined with Open Item 3.2.1.3.F in section 4.1.

The licensee did not provide finalized plant-specific ELAP analysis information commensurate with the level of detail contained in NEDC-33771P, including analysis assumptions and results in their tabulated and plotted formats. Also, the licensee did not provide an in-depth description of the relationship between the NEDC-33771P document and its applicability to plant-specific analyses and decision points, if any, in their integrated plan. This information is essential to determining that containment functions will be maintained in all Phases of an ELAP, which is needed to conclude that containment functions will be maintained in all Phases of an ELAP. This has been identified as Open Item 3.2.3.A in Section 4.1.

In their August 20, 2013 status update, the licensee stated that they will be adopting the BWROG EPG/SAGs, Revision 3, to govern their venting practices. The NRC staff considers the adoption of Revision 3 to the BWROG Emergency Procedure Guidelines (EPG)/Severe Accident Guidelines (SAG) by licensees to be a Generic Concern (and thus an open item for the licensee) because the BWROG has not addressed the potential for the revised venting strategy to increase (relative to currently accepted venting strategies) the likelihood of detrimental effects on containment response for events in which the venting strategy is invoked. In particular it has not been shown that the potential for negative pressure transients, hydrogen combustion, or loss of containment overpressure (as needed for pump NPSH) is not significantly different when implementing Revision 3 of the EPG/SAG vs. Revision 2 of the EPG/SAG. Revision 3 provides for earlier venting than previous revisions. The BWR procedures are structured such that the new venting strategy is not limited to use during the BDBEEs that are the subject of EA-12-049, but could also be implemented during a broad range of events. Acceptance of EPG/SAG Revision 3, including any associated plant-specific evaluations, has been identified as Open Item 3.2.3.B in Section 4.1

On page 19 of the Integrated Plan, the licensee stated that the drywell temperature will be monitored in all Phases of an ELAP. However, the Integrated Plan makes no conclusion that the resulting drywell temperatures determined by the MAAP calculation remain within penetration and equipment qualification limits. Excessive temperatures could result in a loss of containment integrity due to the failure of containment penetration seals or other portions of the containment boundary. Furthermore, excessive temperatures could result in the failure of necessary measurement instruments located in the drywell. Additional information is requested regarding a discussion and the technical basis for concluding that the calculated drywell temperature will not exceed the limits of penetration seals or other equipment. This has been identified as Confirmatory Item 3.2.3.C in Section 4.2.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that the Integrated Plan is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to maintaining containment functions and containment venting. These concerns are identified as Open Items 3.2.3.A and 3.2.3.B above and in Section 4.1.

3.2.4 Support Functions

3.2.4.1 Equipment Cooling – Cooling Water

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.

On page 29 of their Integrated Plan, in the section describing Safety Functions Support, the licensee specified that based on SBO heatup calculations performed in accordance with NUMARC 87-00, equipment operability will not be challenged during heatup in vital locations such as the Reactor Building Emergency Core Cooling (ECCS) Rooms. RCIC equipment room is expected to reach 145.3 degrees Fahrenheit during an SBO event. The expected temperature in the HPCI room is 153.6 degrees Fahrenheit, which is a backup to RCIC in a FLEX event. These temperatures are below the maximum normal temperatures of the associated rooms.

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 additional analysis for equipment cooling, if these requirements are implemented as described.

3.2.4.2 Ventilation – Equipment Cooling

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

> *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 [auxiliary feedwater] AFW pump room, HPCI and RCIC pump rooms, 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 HPCI, RCIC, and 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.
>
> Temperatures in the HPCI pump room and/or steam tunnel for a BWR may reach levels which isolate HPCI or RCIC steam lines. Supplemental air flow or the

capability to override the isolation feature may be necessary at some plants. The procedures/guidance should identify the corrective action required, if necessary.

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 29 of their Integrated Plan, in the section describing Safety Functions Support, the licensee specified that based on SBO heatup calculations performed in accordance with NUMARC 87-00, equipment operability will not be challenged during heatup in vital locations such as the Reactor Building Emergency Core Cooling (ECCS) Rooms. RCIC equipment room is expected to reach 145.3 degrees Fahrenheit during an SBO event. The expected temperature in the HPCI room is 153.6 degrees Fahrenheit, which is a backup to RCIC in a FLEX event. These temperatures are below the maximum normal temperatures of the associated rooms.

The licensee's response did not address maintaining battery room ventilation or the hydrogen gas exhaust path or the accumulation of hydrogen when the batteries are being recharged during Phase 2 and 3. This has been identified as Open Item 3.2.4.2.A in Section 4.1.

The licensee did not provide a discussion in the integrated plan regarding the effects of heightened temperatures (i.e., temperatures above those assumed in the sizing calculation for each battery) on each battery's capability to perform its function for the duration of the ELAP event.

With regard to elevated temperatures as a result of loss of ventilation and/or cooling on electrical equipment being credit as part of ELAP strategies, the licensee did not specify whether the initial temperature condition assumed the worst-case outside temperature with the plant operating at full power, or provide the list of electrical components that are located in the pump rooms that are necessary to ensure successful operation of required pumps, or provide the qualification level for temperature and pressure for these electrical components for the duration that the pumps are assumed to perform their mitigating strategies function. This is identified as Open Item 3.2.4.2.B in Section 4.1.

The licensee provided updated information as part of the audit response process which stated that the battery technical manual for the BSEP 125Vdc and 250Vdc batteries, notes that operating at higher than normal operating temperature (above 60 degrees Fahrenheit – SBO) has the following effects on the batteries; it Increases performance and internal discharge or local action losses, water usage, and maintenance requirements. It lowers cell voltage and shortens life and raises the charging current for a given charge. The licensee specified that for the relative short-duration of this event, the shortened life, increased water usage and maintenance, and increased discharge loss is insignificant. The batteries discharge performance capability change is net positive, with more volts per cell at any discharge level and for any load current. Therefore, the effects of heightened temperatures are not a concern for the batteries' capability to perform their function for the duration of the ELAP event. A discussion is needed on the extreme low temperature effects of the batteries capability to perform its function for the duration of the ELAP event. This has been identified as Open Item 3.2.4.2.C 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-2012-0, and subject to the successful closure of issues related to the Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to use of portable equipment 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.

In the integrated plan the licensee did not discuss the effects of loss of power to heat tracing. This has been identified as Open Item 3.2.4.3.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 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 heat tracing, 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.

A review was made of the Integrated Plan for coping strategies discussing plant lighting and communications systems during an ELAP that support personnel access for coping strategies that maintaining core, containment and SFP cooling. The licensee has not discussed their coping strategies for portable and emergency lighting necessary to facilitate personnel access into plant locations to implement mitigating strategies. This is identified as Open Item 3.2.4.4.A. in Section 4.1.

The NRC staff has reviewed the licensee communications assessment (ADAMS Number ML12311A299) required by in response to the March 12, 2012 50.54(f) request for information letter for BSEP and, as documented in the staff analysis (ML13093A341) 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 Guideline (8) regarding communications capabilities during an ELAP. This has been identified as Confirmatory Item 3.2.4.4.B. in Section 4.2 for confirmation that upgrades to the site's communications systems have been completed.

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/Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to lighting and communications support for accessibility for operator actions 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.

The licensee provided no information regarding local access to the protected areas under ELAP. This has been identified as Open Item 3.2.4.5.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 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.

Section 9.2 of NEI 12-06 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.

On pages 29 and 31 of their Integrated Plan, the licensee discussed habitability limits related to Phases 1 and 2. For Phase 1, the licensee stated that Operator manual action occurrence in areas where habitability is a concern will be minimized and a path for natural air circulation in the areas will be provided. For Phase 2, if necessary, high volume fans will force air through the areas to lower temperatures and improve habitability.

The licensee did not identify or address control room habitability, RCIC Room habitability, HPCI Room habitability or refuel floor habitability in their Integrated Plan. Statements such as, "Operator manual action occurrence in areas where habitability is a concern will be minimized and a path for natural circulation in the areas will be provided" and "...high volume fans will force air through the areas to lower temperatures and improve habitability", are not sufficient. Additional details and supporting technical justification that demonstrate habitability in all areas that require operator actions is requested. This has been identified as Open Item 3.2.4.6.A in Section 4.1.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that the approach is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to personnel habitability – elevated temperatures. This question is identified as Open Item 3.2.4.6.A in Section 4.1.

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.

Heated torus water can be relied upon if sufficient [net positive suction head] NPSH can be established. 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 pages 10 and 12 of their Integrated Plan, the licensee described the sources of water for use in core cooling. The licensee identified the sources of water being the CST as the preferred source of feed to the RPV for makeup. If the CST were unavailable, then RCIC and HPCI would take suction from the Suppression Pool. As the Suppression Pool increases in temperature, RCIC and HPCI would then take suction on the clean water storage tank (CWST).

The CST may be lost during a BDBEE.

A new CWST is going to be built at the BSEP site. In subsequent discussions with the licensee during the audit process, additional information was provided regarding the CWST. The preliminary required volume of this new CWST to accommodate both Units is approximately 870,000 gallons. The Integrated Plan did not address long-term makeup capability for the CWST. In the licensee's August 20, 2013 update to their Integrated Plan, they stated that having a local response/process established at BSEP would better suit long-term makeup to the CWST. The licensee created a new Open Item 21 in their system to track this issue. Due to the importance of water quality, this is identified as Confirmatory Item 3.2.4.7.A in Section 4.2.

The licensee's plans do not discuss clear criteria for the changeover from a heated Suppression Pool supply to the clean water tank as analysis is not complete for NPSH requirements for RCIC pump operations when using the Suppression Pool as a water supply which would affect the timing of the changeover. This has been combined with Open Item 3.2.1.3.C 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/Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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.

On pages 11 and 31 of their Integrated Plan, the licensee stated that in Phase 2, two SAMA DGs would be used to provide power to the motor control centers (MCCs) for the 125/250 VDC battery chargers, prior to battery depletion. During Phase 3, 4,160 VAC power will be provided by the Regional Resource Center (RRC). In subsequent discussions with the licensee during the audit process, additional information was provided regarding the FLEX DGs (formally identified as SAMA DGs in the Integrated Plan). The licensee stated that FLEX DGs would be permanently pre-staged in their own robust/hardened structure.

The licensee plans on using the FLEX DGs to power various systems prior to battery depletion. The licensee did not provide any information or strategy regarding electrical isolation from installed plant equipment. It was determined that there was insufficient information available to conclude that there is reasonable assurance that the licensee will ensure that the FLEX DGs and the Class 1E diesel generators are isolated to prevent simultaneously supplying power to the same Class 1E bus. This has been identified as Open Item 3.2.4.8.A in Section 4.1.

The licensee did not discuss the instrumentation that will be used to monitor portable/FLEX electrical power equipment including their associated measurement tolerances/accuracy to ensure that: 1) the electrical equipment remains protected (from an electrical power standpoint – e.g., power fluctuations) and 2) the operator is provided with accurate information to maintain core cooling, containment, and SFP cooling. This has been identified as Open Item 3.2.4.8.B in Section 4.1.

The licensee provided updated information as part of the audit process regarding sizing of the Phase 2 and 3 generators. The licensee currently relies on SBO procedure (0AOP-36.2) for the kilowatt value of the loads that will be required during Phase 2 and 3. The licensee needs to finalize their load sizing analysis for the Phase 2 and 3 DGs. This is identified as 3.2.4.8.C 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/Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to electrical power sources/isolations/interactions if these requirements are implemented as described.

3.2.4.9 Portable Equipment Fuel.

NEI 12-06, Section 3.2.2, Guideline (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 pages 15 and 27 of their Integrated Plan, licensee stated that portable fuel transfer pumps would remove fuel from the DG tanks (saddle and 4-day) to fill equipment fuel tanks. A vehicle would also be equipped with a fuel storage tank to transport fuel to locations in need of fuel. The BWR Portable Equipment Phase 2 table identifies two electric fuel oil transfer pumps and associated equipment, two deployment vehicles that have a means to deploy equipment, provide fuel replenishment capabilities, etc.

The Integrated Plan states that fuel oil storage tanks will supply portable pumps and DGs. The Integrated Plan does not, however, document the amount or the expected usage rates of fuel that would be necessary to support Phase 2 equipment. Additionally, the Integrated Plan omits any details about the robust structural designs to house, or store fuel for Phase 2 equipment and its protection from seismic events, floods, high winds and missiles/projectiles. The licensee provided updated information as part of the audit process regarding fuel storage for Phase 2. The licensee stated that FLEX equipment would be replenished with on-site diesel fuel stored in a Class 1 structure. The licensee is requested to document the amount and the expected usage rates of fuel for all Phase 2 equipment. This has been identified as Open Item 3.2.4.9.A., in Section 4.1.

The licensee also stated that the fuel oil storage 4-day tank minimum volume is 22,650 gallons (90,600 gallons total) on-site and that technical surveillance requirements ensure fuel oil is maintained in accordance with the Diesel Fuel Oil Testing Program. The licensee did not to discuss the diesel fuel oil supply pathway for the diesel driven FLEX pumps and the permanently pre-staged FLEX DGs and how continued operation to ensure core and SFP cooling is maintained indefinitely (i.e., Phase 2 and 3) particularly in flooded conditions. This has been identified as Open Item 3.2.4.9.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 Open Items, 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, Guideline (6) states:

> *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.

On pages 5 and 41 of the Integrated Plan, the licensee described time limitations regarding when deep load shedding must be completed. Deep load shedding would only required if both FLEX DGs failed to start. Within five hours of the BDBEE, the FLEX DGs must be started with connections to both Unit 1 and Unit 2 Division II battery chargers established. At approximately nine hours after the BDBEE, the FLEX DGs would be aligned to 480 volt ac (VAC) to provide power to 24/48 volt dc (VDC) battery chargers, motor operated valves (MOV), ac instruments, battery room fans, etc. This activity must be completed within 24 hours of the BDBEE to support the 24/48 VDC Hardened Containment Vent System (HCVS) batteries.

The NRC staff reviewed the Integrated Plan for BSEP and determined that the Generic Concern related to battery duty cycles beyond 8 hours is applicable to the plant. The Generic Concern related to extended battery duty cycles, has been resolved generically through the NRC endorsement of NEI position paper entitled "Battery Life Issue" (ADAMS Accession no. ML13241A186 (position paper) and ML13241A188 (NRC endorsement letter).

The purpose of the Generic Concern and associated endorsement of the position paper was to resolve common concerns associated with Order Integrated Plan submittals in a timely manner and on a generic basis, to the extent possible, and provide a consistent review by the NRC. Position papers provided to the NRC by industry further develop and clarify the guidance provided in NEI 12-06 related to industry's ability to meet the intent of Order EA-12-049, "Order Modifying Licenses With Regard To Requirements for Mitigation Strategies for beyond Design Basis External Events."

The Generic Concern related to extended battery duty cycles required clarification of the capability of the existing vented lead-acid station batteries to perform their expected function for durations greater than 8 hours throughout the expected service life. The position paper provided sufficient basis to resolve this concern by developing an acceptable method for demonstrating that batteries will perform as specified in a plant's Integrated Plan that satisfy NRC Order EA-12-049. The methodology relies on the licensee's battery sizing calculations developed in accordance with the Institute of Electrical and Electronics Engineers Standard 485, "Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations," load shedding schemes, and manufacturer data to demonstrate that the existing vented lead-acid station batteries can perform their intended function for extended duty cycles (i.e., beyond 8 hours). The NRC staff will evaluate a licensee's application of the guidance (calculations and supporting data) in its development of the final Safety Evaluation documenting compliance with NRC Order EA-12-049. This is identified as Confirmatory Item 3.2.4.10.A in Section 4.2.

The NRC staff concluded that the position paper provides an acceptable approach for demonstrating that the licensees are capable of implementing mitigation strategies.

The licensee informed the NRC of their plans to abide by this generic resolution.

The licensee provided updated information as part of the audit process regarding the dc load shedding timeline. The licensee currently relies on SBO procedure (0AOP-36.2) for dc load shedding to minimize the battery discharge rate. The licensee needs to finalize their battery depletion analysis. This is identified as Confirmatory Item 3.2.4.10.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 the battery load shed analysis, 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[1] 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.

[1] Testing includes surveillances, inspections, etc.

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.

On page 8 of the Integrated Plan the licensee stated that, equipment associated with mitigating strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control in accordance with NEI 12-06 Section 11.1.

The licensee did not provide specific information on the maintenance and testing that will be performed, therefore there is insufficient information available to provide reasonable assurance that the licensee's proposed strategy for the maintenance and testing of FLEX electrical equipment at BSEP will ensure the capability and availability of FLEX equipment to assist the maintenance of core cooling, containment, and SFP cooling.

The NRC staff reviewed the Integrated Plan for BSEP 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 EPRI technical report on preventive maintenance of FLEX equipment, submitted by NEI by letter dated October 3, 2013 (ADAMS Accession No. ML13276A573). The endorsement letter from the NRC staff is dated October 7, 2013 (ADAMS Accession No. ML13276A224).

This Generic Concern involves clarification of how licensees 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 licensees could use to develop preventative 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 maintaining FLEX equipment in a ready-to-use status.

The licensee informed the NRC of their plans to abide by this generic resolution and of the licensee's plans to address potential plant specific issues associated with implementing this resolution.

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 provides that:

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.

On page 8 of the Integrated Plan, the licensee stated that BSEP will implement programmatic controls. Procedures and guidelines will be reviewed and revised and/or generated as required to address additional programmatic controls as a result of FLEX requirements. The FLEX strategies and basis will be maintained in overall FLEX basis documents. 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 in accordance with NEI 12-06 Section 11.8.

There is insufficient information to conclude that configuration control of equipment and connections will be controlled in conformance with the guidance of NEI 12-06, Section 11.8, Items 1 and 3 regarding a program document that will contain; a historical record of previous strategies and the basis for changes, and a change control process to allow changes to the strategies only if they continue to meet the guidelines of NEI 12-06. This has been identified as Confirmatory Item 3.3.2.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 configuration control, if these requirements are implemented as described.

3.3.3 Training.

NEI 12-06, Section 11.6 provides that:

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]

2. Periodic training should be provided to site emergency response leaders[3] 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.

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[2] The Systematic Approach to Training (SAT) is recommended.

[3] Emergency response leaders are those utility emergency roles, as defined by the Emergency Plan, for managing emergency response to design basis and beyond-design-basis plant emergencies.

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 8 of the Integrated Plan, the licensee noted that training would be initiated through the Systematic Approach to Training (SAT) process. Training would be developed and provided to all involved plant personnel based on any procedural changes or new procedures developed to address and identify FLEX activities. Applicable training will be completed prior to the implementation of FLEX.

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 programs, if these requirements are implemented as described.

3.4 OFF SITE 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).

On pages 4 and 9 of their Integrated Plan, the licensee stated that Phase 3 resources (personnel and equipment) are assumed to start arriving within 24 hours in accordance with the RRC playbook. All resources from the RRC are assumed to be available within 72 hours. In addition, the industry will establish two RRC to support utilities during beyond design basis events. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, 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 of 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. A contract has been signed between the site and the Pooled Equipment Inventory Company to provide Phase 3 services and equipment.

The licensee's plans for the use of off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies (item 1 above). However, the licensee did not address considerations 2 through 10 of NEI 12-06, Section 12.2. This has been identified as 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, 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.C	The licensee has indicated that BSEP procedures and programs are being developed to address storage structure requirements, but insufficient information was provided to ascertain that these procedures and programs will provide for securing large portable equipment to protect them during a seismic event or to ensure unsecured and/or non-seismic components do not damage the equipment as is specified in NEI 12-06, Section 5.3.1, considerations 2 and 3. Item 2 specifies that large portable equipment should be secured as appropriate to protect it during a seismic event. Item 3 specifies that 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.	
3.1.1.2.B	The licensee identified on page 13 of their Integrated Plan, that they plan to construct a clean water tank to supply Reactor Core Isolation Cooling (RCIC) and High Pressure Coolant Injection (HPCI) with water of acceptable quality for RCIC/HPCI injection into the reactor pressure vessel (RPV). However, the licensee did not identify the design specifications for the clean water tank or state that the clean water tank will be designed to withstand all hazards. Therefore, there is not sufficient information to confirm that the clean water tank will survive all hazards.	
3.1.1.3.B	The licensee did not provide a discussion in their Integrated Plan regarding implementation of the mitigating strategies with respect to the procedural interface considerations for seismic hazards associated with large internal flooding sources that are not seismically robust and do not require ac power and the use of ac power to mitigate ground water in critical locations. Therefore, there is not sufficient information to address NEI 12-06 Section 5.3.3 considerations 2 and 3.	
3.2.1.1.F	The MAAP analysis report addressing coping time under ELAP conditions acknowledges that the initial wetwell liquid volume assumed in the MAAP analysis is approximately 25% greater than the actual liquid volume specified in the Brunswick final safety analysis report (reference Table 4-1 in calculation note CN-AEO-13-0001). The MAAP analysis report attempted to justify this discrepancy by stating that the basis for the reduced water volume in the final safety analysis report was a modification to the suction strainers for the emergency core cooling system that are located in the wetwell. The MAAP analysis report further presumed that the consequent reduction to the wetwell initial water volume	

	resulted solely from the displaced volume of the new strainers, ultimately reasoning that the MAAP analysis with the overestimated wetwell liquid volume remains valid because the product of the density and specific heat capacity of the metal strainers would be similar (e.g., estimates to within roughly 15%) to that of the displaced water volume. However, the reasoning presented in the MAAP analysis report appears questionable firstly because the suction strainers are not solid structures (i.e., it is not clear that a substantial part of what the MAAP analysis report presumes to be "displaced volume" is not in fact wetwell liquid that has passed through perforations and filled the interior volume of the strainers). Secondly, displacing a water volume of approximately 20,000 ft^3 solely with stainless steel would require a mass of steel (i.e., roughly 5000 tons) that is significantly larger than expected for wetwell suction strainers. In addition to the above concerns, since the wetwell water volume is actually 20,000 ft^3 less than indicated in the MAAP analysis report, there is a concern over how accurately the initial water level value of 11.84 ft and the rate of water level decrease are represented within the analyses; a lower initial water level or a more rapid decrease in water level could result in inadequate RCIC NPSH when compared to the current analyses. In light of these issues, either provide adequate documentation to substantiate the assumptions and calculations in the MAAP analysis report, or else provide a revised analysis of the coping time available under ELAP conditions that incorporates an initial wetwell water volume and level that is representative of Brunswick.	
3.2.1.2.A	A review was conducted of the licensee's integrated plan and it was determined that there is insufficient information provided to determine the adequacy of the determination of recirculation pump seal or other sources of leakage used in the ELAP analysis.	SIGNIFICANT
3.2.1.3.A	In subsequent discussions with the licensee during the audit process, information was requested regarding HPCI CST to suppression pool switchover instrumentation such that HPCI would remain operational with injection to the RPV uninterrupted, if during the ELAP event, the CST is damaged and no longer available. The discussion was to include whether the switchover function is automatic, fail-safe, and whether function logic and hardware, related piping, valves, systems, structures, and components (SSCs) to support the switchover function are of safety grade and are qualified for all criteria including tornado/high winds. If not, then justify how switchover from CST to Suppression	

	Pool will be assured in ELAP conditions if the CSTs are unavailable. The licensee described the above information for RCIC but not HPCI as requested.	
3.2.1.3.B	On page 41 of the Integrated Plan, the SOE timeline Action Item 3 describes the depressurization of the RPV to 150 – 300 psig within 1 hour. The integrated plan is not consistent between the discussions in the Maintain Containment section and the SOE timeline regarding RPV pressure. Additional information relative to the appropriate RPV pressures during the BDBEE is needed that includes a description of the impact of not attaining these pressure in the required times.	
3.2.1.3.C	Information was not provided to determine if; RCIC will be started automatically or at a time required by analysis following the initiation of the event, if any elapsed time constraint exists for this action or if pressure and temperature conditions in the containment predicted in NEDC-33711P Rev 1, have been considered. In addition, the required net positive suction head required for RCIC to be operable during an ELAP has not been discussed.	
3.2.1.3.F	The SOE timeline on page 42 of 57 identifies that at 19.5 hours, the Action is to vent containment via HCVS. The Remarks/Applicability section states that primary containment pressure is assumed based on MAAP run. It also identifies that the venting must take place prior to exceeding the Primary Containment Pressure Limit (PCPL-A) of 70 psia. In a review of NEDC-33771P, Revision 1, starting to vent containment via the HCVS at 19.5 hours does not appear to be supported when compared to the analysis presented in Appendix B, "BWR/4 Mark I Containment Response Plots (No Venting, Suction from Suppression Pool)" or Appendix C, "BWR/4 Mark I Containment Response Plots (No Venting, Suction from CST)." Please provide justification that 19.5 hours is appropriate.	
3.2.1.4.A	On page 14 of the integrated plan regarding Portable Equipment to Maintain Core Cooling, the licensee describes the use of portable pumps to provide RPV injection. No technical basis or a supporting analysis was provided for the; the diesel-driven FLEX pump capabilities considering the pressure within the RPV and the loss of pressure along with details regarding the FLEX pump supply line routes, length of hoses runs, connecting fittings, elevation changes to show that the pump is capable of injecting water into the RPV with a sufficient rate to maintain and recover core inventory for both the primary and alternate flow paths.	

3.2.1.8.A	On page 50 of the Integrated Plan, the licensee provided Sketch 4, "Flow Diagram for FLEX Strategies." Note 5 states that a booster pump between the CWST and the RCIC pump suction will be dependent on the final design. However, no evaluation to determine if a booster pump is needed and a description of any changes has been provided.	
3.2.3.A	The licensee is requested to provide finalized plant-specific ELAP analysis information commensurate with the level of detail contained in NEDC-33771P, including analysis assumptions and results in their tabulated and plotted formats. An in-depth understanding of the relationship between the NEDC-33771P document and its applicability to plant-specific analyses and decision points, if any, in the licensee's integrated plan is essential to determining that containment functions will be maintained in all Phases of an ELAP. .	SIGNIFICANT
3.2.3.B	The NRC staff considers the adoption of Revision 3 to the BWROG Emergency Procedure Guidelines (EPG)/Severe Accident Guidelines (SAG) by licensees to be a Generic Concern (and thus an open item for the licensee) because the BWROG has not addressed the potential for the revised venting strategy to increase (relative to currently accepted venting strategies) the likelihood of detrimental effects on containment response for events in which the venting strategy is invoked. In particular it has not been shown that the potential for negative pressure transients, hydrogen combustion, or loss of containment overpressure (as needed for pump NPSH) is not significantly different when implementing Revision 3 of the EPG/SAG vs. Revision 2 of the EPG/SAG. Revision 3 provides for earlier venting than previous revisions. The BWR procedures are structured such that the new venting strategy is not limited to use during the BDBEEs that are the subject of EA-12-049, but could also be implemented during a broad range of events. Acceptance of EPG/SAG Revision 3, including any associated plant-specific evaluations	SIGNIFICANT
3.2.4.2.A	The licensee's response did not address maintaining battery room ventilation. A discussion on the hydrogen gas exhaust path for each strategy is needed, and a discussion of the accumulation of hydrogen when the batteries are being recharged during Phase 2 and 3.	
3.2.4.2.B	With regard to elevated temperatures as a result of loss of ventilation and/or cooling on electrical equipment being credit as part of ELAP strategies, the licensee is requested to specify whether the initial temperature condition assumed the worst-case outside temperature with the plant operating at full power, provide the list of electrical components that are located in the pump rooms that are necessary to ensure successful operation of required pumps, and to provide the	

	qualification level for temperature and pressure for these electrical components for the duration that the pumps are assumed to perform its mitigating strategies function.	
3.2.4.2.C	A discussion is needed on the extreme low temperatures effects of the batteries capability to perform its function for the duration of the ELAP event.	
3.2.4.3.A	In the integrated plan the licensee did not discuss the effects of loss of power to heat tracing and therefore additional information is required to conclude that this consideration from NEI 12-06 has been adequately addressed.	
3.2.4.4.A	A review was made of the Integrated Plan for coping strategies discussing plant lighting and communications systems during an ELAP that support personnel access for coping strategies that maintaining core, containment and SFP cooling. The licensee has not discussed their coping strategies for portable and emergency lighting necessary to facilitate personnel access into plant locations to implement mitigating strategies. Therefore, there is insufficient information to conclude that coping strategies for portable and emergency lighting will conform to the guidance of NEI 12-06, Section 3.2.2, consideration (8).	
3.2.4.5.A	The licensee provided no information regarding local access to the protected areas under ELAP.	
3.2.4.6.A	The licensee did not identify or address control room habitability, RCIC Room habitability, HPCI Room habitability or refuel floor habitability in their Integrated Plan. Statements such as, "Operator manual action occurrence in areas where habitability is a concern will be minimized and a path for natural circulation in the areas will be provided" and "...high volume fans will force air through the areas to lower temperatures and improve habitability", are not sufficient. Additional details and supporting technical justification that demonstrate habitability in all areas that require operator actions is requested.	SIGNIFICANT
3.2.4.8.A	The licensee plans on using the FLEX DGs to power various systems prior to battery depletion. The licensee did not provide any information or strategy regarding electrical isolation from installed plant equipment. It was determined that there was insufficient information available to conclude that there is reasonable assurance that the licensee will ensure that the FLEX DGs and the Class 1E diesel generators are isolated to prevent simultaneously supplying power to the same Class 1E bus.	
3.2.4.8.B	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: 1) the electrical equipment remains protected (from an electrical power standpoint – e.g., power	

	fluctuations) and 2) the operator is provided with accurate information to maintain core cooling, containment, and SFP cooling.	
3.2.4.9.A	The Integrated Plan states that fuel oil storage tanks will supply portable pumps and DGs. The Integrated Plan does not, however, document the amount or the expected usage rates of fuel that would be necessary to support Phase 2 equipment. Additionally, the Integrated Plan omits any details about the robust structural designs to house, or store fuel for Phase 2 equipment and its protection from seismic events, floods, high winds and missiles/projectiles. The licensee provided updated information as part of the audit process regarding fuel storage for Phase 2. The licensee stated that FLEX equipment will be replenished with on-site diesel fuel stored in a Class 1 structure. The licensee is requested to document the amount and the expected usage rates of fuel for all Phase 2 equipment.	
3.2.4.9.B	The licensee also stated that the fuel oil storage 4-day tank minimum volume is 22,650 gallons (90,600 gallons total) on-site and that technical surveillance requirements ensure fuel oil is maintained in accordance with the Diesel Fuel Oil Testing Program. The licensee did not to discuss the diesel fuel oil supply pathway for the diesel driven FLEX pumps and the permanently pre-staged FLEX DGs and how continued operation to ensure core and SFP cooling is maintained indefinitely (i.e., Phase 2 and 3) particularly in flooded conditions.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.1.A	The licensee is planning on constructing a FLEX Equipment Storage Building that meet the requirements of NEI 12-06 Section 11. Section 11 provides general storage design guidance but does not provide the details for protection from the seismic hazards as delineated in NEI 12-06, Section 5.3.1. This comment is generic. Each section of the Integrated Plan describing storage protection from hazards makes reference to Section 11 rather than to the specific protection requirements described in NEI 12-06 for the applicable hazard; that is Section 6.2.3.1 for floods, Section 7.3.1 for wind, etc. In discussions with the licensee during the audit process, the licensee provided a description of the design considerations for the FESB however their considerations were not inclusive of all applicable hazards.	
3.1.1.1.B	The licensee updated methodologies and processes associated with the Hardened Containment Vent System (HCVS) that will be incorporated into the response to EA-13-109 and the BSEP Units 1 and 2 will be modified for these processes in accordance with the requirements of EA-13-	

	109. Any applicable Phase 2 FLEX equipment required for the modification/process to facilitate the venting practices (HCVS) will need to be stored and/or protected for all hazards.	
3.1.1.2.A	The licensee identified two vehicles as a means to deploy equipment, provide fuel replenishment, etc., and four flatbed trailers as a means to store and transport hoses, strainers, cables, and miscellaneous equipment but omitted discussion of the protection to be afforded these vehicles/trainers from seismic hazards.	
3.1.1.3.A	The licensee is requested to provide additional information concerning coping strategies for the failure of seismically qualified electrical equipment that can be affected by beyond-design-basis seismic events as discussed in NEI 12-06, Section 5.3.3 consideration 1. That section specifies that each plant should compile a reference source for the plant operators that provide approaches to obtaining necessary instrument readings to support the implementation of the coping strategy. 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. In addition, NEI 12-06, Section 5.3.3 consideration 1 specifies that guidance should include critical actions to perform until alternate indications can be connected. Finally, it also specifies that the guidance to plant operators include instructions on how to control critical equipment without associated control power. In the licensee's 6-month update to their Integrated Plan, section 4, item 6 described that the initial Integrated Plan did not address the need to develop guidance for obtaining local vital indications during an extended loss of alternating current (ac) power (ELAP). The licensee determined that a local process for local vital indications would be developed to support BSEP's FLEX response.	
3.1.1.4.A	On pages 4 and 9 of their Integrated Plan, the licensee provided information regarding the use of the offsite resources through the industry Strategic Alliance for FLEX Emergency Response (SAFER) program, but has not identified local staging areas and method(s) of transportation per the guidance of NEI 12-06, Section 5.3.4, consideration 1, Section 6.2.3.4, considerations 1 and 2, Section 7.3.4, considerations 1 and 2, and Section 8.3.4. Provide a discussion of the effects of these considerations on the ELAP strategies being developed for all hazards.	
3.1.2.A	While licensee has identified the limiting source of flooding as the Probable Maximum Hurricane, the applicable flooding hazard was not characterized in terms of warning time and persistence.	

3.1.2.2.A	There was no discussion of the considerations for movement of equipment and restocking of supplies per consideration 2 in the context of a flood with long persistence. NEI 12-06 Section 3.1.2.2 consideration 2 states: "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." In addition, the licensee did not provide a discussion of the need for and deployment of temporary flood barriers. Therefore, there is insufficient information to conclude that consideration 2 of NEI 12-06 Section 6.2.3.2 will be satisfied concerning the deployment of portable/FLEX equipment during the flooding hazard.	
3.1.3.2.A	In the integrated plan, there was insufficient information with regard to the guidelines identified in NEI 12-06 Section 7.3.2, considerations 2, 4 and 5. Subsequent discussions with the licensee were held during the audit process regarding considerations 2, 4 and 5. During those discussions, the licensee described: • For consideration 2, the Phase 2 strategy does not include any equipment in, or around the UHS so the effects of high wind will not effect deployment of FLEX equipment. Phase 2 on-site equipment (including debris removal, deployment equipment, etc.) credited in the FLEX strategy will be stored in the robust/hardened FLEX structure or permanently pre-staged in a robust/hardened structure other than the intake structure. • For consideration 4, debris removal and tow equipment will be purchased that is suitable to move all equipment from the FLEX structure to deployment areas with high winds taken into consideration. Prior to the event, the debris removal and deployment equipment will be stored in the robust/hardened FLEX structure to protect it from external hazards, including high winds. • For consideration 5, prior to the hurricane, portable FLEX equipment, including debris removal and deployment equipment, will be stored in the robust/hardened FLEX structure (except for those permanently staged pieces of equipment that will be protected from hurricanes in their location). Strategies and movement of equipment during hurricanes will be incorporated into the Flex Support Guidelines to ensure successful deployment without endangering personnel. Due to hurricanes providing days of forewarning, strategies may include pre-staging or certain equipment in robust structures other than the permanent FLEX storage building. These strategies are still under	

	development.	
3.1.4.2.A	The licensee's Integrated Plan for implementation of the strategies to deploy portable equipment in the context of snow, ice, and extreme cold did not provide sufficient information to conclude that the administrative program elements to ensure the pathways were clear would include ice removal. Upon subsequent discussions with the licensee during the audit process, they have described that the deployment of debris removal equipment (including ice removal) has not been finalized. The licensee has also stated that ice removal would be considered in the selection process. In addition, applicable equipment credited for FLEX strategies would be stored in the FLEX structure or permanently pre-staged in a robust/hardened structure.	
3.1.5.3.A	The effects of high temperatures on the storage of equipment was addressed in Section 3.1.5.1 and there was information presented on the heat up of a variety of rooms and enclosures in the integrated plans, but there is no discussion of the potential effects of high temperatures at the location where the portable equipment would actually operate during a high temperature hazard. Subsequent discussions with the licensee during the audit process provided additional guidance. That guidance included that the majority of the FLEX equipment would be deployed to an outside location. The equipment would be purchased with the requirements to operate during a high temperature hazard. The only exception is the FLEX diesel generators (DGs) (identified as SAMA DG in their Integrated Plan) that would be permanently pre-staged in their own robust/hardened structure. The FLEX DGs and structure will be purchased/designed to ensure proper operation at elevated temperatures.	
3.2.1.1.A	From the June 2013 position paper, benchmarks must be identified and discussed which demonstrate that MAAP4 is an appropriate code for the simulation of an ELAP event at your facility.	
3.2.1.1.B	The collapsed level must remain above Top of Active Fuel (TAF) and the cool down rate must be within technical specification limits.	
3.2.1.1.C	MAAP4 must be used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper.	
3.2.1.1.D	In using MAAP4, the licensee must identify and justify the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236). This should include response at a plant-specific level regarding specific modeling options and parameter choices for key models that would be expected to substantially affect the ELAP analysis	

	performed for that licensee's plant. Although some suggested key phenomena are identified below, other parameters considered important in the simulation of the ELAP event by the vendor / licensee should also be included. Nodalization General two-phase flow modeling Modeling of heat transfer and losses Choked flow Vent line pressure losses Decay heat (fission products / actinides / etc.)	
3.2.1.1.E	The specific MAAP4 analysis case that was used to validate the timing of mitigating strategies in the integrated plan must be identified and should be available on the ePortal for NRC staff to view. Alternately, a comparable level of information may be included in the supplemental response. In either case, the analysis should include a plot of the collapsed vessel level to confirm that TAF is not reached (the elevation of the TAF should be provided) and a plot of the temperature cool down to confirm that the cool down is within tech spec limits.	
3.2.1.3.D	The SOE identifies that at 15 minutes, SBO is declared and load shedding begins. At approximately 1 hour and 15 minutes the dc deep load shedding is complete (if both SAMA diesel generators fail to start). During subsequent discussions with the licensee during the audit process, additional information was provided that stated that the deep load shedding decision point is at 1 hour 15 minutes into the event and would occur if both FLEX DGs failed to start. Clarification is needed relative to the completion timing of deep shedding.	
3.2.1.3.E	On page 10 of their Integrated Plan, the licensee stated that SRVs provide RPV pressure control during an ELAP. However, the licensee did not provide information regarding what was needed to support SRV actuation (dc power or pneumatics) or how long those support systems would be available. In addition, depending on primary containment environmental conditions during the event, SRV actuation may require a higher than nominal dc voltage to actuate the SRVs. The SRV pilot solenoid coil electrical resistance would increase due to a higher containment temperature with a longer duration event than an existing SBO coping time. In subsequent discussions with the licensee during the audit process, information was provided that included a plant modification for additional nitrogen bottles to ensure SRV pneumatics would be available for 24 hours into the event and an evaluation/qualification of the SRV solenoid voltage during thermal testing.	
3.2.3.C	The Integrated Plan states on page 19 that the drywell	

	temperature will be monitored in all Phases of an ELAP. However, the Integrated Plan makes no conclusion that the resulting drywell temperatures determined by the MAAP calculation remain within penetration and equipment qualification limits. Excessive temperatures could result in a loss of containment integrity due to the failure of containment penetration seals or other portions of the containment boundary. Furthermore, excessive temperatures could result in the failure of necessary measurement instruments located in the drywell. Additional information is requested regarding a discussion and the technical basis for concluding that the calculated drywell temperature will not exceed the limits of penetration seals or other equipment.	
3.2.4.4.B	The NRC staff has reviewed the licensee communications assessment (ADAMS Number ML12311A299) required by in response to the March 12, 2012 50.54(f) request for information letter for BSEP and, as documented in the staff analysis (ML13093A341) 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 Guideline (8) regarding communications capabilities during an ELAP. This has been identified for confirmation that upgrades to the site's communications systems have been completed.	
3.2.4.7.A	In the licensee's August 20, 2013 update to their Integrated Plan, they stated that having a local response/process established at BSEP would better suit long-term makeup to the Clean Water Storage Tank (CWST). The licensee created a new Open Item 21 in their system to track this item. Due to the importance of water quality, should be confirmed	
3.2.4.8.C	The licensee provided updated information as part of the audit process regarding sizing of the Phase 2 and 3 generators. The licensee currently relies on SBO procedure (0AOP-36.2) for the kilowatt value of the loads that will be required during Phase 2 and 3. The licensee needs to finalize their load sizing analysis for the Phase 2 and 3 DGs.	
3.2.4.10.A	The Generic Concern related to extended battery duty cycles required clarification of the capability of the existing vented lead-acid station batteries to perform their expected function for durations greater than 8 hours throughout the expected service life. The position paper provided sufficient basis to resolve this concern by developing an acceptable method for demonstrating that batteries will perform as specified in a plant's Integrated Plan that satisfy NRC Order	

	EA-12-049. The methodology relies on the licensee's battery sizing calculations developed in accordance with the Institute of Electrical and Electronics Engineers Standard 485, "Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations," load shedding schemes, and manufacturer data to demonstrate that the existing vented lead-acid station batteries can perform their intended function for extended duty cycles (i.e., beyond 8 hours). The NRC staff will evaluate a licensee's application of the guidance (calculations and supporting data) in its development of the final Safety Evaluation documenting compliance with NRC Order EA-12-049.	
3.2.4.10.B	The licensee provided updated information as part of the audit process regarding the dc load shedding timeline. The licensee currently relies on SBO procedure (0AOP-36.2) for dc load shedding to minimize the battery discharge rate. The licensee needs to finalize their battery depletion analysis.	
3.3.2.A	There is insufficient information to conclude that configuration control of equipment and connections will be controlled in conformance with the guidance of NEI 12-06, Section 11.8, Items 1 and 3 regarding a program document that will contain; a historical record of previous strategies and the basis for changes, and a change control process to allow changes to the strategies only if they continue to meet the guidelines of NEI 12-06.	
3.4.A	The licensee's plans for the use of off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies (item 1 above). However, the licensee did not address considerations 2 through 10 of NEI 12-06, Section 12.2. Considerations 2 through 10 are as follows: 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).	

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 Nos. 50-325 and 50-324

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

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