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

December 17, 2013

Mr. James A. Spina
Vice President Corporate Site Operations
Constellation Energy Nuclear Group, LLC
100 Constellation Way, Suite 200C
Baltimore, MD 21202

SUBJECT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2 - INTERIM STAFF EVALUATION RELATING TO OVERALL INTEGRATED PLAN IN RESPONSE TO ORDER EA-12-049 (MITIGATION STRATEGIES) (TAC NOS. MF1142 AND MF1143)

Dear Mr. Spina:

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. ML13066A171), Constellation Energy Nuclear Group, LLC (CENG, the licensee) submitted its Overall Integrated Plan (OIP) for Calvert Cliffs Nuclear Power Plant, Units 1 and 2 (Calvert Cliffs), in response to Order EA-12-049. By letter dated March 8, 2013 (ADAMS Accession No. ML13074A056), CENG submitted a complete revision of the OIP for Calvert Cliffs. By letter dated August 27, 2013 (ADAMS Accession No. ML13254A278), CENG submitted a six-month update to the OIP for Calvert Cliffs.

Based on a review of CENG's plan, including the six-month update dated August 27, 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 Calvert Cliffs Nuclear Power Plant, Units 1 and 2. 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.

---

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

If you have any questions, please contact Mr. Randy Hall, Senior Project Manager in the Mitigating Strategies Directorate, at (301) 415-4032.

Sincerely,

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

Docket Nos. 50-317 and 50-318

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

cc w/encl: Distribution via Listserv

Mr. George H. Gellrich, Vice President
Calvert Cliffs Nuclear Power Plant, LLC
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657-4702

Mr. Edmund M. Tyler
Constellation Fleet Licensing
Constellation Energy Nuclear Group, LLC
100 Constellation Way, Suite 200C
Baltimore, MD 21202

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

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

CONSTELLATION ENERGY NUCLEAR GROUP, LLC

CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2

DOCKET NOS. 50-317 and 50-318

1.0 INTRODUCTION

The earthquake and tsunami at the Fukushima Dai-ichi nuclear power plant in March 2011 highlighted the possibility that extreme natural phenomena could challenge the prevention, mitigation and emergency preparedness defense-in-depth layers. At Fukushima, limitations in time and unpredictable conditions associated with the accident significantly challenged attempts by the responders to preclude core damage and containment failure. During the events in Fukushima, the challenges faced by the operators were beyond any faced previously at a commercial nuclear reactor. The Nuclear Regulatory Commission (NRC) determined that additional requirements needed to be imposed to mitigate beyond-design-basis external events (BDBEE). Accordingly, by letter dated March 12, 2012, the NRC issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" [Reference 1]. The order directed licensees to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities in the event of a BDBEE.

By letter dated February 28, 2013, as completely revised by letter dated March 8, 2013 [Reference 2], Constellation Energy Nuclear Group, LLC (CENG, the licensee) submitted the Overall Integrated Plan for compliance with Order EA-12-049 for the Calvert Cliffs Nuclear Power Plant, Units 1 and 2 (Calvert Cliffs or CCNPP)(hereafter referred to as the Integrated Plan). The Integrated Plan describes the guidance and strategies under development for implementation by CENG 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 27, 2013 [Reference 3], the licensee submitted the first six-month status report since the submittal of the Integrated Plan, describing the progress made in implementing the requirements of the order.

2.0 REGULATORY EVALUATION

Following the events at the Fukushima Dai-ichi nuclear power plant on March 11, 2011, the NRC established a senior-level agency task force referred to as the Near-Term Task Force (NTTF). The NTTF was tasked with conducting a systematic and methodical review of the NRC's regulations and processes, and with determining whether 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 beyond-design-basis external events. 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

---

[1] Attachment 3 provides the requirements for Combined License holders

phase requires providing sufficient portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. Specific 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 [UHS] 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 BDBEE 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 overall Integrated Plans submitted by licensees in response to Order EA-12-049, Section IV.C.1.a should follow the guidance in NEI 12-06, Section 13, which states that:

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

By letter dated August 28, 2013 [Reference 20], the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process to be used by the staff in its reviews, leading to the issuance of an interim staff evaluation and audit report for each site. The purpose of the staff's audits is to determine the extent to which 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 Calvert Cliffs, submitted by CENG's letter dated February 28, 2013, as revised by letter dated March 8, 2013, and as further supplemented. NRC and MTS staff have reviewed the submitted information and held clarifying discussions with CENG in evaluating the licensee's plans for addressing beyond-design-basis external events and its progress towards implementing those plans.

A simplified description of the Calvert Cliffs Integrated Plan to mitigate the postulated extended loss of ac power (ELAP) event is as follows: the licensee will initially remove the core decay heat by adding water to the steam generators (SGs) and releasing steam from the SGs to the atmosphere through the Atmospheric Dump Valves. The water will initially be added by the turbine-driven auxiliary feedwater (TDAFW) pump, taking suction from the condensate storage tank. Starting at 2 hours after the event, the reactor coolant system (RCS) will be cooled down to slightly above 350 degrees Fahrenheit (F), which will reduce the RCS and SG pressures. When the TDAFW pump can no longer be operated reliably, a FLEX pump will be used to add water to the SGs. For each unit, a FLEX generator will be used to reenergize one vital 480 volt ac load center. This will allow running a FLEX makeup pump to add water to the RCS, and will energize the installed battery chargers to keep the necessary direct current (dc) buses energized. In the long-term, additional equipment, such as 4160 volt ac generators, will be delivered from the Regional Response Center.

During an ELAP event, normal cooling to the SFP will be lost and the SFP water may reach the boiling point, but even for the worst case, it would take more than a day to boil down to the top of the fuel assemblies. A FLEX pump will be used to add water to the SFP to keep a substantial amount of water above the top of the stored fuel assemblies. The FLEX pump will take suction from one of the Refueling Water Tanks, or from one of several other tanks, or from the ultimate heat sink, as necessary.

Calvert Cliffs has large dry containment buildings, which contain the reactor vessel and the RCS for each unit. The licensee's analysis shows that the heatup of the containment buildings is fairly slow, and that even for the worst case, active cooling will not be required for several days, which allows time to utilize equipment from the Regional Response Center, if needed.

By letter dated December 9, 2013 [Reference 21], MTS documented the interim results of the Calvert Cliffs Integrated Plan 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.

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 certain review items to one of the following categories:

> 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.
>
> 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 are expected to require some minimal follow up review or audit prior to the licensee's compliance with order EA-12-049.

As discussed in Section 3.0, above, the NRC staff has reviewed MTS' TER for consistency with NRC policy and technical accuracy and finds that, in general, it accurately reflects the state of completeness of the licensee's Integrated Plan. The open and confirmatory items identified in the TER are listed in the tables below, with some NRC edits made for clarity from the TER version. In addition to the editorial clarifications, confirmatory items 3.2.1.9.A, 3.2.1.9.B, and 3.2.3.B from the TER were closed because the NRC staff determined that they were not applicable to Calvert Cliffs, and confirmatory item 3.1.3.2.B was also closed, as it is covered by confirmatory item 3.1.2.2.C. Thus, the summary tables presented below, as edited, provide a brief description of the issue of concern and represent the NRC's assessment of the open and confirmatory items for Calvert Cliffs under this review. Further details for each open and confirmatory item are provided in the corresponding sections of the TER, identified by the item number.

4.1 Open Items

Item Number	Description	Notes
3.2.1.1.A	The licensee will need to perform a plant specific analysis of RCS cooling and inventory control. If the CENTS code is used, the value of flow quality at the upper region of SG tubes for the condition when the RCS makeup pump is required to inject water into the RCS will also need to be submitted, and the licensee should confirm that CENTS is not used outside of any ranges of applicability discussed in the white paper addressing the use of CENTS (e.g., prior to the reflux boiling initiation). If other codes are used for the ELAP analysis, the licensee will need to justify the acceptance of the codes for this use.	
3.2.1.1.B	The licensee's plan for analysis for core and containment cooling is still under development and CENG will identify additional analysis to support the mitigating strategies. The subjects of the analyses are: maintaining core cooling	

	(e.g., confirm shutdown margin during cooldown, dc load shedding, and adequate steam pressure for TDAFW pump operation), containment temperature and pressure response for containment cooling, and various safety functions regarding ventilation and cooling systems (e.g., for the main control room, TDAFW pump room, cable spreading room, battery rooms, switchgear rooms and the SFP area). Review of these analyses is needed to confirm acceptability of the mitigating strategies.	
3.2.1.8.A	During the audit process, the licensee informed the NRC staff of its intent to abide by the Pressurized-Water Reactor Owners Group (PWROG) generic approach regarding boric acid mixing discussed in Section 3.2.1.8 of this report; however, the NRC staff concluded that the August 15, 2013, position paper was not adequately justified and that further information is required.	

4.2 Confirmatory Items

Item Number	Description	Notes
3.1.1.1.A	On page 8 of the Integrated Plan, the licensee specified that Phase 2 FLEX components will be stored at the site in a location or locations such that they are reasonably protected and that no one external event can reasonably fail the site FLEX capability. Provision will be made for multiple sets of portable on-site equipment stored in diverse locations or through storage in structures designed to reasonably protect from applicable external events. FLEX equipment storage location(s) have not been selected.	
3.1.1.1.B	The licensee will provide the specific protection requirements described in NEI 12-06 for the applicable hazard.	
3.1.1.4.A	The licensee has not yet identified the local staging area or described the methods to be used to deliver the equipment to the site for all hazards. The licensee will develop a playbook which will provide the detail necessary to ensure the successful delivery of the portable FLEX equipment from the RRC to the local staging area and from the local staging area to the site.	
3.1.2.2.A	The licensee identified two open items; one regarding evaluating deployment strategies and deployment routes to ensure they are assessed for and address applicable hazards impact. The second was to provide an administrative program governing the FLEX deployment strategy, marking of setup locations, including primary and alternate pathways, maintaining the pathways clear, and clearing the pathways.	
3.1.2.2.B	Regarding the open items noted in 3.1.2.2.A, evaluations are needed to assure that connection points for portable equipment remain viable for the flooded condition, and	

	that the effects of the maximum storm surge or probable maximum hurricane should be considered in evaluating the adequacy of the baseline deployment strategies.	
3.1.2.2.C	The licensee specified that primary access to the UHS is via the openings in the CW Discharge Structure (plant outfall). An alternate UHS location has not been established; however the licensee has identified an open item to implement a design change to install a protected alternate means of accessing the UHS for all BDBEEs, including installing necessary modifications to meet required deployment times. The strategy must also address how debris in the UHS will be filtered and/or strained and how the resulting debris will affect core cooling.	
3.1.3.2.A	The licensee specified that CCNPP currently has a varied array of wheeled vehicles, e.g., forklifts, small tractors, and a backhoe, that could be used for debris removal. However, the licensee did not specify if this equipment would be protected from high wind and other hazards.	
3.1.4.2.A	The licensee did not address procurement requirements to ensure that the FLEX equipment can be operated in extreme hot or cold temperature environments or how hot or cold temperatures will affect manual actions.	
3.1.4.2.B	Deployment of FLEX equipment has not been addressed for conditions of snow, ice and extreme cold. The current screening omits a discussion of deployment of FLEX equipment for hazards due to ice blockage or formation of frazil ice on the UHS.	
3.2.1.2.A	The RCP seal initial maximum leakage rate should be greater than or equal to the upper bound expectation for the seal leakage rate for the ELAP event discussed in the PWROG white paper addressing the RCP seal leakage for CE plants. If the RCP seal leakage rate used in the plant-specific ELAP analysis is less than upper bound expectation for the seal leakage rate discussed in the white paper, justification should be provided.	
3.2.1.5.A	The licensee has not provided sufficient analyses to confirm instruments are reliable and accurate in the containment harsh conditions with high moisture levels, temperature and pressure during the ELAP event.	
3.2.1.6.A	The following references used as basis for several sequence of events (SOE) Action Time constraints were not available for review: CCN0012-17-STUDY-001, and CCNPP FLEX Strategy Table Top.	
3.2.1.6.B	The licensee has not completed final analysis regarding validation of the action times reported in the Sequence of Events, including any SOE changes that may result from ongoing evaluations for; RCP seal leakage, plant specific CENTS analysis, and any revised battery load shed analysis.	
3.2.1.7.A	The Generic Concern related to the shutdown and refueling modes, required clarification of CCNPP's approach to	

	demonstrate that the strategies can be implemented in all modes. During the audit, the licensee informed the NRC of their plans to abide by this generic resolution. The implementation of these plans is identified as Confirmatory Item 3.2.1.7.A.	
3.2.1.9.C	During the audit process, the licensee stated that it will provide revised analyses as detailed engineering evaluations are performed for each Phase 3 FLEX component and modification strategy.	
3.2.1.9.D	The licensee provided an open item, to perform engineering analysis to determine that there is sufficient decay heat generated for TDAFW operation 36-hours after shutdown and that the TDAFW pumps can operate reliably provided there is greater than 65 psia steam pressure in one of the SGs.	
3.2.2.A	The licensee did not discuss the impacts of salt/brackish water on the structures and components of the SFP system, and the fuel. During the audit process the licensee specified that they will perform an analysis to determine the effects of salt/brackish water on the structures and components (including instrumentation) of the SFP system and the stored fuel.	
3.2.2.B	The licensee will perform an analysis to verify that the proposed strategy for SFP ventilation will provide sufficient air flow to vent steam from the SFP area, in order to determine whether natural air circulation is sufficient, or forced ventilation provided by FLEX equipment will be required.	
3.2.3.A	The licensee specified that an analysis of the Containment response during the ELAP event indicated that the Containment would not require additional cooling. During the audit, the licensee provided a document entitled "CCNPP Containment Analysis" that was based on the GOTHIC code, however, the tabulated results did not match those transmitted in the August 2013 6-month update.	
3.2.4.1.A	Charging Pump Room ventilation is provided by the non-safety related Auxiliary Building Supply and Exhaust Ventilation System. An evaluation will be performed to determine if the Charging Pumps can meet their mission time without room ventilation.	
3.2.4.2.A	The licensee identified an open item to perform an analysis to determine the Control Room temperature response over a period of 72 hours.	
3.2.4.2.B	The licensee identified an open item to develop strategies for use of the Control Room and Cable Spreading Room Appendix R Ventilation System during an ELAP.	
3.2.4.2.C	The licensee identified an open item to perform an analysis to evaluate hydrogen buildup in the battery rooms during charging and room temperature profiles.	
3.2.4.2.D	The licensee identified an open item to perform an analysis to determine the Switchgear Room temperature response following the reenergizing of buses and assuming various 480	

	VAC load center and 4160 VAC bus loadings over a period of 72 hours.	
3.2.4.2.E	The West Electrical Penetration Rooms will begin to heat up after the Reactor motor control centers (MCC) are re-energized from the FLEX 480 VAC DGs, therefore, they will need to be evaluated for limiting temperatures for equipment survivability.	
3.2.4.4.A	On page 56 of the Integrated Plan, the licensee identified five open items to; 1) investigate changing Appendix R lighting batteries to a longer life battery or new battery technology to lengthen the duration of lighting available in vital areas of the plant, 2) procure battery operated hardhat mounted lights ("miners" lights) for on-shift and emergency response organization (ERO) personnel, 3) to procure a sufficient quantity of hand-held battery operated hardhat lanterns for on-shift and ERO personnel, 4) to procure six (6) portable diesel generator powered exterior lighting units with 30 ft. masts and a minimum 400,000 lumens, and 5) to change Appendix R lighting from incandescent to LED to lengthen the duration of lighting available in vital areas of the plant.	
3.2.4.4.B	The NRC staff reviewed the licensee communications assessment and 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. Confirmation that upgrades to the site's communications systems have been completed will be accomplished at a later date.	
3.2.4.5.A	The licensee has not completed its evaluation of the primary and alternate access points	
3.2.4.6.A	The licensee has identified an open item to perform an analysis to determine the temperature profile over 72 hours in the area around the Atmospheric Dump Valve enclosures.	
3.2.4.6.B	The licensee identified an open item to perform an analysis to determine the Cable Spreading Room temperature response over a period of 72 hours.	
3.2.4.6.C	The licensee identified two open items to perform an analysis to determine the possible effects of BDBEE on the Turbine Building structure and the potential effect on access to the TDAFW Pump Room, and to develop an alternate access strategy for access into the TDAFW Pump Room.	
3.2.4.8.A	The medium voltage 4160VAC generators and the low voltage 480VAC 800kW generators that will arrive from the RRC will have protective devices as specified in AREVA document 51-9199717-000. An evaluation will be performed to verify the internal protection is adequate to protect the 1E buses.	
3.2.4.8.B	One 480VAC/675KVA diesel generator set will be deployed for each unit to connect to one vital 480 VAC Load Center on that unit. The 480VAC/125KVA diesel generators are intended as	

	an alternate strategy to connect to one of two vital reactor MCCs on each unit. The supplied reactor MCC can be cross-connected to the redundant train reactor MCC on that unit. An evaluation to validate the intended use of these diesel generators is pending.	
3.2.4.9.A	The licensee identified Open items to perform an analysis of the fuel consumption rate for all of the FLEX equipment that could be in operation during an ELAP for a period of 72 hours to determine a conservative refueling interval, and to develop strategies to reduce the transport time for fuel oil loading and delivery.	
3.2.4.10.A	On page 19 of the Integrated Plan, the licensee identified Open Items: to implement a design change to clearly identify the set of dc load breakers that will either be left energized or load shed by identifying the selected breakers by their unique numbers and load title; to implement a procedure or FSG to perform the dc load shedding; and to complete a time-motion study to validate that DC load shedding can be accomplished on each unit in one hour.	
3.2.4.10.B	Maintenance of vital 125 VDC power will include aligning the Reserve Battery to one of the four vital 125 VDC buses via bus work and disconnects that are currently being installed under an existing plant modification. This action will extend the coping time for one vital 125 VDC bus to greater than 20 hours. The licensee needs to provide a copy of the analysis/calculations which shows aligning the Reserve Battery to one of the four 125VDC buses can extend the coping time for one vital 125 VDC bus to greater than 20 hours.	
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. The licensee did not address the remaining minimum capabilities of Section 12.2.	

Based on a review of CENG's plan, including the six-month update dated August 27, 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 for Calvert Cliffs Nuclear Power Plant, Units 1 and 2. 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 this Interim Staff Evaluation and Audit Report.

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. With the exception of the items noted in Section 4.0 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 alternating current power and the ultimate heat sink. Full compliance with the order will enable the NRC to continue to have reasonable assurance of adequate protection of public health and safety. The staff will issue a safety evaluation confirming compliance with the order and may conduct inspections to verify proper implementation of the licensee's proposed measures.

6.0 REFERENCES

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

2. Letter from Constellation Energy Nuclear Group, LLC, to NRC, "Calvert Cliffs Nuclear Power Plant, Units 1 and 2 – Supplement to Overall Integrated Plan for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 8, 2013 (ADAMS Accession No. ML13074A056)

3. Letter from Constellation Energy Nuclear Group, LLC, to NRC, " Calvert Cliffs Nuclear Power Plant, Units 1 and 2 - 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 27, 2013 (ADAMS Accession No. ML13254A278)

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

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

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

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

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

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

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

11. SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," February 17, 2012 (ADAMS Accession No. ML12039A103)

12. SRM-SECY-12-0025, "Staff Requirements – SECY-12-0025 - Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," March 9, 2012 (ADAMS Accession No. ML120690347)

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

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

15. Draft JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," May 31, 2012 (ADAMS Accession No. ML12146A014)

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

17. Nuclear Energy Institute, Comments from Adrian P. Heymer on Draft Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,", 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)

Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,", July 3, 2012 (ADAMS Accession No. ML121910390)

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

19. Final Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," August 29, 2012 (ADAMS Accession No. ML12229A174)

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

21. Letter from J. Bowen, MegaTech Services, LLC, to E. Bowman, NRC, "Second Batch SED Final Revision 1 – 7 Sites," dated December 9, 2013 (ADAMS Accession No. ML13346A616), submitting the Technical Evaluation Report for the Calvert Cliffs Nuclear Power Plant, Units 1 and 2.

Principal Contributors: S. Sun, J. Kaizer, V. Goel, R. Hall, M. Levine, E. Bowman, B. Titus

Date: December 17, 2013

Enclosure 2

Technical Evaluation Report

ML13338A646

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

December 9, 2013

Constellation Energy Nuclear Group, LLC
Calvert Cliffs Nuclear Power Plant, Units 1 and 2
Docket No. 50-317 and 50-318

Prepared for:

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

Contract NRC-HQ-13-C-03-0039
Task Order No. NRC-HQ-13-T-03-0001
Job Code: J4672
TAC Nos. MF1142 and MF1143

Prepared by:

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

Technical Evaluation Report

Calvert Cliffs Nuclear Power 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.

2.0EVALUATION 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 28, 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. ML13066A171), Constellation Energy Nuclear Group, CENG (hereinafter referred to as the licensee) provided Calvert Cliffs Nuclear Power Plant (CCNPP) Integrated Plan for Compliance with Order EA-12-049. By letter dated March 8, 2012, (ADAMS Accession No. ML13074A056) provided a revised version of the Integrated Plan, changing the discussion of equipment delivery by the Strategic Alliance for FLEX Emergency Response (SAFER) and replacing the letter dated February 28, 2013, in its entirety. By letter dated August 28, 2013 (ADAMS Accession No. ML13254A278), the licensee provided CCNPP's first six-month update, which included supplementary information and changes to the Integrated Plan. 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.

On page 5 of the Integrated Plan, the licensee specified that CCNPP was originally designed to a Housner shaped Safe Shutdown Earthquake (SSE) with a 0.15g Peak Ground Acceleration (PGA). The licensee provided a further discussion regarding liquefaction potential at the site. Per CCNPP Units I and 2 UFSAR Section 2.7.6.3, Liquefaction Potential, examination of liquefaction potential at the site used data from dynamic triaxial testing, standard penetration resistances from the borings, in-place density determinations and geological origin of the sedimentary soils at the site. All of these data showed that the soil at the site was not of a liquefaction potential. The dynamic tests showed exceptional strength under constant cyclic stress. Therefore, the licensee concluded that likelihood of liquefaction at the site for a DBE event with a maximum horizontal acceleration equal to 0.15g appears to be low and that CCNPP screens in for an assessment for seismic hazard except for liquefaction. In addition, the licensee stated that the seismic re-evaluations pursuant to the NRC 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore not assumed in their Integrated Plan. As the reevaluations are completed, appropriate issues will be entered into the corrective action system and addressed on a schedule commensurate with other licensing bases changes.

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

3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

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

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

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

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

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

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

On page 8 of the Integrated Plan, the licensee specified that Phase 2 FLEX components will be stored at the site in a location or locations such that they are reasonably protected and that no one external event can reasonably fail the site FLEX capability. Provision will be made for multiple sets of portable on-site equipment stored in diverse locations or through storage in structures designed to reasonably protect from applicable external events. FLEX equipment storage location(s) have not been selected. This has been identified by the licensee as an open item on page 9 of the Integrated Plan and is being tracked as open item 7 in the August 2013 6-month update. This has been identified as Confirmatory Item 3.1.1.1.A in Section 4.2.

On page 30 and 39 of the Integrated Plan, the licensee specified that structures to provide protection of the FLEX equipment will be constructed to meet the requirements identified in NEI 12-06 section 11. However, Section 11 provides general storage design guidance but does not provide the details for protection from the seismic hazards by securing and evaluating for interactions 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 addition, the schedule to construct the structures is still to be determined. The licensee specified that CCNPP procedures and programs will be developed to address storage structure requirements relative to the hazards applicable to CCNPP. This has been identified by the licensee as an open item on page 9 of the integrated plan and is being tracked as open item 6 in the August 2013 6-month update. This has been identified as Confirmatory Item 3.1.1.1.B in Section 4.2.

On pages 65 and 67 of the Integrated Plan, the licensee specified that plant piping and valves for FLEX connections will be missile protected and enclosed within Seismic Category 1 or seismically rugged structure. New FLEX piping shall be installed to meet necessary seismic requirements.

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 storage of FLEX equipment during seismic events, if these requirements are implemented as described.

3.1.1.2 Deployment of FLEX Equipment - Seismic Hazard

NEI 12-06, Section 5.3.2 states:

> The baseline capability requirements already address loss of non-seismically robust equipment and tanks as well as loss of all AC. So, these seismic considerations are implicitly addressed.
>
> There are five considerations for the deployment of FLEX equipment following a seismic event:
>
> 1. If the equipment needs to be moved from a storage location to a different point for deployment, the route to be traveled should be reviewed for potential soil liquefaction that could impede movement following a severe seismic event.
>
> 2. At least one connection point for the FLEX equipment will only require access through seismically robust structures. This includes both the connection point and any areas that plant operators will have to access to deploy or control the capability.
>
> 3. If the plant FLEX strategy relies on a water source that is not seismically robust, e.g., a downstream dam, the deployment of FLEX coping capabilities should address how water will be accessed. Most sites with this configuration have an underwater berm that retains a needed volume of water. However, accessing this water may require new or different equipment.
>
> 4. If power is required to move or deploy the equipment (e.g., to open the door from a storage location), then power supplies should be provided as part of the FLEX deployment.
>
> 5. A means to move FLEX equipment should be provided that is also reasonably protected from the event.

On page 5 of the Integrated Plan, the licensee specified that, per the FSAR, the soil at the site has a low potential for liquefaction, and that the likelihood of liquefaction at the site is low.

On page 8 of the Integrated Plan, the licensee stated in part that the designed hardened connections will be protected against external hazards. The licensee has a self-identified open item to evaluate deployment strategies and deployment routes to ensure they are assessed for and address applicable hazards impact. In addition, on page 12 of the Integrated Plan the licensee specified that the deployment routes shown in Attachments 5-1 and 5-2 are expected to be utilized to transport FLEX equipment to the deployment locations. The identified paths and deployment areas will be accessible during all modes of operation. This deployment strategy will be included within an administrative program to ensure the pathways remain clear and actions to clear the pathways if necessary.

On page 22 of the Integrated Plan, the licensee specified that deploying and operation of the portable FLEX pumps to supply RCS makeup or injection flow must commence expeditiously following the onset of the event, and that this should be achievable given that additional personnel are on site around the clock during outages to provide the necessary resources. The licensee stated that they will provide guidance to ensure that designated deployment areas identified and that deployment paths remain accessible without interference from outage equipment during refueling outages, and develop an FSG to ensure that designated deployment areas are identified and that deployment paths remain accessible without interference from outage equipment during refueling outages. Additionally the licensee will store pickup trucks and trailers in FLEX storage areas noted in Table 1 of the integrated Plan, PWR Portable Equipment Phase 2.

On page 27 of the Integrated Plan the licensee specified that the UHS (Chesapeake Bay) can also be used as a limitless source of cooling water. Portable FLEX pumps can be deployed adjacent to the Circulating Water discharge structure with suction hoses placed into openings in the discharge structure. The licensee identified an open item to implement a design change to install a protected alternate means of accessing the UHS for all BDBEEs including installing necessary modifications to meet required deployment times. Consideration 3 does not apply to Calvert Cliffs as the site is located on the Chesapeake Bay and hence there are no downstream dams that could affect the water supply.

The Integrated Plan did not address the need for power to move or deploy the FLEX equipment. During the audit response the licensee specified that the doors for the FLEX storage building would be designed to slide or rollup and could be operated manually or with an electric powered backup generator. The licensee stated that an alternate approach would be to provide staggered missile barriers in front of the doors for missile protection.

The licensee will store pickup trucks and trailers in FLEX storage areas noted in Table-1, PWR Portable Equipment Phase 2, to provide a means to move the FLEX equipment which is also reasonably protected from the event.

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

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

> There are four procedural interface considerations that should be addressed.

1. Seismic studies have shown that even seismically qualified electrical equipment can be affected by BDB seismic events. In order to address these considerations, each plant should compile a reference source for the plant operators that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (see Section 3.2.1.10). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance should include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power.

2. Consideration should be given to the impacts from large internal flooding sources that are not seismically robust and do not require ac power (e.g., gravity drainage from lake or cooling basins for non-safety-related cooling water systems).

3. For sites that use ac power to mitigate ground water in critical locations, a strategy to remove this water will be required.

4. Additional guidance may be required to address the deployment of FLEX for those plants that could be impacted by failure of a not seismically robust downstream dam.

On page 22 of the Integrated Plan, the licensee specified that CCNPP will utilize the industry developed guidance from the Owners Groups, Electric Power Research Institute (EPRI) and NEI Task team to develop site specific procedures or guidelines to address NEI 12-06. These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOPs.

The Integrated Plan did not address determination of necessary instrument readings per NEI 12-06 Section 5.3.3, consideration 1, in the event that seismically qualified electrical equipment is affected by beyond-design-basis seismic events. During the audit process the licensee specified that FSG guidance would be developed equivalent to Combustion Engineering FSG-7 that will include the instrument reference source as an attachment and the appropriate training will be provided.

The Integrated Plan did not address procedural interfaces 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. During the audit process the licensee specified that flood analysis includes equipment damage from spray as well as high water level. The licensee stated that these risks may be created by failure of fluid system piping, water storage tanks inside safety-related buildings and by spurious actuation of fire suppression system. The licensee also stated that based on plant walkdowns, all the safety-related piping systems and water storage tanks inside the Containment and the Auxiliary Building (AB) are considered seismically rugged and screened at a minimum High Confidence of Low Probability of Failure (HCLPF) of 0.3g. The non-safety-related piping, particularly the Fire Protection system in the safety-related buildings, is well supported and is also screened at a HCLPF of at least 0.3g. In the Turbine Building (TB), piping in the proximity of electrical components and the Fire Protection system are screened at 0.3g. Part of the Service Water (SRW) piping did not meet the HCLPF screening due to spatial interaction. The licensee stated that thus, SRW could be a potential flood source if the piping breaks during a seismic event, however, the results of the IPE Internal Flooding analysis indicated that the flooding from SRW source in the TB presents no significant risk to plant safety.

As noted above, the licensee did not identify any large internal flooding sources due to seismic hazards at CCNPP as part of the IPEEE program. The licensee stated that CCNPP utilizes a gravity drainage system, the Subsurface Drainage System, (SSD) and does not require ac power to mitigate groundwater, and that the SSD was installed to lower the original plant ground water elevation. The SSD is a design feature that, in combination with waterproofing of subsurface structure exterior walls and installation of water stops, was provided to reduce the possibility of ground water infiltration or flooding of equipment located below ground water level

Consideration 4 does not apply to Calvert Cliffs as the site is located adjacent to the Chesapeake Bay, as discussed in Section 3.1.1.2 above.

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

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

On page 13 of the Integrated Plan, the licensee specified that they will participate in the establishment and support of the Regional Response Centers (RRCs) through the SAFER. SAFER will provide requested portable FLEX equipment to a local staging area which has not yet been identified. The licensee will develop a playbook which will provide the detail necessary to ensure the successful delivery of the portable FLEX equipment from the RRC to the local staging area and then to the site. The licensee identified four incomplete open items to track issues related to off-site resources that included 1) determining the location of the CCNPP local staging area, primary and alternate delivery routes, and delivery methods to the proposed onsite laydown areas. The licensee will 2) define criteria for the local staging area, 3) establish a suitable local staging area for portable FLEX equipment to be delivered from the RRC to the site, and 4) develop site specific playbook for delivery of portable FLEX equipment from the RRC to the site. These items are being tracked in the 6-month update process as items 10, 12, 13, and 14. This has been identified as Confirmatory Item 3.1.1.4.A in Section 4.2.

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

3.1.2 Flooding

NEI 12-06, Section 6.2 states:

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

NEI 12-06, Section 6.2.1 states in part:

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

On page 6 of the Integrated Plan, the licensee specified that the Design Basis Flood Level (DBFL) for CCNPP is 27.1 feet. Per CCNPP Units 1 and 2 UFSAR Section 2.8.3, the Probable Maximum Hurricane (PMH) will produce a calculated wave run-up to elevation 27.1 ft. mean seal level (MSL). The principal structure of concern is the Intake Structure. The Intake Structure has a roof elevation of 28.5 ft. MSL and an open deck at elevation 10.0 ft. MSL on the Chesapeake Bay side. The deck is about 50 ft. wide and has openings for the trash rakes and racks, stop logs, and traveling screens. Therefore, CCNPP is not a "dry" site because portions of the plant are below the DBFL. The recently completed Flood Hazard Reevaluation (FHR) report identified two potential new external flood hazards. The issues and the interim actions are outlined in the FHR submittal and are available for review (ADAMS Accession Nos. ML13078A010 and ML13254A151).

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

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

> These considerations apply to the protection of FLEX equipment from external flood hazards:

1. The equipment should be stored in one or more of the following configurations:

    a. Stored above the flood elevation from the most recent site flood analysis. The evaluation to determine the elevation for storage should be informed by flood analysis applicable to the site from early site permits, combined license applications, and/or contiguous licensed sites.

    b. Stored in a structure designed to protect the equipment from the flood.

    c. FLEX equipment can be stored below flood level if time is available and plant procedures/guidance address the needed actions to relocate the equipment. Based on the timing of the limiting flood scenario(s), the FLEX equipment can be relocated [footnote 2 omitted] to a position that is protected from the flood, either by barriers or by elevation, prior to the arrival of the potentially damaging flood levels. This should also consider the conditions on-site during the increasing flood levels and whether movement of the FLEX equipment will be possible before potential inundation occurs, not just the ultimate flood height.

2. Storage areas that are potentially impacted by a rapid rise of water should be avoided.

On pages 7 and 8 of the Integrated Plan the licensee specified that the flood re-evaluation pursuant to the NRC 10 CFR 50.54(f) letter of March 12, 2012 was not completed. The licensee identified an Open Item to perform an analysis to confirm the Probable Maximum Precipitation (PMP) event maximum flood height will not impact the operation of Turbine Driven Auxiliary Feedwater (TDAFW) Pump or preclude access to the room. In the August 2013 6-month update the licensee specified that this open item is complete. The licensee stated that Bechtel calculation 25794-000-KOC-0000-00005, "CCNPP Units 1&2 Flooding Reevaluation" (ADAMS Accession No's ML13078A010 and ML13254A151), was completed as part of the flooding submittal. This calculation concluded that flooding from the PMP event would not cause inoperability of any safety related equipment, even with TB doors left open during the duration of the event.

On page 8 of the Integrated Plan, the licensee specified that Phase 2 FLEX components will be stored at the site in a location or locations such that they are reasonably protected and that no one external event can reasonably fail the site FLEX capability. Provision will be made for multiple sets of portable on-site equipment stored in diverse locations or through storage in structures designed to reasonably protect from applicable external events. FLEX equipment storage location(s) have not been selected. This has been combined with Confirmatory Item 3.1.1.1.A in section 4.2

On pages 30, 39 and 48 of the Integrated Plan, the licensee specified that structures to provide protection of the FLEX equipment will be constructed to meet the requirements identified in NEI 12-06 Section 11. As discussed in Section 3.1.1.1, the licensee makes reference to Section 11 rather than to the specific protection requirements described in NEI 12-06 for the applicable hazard. CCNPP procedures and programs will be developed to address storage structure requirements deployment path requirements, and FLEX equipment requirements relative to the hazards applicable to CCNPP. This has been combined with Confirmatory Item 3.1.1.1.B in Section 4.2

On pages 30 and 64 of the Integrated Plan, the licensee specified that if FLEX equipment is stored below current flood level, procedures will be developed to ensure equipment is moved prior to exceeding flood level.

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 storage of FLEX equipment during flood events, if these requirements are implemented as described.

3.1.2.2 Deployment of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.2 states:

> There are a number of considerations which apply to the deployment of FLEX equipment for external flood hazards:
>
> 1. For external floods with warning time, the plant may not be at power. In fact, the plant may have been shut down for a considerable time and the plant configuration could be established to optimize FLEX deployment. For example, the portable pump could be connected, tested, and readied for use prior to the arrival of the critical flood level. Further, protective actions can be taken to reduce the potential for flooding impacts, including cooldown, borating the RCS, isolating accumulators, isolating RCP seal leak off, obtaining dewatering pumps, creating temporary flood barriers, etc. These factors can be credited in considering how the baseline capability is deployed.
>
> 2. The ability to move equipment and restock supplies may be hampered during a flood, especially a flood with long persistence. Accommodations along these lines may be necessary to support successful long-term FLEX deployment.
>
> 3. Depending on plant layout, the ultimate heat sink may be one of the first functions affected by a flooding condition. Consequently, the deployment of the FLEX equipment should address the effects of LUHS, as well as ELAP.
>
> 4. Portable pumps and power supplies will require fuel that would normally be obtained from fuel oil storage tanks that could be inundated by the flood or above ground tanks that could be damaged by the flood. Steps should be considered to protect or provide alternate sources of fuel oil for flood conditions. Potential flooding impacts on access and egress should also be considered.
>
> 5. Connection points for portable equipment should be reviewed to ensure that they remain viable for the flooded condition.
>
> 6. For plants that are limited by storm-driven flooding, such as Probable Maximum Surge or Probable Maximum Hurricane (PMH), expected storm

conditions should be considered in evaluating the adequacy of the baseline deployment strategies.

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

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

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

On page 12 of the Integrated Plan, the licensee specified that deployment routes are expected to be utilized to transport FLEX equipment to the deployment locations, and that the specified paths and deployment areas will be accessible during all modes of operation. This deployment strategy will be included within an administrative program to ensure the pathways remain clear and actions to clear the pathways if necessary. On page 6 of the Integrated Plan the licensee specified that per NEI 12-06, Section 6.2.1, CCNPP is not a "dry" site because portions of the plant are below the design basis flood level (DBFL), and per NEI 12-06, Table 6-1, Flooding Warning and Persistence Conditions, the warning time for CCNPP would be days and the persistence of the event would be hours.

The licensee identified two open items in the Integrated Plan; one regarding evaluating deployment strategies and deployment routes to ensure they are assessed for and address applicable hazards impact. The second was to provide an administrative program governing the FLEX deployment strategy, marking of setup locations, including primary and alternate pathways, maintaining the pathways clear, and clearing the pathways. Review of these evaluations and administrative programs has been identified as Confirmatory Item 3.1.2.2.A in Section 4.2.

Regarding the above open items, evaluations are needed to assure that connection points for portable equipment remain viable for the flooded condition per consideration 5, and that the effects of the maximum storm surge or PMH should be considered in evaluating the adequacy of the baseline deployment strategies per consideration 6. Additionally, the licensee did address the need for temporary flood barriers per consideration 8. This has been identified as Confirmatory Item 3.1.2.2.B in Section 4.2.

On pages 57 and 58 of the Integrated Plan, the licensee specified that primary access to the UHS will be located on the waterfront 10 ft. elevation north of the Sewage Treatment Building. An alternate UHS location has not been established, however the licensee intends on implementing a design change to install a protected alternate means of accessing the UHS for all BDBEEs, including installing necessary modifications to meet required deployment times. The strategy must also address how debris in the UHS will be filtered or strained, and how the resulting debris will affect core cooling. This has been identified a Confirmatory Item 3.1.2.2.C in Section 4.2.

On page 58 of the Integrated plan, the licensee specified that station administrative procedure EP-1-108, "Severe Weather Preparation," contains a limited amount of information regarding consumables for site personnel and augment staff personnel who may also be on site, however, it lacks a detailed inventory of consumables that should be stocked to support at least 24 hours of site operation independent of offsite support. The licensee identified three Open Items regarding off site resources during flooding conditions: 1) to purchase the consumables that should be stocked to support at least 24 hours of site operation independent of offsite support; 2) To provide a procedure governing the maintenance and distribution of the consumables that will be stocked to support at least 24 hours of site operation independent of offsite support; and 3) to develop a strategy to protect onsite consumables for use after a BDBEE.

The licensee listed equipment for moving FLEX equipment and for dewatering that includes two pickup trucks, three 14 ft. by 7 ft. enclosed trailers, two dewatering pumps and ten submersible dewatering pumps available from the RRC as a contingency. The licensee will store pickup trucks and trailers in FLEX storage areas noted in Table-1, PWR Portable Equipment Phase 2, to provide a means to move the FLEX equipment which is also reasonably protected from the event.

On page 63 of 109 of its Integrated Plan, the licensee specified that the CCNPP Transportation Center located outside of the PA just south of the Outside Building Complex has a buried 4,000 gallon diesel fuel oil tank that will be used on an interim basis for fueling the FLEX pumps, generators, and air compressors. This diesel fuel oil storage tank is refilled when stored volume reaches 2,000 gallons. The turnover rate of this fuel is such that a low sulfur content of less than 15 ppm is maintained. The licensee will provide a permanent, fully protected diesel fuel oil storage tank for refueling the FLEX diesel-driven 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 Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of FLEX equipment for flooding hazards, if these requirements are implemented as described.

3.1.2.3 Procedural Interfaces - Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

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

On page 30 and 39 of the Integrated Plan, the licensee specified that CCNPP procedures and programs will be developed to address storage structure requirements, deployment path requirements, and FLEX equipment requirements relative to the hazards applicable to CCNPP, and on page 66 that CCNPP will need to develop procedures needed for implementation of Phase 3 strategies.

The Integrated Plan did not address deployment of temporary flood barriers and the need for water extraction pumps. During the audit process the licensee specified that an analysis compared the circulating water failure to the resulting flooding from the PMP and determined that no safety-related equipment is in jeopardy, in particular, the TDAFW system. Therefore, flood barriers and extraction pumps are not required.

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

3.1.2.4 Considerations in Using Offsite Resources - Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

On page 6 of the integrated Plan the licensee specified that per NEI 12-06, Section 6.2.1, CCNPP is not a "dry" site because portions of the plant are below the design basis flood level (DBFL), and per NEI 12-06, Table 6-1, Flooding Warning and Persistence Conditions, the warning time for CCNPP would be days and the persistence of the event would be hours, therefore flood persistence will not impact receipt of RRC resources, as these resources will not be arriving before 24 hours.

The licensee has not yet identified the local RRC staging area and developed a playbook which will provide the detail necessary to ensure the successful delivery of the portable FLEX equipment from the RRC to the local staging area and then to the site. This has been combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

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

3.1.3 High Wind Hazard

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 6 of the Integrated Plan, the licensee specified that CCNPP is located at 38^0 25' 55" N latitude and 76° 26' 32" W longitude. Per NEI 12-06, Figure 7-1, the hurricane induced peak-gust wind speed hazard is 150 - 160 miles per hour. Additionally, per NEI 12-06, Figure 7-2, CCNPP has a tornado wind speed hazard of 166 miles per hour. As this is greater than the NEI 12-06 threshold of 130 mph, the site will address tornado hazards impacting FLEX deployment. Thus CCNPP screens in for an assessment for High Wind Hazard from tornadoes and hurricanes.

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

3.1.3.1 Protection of FLEX Equipment - High Wind Hazard

NEI 12-06, Section 7.3.1 states:

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 8 of the Integrated Plan, the licensee specified that Phase 2 FLEX components will be stored at the site in a location or locations such that they are reasonably protected and that no one external event can reasonably fail the site FLEX capability. Provision will be made for multiple sets of portable on-site equipment stored in diverse locations or through storage in structures designed to reasonably protect from applicable external events. FLEX equipment storage location(s) have not been selected. This has been combined with Confirmatory Item 3.1.1.1.A in section 4.2

On pages 30, 39 and 48 of the Integrated Plan, the licensee specified that structures to provide protection of the FLEX equipment will be constructed to meet the requirements identified in NEI 12-06 section 11. As discussed in Section 3.1.1.1, the licensee makes reference to Section 11 rather than to the specific protection requirements described in NEI 12-06 for the applicable hazard. CCNPP procedures and programs will be developed to address storage structure requirements deployment path requirements, and FLEX equipment requirements relative to the hazards applicable to CCNPP. This has been combined with Confirmatory Item 3.1.1.1.B in Section 4.2

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and 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 to FLEX equipment during high wind events, if these requirements are implemented as described.

3.1.3.2 Deployment of Portable 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.

On page 12 of the Integrated Plan, the licensee specified that deployment routes shown in Attachments 5-1 and 5-2 of the Integrated Plan are expected to be utilized to transport FLEX equipment to the deployment locations. The identified paths and deployment areas will be accessible during all modes of operation. This deployment strategy will be included within an administrative program to ensure the pathways remain clear and actions to clear the pathways if necessary. This has been combined with Confirmatory Item 3.1.2.2.A in Section 4.2.

On page 57 of the Integrated Plan, the licensee specified that CCNPP currently has a varied array of wheeled vehicles, e.g., forklifts, small tractors, and a backhoe, that could be used for debris removal. However the licensee did not specify if this equipment would be protected from high wind and other hazards. This has been identified as Confirmatory Item 3.1.3.2.A in Section 4.2.

The licensee also specified that primary access to the UHS is via the openings in the CW Discharge Structure (plant outfall) located on the waterfront 10 ft. elevation north of the Sewage Treatment Building. An alternate UHS location has not been established; however the licensee has identified an open item to implement a design change to install a protected alternate means of accessing the UHS for all BDBEEs, including installing necessary modifications to meet required deployment times. The strategy must also address how debris in the UHS will be filtered / strained and how the resulting debris will effect core cooling. This has been identified as Confirmatory Item 3.1.3.2.B in Section 4.2.

On page 73 of the Integrated Plan, the licensee listed the following transportation equipment and debris clearing equipment:

- Two (2) 4WD diesel tow vehicles
- RAM 2500 or equivalent with onboard DFO transfer pump
- Two (2) Debris Removal Vehicles
- One (1) Bobcat S130 or equivalent
- One (1) Bobcat TI 80 or equivalent with grapple bucket

However, the Integrated Plan documents on page 57 that the site lacks tracked or wheeled vehicles of sufficient capacity to remove the possible debris generated during a BDBEE. The licensee identified an open item to purchase one wheeled and one tracked vehicle with bucket/blade and grapple of sufficient size and load handling capacity to remove debris.

Station administrative procedure EP-1-108, Severe Weather Preparation, contains a limited amount of information regarding consumables for site personnel and augment staff personnel who may also be on site, however, it lacks a detailed inventory of consumables that should be stocked to support at least 24 hours of site operation independent of offsite support. The licensee identified open items to purchase the consumables that should be stocked to support at least 24 hours of site operation independent of offsite support, to provide a procedure governing the maintenance and distribution of the consumables that will be stocked to support at least 24 hours of site operation independent of offsite support, and to develop a strategy to protect onsite consumables for use after a BDBEE.

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

3.1.3.3 Procedural Interfaces - High Wind Hazard

NE 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.

On pages 30 and 39 of the Integrated Plan, the licensee specified that CCNPP procedures and programs will be developed to address storage structure requirements, haul path requirements, and FLEX equipment requirements relative to the hazards applicable to CCNPP.

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

3.1.3.4 Considerations in Using Offsite Resources - High Wind Hazard

NEI 12-06, Section 7.3.4 states:

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

The licensee has not yet identified the local RRC staging area and develop a playbook which will provide the detail necessary to ensure the successful delivery of the portable FLEX equipment from the RRC to the local staging area and then to the site. This has been combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

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

3.1.4 Snow, Ice and Extreme Cold Hazard

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 35th Parallel should provide the capability to address extreme snowfall with snow removal equipment. Finally, all sites except for those within Level 1 and 2 of the maximum ice storm severity map contained in Figure 8-2 should address the impact of ice storms.

On pages 6 and 7 of the Integrated Plan, the licensee stated that CCNPP is located above the 35th parallel and thus the capability to address extreme snowfall with snow removal equipment needs be provided. Additionally, CCNPP is located within the region characterized by EPRI as ice severity level 4 per NEI 12-06, Figure 8-2. As such, CCNPP is subject to severe icing conditions that could also cause catastrophic destruction to electrical transmission lines. Thus CCNPP screens in for an assessment for Snow, Ice and Extreme Cold Hazard.

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

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

NEI 12-06, Section 8.3.1 states:

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

On page 8 of the Integrated Plan, the licensee specified that Phase 2 FLEX components will be stored at the site in a location or locations such that they are reasonably protected and that no one external event can reasonably fail the site FLEX capability. Provision will be made for multiple sets of portable on-site equipment stored in diverse locations or through storage in structures designed to reasonably protect from applicable external events. FLEX equipment storage location(s) have not been selected. This has been combined with Confirmatory Item 3.1.1.1.A in section 4.2

On pages 30, 39 and 48 of the Integrated Plan, the licensee specified that structures to provide protection of the FLEX equipment will be constructed to meet the requirements identified in NEI 12-06 section 11. As discussed in Section 3.1.1.1, the licensee makes reference to Section 11 rather than to the specific protection requirements described in NEI 12-06 for the applicable hazard. CCNPP procedures and programs will be developed to address storage structure requirements deployment path requirements, and FLEX equipment requirements relative to the hazards applicable to CCNPP. This has been combined with Confirmatory Item 3.1.1.1.B in Section 4.2

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and 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 of equipment for snow, ice and extreme cold hazards, if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.2 states:

> There are a number of considerations that apply to the deployment of FLEX equipment for snow, ice, and extreme cold hazards:
>
> 1. The FLEX equipment should be procured to function in the extreme conditions applicable to the site. Normal safety-related design limits for outside conditions may be used, but consideration should also be made for any manual operations required by plant personnel in such conditions.
>
> 2. For sites exposed to extreme snowfall and ice storms, provisions should be made for snow/ice removal, as needed to obtain and transport equipment from storage to its location for deployment.
>
> 3. For some sites, the ultimate heat sink and flow path may be affected by extreme low temperatures due to ice blockage or formation of frazil ice. Consequently, the evaluation should address the effects of such a loss of the UHS on the deployment of FLEX equipment. For example, if UHS water is to be used as a makeup source, some additional measures may need to be taken to assure that the FLEX equipment can utilize the water.

On pages 8 and 12 of 109 in the integrated plan, the licensee identified open items to evaluate deployment strategies and deployment routes to ensure they are assessed for and address applicable hazards impact, and to provide an administrative program governing the FLEX deployment strategy, marking of setup locations, including primary and alternate pathways, maintaining the pathways clear, and clearing the pathways. The licensee did not address procurement requirements to ensure that the FLEX equipment can be operated in extreme cold temperature environments or how cold temperature will affect manual actions. This has been identified as Confirmatory Item 3.1.4.2.A in Section 4.2.

On page 12 of the Integrated Plan, the licensee specified that deployment routes shown in Attachments 5-1 and 5-2 of the Integrated Plan are expected to be utilized to transport FLEX equipment to the deployment locations. The identified paths and deployment areas will be accessible during all modes of operation. This deployment strategy will be included within an administrative program to ensure the pathways remain clear and actions to clear the pathways if necessary. This has been combined with Confirmatory Item 3.1.2.2.A in Section 4.2.

On pages 57 and 58 of the Integrated Plan, the licensee specified that primary access to the UHS is located on the waterfront 10 ft. elevation north of the Sewage Treatment Building. An alternate UHS location has not been established, however the licensee intends on implementing a design change to install a protected alternate means of accessing the UHS for all BDBEEs, including installing necessary modifications to meet required deployment times.

Deployment of FLEX equipment has not been addressed for conditions of snow, ice and extreme cold. The current screening omits a discussion of deployment of FLEX equipment for hazards due to ice blockage or formation of frazil ice on the UHS. However, the discussion notes that CCNPP's location is within the level 4 region of NEI 12-06, Figure 8-2, which corresponds to the Level 4 ice storm severity region, and that as such, would require consideration of an ice or snow storm impact on the coping strategies for this hazard. This has been identified as Confirmatory Item 3.1.4.2.B in Section 4.2.

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

3.1.4.3 Procedural Interfaces - Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.3 states:

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

On page 30 and 39 of the Integrated Plan, the licensee specified that CCNPP procedures and programs will be developed to address storage structure requirements, deployment path requirements, and FLEX equipment requirements relative to the hazards applicable to CCNPP.

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

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

NEI 12-06, Section 8.3.4, states that:

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

The licensee has not yet identified the local RRC staging area and develop a playbook which will provide the detail necessary to ensure the successful delivery of the portable FLEX equipment from the RRC to the local staging area and then to the site. This has been combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

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

3.1.5 High Temperature Hazard

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.

On page 7 of the Integrated Plan, the licensee specified that in the Chesapeake Bay western shore region of Maryland summers are warm and humid, with rare periods of extremely hot weather over 100 degrees F. The historical high temperature recorded at Lusby, MD, located approximately 3 miles to the south of the site was 103 degrees F in July 1980. Per CCNPP UFSAR Section 9.8, Plant Ventilation Systems, the plant is designed for outside air temperatures ranging from 0 degrees F to 95 degrees F. Thus CCNPP screens in for an assessment for extreme High Temperature.

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

3.1.5.1 Protection of FLEX Equipment - High Temperature Hazard

NEI 12-06 Section 9.3.1 states that all sites should maintain the equipment at a temperature within a range to ensure its likely function when called upon.

On page 8 of the Integrated Plan, the licensee specified that Phase 2 FLEX components will be stored at the site in a location or locations such that they are reasonably protected and that no one external event can reasonably fail the site FLEX capability. Provision will be made for multiple sets of portable on-site equipment stored in diverse locations or through storage in structures designed to reasonably protect from applicable external events. FLEX equipment storage location(s) have not been selected. This has been combined with Confirmatory Item 3.1.1.1.A in section 4.2

On pages 30, 39 and 48 of the Integrated Plan, the licensee specified that structures to provide protection of the FLEX equipment will be constructed to meet the requirements identified in NEI 12-06 section 11. As discussed in Section 3.1.1.1, the licensee makes reference to Section 11 rather than to the specific protection requirements described in NEI 12-06 for the applicable hazard. CCNPP procedures and programs will be developed to address storage structure requirements deployment path requirements, and FLEX equipment requirements relative to the hazards applicable to CCNPP. This has been combined with Confirmatory Item 3.1.1.1.B in Section 4.2

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and 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 of FLEX equipment during high temperature events, if these requirements are implemented as described.

3.1.5.2 Deployment of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

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

On page 8 of the Integrated Plan, the licensee specified that Phase 2 FLEX components will be stored at the site in a location or locations such that they are reasonably protected and that no one external event can reasonably fail the site FLEX capability. Provision will be made for multiple sets of portable on-site equipment stored in diverse locations or through storage in structures designed to reasonably protect from applicable external events.

On pages 8 and 12 of 109 in the integrated plan, the licensee identified open items to evaluate deployment strategies and deployment routes to ensure they are assessed for and address applicable hazards impact, and to provide an administrative program governing the FLEX deployment strategy, marking of setup locations, including primary and alternate pathways, maintaining the pathways clear, and clearing the pathways. The licensee did not address procurement requirements to ensure that the FLEX equipment can be operated in high temperature environments or how high temperature will affect manual actions for example expansion of sheet metal, or swollen door seals. This has been combined with Confirmatory Item 3.1.4.2.A in Section 4.2 below

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

3.1.5.3 Procedural Interfaces - High Temperature Hazard

NEI 12-06, Section 9.3.3 states:

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

The licensee did not provide any information regarding operation of portable equipment at the high temperatures that may be experienced due to the ELAP, if the equipment would have to operate in these areas of the plant when deployed. During the audit process the licensee specified that the 480 VAC/100KW/125KVA generators will be deployed to the West Road staging location, adjacent to and outside of the AB near the roll-up door 419, to the 45 ft. AB Truck Bay. Since this equipment is to be operated only in outside ambient conditions, it will not be affected by potentially higher temperatures inside plant structures.

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

3.2 PHASED APPROACH

Attachment (2) to Order EA-12-049 describes the three-phase approach required for mitigating beyond-design-basis external events in order to maintain or restore core cooling, containment and spent fuel pool 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 spent fuel pool and to maintain containment capabilities in the context of a beyond-design-basis external event 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.

NEI 12-06, Section 3.2.2, Guideline (13) states in part that "Regardless of installed coping capability, all plant will include the ability to use portable pumps to provide RPV/RCS/SG makeup as a means to provide a diverse capability beyond installed equipment".

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

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

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

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 2.1, strategies that have a time constraint to be successful should be identified and a basis provided that the time can be reasonably met. NEI 12-06, Section 3 provides the performance attributes, general criteria, and baseline assumptions to be used in developing the technical basis for the time constraints. Since the event is a beyond-design-basis event, the analysis used to provide the technical basis for time constraints for the mitigation strategies may use nominal initial values (without uncertainties) for plant parameters, and best-estimate physics data. All equipment used for consequence mitigation may 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 3.2.1.4 describes boundary conditions for the reactor transient.

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

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

Section 3.2 of WCAP-17601 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML13042A011 and ML13042A013) discusses the pressurized water reactor owner group's (PWROG's) recommendations that cover various subjects for consideration in developing FLEX mitigation strategies.

The licensee provided information regarding generic analysis performed by Westinghouse and appropriately refers to PWROG generic activities that are underway. A plant specific analysis has not been provided that serves as the basis for the timing of mitigating strategies and maintaining core cooling and RCS inventory. During the audit process the licensee was requested to provide a discussion regarding plant specific analysis needed to support CCNPP's mitigating strategies. The NRC requested that the information discuss the licensee's positions for the following from Section 3.2 of WCAP-17601: (1) minimizing RCP seal leakage rates; (2) adequate shutdown margin; (3) time initiating cooldown and depressurization; (4) prevention of the RCS overfill; (5) blind feeding an SG with a portable pump; (6) nitrogen injection from SITs, and (7) asymmetric natural circulation cooldown. The licensee was also requested to list the recommendations that are applicable to the plant, provide rationale for the applicability, address how the applicable recommendations are considered in the ELAP coping analysis, and discuss the plan to implement the recommendations. If a recommendation was determined to be not applicable to CCNPP, then the licensee should also provide a rationale for that determination.

The licensee provided the following information in the audit process regarding the above seven issues:
1) A modification would be required to isolate controlled bleedoff (CBO) from the RCPs therefore this modification will not be pursued in lieu of an early cooldown as recommended by the WCAP.
2) Engineering Evaluation CA08023 "Minimum Allowable RCS Temperature to Support FLEX Implementation" was completed to analyze plant specific shutdown margin out to 72 hours. It was determined that with plant specific cooldown to 325 degrees F and no boron addition to the RCS, adequate shutdown margin (1% delta-rho) exists for approximately 32 hours. Boration can be started at approximately 12 hours into the event.
3) An expeditious RCS cooldown to approximately 350 degrees F and the resultant depressurization will be initiated at approximately 2 hours into the event.
4) Reactor Vessel Level Monitoring System and Pressurizer level indications will be available to prevent RCS over fill when using a pumped source. Not isolating CBO reduces the possibility of solid plant conditions.

5) Not applicable to CCNPP as SG level will be maintained to prevent blind feeding a SG.
6) SIT level and pressure instrumentation will be maintained. The operator will close the SIT isolation MOV's prior to emptying the SITs to prevent nitrogen injection.
7) Not applicable to CCNPP as asymmetric natural circulation cooldown will not be conducted.

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 RCS cooldown and RCS inventory strategies, if these requirements are implemented as described.

3.2.1.1. Computer Code Used for ELAP Analysis

NEI 12-06, Section 1.3 states:

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

On page 17 of the Integrated Plan the licensee specified that per the WCAP-17601-P recommendations, an early and extensive RCS cooldown will be initiated at approximately two (2) hours into the event. The cooldown will significantly increase coping time by reducing the probability of Reactor Coolant Pump (RCP) seal failure. The depressurization of the RCS which accompanies the cooldown reduces the RCS inventory loss from any leak and measurably increases the coping time of an ELAP event. The CENTS analysis performed demonstrated that the onset of core uncovery can be extended from about 67 hours out to approximately 10.6 days by performing an early RCS cooldown. Per the WCAP, for CE plants, plant depressurization also allows SIT injection to add boron to the RCS, helping to maintain shutdown margin. The licensee did not provide any other discussion or supporting analysis in the Integrated Plan regarding use of the CENTS code.

CENTS, described in Westinghouse topical report WCAP-15996-A (ADAMS Accession No. ML053320174), is a computer code for calculation of the transient thermal-hydraulic (T-H) conditions in the RCS primary and secondary systems of a pressurized-water reactor (PWR) for design non-loss-of-coolant accident (LOCA) transients. It was previously reviewed and approved by NRC (ADAMS Accession No. ML032790634) for referencing in a licensing application for the calculation of the T-H response in the PWRs designed by Combustion Engineering (CE) and Westinghouse Electric Company. The NRC staff's review of the licensee's mitigating strategy identified a generic concern associated with the use of the CENTS code for performing analysis of the ELAP event. This generic concern is applicable to the plant. The generic concern associated with the use of CENTS for ELAP analysis arose because NRC staff reviews for previous applications of the CENTS code had imposed a condition limiting the code's heat transfer modeling in natural circulation (NC) to the single-phase liquid flow regime. This condition was imposed due to the lack of benchmarking for the two-phase flow models that would be activated in LOCA scenarios. Because the postulated ELAP scenario includes leakage from reactor coolant pump (RCP) seals and other sources, two-phase NC flow may be reached in the RCS prior to reestablishing primary makeup. Therefore, the NRC staff requested that the industry provide adequate basis for reliance on simulations with the CENTS code as justification for licensees' mitigation strategies.

To address the NRC staff's concern associated with the use of CENTS to simulate two-phase NC flow that may occur during an ELAP for CE-designed PWRs, the Pressurized Water Reactor Owners Group (PWROG) submitted a white paper (ADAMS Accession No. 13297A174), which provided a comparison of several small-break (SB) LOCA simulations using the CENTS code to the CEFLASH-4AS code that is approved for analysis of design-basis SBLOCAs. The analyses in the white paper show that the predictions of CENTS were similar or conservative relative to CEFLASH-4AS for key figures of merit for NC conditions, including the predictions of loop flow rates and the timing of the transition to reflux boiling. The NRC staff further observed the fraction of the initial RCS mass remaining at the transition to reflux boiling predicted by the CENTS code for the ELAP simulations in WCAP-17601 to be in reasonable agreement with confirmatory analysis performed by the staff with the TRACE code. Therefore, as documented in a letter dated October 7, 2013 (ADAMS Accession No. ML13276A555), the NRC staff's review of the white paper concluded that the approach therein would acceptably address the generic concern associated with the application of CENTS to beyond-design-basis ELAP analysis with the following limitation:

- The use of CENTS in the ELAP analysis for CE plants is limited to the flow conditions before reflux boiling initiates.

During the audit process the licensee specified that the CENTS code has not been used in plant specific analyses for the Calvert Cliffs Nuclear Power Plant beyond those performed in WCAP-17601-P. The licensee is aware that the PWROG is in discussions with the NRC on the application of the CENTS code for the performance of thermal-hydraulic analyses in support of ELAP conditions. Generally, the licensee will rely on guidance resulting from these discussions, as documented in a PWROG-issued report, before deciding on the adequacy of present analyses and on the need to perform site-specific analyses using CENTS or other codes..

During the audit process the licensee was requested to perform a plant specific analysis, in order to conform to NEI 12-06 regarding plant-specific ELAP analysis and also include the computer codes/models and assumptions used in the analysis, The value of flow quality at the upper region of SG tubes for the condition when the RCS makeup pump is required to inject water into the RCS will also need to be provided, and a confirmation that CENTS is not used outside of any ranges of applicability discussed in the white paper addressing the use of CENTS (e.g., prior to the reflux boiling initiation) is required. If other codes are used for the ELAP analysis, the licensee will need to justify the acceptance of the codes for this use. This has been identified in Open Item 3.2.1.1.A in Section 4.1.

The licensee did not provide information in the Integrated Plan regarding the installed non-safety related plant systems or equipment that are credited in the ELAP analysis for supporting FLEX strategies, and for all the systems or equipment, did not discuss the associated design safety functions and justify that the listed systems or equipment are available and reliable to provide the design functions on demand during the ELAP.

During the audit process the licensee specified that they rely on several non-safety systems, credited in the ELAP analysis, such as SFP wide range level indication, the sound powered phone system, and various water storage tanks. This includes tanks in the Tank Farm, RWTs and the OCA Fire Protection System Storage Tank as follows:

- OCA FP Storage Tank – Available/Reliable: The 220,000 gallon OCA Fire Protection System Storage Tank will likely survive a high wind event due to its location greater than 1200 feet southwest of the Tank Farm
- DI Storage Tank – Available/Reliable: Seismically qualified under the CCNPP Seismic Verification Program
- 11 and 12 PTWSTs – Available/Reliable: Seismically qualified under the CCNPP Seismic Verification Program
- 11/12 RCWRTs and 11/12 RCWMTs – Available/Reliable: Protected from seismic and high wind hazards due to the location inside the Class 1 AB
- Well Water System – Available/Reliable: Under consideration as an available and reliable source for high wind events

In the event that the above tanks are rendered unavailable, the strategy is to draw water from the ultimate heat sink, the Chesapeake Bay.

- Circulating Water Discharge Structure – Available/Reliable: Passive concrete structure for access to the UHS in high wind events due to its location below ground level

On page 11 of the integrated plan the licensee stated that the mitigating strategies in this integrated plan rely upon existing CCNPP-specific technical basis information or will rely upon CCNPP technical basis support information that will be developed. The licensee identified an Open Item, to identify analysis needed to develop or support mitigating strategies. The licensee also stated that CENG's plan for analysis for core and containment cooling is still under development and CENG will identify additional analysis to support the mitigating strategies. The licensee was requested to provide a discussion regarding the additional analysis needed to complete CCNPP's mitigating strategies when complete. During the audit process the licensee provided a list of the various analyses (18 total) that are needed to be completed to develop or support mitigating strategies. The types of analyses and their status as of August 2013 are also noted in the first CCNPP 6-month update. The licensee stated that as additional analyses are identified to support responding to the requirements of Order EA 12-049, they will be reported in a future 6-month update. The subjects of the analyses are: maintaining core cooling (e.g., confirm shutdown margin during cooldown, dc load shedding, and adequate steam pressure for TDAFW pump operation), containment temperature and pressure response for containment cooling, and various safety functions regarding ventilation and cooling systems (e.g., for the main control room, TDAFW pump room, cable spreading room, battery rooms, switchgear rooms and the SFP area). This has been identified as Open Item 3.2.1.1.B 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 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 the computer code used for ELAP analysis, and supporting analyses for the mitigating strategies. These questions are identified as Open Items above and in Section 4.1

3.2.1.2 Reactor Coolant Pump Seal Leakage Rates

NEI 12-06, Section 1.3 states:

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

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

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

- WCAP-17601-P, Revision 1, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs" dated January 2013 (ADAMS Accession No. ML13042A011 and ML13042A013 (Non-Publically Available)).
- A position paper dated August 16, 2013, entitled "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Reactor Coolant Pump (RCP) Seal Leakage in Support of the Pressurized Water Reactor Owners Group (PWROG)" (ADAMS Accession No. ML13235A148 (Non-Publically Available)).

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

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

In Section 4.4.2 of WCAP-17601, it is stated that "It has been shown that the probability of seal failure greatly increases when there is less than 50 degrees F of subcooling in the Cold Legs." On page 17 of the Integrated Plan, the licensee specified that EOP-7 directs an RCS cooldown at less than 100 degrees F to restore and maintain subcooling between 30 and 50 degrees F using ADVs. The licensee did not explain why they do not maintain subcooling greater than 50 degrees F.

During the audit process the licensee specified that per the EOP 7 Technical Basis Document, the upper limit of 50 degrees F was chosen to prevent excessive cooldown of the RCS. The 50 degrees F of subcooling provides sufficient margin for maintaining subcooling and prevents the operator from excessively cooling down the plant to maintain subcooling. When on natural circulation, the EOP directs the control of subcooling as measured by Core Exit Thermocouples. This is representative of hot leg conditions. After the coolant passes through the SGs, it is 20-25 degrees F cooler. This yields a minimum subcooling of 50-55 degrees F in the cold leg for comparison to the statement contained in WCAP-17601-P.

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

3.2.1.3 Decay Heat

NEI Section 3.2.1.2 under initial plant conditions states:

> The initial plant conditions are assumed to be the following:
>
> (1) Prior to the event the reactor has been operating at 100 percent rated thermal power for at least 100 days or has just been shut down from such a power history as required by plant procedures in advance of the impending event.

On page 8 of the Integrated Plan the licensee specified that the best estimate of the decay heat load analysis and decay heat is used to establish operator action time.

The licensee did not provide the following information for review: The applicability of assumption 4 on page 4-13 of WCAP-17601, which indicates that the decay heat is per ANS 5.1-1979 + 2 sigma, or equivalent. If the ANS 5.1-1979 + 2 sigma model is used in the ELAP analysis, address the adequacy of the use of the decay heat model in terms of the plant-specific values of the following key parameters: (1) initial power level, (2) fuel enrichment, (3) fuel burnup, (4) effective full power operating days per fuel cycle, (5) number of fuel cycles, if hybrid fuels are used in the core, and (6) fuel characteristics (addressing whether they are based on the beginning of the cycle, middle of the cycle, or end of the cycle). If a different decay heat model is used, describe the specific model and address the adequacy of the model and the analytical results.

During the audit process the licensee specified that decay heat loads were discussed on page 45 of the submittal. Operating parameters considered include six 24-month low-leakage fuel cycles, up to 720 EFPD with varying reload batch sizes and power distributions (same as Cases A thru F shown on page 18 of Enclosure 10, "Source Terms Calculation," to November 3, 2005 license amendment request for revision to accident source term, ADAMS accession no. ML053210289), maximum assembly EOC burnup of 66 GWd/MTU, bounding assembly MTU, fuel enrichments ranging from 4 to 5 wt.% U-235, and a core power level of 2738 MWt. NUREG/CR-5625 and AECL RC-1429 discuss the results of numerous comparisons of ORIGEN based decay heats with measured data for a variety of fuel types and decay times that bound those considered. The uncertainty was determined to be ±5% at early decay times (seconds to hours) and ±3% at later decay times (years).

Therefore, calculated decay heats were conservatively increased by 5% to bound these uncertainties. NRC Information Notice 96-39 uses ORIGEN as a basis for comparing the adequacy of ANS-5.1-79 based calculations, citing it as "a rigorous calculation of all decay heat inputs" because it "does not use empirical methods to calculate decay heat but tracks the building and decay of the individual fission products within the reactor core during operation and shutdown" and "also includes the effect of element transmutation from neutron capture both in fissile isotopes and fission products."

The decay heat power fraction table used for the CCNPP specific calculations in the ELAP analyses of WCAP-17601, Rev. 1 was originally calculated in ABB Calculation 25/26/27-AS95-C-015, Rev 03, "PVNGS Decay Heat Curve Including Long Term Actinides," June 7, 1999. The curve is based upon the ANS 5.1 1979 curve, with fission product capture, uncertainties (+2 sigma), and decay of U-239, Np-239 up to 1E5 seconds and other actinide decay beyond 1E5 seconds. This curve applies with the following limits:

- Fuel Burnups up to 73,000 Mwd/MTU
- Fuel Enrichments up to 5.0% (by weight)
- Up to a 24 month operating cycle
- Decay heat curve was developed for a combination of fuel batches and not a single limiting assembly
- Correction for actinides other than U-239 and Np-239 is based on a fuel burnup of 34 Mwd/MTU

A core power level of 2700 MWT was utilized for CCNPP in the WCAP-17601 analyses. While this is slightly below the current licensed power level of 2737 MWt for CCNPP, the resulting decay heat curve remains conservative at all times compared the SAS2H/ORIGEN-S based results discussed above for a core power of 2738 MWt. The WCAP decay heat exceeds the ORIGEN based decay heat results in CA06535 (including uncertainty) by 8% initially, dropping to 4% at 100 seconds, 3% at 1000 seconds, and 0.2% at 10000 seconds. However, following that time the WCAP surge conservatism relative to ORIGEN again increases to 10-13%.

The CCNPP calculation CA03767 used to determine cooldown water requirements discussed in the Integrated Plan also uses a decay heat curve based on ANS-5.1979 and a core power level of 2700 MWt. However, the curve used for that calculation is based on the more conservative Simplified Method discussed in Section 3.6 of ANS-5.1979. The conservatism relative to the 2738 MWt ORIGEN based decay heat results in CA06535, including uncertainty, ranges from 14% initially to 4% at 1E7 seconds, with the amount of conservatism generally decreasing as the time increases over that range.

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 decay heat rate determination, if these requirements are implemented as described.

3.2.1.4 Initial Values for Key Plant Parameters and Assumptions

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

On page 8 of the Integrated Plan the licensee specified that the following initial conditions exist for the baseline case:

- Seismically designed direct current (DC) battery banks are available.
- Seismically designed alternating (AC) and DC distribution systems are available.
- Plant initial response is the same as Station Blackout (SBO).
- Entry into Extended Loss of AC Power (ELAP) will occur by the one hour point.
- Best estimate of the decay heat load analysis and decay heat is used to establish operator action time.
- One System, Subsystem, Component (SSC) single failure is assumed. Per NEI 12-06 Section 3.2, all installed emergency and SBO AC sources are not available, which constitutes the single failure. Therefore the TDAFW System and other non-AC power source safety-related equipment on both Units 1 and 2 will function as designed.

The licensee did provide information in the Integrated Plan regarding initial specific plant conditions. During the audit process the licensee provided the values for various plant parameters/initial conditions, e.g., initial power level, RCS temperatures and pressures, SG level and pressure, and containment pressure that CCNPP assumed in their analysis.

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 specification of initial plant conditions for the ELAP, if these requirements are implemented as described.

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states:

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

On pages 23 and 37 of the Integrated Plan, the licensee listed the following instrumentation that they credit in their coping analysis:

1. Steam Generator Pressure, and Steam Generator Level
2. Sub cooled Margin
3. Core Exit Thermocouples
4. Hot/Cold Leg temperature
5. 12 CST Level
6. Steam Generator Steam Train AFW Flow
7. TDAFW Pump Steam Supply/Discharge Pressure
8. Pressurizer Level and Pressure
9. Reactor Vessel Level
10. Safety Injection Tank Level and Pressure
11. Wide Range Log Power
12. Average RCS Level
13. Vital DC Bus voltage
14. Containment Wide Range Pressure, Dome Temperature
15. Reactor Cavity Temperature

For Modes 5 and 6, the required instrumentation includes:

1. Containment Wide Range Pressure
2. Containment Dome Temperature
3. Reactor Cavity Temperature

The licensee was requested to provide a discussion regarding plant specific analysis needed to support CCNPP's mitigating strategies. The information to be submitted should include the following item: Justify that the instrumentation listed on pages 23 and 37 of the integrated plan, and the associated setpoints credited in the ELAP analysis for automatic actuations and indications required for the operator to take appropriate actions, are reliable and accurate in the containment harsh conditions with high moisture levels, temperature and pressure during the ELAP event. The information should (1) include a discussion of the analysis that is used to determine the containment temperature, pressure, and moisture profiles during the ELAP event and to show whether the listed instrumentation will function as designed, and (2) address the adequacy of the computer codes/methodologies, and assumptions used in the analysis.

During the audit process the licensee specified that the aspects to this question regarding plant instrumentation are: the effects of an ELAP event on containment integrity, equipment qualification (EQ), and the adequacy of inputs/assumptions/methods. The licensee specified that containment integrity is maintained and the reference "CCNPP Containment Analyses" contains relevant information regarding this issue. The review of these analyses has been identified as Confirmatory Item 3.2.1.5.A in Section 4.2.

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

3.2.1.6 Sequence of Events

NEI 12-06, Section 3.2.1.7, Item 6 states:

> Strategies that have a time constraint to be successful should be identified and a basis provided that the time can reasonably be met.

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.

On pages 9 and 10 of the Integrated Plan the licensee specified the following sequence of events and the technical basis for each event that has a time constraint:

Note: Not all action items from Attachment 1-1A are provided here. The following Action Items represent the major time dependent actions provided in the Integrated Plan.

Action Item 9 specifies that at 2 hours, commence Reactor Coolant System (RCS) cooldown at 75 degrees F per hour to RCS cold leg temperature of greater than 350 degrees F. The technical basis is WCAP-17601-P.

Action Item 10 specifies that at 2 hours, the DC Load shed is complete. The DC buses are readily available in the Cable Spreading Room located one level below the Control Room for operator access and breakers will be appropriately identified to show which are required to be opened to affect a deep load shed. From the time that ELAP conditions are declared, it is reasonable that operators can complete the DC bus load shed in approximately 60 minutes. DC load shedding must be completed within two (2) hours of event initiation to extend CCNPP station vital 125 VDC battery coping to greater than 11 hrs. for maintenance of essential instrumentation. The technical basis is contained in CCN0012-17-STUDY-001. This reference was not provided for review. This has been identified as Confirmatory Item 3.2.1.6.A in Section 4.2.

Action Item 11 specifies that at 2 hours, the portable diesel-driven alternate AFW pump is deployed. Portable pump ready to provide backup for TDAFW pump and is deployed such that final connection and startup can be completed in less than 1 hour. The technical basis is WCAP-17601-P.

Action Item 13 specifies that at 6 hours, the RCS cooldown is complete. The RCS cooldown is terminated and RCS cold leg temperature is stabilized at greater than 350 degrees F for Safety Injection Tank (SIT) injection of borated water into the RCS. The technical basis is WCAP-17601-P.

Action Item 14 specifies that at 7 hours, direction given to deploy and connect 12 Condensate

Storage Tank (CST) makeup strategy equipment and hoses. The 12 CST makeup strategy should be connected ready for use in less than 3 hours. Resources permitting, this equipment should be deployed and connected as soon as possible. The technical basis is noted in CCNPP FLEX Strategy Table Top. This information from this table top (discussion) was not provided for review. This has been combined with Confirmatory Item 3.2.1.6.A in Section 4.2.

Action Item 15 specifies that at 7 hours, direction given to deploy and connect 675 KVA 480 VAC portable diesel generator (DG) to 1 vital 480 VAC Load Center on each unit. The portable DG should be connected and ready for use in less than 4 hours. Resources permitting, this equipment should be deployed and connected as soon as possible. The Technical Basis is the CCNPP FLEX Strategy Table Top. This has been combined with Confirmatory Item 3.2.1.6.A in Section 4.2.

Action Item 16 specifies that at 10 hours, commence makeup to 12 CST. Makeup to 12 CST is commenced prior to depleting the available water volume. CCNPP Technical Specification minimum water volume per unit is 150,000 gallons. The technical basis is CCNPP Calculation CA03767, EOP-7 Station Blackout, and EOP Attachments - Att. 9.

Action Item 17 specifies that at approximately 11 hours, energize one vital 480 VAC load center on each unit, and startup associated battery chargers. The technical Basis is: CCN0012-17-STUDY-001.

Action Item 18 specifies that at approximately 12 hours, if needed, start charging and boration on both units. The technical basis is WCAP-17601.

Action Item 19 specifies that at 12-24 hours, maintain RCS at greater than 350 degrees F, S/G pressure at 120 psia via natural circulation RCS flow, using the TDAFW, and ADVs. The technical basis is WCAP-17601.

The licensee has not completed final analysis regarding validation of the action times reported in the Sequence of Events. The licensee's basis for the action item times is noted as; WCAP-17601-P, Procedure EOP-7, Station Blackout, CCNPP Calculation CA03767, CCNOO 12-17-STUDY-00I, and CCNPP FLEX Strategy Table Top. Very little supporting discussion or analysis related to these documents or activities was provided in the Integrated Plan. Information from the table top exercise and reference CCN0012-17-STUDY-001 was not available for review. The licensee was requested to provide a discussion regarding the SOE analysis when complete, and to provide if necessary, a revised sequence of events (SOE) for the plant specific ELAP analysis used to support the FLEX mitigation strategies, noting any revised action times that may result from ongoing analysis. Additionally, the licensee was requested to discuss any SOE changes that may result from ongoing evaluations for; RCP seal leakage, plant specific CENTS analysis, and any revised battery load shed analysis. During the audit process the licensee specified that they will provide information from the validation of the action items and any additional information as it becomes available. This has been identified as Confirmatory Item 3.2.1.6.B in Section 4.2.

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

3.2.1.7 Cold Shutdown and Refueling

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

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

The NRC staff reviewed the integrated Plan for CCNPP and determined that the Generic Concern related to shutdown and refueling requirements is applicable to the plant. The Generic Concern, shutdown and refueling requirements, has been resolved generically through the NRC endorsement (ADAMS Accession No. ML13267A382) of NEI position paper entitled "Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514).

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 Generic Concern related to the shutdown and refueling modes, required clarification of CCNPP's approach to demonstrate that the strategies can be implemented in all modes. During the audit, the licensee informed the NRC of their plans to abide by this generic resolution. The implementation of these plans is identified as Confirmatory Item 3.2.1.7.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 core cooling in Modes 5 and 6, if these requirements are implemented as described.

3.2.1.8 Core Sub-Criticality

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

> All plants provide means to provide borated RCS makeup

The licensee identified an open item to perform engineering analyses to confirm that CCNPP maintains an adequate level of SDM for an RCS cooldown to 350 degrees F over a period of at least 72 hours. At time two (2) hours, operators will initiate a plant cooldown by directing local manual operation of the ADVs to lower S/G pressure and RCS temperature to establish a natural circulation flow RCS cooldown to just greater than 350 degrees F.

The AFW flow control valve (FCV) air accumulators provide a sufficient volume of pressurized air for regulating AFW flow to the S/Gs for at least two (2) hours following a complete loss of AC power. The control air system also has nitrogen (N2) backup capability that can provide pressurized N2 for several days. Operators would then manually regulate the system. The plant cooldown will be conducted beginning at an initial rate of approximately 75 degrees F/hour and then be gradually reduced due to the limitations of ADV capacity. Simulator validation has demonstrated that the cooldown to an RCS cold leg temperature just greater than 350 degrees F and S/G pressure of 120 psia can be accomplished in approximately 3.75 hours. The cooldown was terminated when RCS pressure was slightly above the 215 - 225 psig N2 pressure in the SITs. By lowering RCS pressure slightly SIT injection into the RCS will begin. Key to this strategy is the ability to monitor SIT level and N2 pressure in the control room. To prevent N2 entry into the RCS, the ability to isolate SIT injection or vent off the N2 in the SIT is also key to this strategy. Per current plant design, the SIT level and pressure indicators are powered from a nonvital 120 VAC instrument bus. The SITs have remotely operated from the control room outlet isolation motor operated valves (MOV), however, during the ELAP they will be de-energized. The licensee provided an open item to Implement a design change to re-power the SIT level and pressure indicators and vent valves from a vital 120 VAC instrument bus.

As noted in the discussion under Phase 1, core inventory above, the licensee will rely on the borated water in the SIT's for RCS makeup and boration during the initial phases. For Action Item 18 above, at approximately 12 hours the licensee notes that if needed, start charging and boration on both units. On page 71 of the Integrated Plan in Attachment 4 Table 2 for Phase 3 equipment the licensee lists two FLEX high pressure pumps with a capacity of 60 gpm at 1000-3000 psi for RCS inventory makeup and boration.

SOE Action Item 18 on Page 75 notes that at approximately 12 hours, if needed, start charging and boration on both units. However the charging pumps, listed as Phase 3 equipment, are apparently to be obtained from the RRC's, but would not be available for at least 24 hours. The licensee provides no further discussion or analysis in the Phase 2 or 3 sections on maintaining RCS inventory regarding the use of or need for high pressure charging pumps to maintain RCS inventory following depletion of the available inventory of borated water in the SIT's. The licensee noted that additional analysis is required to confirm that CCNPP maintains an adequate level of SDM for an RCS cooldown to 350 degrees F over a period of at least 72 hours.

In the audit process the licensee specified that CCNPP will connect the Phase 2 FLEX 480 VAC, 675 KVA DGs at approximately 10 hours. They are sized to power two 125VDC Battery Chargers, a Charging Pump and a Reactor Motor Control Center (MCC). In Phase 2, the primary strategy for RCS inventory control is to operate one of the installed Charging Pumps to restore RCS water inventory. Charging Pump suction can be aligned to the Boric Acid Storage Tanks (BAST) or to the RWT if it is available. Each of the two BASTs per unit has sufficient volume and boron concentration to provide for RCS inventory control and RCS boration to meet shutdown margin requirements. The backup strategy will employ a portable high pressure charging pump to pump into the RCS via new connections installed on the high pressure Safety Injection System. The licensee identified an open item to implement a design change to provide dedicated hose connections and piping to the Safety Injection System. This connection will be used for the Phase 3 high pressure charging pumps. These pumps will include boric acid batching tanks to provide for RCS boration.

Engineering Calculation CA08023, "Minimum Allowable RCS Temperature to Support FLEX Implementation" was completed to analyze plant specific shutdown margin out to 72 hours. It determined that with plant cooldown to 325 degrees F and no boron addition to the RCS, adequate shutdown margin (1% delta-p) exists for approximately 40 hours.

The licensee's Integrated Plan did not discuss the boron mixing model used in the ELAP analysis to show core sub-criticality, nor address the adequacy of the boron mixing model for the intended purpose with support of an analysis and/or boron mixing test data applicable to the ELAP conditions, where the RCS flow rate is low and the RCS may involve two-phase flow.

Also the licensee did not discuss how the boron concentration in the borated coolant added to the RCS is considered in the cooldown phase of the ELAP analysis, considering that it needs time for the added borated coolant to mix uniformly or partially throughout the RCS.

During the audit process the licensee specified that the boron mixing model developed in the reference is based on strategy limitations that must be confirmed on a plant specific basis. Variables include the cool down strategy employed, the amount of leakage assumed, the timing of boron injection, the flow regime encountered and the elapsed scenario time. The RCS can be treated as achieving homogenous equilibrium with the expected ranges of injection flow rates of borated coolant injected through the cold leg within 60 minutes of injection, for the purpose of maintaining adequate shutdown margin through soluble boron concentration, during the first 100 hours of an ELAP event.

Additionally Engineering Calculation CA08023, noted above demonstrates that with no boration, the plant will remain subcritical until 32 hours into the event. Beyond 32 hours, boration is required to remain subcritical by more than 1000 pcm. Although the neutronics analysis does not show a return to critical for the duration of the event, the subcritical margin beyond 32 hours is insufficient to account for variation in cycle-to-cycle core design or variation in the transient response. CCNPP mitigating strategy for core inventory will initiate RCS make-up and boration via a charging pump at approximately 12 hours into the ELAP event to restore RCS level and maintain adequate shutdown margin.

Review of the Integrated Plan for CCNPP revealed that the Generic Concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the reactor coolant system (RCS) under natural circulation conditions potentially involving two-phase flow was applicable to CCNPP.

The Pressurized Water Reactor Owners Group sent NRC a position paper, dated August 15, 2013 (withheld from public disclosure for proprietary reasons), which provides test data regarding boric acid mixing under single-phase natural circulation conditions and outlined applicability conditions intended to ensure that boric acid addition and mixing would occur under conditions similar to those for which boric acid mixing data is available.

During the audit process, the licensee informed the NRC staff of its intent to abide by the generic approach discussed above; however, the NRC staff concluded that the August 15, 2013, position paper was not adequately justified and has not yet endorsed this position paper, or stated any required additional conditions and limitations. As such, resolution of this concern for CCNPP is identified as Open Item 3.2.1.8.A in Section 4.1.

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

3.2.1.9 Use of portable pumps

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

> Regardless of installed coping capability, all plants will include the ability to use portable pumps to provide RPV/RCS/SG makeup as a means to provide diverse

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

NEI 12-06 Section 11.2 states in part:

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

Phase 2 strategies for makeup water include deploying of a FLEX pump to take suction from the fully protected 12 CST, the four (4) fully protected Reactor Coolant Waste Tanks or any other surviving water storage tank (11 or 21 CST, 11 DWST, 11 or 12 PTWST, 11 or 21 RWT) or utilizing a FLEX pump taking a suction from the Chesapeake Bay at the Circulating Water Discharge Structure. For the lower mode strategies where RCS make-up will be needed, the FLEX pump will discharge to dedicated hose connections on the Safety Injection System.

The alternate strategy is to use the backup to the existing TDAFW pumps, the alternate AFW FLEX pump. This pump is designed to deliver a minimum of 300 gpm to the S/Gs at pressures of 300 psia. This flow rate will be sufficient to provide adequate core cooling to remove decay heat. In the August 2013 update the license modified this strategy as follows:

CCNPP Units 1 and 2 each have two installed TDAFW pumps. If the in-service pump fails during ELAP, the standby TDAFW pump can readily be placed in service. This feature of the AFW system affords additional time to connect the portable alternate AFW pump such that "plug and play" connections on the exterior west side of the AB are not needed. Personnel will have sufficient time to deploy hoses to newly installed, dedicated hose connections located on the east side of the 45 ft. elevation of the AB, with piping run to the 27 ft. East Penetration Rooms to connect to the AFW to S/G headers.

The AB is a fully protected seismic Class 1 structure. This connection will be placed above flood height and have a cover provided for wind-driven missile protection. This alternate AFW pump line will be seismically mounted and run over to the 45 ft. elevation East Electrical Penetration Room to a tee, isolation valves, and then separate lines for each S/G. The lines will then penetrate the room floor into the 27 ft. elevation East Piping Penetration Room and then connect to the individual AFW headers for the S/Gs at locations on the headers near the penetrations into the containment building.

The alternate connection strategy will employ the lineup and connections similar to that which is described in Emergency Response Plan Implementing Procedure (ERPIP-6 11), Severe Accident Management Restorative Actions, Alternate Water Sources. This line-up employs the fleet standard pump in the same setup location near the Tank Farm and discharge hose run to the 45 ft. el. west side of the AB and into the AB via any available personnel door or roll-up door. The hose is then run down to the 5 ft. el. via stairway AB-2, east through the 5 ft. el. hallway, and into the 5 ft. el. AB Exhaust Ventilation Fan Room. The hose is then run into the Service Water Pump (SRW) Room from the 5 ft. fan room via a watertight door to the designated connection point on the discharge of 13 (23) motor-driven AFW pump.

On pages 68 to 71 of the Integrated Plan (Tables 1 and 2), the licensee lists the portable equipment required for the ELAP mitigation. Table 1 lists three FLEX pumps with a capacity of 300 gpm at 220 psig and two portable compressors with a capacity of 185 CFM at 100 psig for use to maintain core cooling and sub-criticality during Phase 2. For Phase 3, Table 2 lists two FLEX pumps with a minimum flow rate of 500 gpm and maximum pressure of 500 psi, two FLEX high pressure pumps with a flow rate of 60 gpm for the pressure range from 1000 to 3000 psi, and two FLEX pumps with a flow rate of 2500 gpm and maximum pressure of 300 psi.

The licensee did not specify the required time for the operator to deploy each of the above discussed pumps and confirm that the required times are consistent with the results of the ELAP analysis, or discuss the analyses that are used to determine the required flow rate and corresponding pressure for each of the portable pumps or justify that that the required capacity and mission time for each of the above discussed portable pumps are adequate to maintain core cooling, and sub-criticality during Phases 2 and 3 of ELAP.

During the audit process the licensee specified that regarding deployment time the following will be accomplished: Deployment of the FLEX SG Feed Pump, 300GPM at 220psig, will commence T+1 hour in Phase 1 to meet the recommendations of WCAP-17601-P. The FLEX AFW pump is deployed at T+1 based on WCAP recommendations to commence early deployment in case of some unforeseen failure of the installed TDAFW pump. Since the TDAFW pump is the only permanent means of conveying water to the SGs, a backup portable pump becomes almost mandatory should an ELAP occur. The size and ease of use (time to connect to a SG and water source) of this pump must be considered by each Utility. CCNPP will perform a time study to determine how long it takes to deploy the FLEX AFW pump in Phase 1 and 2. This has been identified as Confirmatory Item 3.2.1.9.A in Section 4.2.

Deployment of a 185 SCFM air compressor is an alternate strategy to restoration of power to the installed emergency (Saltwater Air) compressors to restore safety related instrument air. The deployment of the air compressor is uncomplicated and the hose run small and light. These air compressors will be deployed after deployment of the portable diesel generators and the CST makeup pump. The licensee will perform a time study to determine how long it takes to deploy the FLEX air compressor in Phase 2. This has been identified as Confirmatory Item 3.2.1.9.B in Section 4.2.

Phase 3 Pump Deployment includes:

- 2 FLEX pumps with a minimum flow rate of 500 gpm and maximum pressure of 500 psi – backup to Phase 2 FLEX pumps for S/G feed, SFP makeup, or CST makeup

- 2 FLEX high pressure pumps with a flow rate of 60 gpm for the pressure range from 1000 to 3000 psi – RCS Inventory makeup and boration pump; intended as backup to Phase 2 FLEX equipment
- 2 FLEX pumps with a flow rate of 2500 gpm and maximum pressure of 300 psi Containment Spray Pump – Back up to Phase 2 equipment

An analysis will be provided in future six month updates as detailed engineering evaluations are performed for each FLEX component and modification strategy. This has been identified as Confirmatory Item 3.2.1.9.C in Section 4.2.

The licensee has provided strategies using portable pumps for RCS cooling described above. The licensee provided an open item, to perform engineering analysis to determine that there is sufficient decay heat generated for TDAFW operation 36 hours after shutdown. The licensee also noted that a CCNPP Engineering Calculation has been requested to confirm the assumption that the TDAFW pumps can operate reliably provided there is greater than 65 psia steam pressure in one of the S/Gs. This is identified as Confirmatory Item 3.2.1.9.D in Section 4.2.

Section 3.2.4.9 Portable Equipment Fuel, below addresses the fuel necessary to operate the FLEX equipment. The discussion in this section provides reasonable assurance that sufficient quantities of fuel as well as delivery capabilities are available.

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 use of portable pumps, if these requirements are implemented as described.

3.2.2 Spent Fuel Pool Cooling Strategies

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

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 2.1, strategies that have a time constraint to be successful should be identified and a basis provided that the time can be reasonably met. NEI 12-06, Section 3, provides the performance attributes, general criteria, and baseline assumptions to be used in developing the technical basis for the time constraints. Since the event is a beyond-design-basis event, the analysis used to provide the technical basis for time constraints for the mitigation strategies may use nominal initial values (without uncertainties) for plant parameters, and best-estimate physics data. All equipment used for consequence mitigation may assume to operate at nominal setpoints and capacities. NEI 12-06, Section 3.2.1.2 describes the initial plant conditions for the at-power mode of operation; Section 3.2.1.3 describes the initial conditions; and Section 3.2.1.6 describes SFP initial conditions.

NEI 12-06, Section 3.2.1.1 provides the acceptance criterion for the analyses serving as the technical basis for establishing the time constraints for the baseline coping capabilities described in NEI 12-06, which provide an acceptable approach to meeting the requirements of EA-12-049 for maintaining SFP cooling. This criterion is keeping the fuel in the SFP covered.

On page 44 of the Integrated Plan the licensee specified that the Spent Fuel Pool Cooling Phase 1 strategy will be to monitor SPF level to ensure adequate water level remains over the fuel and that makeup to the SFP is not needed in Phase 1. The licensee will install a new wide range level indication with integral backup power supply to allow for remote monitoring.

Per EOP-7, Station Blackout, Operators will be directed to implement AOP-6F, Spent Fuel Pool Cooling System Malfunctions, Section VIII for a sustained loss of SFP cooling. Actions include placing a portable battery powered digital thermocouple in the SFP for monitoring temperature from outside of the SFP area and use of an AOP attachment to monitor SFP level as referenced against the elevations of the New Fuel Elevator.

Engineering Calculation CA06535, Spent Fuel Pool Decay Heat for 24-M VAP Core with Appendix K Power Uprate, developed a bounding SFP decay heat load that considers 24-month low leakage fuel cycles, a full core of Value Added Pellet (VAP) fuel, and an Appendix K power uprate to a core power level of 2738 MWt. The analysis of record for the current core power level of 2700 MWt is summarized in UFSAR Section 9.4.1, and is based on the simplified ANS-5.1-1979 Decay Heat Standard. The ANS-5.1-1979 method has limited value for high burnup spent fuel due to the inability to accurately treat actinide formation and neutron capture effects. Therefore, this analysis utilizes the SAS2H/ORIGEN-S sequence of the SCALE 4.4 code system to calculate decay heat loads.

To be consistent with the current UFSAR, two sequences are defined: "normal" and "abnormal." Normal operation of the spent fuel pool means that there is extra fuel rack storage capacity for the offload of a complete core (at least 217 empty spaces in the racks) and the last fuel discharge is from a partial defueling during a normally scheduled refueling outage. Abnormal indicates the SFP fuel racks are filled to capacity, with the last 217 assemblies coming from a core offload. The abnormal case bounds a full core offload during a normally scheduled refueling outage.

During normal operation, it is assumed that the SFP is cooled only by the SPF Coolers (SFPHXs). Each of the two SFPHXs has a cooling capacity of 10.1×10^6 Btu/hr under design conditions; therefore, under normal operation, the SFP cooling system can remove 20.2×10^6 Btu/hr. During abnormal operation it is assumed the SFP cooling system is supplemented with one shutdown cooling heat exchanger from the offloaded unit. The heat removal capacity under these conditions is limited to 38.6×10^6 Btu/hr by the UFSAR (note that the maximum heat removal capacity in this configuration is 47.5×10^6 Btu/hr).

Per Engineering Evaluation ES200500540-000, if all SFP cooling is lost, the minimum time to boil is 6.19 hours. The minimum time to fuel uncovery from the time to boil is 46.87 hours, which gives the operators 53 hours to initiate compensatory measures from the loss of heat removal function. The maximum make-up rate to compensate for loss of SFP inventory due to bulk boiling is 139 gpm.

In Phase 2, as soon as manpower resources are available, and prioritized with Core Cooling strategies, a FLEX pump will be deployed and connected ready to provide SFP makeup before SFP level lowers to 50 feet. Using the most conservative bounding condition of heat load on the SFP described above, this level will be approached during Phase 3. The FLEX pump will be staged near and take suction from one of the RWTs or any of the non-qualified storage tanks that may survive the event. On each RWT a new 6-inch hose connection will be installed along with dedicated hose connections to the SFP Cooling system.

During the audit process the NRC staff questioned the use of the RWT for SFP cooling because the RWT is a non-robust water source. The licensee specified that their intent is to use any available clean water source as a first option. Since it is unknown which tanks will survive beyond 12 CST, the station will exercise all options to use any surviving water storage tank. For SFP cooling, this includes the RWTs. In the event that these tanks are rendered unavailable, the strategy is to draw water from the ultimate heat sink (Chesapeake Bay), as identified on page 47 of the Integrated Plan, and discharge to the SFP through two flow paths, one of which includes a new modification to the spent fuel pool cooling system piping to install two hose connection points and by hose directly to the SFP. A damaged and partially drained non-robust water storage tank will be used as a makeup source if possible.

On page 47 of the Integrated Plan the licensee identified two alternate strategies. The Chesapeake Bay can also be used as a limitless source of cooling water. One of the portable FLEX pumps can be set up adjacent to the Circulating Water discharge structure with suction hoses placed into openings in the discharge structure (B.5.b pump setup location at the plant outfall). The Circulating Water discharge structure is located at the +10 ft. waterfront elevation just north of the Sewage Treatment Building. As noted in Section 3.1.2.2 "Flooding Hazard Deployment", evaluations of deployment strategies and deployment routes to ensure they are assessed for and address applicable hazards impact are ongoing to ensure that primary and alternate pathways remain clear (Confirmatory Item 3.1.2.2.A). However, the licensee did not discuss the impacts of salt/brackish water on the structures and components of the SFP system, and the fuel. During the audit process the licensee specified that they will perform an analysis to determine the effects of salt/brackish water on the structures and components (including instrumentation) of the SFP system and the stored fuel. The results of this analysis will be provided as soon as it becomes available. This has been identified as Confirmatory Item 3.2.2.A in Section 4.2.

The second alternate strategy is to use the FLEX pump Circulating Water discharge structure as described above with same hose routing to the SFP Area. The backup portable Oscillating (Ozzie) Monitor is then setup in a designated location to provide spray to the SFP. The 5-inch FLEX pump discharge hose is connected to the Oscillating Monitor.

The above strategy is similar to that described in ERPIP-612, "Candidate High Level Actions SFP Uncovered, Attachment 5, "Providing Local Spray to the Spent Fuel Pool". The licensee identified an open item to develop procedures or FSGs that mimic the ERPIP-612 sections for SFP makeup and SFP spray.

On page 50 of the Integrated Plan, the licensee specified that the same strategies employed in Phase 2 can be employed in Phase 3. The licensee did not provide a specific description of the primary strategy that the licensee will use for Phase 3 SFP cooling. During the audit process the licensee specified that the primary strategy for Phase 2 is that as soon as manpower resources are available and prioritized with Core Cooling strategies, a FLEX pump will be deployed and connected ready to provide SFP makeup before SFP level lowers to 50 feet.

Using the most conservative bounding condition of heat load on the SFP described above, this level will be approached during Phase 3. As described above, the primary strategy for Phase 3 SFP cooling is the deployment of a FLEX pump ready to provide SFP makeup before SFP level lowers to 50 feet.

In addition, when available, a 4160 VAC, 2000 KW diesel generator from the RRC could be employed to power 14 (Unit 1) or 24 (Unit 2) Class 1E 4160 VAC buses to power the 480 VAC Load Centers 14A or 24A that provide power to 11 or 12 SFPC pumps. This coping strategy will require two additional actions: 1) a Service Water (SRW) pump will be repowered from the Class 1E 4160 VAC bus to provide SRW cooling water flow to one of the SFP cooling heat exchangers, and 2) restoration of cooling water flow in a Saltwater (SW) header with a large capacity (5000 gpm minimum) RRC pump taking a suction from the UHS (Chesapeake Bay). A modification is planned to add the necessary RRC portable pump connections to the SW headers on each unit.

The licensee did not discuss in the Integrated Plan strategies for providing ventilation for steam and condensate from the SFP area. During the audit process the licensee specified that a base line capability for the Spent Fuel cooling is to provide a vent pathway for steam and condensate from the SFP. This will consist of a cross-area air flow path on the 69-ft. elevation that can be established by; opening the doors to the AB Supply Ventilation air plenum, opening the northeast door from the SFP area to the Unit 1 containment access areas, opening the door to the Unit 1 main vent fan room, and finally opening the hatch on the Unit 1 main ventilation exhaust system plenum. This should create a draft path for air flow.

To confirm that this cross-area flow path will create adequate air flow, the licensee will perform an analysis to verify that the above strategy will provide sufficient air flow to vent steam from the SFP area. The result of this analysis will help determine whether or not natural air circulation is sufficient to vent steam and condensate from the SFP or whether forced ventilation provided by FLEX equipment will be required. This has been identified as Confirmatory Item 3.2.2.B in Section 4.2.

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

3.2.3 Containment Functions Strategies

NEI 12-06, Table 3-2 and Appendix D provide some examples of acceptable approaches for demonstrating the baseline capability of the containment strategies to effectively maintain containment functions during all phases of an ELAP. These include: utilizing containment spray for containment pressure control/heat removal or repowering hydrogen igniters for ice condenser containments.

On page 36 of the Integrated Plan, the licensee stated that during Phase 1, containment integrity is maintained by normal design features of the containment, such as the containment isolation valves. In accordance with NEI 12-06, Att. 3-1, the containment is assumed to be isolated following the event. Per EOP-7, Station Blackout, Block Step N, operators are directed to ensure containment integrity. The containment isolation valves are verified shut in order to ensure containment integrity. Per EOP-7 Technical Basis, containment integrity is verified to the extent required by NUREG-1.155.

Due to the loss of power to the Containment Air Cooling (CAC) Units and loss of flow in the Service Water Cooling System (SRW) that supplies cooling water to the CAC heat exchangers, and loss of the UHS, the containment will begin to heat up and pressurize from sensible heat transferred from the Nuclear Steam Supply System components.

Containment narrow range and wide range pressure can be monitored in the Control Room at panel C09, however containment dome and reactor cavity temperatures cannot be monitored. These instruments are currently powered from a non-vital 120 VAC instrument bus. The licensee identified an Open Item to implement a design change to power containment dome and reactor cavity temperatures instrumentation from a vital 120 VAC instrument bus.

The containment concrete surface design temperature is 276 degrees F per the CCNPP UFSAR Sections 5.1.1 and 14.20. The CCNPP Station Blackout Analysis states that containment temperature is predicted to reach 185 degrees F at four hours into the event. Containment temperature is expected to rise from nominal summer temperature of 115 degrees F and stabilize at a temperature well below 276 degrees F. The containment design pressure is 50 psig, per the CCNPP UFSAR Sections 5.1.1 and 14.20. Containment pressure limits are not expected to be approached during the event.

In the Integrated Plan the licensee noted that a CCNPP Engineering Calculation will be performed to confirm containment temperature and pressure response over the first 72 hours of the event.

In the August 2013 update, the licensee specified that this analysis is complete. An analysis of the containment response during the ELAP event indicated that the containment would not require additional cooling. The containment response analysis for an ELAP while RCS is being cooled by TDAFW indicates that the containment buildings of CCNPP Units 1 and 2 are passive/safe in an ELAP and do not require active cooling of CAC or Containment Spray (CS). Therefore in an ELAP; containment integrity is maintained (i.e., peak pressure under expected conditions reaches approximately 4 psig, which is well below the Technical Specification limit of 50 psig, the peak pressure occurs in about 2.5 hours from the time all AC power supplies are lost, the peak containment temperature remains below 170 degrees F, the temperature on the surface of the containment shell remains well below the limit of 276 degrees F, and the equipment qualification envelope is maintained with ample margin. The licensee provided a document titled CCNPP Containment Analysis that was based on the GOTHIC code, however it did not have an approval date or author approvals, and the tabulated results did not match those transmitted in the aforementioned 6-month update. This has been identified as Confirmatory Item 3.2.3.A in Section 4.2.

The Phase 3 strategy for containment integrity will be to restore containment cooling either via a FLEX pump and a FLEX 480 VAC DG or via a RRC 4KV DG restoring one vital 4160 Vac bus on each Unit. The primary strategy to be employed by CCNPP is to restore at least one CAC Unit to service and support systems (SW and SRW) to operation with a RRC 4KV DG.

On page 35 of the Integrated Plan the licensee specified that no portable equipment is expected to be required to maintain containment in Phases 1 and 2. On page 38 the licensee states that the Phase 2 strategy for containment integrity is to continue to monitor containment parameters and if necessary initiate containment spray via a FLEX pump.

During the audit process the licensee specified that for the Maintain Containment strategy, deployment of a FLEX pump for containment spray in Phase 2 is a contingency action only. The pump will be deployed to its staging area and suction and discharge hoses set up but not connected. Though not expected based on containment temperature and pressure response calculations, these actions are deemed prudent in the unlikely event they are needed. Additionally, the CCNPP Containment Calculation document concluded that given a choice between recovering containment fan coolers or containment spray, the recovery of containment fan coolers is preferred. With these seemingly conflicting directions, the licensee did not provide a clear position on the use of FLEX pumps and equipment during Phase 2 to maintain containment integrity. This has been identified as Confirmatory Item 3.2.3.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 containment functions strategies, if these requirements are implemented as described.

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.

The licensee's Integrated Plan did not provide sufficient information regarding cooling functions provided by such systems as auxiliary building cooling water, service water, or component cooling water cooling when ac power is lost during the ELAP for Phase 1 and 2. Additional formal analysis by the licensee is required to determine the acceptability of the licensee's plans to provide supplemental cooling to the subject equipment when normal cooling will not be available during the ELAP.

During the audit process the licensee specified that the TDAFW turbine and pump bearing oil cooling is provided by a closed oil system cooled by the water flowing to and through the TDAFW pumps from the 12 Condensate Storage Tank. The licensee also specified that charging pump seal cooling is provided by a skid mounted closed system that includes a small seal water storage tank, and that the pumps are designed to operate satisfactorily without seal cooling but depend on room cooling being available. The licensee will perform an evaluation to determine if the charging pumps can meet their mission time without room ventilation. This has been identified as Confirmatory Item 3.2.4.1.A in Section 4.2.

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

3.2.4.2 Ventilation – Equipment Cooling

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

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

On page 53 of the Integrated Plan, the licensee specified that per the CCNPP Station Blackout Analysis, Bechtel Calculation M-88-28, Rev. 3, the Control Room will reach 103 degrees F at four hours into the event. Additionally under ELAP conditions with no mitigating actions taken, the blackout analysis states that the control room may surpass 110 degrees F (the assumed maximum temperature for efficient human performance as described in NUMARC 87-00) at some point during a blackout. The licensee also specified that the Phase 1 FLEX strategy is to remove panel lower covers per the existing station blackout EOP, which will establish natural circulation air flow through the control room panels. A Phase 1 or 2 strategy will be to block open the doors to the Control Room and set up portable air circulation fans powered by small portable ac generators.

The licensee identified an open item to perform an analysis to determine the Control Room temperature response over a period of 72 hours. This has been identified as Confirmatory Item 3.2.4.2.A in Section 4.2.

On page 53 of the Integrated Plan, the licensee specified that the CCNPP Station Blackout Analysis, Bechtel Calculation M-88-28, Rev. 3, the TDAFW Pump Room will reach 137 degrees F at four hours into the event. The licensee also specified that this calculation assumed that the double watertight doors to the room would be open and operators could enter the room for short periods of time to control and monitor TDAFW pump performance. The licensee stated that per the CCNPP UFSAR Section 6.9, the AFW Pump Room cooling system is designed to prevent the room air temperature from rising above 130 degrees F so as to prevent failure of the air cooled bearings on the pump during emergency shutdown of the plant, however, during ELAP this small HVAC unit will be without power and cooling water.

The licensee stated that Engineering Calculation CA04467, "AFW Pump Room Transient Temperature Analysis, Appendix R Fire/LOOP and SBO Scenarios, Using Gothic Code," showed room temperature peaking at 123.4 degrees F, and that based on the slope of the temperature curve the TDAFW pump could be kept in operation for 72 hours without exceeding 130 degrees F air temperature in the room. In the August 2013 update, the licensee confirmed that further analysis showed that the temperature would remain below 130 degrees F over 72 hours of pump operation.

In the Integrated Plan the licensee identified an open item to develop primary and alternate strategies for ventilating the TDAFW Pump Room. This item is complete and the licensee specified in the August 2013 update that the primary Phase 2 strategy will be to restore power to one of the two 480 VAC MCCs on each unit via a FLEX 480 VAC DG connected to the MCC's associated vital 480 VAC Load Center. The licensee also specified that this will allow operation of one of the two TDAFW Pump Room emergency ventilation fans, and that the alternate Phase 2 strategy will be to set up a portable air circulation fan powered by a small portable ac generator to ventilate the TDAFW Pump Room.

On page 55 of the Integrated Plan, the licensee stated that the Unit 1 and 2 Cable Spreading Rooms contain the battery chargers, 125 VDC to 120 VAC inverters, bus work, and power panels that supply essential instrumentation power. Per CCNPP Station Blackout Analysis (Bechtel Calculation M-89-3, Rev. 2), the Cable Spreading Room will reach 103 degrees F at four hours into the event. Under ELAP conditions with no mitigating actions taken, the blackout analysis states that the cable spreading room may surpass 110 degrees F, the assumed maximum temperature for efficient human performance as described in NUMARC 87-00, at some point during a blackout. A Phase 1 or 2 strategy will be to block open the doors to the Cable Spreading Room and set up portable air circulation fans powered by small portable ac generators.

On page 61 of the Integrated Plan, the licensee specified that operating instructions provide a procedure for emergency operation of the Control Room and Cable Spreading Room Appendix R Ventilation System. However, the procedure requires power and cooling water sources in order to be successful. A modified version of this procedure as an FSG, with temporary power and cooling water appears feasible. The licensee identified an open item to develop strategies for use of the Control Room and Cable Spreading Room Appendix R Ventilation System during an ELAP. This has been identified as Confirmatory Item 3.2.4.2.B in Section 4.2

On page 61 of the Integrated Plan, the licensee specified that during battery charging operations in Phase 2 and 3, ventilation is required in the Station Battery rooms due to hydrogen generation. The primary strategy is restore power to one of the two 480 VAC reactor motor control center (MCC) on each unit via a FLEX 480 VAC diesel generator connected to the MCCs associated vital 480 VAC Load Center. The alternate strategy is to prop open doors and set up portable fans to ventilate the rooms. The licensee identified an open item to perform an analysis to evaluate hydrogen buildup in the battery rooms during charging and the long term room temperature profiles. This has been identified as Confirmatory Item 3.2.4.2.C in Section 4.2.

On page 62 of 109 of its Integrated Plan, the licensee states in part regarding Switchgear Room Ventilation, that for Phase 2, the vital 480 VAC/4160 VAC Switchgear Rooms containing the 480 VAC Load Centers will begin to heat up after the load center is energized from the FLEX 480 VAC DGs; therefore, they will need to be evaluated for limiting temperatures for equipment survivability. The calculations performed for the CCNPP Station Blackout, indicate that switchgear rooms rise to a maximum of 129 degrees F at the 27 ft. elevation, and 127 degrees F for the 45 ft. elevation Switchgear Room, at the end of a four hour coping period. These temperatures are beyond the design temperature of 104 degrees F for the electrical equipment. The CCNPP Station Blackout Analysis evaluated the component specific temperature ratings of this equipment. Maximum rated temperatures ranged from 131 to 176 degrees F. These temperatures are well above the 4 hour SBO temperatures for the switchgear rooms. Under ELAP conditions, both Unit's vital 480 VAC Load Centers are de-energized at the onset of the ELAP and remain de-energized until Phase 2 when at least one (1) 480 VAC Load Center on each unit is reenergized from the FLEX 480 VAC DGs. Therefore, in Phase 2 following the re-energization of the 480 VAC Load Centers from the FLEX 480 VAC DGs the rooms will begin to heat up and a coping period for the duration of Phase 2 must be considered.

The licensee identified an open item to perform an analysis to determine the Switchgear Room temperature response following the reenergizing of buses and assuming various 480 VAC load center and 4160 VAC bus loadings over a period of 72 hours. This has been identified as Confirmatory Item 3.2.4.2.D in Section 4.2

During the audit process, the licensee stated that the AB 69 ft. elevation West Electrical Penetration Rooms have supply and exhaust ventilation provided by the AB supply and exhaust ventilation system. The AB 45 ft. elevation West Electrical Penetration Rooms have supply air provided from the general area of the 45 ft. elevation of the AB and exhaust ventilation provided by the Penetration Room exhaust ventilation system. The West Electrical Penetration Rooms will begin to heat up after the Reactor MCCs are re-energized from the FLEX 480 VAC DGs;

therefore, they will need to be evaluated for limiting temperatures for equipment survivability. This has been identified as Confirmatory Item 3.2.4.2.E in Section 4.2.

On page 66 of the Integrated Plan, the licensee specified that the CCNPP Phase 3 strategy for portable equipment is to continue the strategies of Phase 2 and maintain the operation of the portable FLEX equipment. As RRC equipment arrives, is deployed, and connected, then Safety Function maintenance and support will be transferred to those systems.

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

3.2.4.3 Heat Tracing

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

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

In the Integrated Plan the licensee did not discuss the effects of loss of power to heat tracing.

During the audit process the licensee specified that during shutdown/refueling the area of concern is inside containment, in addition to the areas/components of concern listed below. During cold weather month shutdown or refueling, containment heating and ventilation are provided by the Containment Purge Air system. The Containment Purge Supply ducting contains heating coils supplied with heating steam from the Plant Heating system. Containment temperature during cold weather month shutdown conditions is generally 70 degrees F and, therefore, plant heating to the purge supply air heating coils is not needed. It is expected during ELAP the containment will heat up as the RCS heats up from normal shutdown cooling RCS temperatures of 95 degrees F to 105 degrees F.

The licensee specified that the 12 CST is not provided heating, however, short sections of exposed AFW suction line, recirculation line and DI makeup water line inside the enclosure building are insulated and heat traced. During TDAFW pump operation, part of the pump discharge is recirculated back to 12 CST. This return flow to the tank will provide some amount of mixing action to prevent the stored water from freezing. Significant surface icing is not expected.

The licensee also specified that the TDAFW suction line is an 8" pipe which is heat traced and insulated and that the heat loss rate at the lowest ambient air temperature with the insulation fully intact is insufficient to result in freezing the suction line located above ground. High winds will have some effect through the 12 CST concrete structure entrance ways but the concrete structure limits air exchange and cooling of the AFW lines that are no longer warmed by heat tracing.

The licensee specified that the 11 and 12 PTWSTs are each provided heating by a closed loop heating circuit consisting of a small recirculation pump and a small heat exchanger that uses Plant Heating system steam as the heating source. This heating loop is in service during cold weather months to maintain PTWST water temperature greater than 40 degrees F. PTWST water temperature is maintained at approximately 70 degrees F when the heating system is in service. At the onset of ELAP the PTWST Recirc pump will lose power, and the source of Plant Heating steam from the Reheat Steam system will be lost when Units 1 and 2 trip. Each PTWST contains approximately 500,000 gallons of water. It is expected that it will take greater than 72 hours for this volume to cool to less than 40 degrees F. Significant surface icing is not expected.

The licensee specified that the 90,000 gallon Reactor Coolant Waste Receiver and Waste Monitor tanks are located inside of the AB on the -10 ft. elevation and are expected to remain above freezing beyond 72 hours. AB ambient air temperature is room dependent but ranges from 75 degrees F to 85 degrees F during cold weather months.

The BASTs are located on the 5 ft. elevation of the AB. The CVC system is located on and between the 27 ft., 5 ft., and -10 ft. elevations of the AB. AB ambient air temperature is room dependent but ranges from 75 to 85 degrees F during cold weather months.

The licensee specified that with ventilation secured, the thermal mass from the BASTs and CVCS is expected to maintain room temperatures above freezing beyond 72 hours, and in addition to the loss of ventilation, there will be a loss of power to the heat trace circuits.

The licensee specified that CCNPP's mitigation strategy for Core inventory restoration is planned to begin at 10-12 hours into the ELAP, and that once a vital 480VAC Load center is recovered by a FLEX portable DG a charging pump, taking direct suction from the BAST, will be started to begin restoring RCS inventory. The 3-inch jacket insulated charging pump to BAST direct suction pipe is approximately 30 feet long. The conservative initial condition will be the heat trace temperature controller has turned off and temperature is drifting down to the controller ON set point of 150 degrees F at the time of ELAP. The licensee also specified that based on a 7% solution of boric acid, it will take approximately 5 hours for the boric solution in the 3-inch suction line to reach 115 degrees F and begin to precipitate out of solution. Additionally, there is insufficient boric acid in solution to cause suction line blockage assuming that it takes 5 hours for the 3-inch line suction temperature cool to 115 degrees F and the boric acid to precipitate fully out of solution.

The licensee also specified that the 11 and 21 RWTs are provided heating by a closed loop heating circuit consisting of a small recirculation pump and a small heat exchanger that uses Plant Heating system steam as the heating source. This heating loop is in service during cold weather months to maintain RWT water temperature between 40 degrees F (TS minimum temperature) and 100 degrees F (TS maximum temperature). RWT water temperature is maintained between 70 degrees F to 80 degrees F when the heating system is in service. The licensee stated that the onset of ELAP, the RWT Recirc pump will lose power and the source of

Plant Heating steam from the Reheat Steam system will be lost when Units 1 and 2 trip. At TS minimum level each RWT contains 400,000 gallons of water containing TS boron concentration of 2300 to 2700 ppm boron. The licensee specified that it is expected that it will take greater than 72 hours for this volume to cool to less than 40 degrees F. The licensee specified that significant surface icing is not expected.

The licensee specified that CCNPP is developing strategies that deploy pumps connected to available water sources and discharging to the SG's, SFP, RCS Makeup, and/or Containment Spray, which will be set up but not charged until ready to inject. Once fluid is processed the procedures will define recirculation requirements back to the tank to prevent freezing. If flow loops will sit for long durations, they will be disconnected and drained until recalled for service. The procedures will be temperature based and not required in conditions that would not cause freezing. Recirculation can be accommodated using "Y" valves in the discharge of each pump at the point of entering the plant buildings.

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 heat tracing and component cold weather protection, if these requirements are implemented as described.

3.2.4.4 Accessibility - Lighting and Communications

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

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

On page 55 of 109 of the Integrated Plan, the licensee stated that battery backed emergency lighting exists in many areas of the plant. The licensee also specified that the majority of lights consist of 12 watt lamps powered by local battery packs rated for eight hours, and that lighting levels are only sufficient for entering and exiting rooms and some important equipment. Personnel will need use flashlights or portable lanterns for supplemental lighting.

The licensee also specified that per CCNPP Station Blackout Analysis, the Control Room has a sufficient level of battery backed lighting to perform all essential tasks for over four (4) hours. The Control Room and adjacent plant computer data acquisition (DAS) rooms have a separate emergency lighting system powered from vital 125 VDC Station Battery 22.

The licensee stated that the CCNPP Station Blackout Analysis has a list of rooms that might be entered by personnel during an SBO, emergency lighting wattage per room, and drawing references for each lighting circuit, and that exterior area lighting will be without power during an

ELAP. Portable diesel generator powered lighting units will be needed to provide lighting in the areas where FLEX equipment is expected to be deployed.

On page 56 of the Integrated Plan, the licensee identified five open items to; 1) investigate changing Appendix R lighting batteries to a longer life battery or new battery technology to lengthen the duration of lighting available in vital areas of the plant, 2) procure battery operated hardhat mounted lights ("miners" lights) for on-shift and ERO personnel, 3) to procure a sufficient quantity of hand-held battery operated hardhat lanterns for on-shift and ERO personnel, 4) to procure six (6) portable diesel generator powered exterior lighting units with 30 ft. masts and a minimum 400,000 lumens, and 5) to change Appendix R lighting from incandescent to LED to lengthen the duration of lighting available in vital areas of the plant." These open items are identified as Confirmatory Item 3.2.4.4.A in Section 4.2.

On page 56 of 109 of the Integrated Plan, the licensee stated that the CCNPP Plant Communications System provides communications capability inside and outside of the plant during normal and emergency operating conditions. The system consists of twelve major systems/subsystems:

Plant Public Address
Administrative Telephones
800 MHz Radio Telephone/Radios
Dedicated Telephone
Pager Recall System
Liquid Natural Gas (LNG) Hotline
Microwave Telephone
Nuclear Regulatory Commission (NRC) Hotline
Sound Powered Phones
Public Alert and Notification
Dedicated Cellular Phones
Dedicated Fixed Satellite Phones and
Portable Satellite Phones

The licensee stated that only the sound-powered phones and the portable satellite phones will be available during all external hazards applicable to CCNPP. The licensee also stated that CCNPP has an extensive sound-powered phone network, both primary and backup circuits. Phone jacks are located on multiple panels in the Control Room and vital areas of the plant. This system initially will be used by operations personnel for plant control. Eighteen (18) additional sound-powered phone headsets have been purchased and are stored in the Technical Support Center (TSC) Annex for this use. Five additional portable satellite phones have been purchased for the Control Room and TSC. These phones are stored in the TSC.

The licensee identified open items to; 1) implement a design changes to install a protected backup power supply capable of 24 hrs. of operation, for the Plant Public Address system, which includes backup power for the individual building speaker network amplifiers, 2) to modify the Fixed Dedicated Satellite Phone System to provide protection from external hazards, and transmitter and antennas protected from seismic, wind, and wind-driven missiles, including back-up power supply capable of 24 hours operation for the system, and 3) to modify the 800 MHz Radio System to provide protection from external hazards, transmitter and antennas protected from seismic, wind, and wind-driven missiles, including back-up power supply capable of 24 hours operation for the system and repeaters.

The NRC staff reviewed the licensee communications assessment (ML12311A300 and ML13066A710) in response to the March 12, 2012 50.54(f) request for information letter for CCNPP and, as documented in the staff analysis (ML13100A240) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2 (8) regarding communications capabilities during an ELAP. This has been identified as Confirmatory Item 3.2.4.4.B in Section 4.2 below 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 Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to providing adequate lighting and communications, if these requirements are implemented as described.

3.2.4.5 Protected and Internal Locked Area Access

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

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

The licensee provided no information in the Integrated Plan regarding local access to the protected areas under ELAP.

During the audit process the licensee specified that CCNPP currently has two access points into the Protected Area (PA) that support deployment of FLEX equipment. The licensee also specified that the path is through the existing vehicle access point that has features that may need to be defeated due to loss of power to allow for rapid access but the details of loss of power effects on selected features and alternate actions have not been evaluated at this time.

Additionally, the licensee specified that the second access point is via a normally blocked off road near the facility Main Gate, and that access to the PA via this route can be accomplished via FLEX protocols with Nuclear Security and manual actions. This route is not impacted by loss of power effects. A new third access point into the PA is under evaluation. Some infrastructure for this route currently exists, however an existing road will need to be extended a short distance to the PA boundary. The above issues have been identified as Confirmatory Item 3.2.4.5.A in Section 4.2.

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

3.2.4.6 Personnel Habitability – Elevated Temperature

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

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

NEI 12-06 Section 9.2 states:

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

On page 55 of the Integrated Plan, the licensee specified that for the Units 1 and 2 AB 45 Ft. El. Atmospheric Dump Valve (ADV) Enclosure Areas (Areas A408, A428) Habitability, the CCNPP Station Blackout Analysis does not specify a 4 hour temperature for this area. The ADV enclosures are adjacent to the S/G Blowdown Tank. S/G blowdown is secured early in the event per EOP-7, Station Blackout to protect the main condenser from over pressurization and to conserve S/G inventory. However, the stored heat of the S/G blowdown tank will dissipate to the area.

The licensee has identified an open item to perform an analysis to determine the temperature profile over 72 hours in the area around the ADV enclosures. This has been identified as Confirmatory Item 3.2.4.6.A in Section 4.2.

The licensee also specified that the Unit 1 and 2 Cable Spreading Rooms contain the battery chargers, 125 VDC to 120 VAC inverters, bus work, and power panels that supply essential instrumentation power. Per CCNPP Station Blackout Analysis Bechtel Calculation M-89-3, the Cable Spreading Room will reach 103 degrees F at four (4) hours into the event. The licensee also specified that under ELAP conditions with no mitigating actions taken, the blackout analysis states that the cable spreading room may surpass 110 degrees F (the assumed maximum temperature for efficient human performance as described in NUMARC 87-00 at some point during a blackout. A Phase 1 or 2 strategy will be to block open the doors to the Cable Spreading Room and set up portable air circulation fans powered by small portable ac generators. The licensee identified an open item to perform an analysis to determine the Cable

Spreading Room temperature response over a period of 72 hours. This has been identified as Confirmatory Item 3.2.4.6.B in Section 4.2.

On page 61 of the Integrated Plan, the licensee specified that operating Instructions provide a procedure for emergency operation of the Control Room and Cable Spreading Room Appendix R ventilation system, however, the procedure requires power and cooling water sources in order to be successful. The licensee identified an open item to develop strategies for use of the Control Room and Cable Spreading Room Appendix R Ventilation System during an ELAP. This has been combined with Confirmatory Item 3.2.4.2.B in Section 4.2.

On page 61 of 109 of its Integrated Plan, the licensee states in part regarding the TDAFW Pump room habitability during Phase 2 that the primary Phase 2 strategy for maintaining TDAFW pump rooms will be to restore power to one of the two 480 VAC reactor motor control centers (MCC) on each unit via a FLEX 480 VAC diesel generator connected to the MCCs' associated vital 480 VAC Load Center. The licensee also specified that this will allow operation of one of the two TDAFW pump room emergency ventilation fans. The licensee identified an alternate strategy which is to set up a portable air circulation fan powered by a small portable AC generator to ventilate the TDAFW pump room. See Section 3.2.4.2 above regarding an analysis of the TDAFW pump room conditions during the ELAP.

On pages 54 and 55 of the Integrated Plan, the licensee specified that a BDB seismic event is assumed to cause some level of damage to the TB, and that the TB is a non-seismic structure. Though the TB is designed for wind speeds up to 100 mph, it is not designed for wind-driven missiles or for the wind speeds as determined using NEI 12-06, Tables 7-1 and 7-2. The TDAFW pump room is located on the 12 ft. elevation of the TB. The room is a fully protected reinforced concrete structure that houses the two terry turbine AFW pumps. The room is normally accessed via the TB via a personnel watertight door and during pump operation by opening and keeping open a double watertight door located on the east side of the room. The room also has two emergency access points, one into the top of the room from the 27 ft. elevation of the TB and one at the 20 ft. elevation through the side of the room. The room also has a small ventilation tunnel between the room and the 5 ft. elevation AB Exhaust Ventilation Fan Room. The tunnel is approximately 24 inches in diameter and about 4 feet long. There is a removable hatch on the AB side and a bolted in place screen on the TDAFW pump room side.

The licensee identified two open items to perform an analysis to determine the possible effects of BDB external events on the TB structure and the potential effect on access to the TDAFW Pump Room, and to develop an alternate access strategy for access into the TDAFW Pump Room. This has been identified as Confirmatory Item 3.2.4.6.C in Section 4.2.

On page 66 of the Integrated Plan, the licensee specified that the primary strategy for cooling the Control Room is the same in Phase 3 as for Phase 2, and that the alternate strategy is to repower the Control Room HVAC (CREVS) System chillers and air handling units from their associated 480 VAC MCCs, 480 VAC Load Centers and 4160 VAC vital bus if it has been energized by one of the RRC FLEX 4160 VAC DG.

The licensee also specified that as part of Phase 3 strategies, a LPSI or CS Pump is placed into service in order to establish SDC, and that this will result in heat-up of the associated ECCS Pump Room due to the heat generated by the 4KV motors, as well as heat dissipated from the associated piping and RHR heat exchanger. The licensee stated that placing SDC in service will require the SW system to be in service which is the cooling medium for the ECCS Pump Room Air Coolers, and that when the vital 480 VAC reactor MCCs are re-energized, then power will be available to operate the ECCS Pump Room Air Cooler fans.

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 access and personnel habitability, if these requirements are implemented as described.

3.2.4.7 Water Sources

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

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

On page 25 of the Integrated Plan, the licensee specified that Phase 2 strategies for makeup water include deploying of a FLEX pump to take suction from; the fully protected 12 CST, the four (4) fully protected Reactor Coolant Waste Tanks or any other surviving water storage tank, for example the 11 or 21 CST, each with a capacity of 350,000 gallons, the 11 DWST, with a capacity of 350,000 gallons, the 11 or 12 PTWST, with a capacity of 500,000 gallons, or the 11 or 21 RWT, with a Technical Specification minimum volume per unit is 400,000 gallons. The licensee can also use a FLEX pump to take suction from the Chesapeake Bay at the Circulating Water Discharge Structure. For the lower mode strategies where RCS make-up will be needed, the FLEX pump will discharge to dedicated hose connections on the Safety Injection System.

On page 25 of the Integrated Plan, the licensee specified that per EOP Attachments, Attachment 9, Makeup Water Required for RCS Cooldown, using a water consumption rate over 6 hours of 164 gpm per unit, 12 CST will have a useable volume for approximately 10 hours. The normal make-up method from the Demineralized (DI) Water System to 12 CST will not be available due to the loss of power to the DI Transfer Pumps. 12 CST does not have hose connections for external makeup. A modification will add makeup and pump suction hose connections for FLEX pump connection to 12 CST, and modifications will be made to install a design change to add hose connections at 12 CST and 11 and 21 RWTs for RCS makeup and suction for the FLEX pumps. In the August 2013 update the licensee specified that modifications to replace the 2-1/2 inch hose connections with 4 inch hose connections at 11 and 21 CSTs, 11 DWST, and 11 and 12 PWSTs was deleted as a trailer-mounted hose manifold will be utilized instead to ensure the FLEX portable pumps have an adequate suction supply. The purpose for the manifold is to allow multiple tanks to be connected to the pump.

The licensee also provides additional water sources, including the 11 and 21 CSTs which each have a capacity of 350,000 gallons. The 11 and 21 CSTs have a 5 foot standpipe for protection of the main condensers. The CSTs are vertical, cylindrical stainless steel tanks that are seismically qualified under the CCNPP Seismic Verification Program.

The licensee identified in the Integrated Plan that they would perform an analysis to determine the seismic survivability of the three 640 ft. deep wells as a long-term source of make-up water. This open item has been deleted. The licensee specified that the UHS, the Chesapeake Bay, can be used as a limitless source of cooling water. The licensee also specified that one of the portable FLEX pumps can be set up adjacent to the Circulating Water discharge structure with suction hose placed into openings in the discharge structure (B.5.b pump setup location). The Circulating Water discharge structure is located at the +10 ft. elevation just north of the Sewage Treatment Building. The FLEX pump will provide water to 12 CST via hoses run up to the 45 ft. elevation and to hose connections that will be installed on the CST.

In the Integrated Plan the licensee identified an open item to perform an analysis to determine the long-term effect on the S/Gs from use of water from the UHS as a cooling medium. In the August 2013 update the licensee specified that this evaluation is not needed, and that the UHS will be used for cooling only after preferred sources of treated water are unavailable. FSGs will provide guidance on available water sources and direct usage of the UHS as a final source of cooling fluids. The licensee provided times for switching from SG makeup water sources and RCS makeup water sources in the SOE as discussed in Section 3.2.1.6 above.

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

3.2.4.8 Electrical Power Sources/Isolations and Interactions

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

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

In the Integrated Plan the licensee did not provide any information regarding how portable generators would be electrically isolated from plant equipment.

During the audit process the licensee specified that regarding Class 1E equipment protection, no written technical specifications, engineering evaluations, or developed purchase specifications for the FLEX generators has been developed at this time. The licensee also specified that most commercial generators include fault protection features but CCNPP recognizes this may not be adequate for protection of the 1E buses and associated equipment. The modification that will approve the 480VAC 675KVA generator will include an evaluation of additional protective relay devices (if needed) to ensure the 1E bus is protected.

The licensee specified that the 480VAC 125 KVA generators already purchased do have protective features, and that this generator is only sized to power a single safety-related battery charger which will be isolated from other equipment. An evaluation will be performed to verify the internal protective features are adequate to protect the battery charger or if additional protection will be required. The medium voltage 4160VAC generators and the low voltage 480VAC 800kW generators that will arrive from the RRC will have protective devices as specified in AREVA document 51-9199717-000, and that an evaluation will be performed to verify the internal protection is adequate to protect the 1E buses. This has been identified as Confirmatory Item 3.2.4.8.A in Section 4.2.

During ELAP CCNPP will implement procedures or guidelines that will strip unnecessary loads from the bus that will be powered by the FLEX generator and isolate the bus from normal power sources such that an unplanned restoration of power does not occur when the FLEX generator is powering the bus. In the same manner the bus will only be powered by more than one FLEX generator when specifically intended to synchronize two generators for additional service (RRC proposed solution for large 4160 VAC generator sets). FLEX Support Guidelines will be developed to ensure adequate protection is in place for separation, isolation, connection and load stripping of generators, buses and equipment.

On page 68 of the Integrated Plan, the licensee provided a list of PWR portable equipment for Phase 2 of the mitigation strategies. In the list are included two 480VAC diesel generators rated 125 kVA each, and two 480VAC diesel generators rated 675 kVA each. The licensee did not provide a summary of sizing calculations of these diesel generators, or identify all the loads which will be fed from each of the diesel generators. Additionally the licensee did not provide a Single Line Diagram showing the proposed connection of the Phase 2 diesel generators to the 480V system, to clarify how these portable generators will be deployed to meet the N+1 requirement as it appears the Unit 1 and 2 switchgear are not cross-connected.

During the audit process the licensee specified that the 480 VAC/125KVA diesel generator sets were purchased using an initial assessment performed by design engineering for the sole purpose of providing power to a single 125VDC battery charger. Two diesel generators were purchased in 2012 to meet the March 2012 NSAIC commitment. A third diesel generator will need to be purchased to meet N+1 requirements, and a formal evaluation will be performed to validate the intended use.

The three proposed 480VAC/675KVA diesel generator sets have not been purchased at this time but were preliminarily sized based on the following loads; one charging pump, a battery charger and selected RX MCC loads such as the SIT outlet MOV's, the TDAFW room emergency exhaust fans, the battery room exhaust fans, and the SW 1A emergency air compressors. The supplied reactor MCC can be cross-connected to the redundant train reactor MCC on that unit.

The 480VAC/125KVA diesel generators are intended as an alternate strategy to connect to one of two vital reactor MCCs on each unit. The supplied reactor MCC can be cross connected to the redundant train reactor MCC on that unit. Selected RX MCC loads include the vital 120 VAC Inverter backup bus, the SIT outlet MOV's, the TDAFW room emergency exhaust fans and the battery room exhaust fans.

One 480VAC/675KVA diesel generator set will be deployed for each unit to connect to one vital 480 VAC Load Center on that unit. An evaluation to validate the intended use of these diesel generators is pending. This has been identified as Confirmatory Item 3.2.4.8.B in Section 4.2.

The licensee will provide Single Line Diagrams showing the proposed connection of the Phase 2 diesel generators to the 480V systems. Breaker/relay protection information will be included on the Single Line Diagrams.

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

3.2.4.9 Portable Equipment Fuel

NEI 12-06, Section 3.2.2, 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 page 62 and 63 of the Integrated Plan, the licensee specified that CCNPP has a minimum total of 128,580 gallons of diesel fuel oil stored in fully protected, seismic Class 1 plant structures. This total is the combined Technical Specification minimum levels of 21 Fuel Oil Storage Tank (FOST), 1A DG FOST, and 1A, 1B, 2A, and 2B DG Day Tanks. All of these tanks are located inside of seismic Class 1 reinforced concrete structures. However, the sulfur content of this diesel fuel oil is well above the maximum recommended by the manufacturers of the diesel engines for the FLEX pumps and generators. The recommended maximum sulfur content in the diesel fuel oil for these machines is 15 ppm. The sulfur content in the tanks described above is 400 ppm. This sulfur level is slowly lowering as new diesel fuel oil is added to the tanks, however it will take many years before the sulfur content is less than 15 ppm.

The licensee identified Open Items to evaluate the cost of draining 21 FOST and 1A DG FOST and refilling with low sulfur diesel fuel oil and to implement a design change to install dedicated FLEX hose connections on 21 FOST, IA DG FOST, and the IB, 2A, and 2B DG fuel oil Y-strainers.

The licensee specified that the CCNPP Transportation Center located outside of the PA just south of the Outside Building Complex has a buried 4,000 gallon diesel fuel oil tank that will be used on an interim basis for fueling the FLEX pumps, generators, and air compressors. This diesel fuel oil storage tank is refilled when stored volume reaches 2,000 gallons. The turnover rate of this fuel is such that a low sulfur content of less than 15 ppm is maintained.

The fleet standard FLEX pump diesel engine has a 190 gallon fuel tank. Fuel consumption rate at maximum horse power is 13.4 gallons per hour. The onboard fuel tank has sufficient fuel capacity for over 12 hours of operation. The FLEX 100 KW, 125 KVA Cummins Power Generation diesel generator has a 180 gallon fuel tank. Fuel consumption at maximum generator load is 8.2 gallons per hour. The onboard fuel tank has sufficient fuel capacity for over 20 hours of operation.

The licensee specified that CCNPP has purchased a 2800 gallon fuel oil tanker truck for transport of diesel fuel oil to the FLEX portable equipment. Additionally, two (2) gasoline powered fuel oil transfer pumps and hoses have been purchased for transfer of fuel oil from the identified protected storage locations to the fuel oil tanker truck.

The licensee identified Open items to perform an analysis of the fuel consumption rate for all of the FLEX equipment that could be in operation during an ELAP for a period of 72 hours to determine a conservative refueling interval, and to develop strategies to reduce the transport time for fuel oil loading and delivery. This has been identified as Confirmatory Item, 3.2.4.9.A in Section 4.2 below

The licensee's Integrated Plan did not describe plans for supplying fuel oil to FLEX equipment, i.e., fuel oil storage tank volume, supply pathway and did not explain how fuel quality will be assured if stored for extended periods of time.

During the audit process, the license specified that they plan to install a dedicated 30,000 gallon FLEX Fuel Oil Storage Tank (FOST) that will be located with the planned FLEX Storage Buildings (FSB). CCNPP has purchased one 2800 gallon fuel tanker truck and intends to purchase additional tanker truck(s) to reduce FLEX equipment refueling cycle time. The licensee also specified that fuel oil supply routes will follow the same pathways as the FLEX equipment deployment pathways. The licensee stated that the proposed FLEX FOST will hold fuel oil meeting Ultra-Low Sulfur Fuel (ULSF) requirements with the proper additive package for long term storage comparable to fuel oil stored in the station's SR FOSTs, and that testing of the fuel oil will follow the same procedural control process as the other FOSTs located on site.

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 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 page 19 of the Integrated Plan, the licensee specified that per current CCNPP design and the SBO Analysis, the four (4) Class 1E 125 VDC station batteries are designed to cope in an SBO event for four (4) hours. Per CCNPP E-93-016, Revision 1, using a minimum voltage of 105 VDC, the 4 station batteries can supply their respective SBO loads from 259 minutes to 305 minutes depending on the battery. DC load shedding is needed to extend this coping time out beyond six (6) hours. The licensee also specified that preliminary results show that the station battery life can be extended past 6 hours with additional load shedding, and identified four open items related to load shedding including one to perform additional analysis to determine the scope of the load shedding strategy.

The licensee also specified that for DC Buses 12 and 22, the calculation assumed that the plant computer inverters remained energized for the duration of the scenario but in reality, these inverters are secured within 30 minutes of the event initiation as directed from EOP-7. Following declaration of ELAP at time one (1) hour, operators will be directed to perform non-vital dc load shedding of loads supplied from the four (4) vital 125 VDC buses and their associated dc power panels. The dc buses and power panels are located in the Unit 1 and 2 Cable Spreading Rooms that are located on the 27 ft. el. below the Control Room. The designated dc load breakers will be marked or labeled for ease of identification.

On page 19 of the Integrated Plan, the licensee identified Open Items: to implement a design change to clearly identify the set of dc load breakers that will either be left energized or load shed by identifying the selected breakers by their unique numbers and load title; to implement a procedure or FSG to perform the dc load shedding; and to complete a time-motion study to validate that DC load shedding can be accomplished on each unit in one hour. This is identified as Confirmatory Item 3.2.4.10.A in Section 4.2.

During the audit process the licensee reiterated that they will perform an analysis to determine the necessary scope of the DC load shedding strategy. The licensee specified that the vital 125 VDC Station Batteries are expected to be available for up to 11 hours without recharging following DC load shedding, and that they will perform an analysis to determine station battery coping time with DC load shedding. The analysis will consider battery age, battery performance without battery room ventilation and load, and load duration prior to completion of DC load shedding. The maintenance of vital 125 VDC power will include aligning the Reserve Battery to one of the four vital 125 VDC buses via bus work and disconnects that are currently being installed under an existing plant modification, ECP-11-000293 and the similar ECP-11-000294 for Units 1 and 2. The Unit 1 portion of this modification will be completed during the Unit 1 2014 refueling outage (RFO) and on Unit 2 during the 2015 RFO. The licensee also specified that this action will extend the coping time for one vital 125 VDC bus to greater than 20 hours. The licensee was requested to provide a copy of the analysis/calculations which shows aligning the Reserve Battery to one of the four 125VDC buses can extend the coping time for one vital 125 VDC bus to greater than 20 hours. This is identified as Confirmatory Item 3.2.4.10.B in Section 4.2.

During the audit process the licensee specified that an analysis that would provide information on the adequacy of the ventilation provided in the battery rooms to protect the batteries from the effects of extreme high and low temperatures has not been performed under ELAP conditions. The licensee also specified that the ventilation that is planned for the battery rooms under ELAP conditions consists of a fan that would serve the dual purposes of precluding the possibility of hydrogen accumulation through dilution with air external to the battery rooms while maintaining the room temperatures at or equal to that of the makeup air. Additionally, the makeup air brought into the battery rooms by the temporary (FLEX) fans would come from inside the building, and as such would not be affected or be representative of extreme seasonal, outdoor temperatures. The licensee specified that consequently, it is expected that the temperatures in the battery rooms would not be significantly impacted in the first 72 hours of an ELAP event but would remain comparable to ambient building internal temperatures. The licensee noted that under SBO conditions, it has been determined that the battery rooms for both the normal and reserve batteries are not a significant source of heat.

The NRC staff reviewed the licensee's Integrated Plan and determined that the Generic Concern related to battery duty cycles beyond 8 hours is applicable to the plant. This Generic Concern 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 concerns associated with Integrated Plan submittals in a timely manner and on a generic basis, to the extent possible, and provide a consistent review by the NRC staff. 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 requirements 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 of the battery. 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. 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 concluded that the position paper provides an acceptable approach for licensees to use in demonstrating that vented lead-acid batteries can be credited for durations longer than

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 review of the licensee's Integrated Plan.

The licensee informed the NRC of their plan to abide by this generic resolution, and their plans to address potential plant-specific issues associated with implementing this resolution that were identified during the audit process.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and 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 load reduction to conserve dc power, if these requirements are implemented as described.

3.3 PROGRAMMATIC CONTROLS

3.3.1 Equipment Maintenance and Testing

NEI 12-06, Section 3.2.2, following item (15) provides that:

> In order to assure reliability and availability of the FLEX equipment required to meet these capabilities, the site should have sufficient equipment to address all functions at all units on-site, plus one additional spare, i.e., an N+1 capability, where "N" is the number of units on-site. Thus, a two-unit site would nominally have at least three portable pumps, three sets of portable ac/dc power supplies, three sets of hoses & cables, etc. It is also acceptable to have a single resource that is sized to support the required functions for multiple units at a site (e.g., a single pump capable of all water supply functions for a dual unit site). In this case, the N+1 could simply involve a second pump of equivalent capability. In addition, it is also acceptable to have multiple strategies to accomplish a function (e.g., two separate means to repower instrumentation). In this case the equipment associated with each strategy does not require N+1. The existing 50.54(hh)(2) pump and supplies can be counted toward the N+1, provided it meets the functional and storage requirements outlined in this guide. The N+1 capability applies to the portable FLEX equipment described in Tables 3-1 and 3-2 (i.e., that equipment that directly supports maintenance of the key safety functions). Other FLEX support equipment only requires an N capability.

NEI 12-06, Section 11.5 states:

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

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

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

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

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

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

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

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

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

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

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

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

On page 78 of the Integrated Plan, in Attachment 2-1, Milestone Schedule, the licensee specified that the target date for creating maintenance and testing procedures is June 2014 and that they have not created maintenance and testing procedures.

The licensee's plan for equipment maintenance and testing, which endorses the EPRI industry program for maintenance, which is currently under development, did not provide details to show how the planned maintenance and testing of FLEX electrical equipment such as batteries, cables, and diesel generators will conform to the guidance of NEI 12-06, Section 11.5.

During the audit process, the licensee specified that they have established a system number for FLEX equipment at CCNPP - System 130, Beyond Design Basis. This system will be managed by a system manager within system engineering. The new system manager will be developing the system PM basis using the EPRI maintenance template and the manufacturer's technical manual recommendations for each component package. The PM program will follow the AP-913 equipment reliability program, equipment will be assigned QSS service weeks and preventive maintenance and seasonal readiness programs will apply. The details of component/subcomponent PM's and seasonal readiness are not yet defined under the program for FLEX equipment. Technical requirements/purchasing have not taken place for many of the FLEX components to date.

Equipment unavailability will be tracked in the same manner as existing plant processes with procedure controls to procure replacement equipment in the event the component is in jeopardy of exceeding the 90 day unavailability limit. Approximate operational return to service priority will be assigned and integrated work management processes will be followed to ensure out service FLEX equipment return to service is prioritized to meet the guidance in NEI 12-06 Section 11.5.3.f.

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

This Generic Concern involves clarification of how 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 developing a program for maintaining FLEX equipment in a ready-to-use status. The NRC staff will evaluate the resulting program through the audit and inspection processes.

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 equipment maintenance and testing, if these requirements are implemented as described.

3.3.2 Configuration Control

NEI 12-06, Section 11.8 states:

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

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

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

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

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

On page 12 of the Integrated Plan, the licensee stated that CCNPP will establish a system designation for emergency portable equipment and will manage this system in a manner consistent with medium-risk plant systems per the licensee procedure CNG-OP-4.01- 1000, Integrated Risk Management. All elements of the program described in NEI 12-06 Section 11, including recommended "should" items will be included in the station program. A system engineer will be assigned the responsibility for configuration, maintenance and testing. The equipment for FLEX will have unique identification numbers. Installed structures, systems and components pursuant to 10 CFR50.63 (a) will continue to meet the augmented quality guidelines of Regulatory Guide 1.155, Station Blackout. Preventive maintenance procedures (PMs) will be established for all components and testing procedures will be developed with frequencies established based on type of equipment will be developed with frequencies established based on type of equipment, OEM recommendations and considerations made within EPRI guidelines.

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

3.3.3 Training

NEI 12-06, Section 11.6 states:

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

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

3. Personnel assigned to direct the execution of mitigation strategies for beyond-design basis events will receive necessary training to ensure

familiarity with the associated tasks, considering available job aids, instructions, and mitigating strategy time constraints.

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

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

On page 13 of the Integrated Plan, the licensee stated that CCNPP will implement training of station staff prior to the second refueling outage after February 28, 2013. These programs and controls will be implemented in accordance with the Systematic Approach to Training (SAT).

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

3.4 <u>OFF-SITE RESOURCES</u>

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 page 13 and 14 of the Integrated Plan, the licensee stated that the licensee has signed contracts and issued purchase orders to Pooled Inventory Management (PIM for participation in the establishment and support of two (2) Regional Response Centers (RRCs) through the Strategic Alliance for FLEX Emergency Response (SAFER). Each site has agreed to enter portable FLEX equipment inventory into the Rapid Parts Mart which is an internet based search capability currently used for other spare part needs.

SAFER will provide requested portable FLEX equipment to a local staging area where the equipment will be serviced (e.g., fuel and lubricating oil) and made ready for transport to the site. The criteria for the local staging area will be defined by June 2013. The staging area must be outside the 25 mile radius of the site, because the FLEX strategy evaluations assume that there will be significant damage and no power or communications within the 25 mile radius. If an individual site provides qualified power and communications to a staging area within the 25 mile radius, then that staging area will be considered acceptable. The RRC will support initial portable FLEX equipment delivery to the site within 24 hours of a request for deployment.

Each the licensee site will develop a playbook which will provide the detail necessary to ensure the successful delivery of the portable FLEX equipment from the RRC to the local staging area and from the local staging area to the site. Pilot playbooks are to be developed and ready for use by each site as a template by June 2013.

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. The licensee did not address the remaining minimum capabilities of 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 use of off-site resources during seismic events, if these requirements are implemented as described.

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.2.1.1.A	To conform to NEI 12-06 regarding the plant-specific ELAP analysis to provide the basis for the timing of mitigating strategies and maintaining core cooling and RCS inventory	

	(including computer codes/models and assumptions used in the analysis), the licensee will need to perform a plant specific analysis. If the CENTS code is used, the value of flow quality at the upper region of SG tubes for the condition when the RCS makeup pump is required to inject water into the RCS will also need to be submitted, and the licensee should confirm that CENTS is not used outside of any ranges of applicability discussed in the white paper addressing the use of CENTS (e.g., prior to the reflux boiling initiation). If other codes are used for the ELAP analysis, the licensee will need to justify the acceptance of the codes for this use.	
3.2.1.1.B	The licensee's plan for analysis for core and containment cooling is still under development and CENG will identify additional analysis to support the mitigating strategies. The licensee stated that as additional analyses are identified to support responding to the requirements of Order EA 12-049, they will be reported in a future 6-month update. The subjects of the analyses are: maintaining core cooling (e.g., confirm shutdown margin during cooldown, dc load shedding, and adequate steam pressure for TDAFW pump operation), containment temperature and pressure response for containment cooling, and various safety functions regarding ventilation and cooling systems (e.g., for the main control room, TDAFW pump room, cable spreading room, battery rooms, switchgear rooms and the SFP area). Review of these analysis is needed to confirm acceptability of the mitigating strategies.	
3.2.1.8.A	During the audit process, the licensee informed the NRC staff of its intent to abide by the PWROG generic approach regarding boric acid mixing discussed in Section 3.2.1.8 of this report; however, the NRC staff concluded that the August 15, 2013, position paper was not adequately justified and that further information is required.	

4.2 <u>CONFIRMATORY ITEMS</u>

Item Number	Description	Notes
3.1.1.1.A	On page 8 of the Integrated Plan, the licensee specified that Phase 2 FLEX components will be stored at the site in a location or locations such that they are reasonably protected and that no one external event can reasonably fail the site FLEX capability. Provision will be made for multiple sets of portable on-site equipment stored in diverse locations or through storage in structures designed to reasonably protect from applicable external events. FLEX equipment storage location(s) have not been selected.	
3.1.1.1.B	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.	

3.1.1.4.A	The licensee has not yet identified the local staging area or described the methods to be used to deliver the equipment to the site for all hazards. The licensee will develop a playbook which will provide the detail necessary to ensure the successful delivery of the portable FLEX equipment from the RRC to the local staging area and from the local staging area to the site.	
3.1.2.2.A	The licensee identified two open items; one regarding evaluating deployment strategies and deployment routes to ensure they are assessed for and address applicable hazards impact. The second was to provide an administrative program governing the FLEX deployment strategy, marking of setup locations, including primary and alternate pathways, maintaining the pathways clear, and clearing the pathways.	
3.1.2.2.B	Regarding the open items noted in 3.1.2.2.A, evaluations are needed to assure that connection points for portable equipment remain viable for the flooded condition, and that the effects of the maximum storm surge or PMH should be considered in evaluating the adequacy of the baseline deployment strategies.	
3.1.2.2.C	An alternate UHS location has not been established, however the licensee intends on implementing a design change to install a protected alternate means of accessing the UHS for all BDBEEs, including installing necessary modifications to meet required deployment times. The strategy must also address how debris in the UHS will be filtered / strained and how the resulting debris will affect core cooling.	
3.1.3.2.A	The licensee specified that CCNPP currently has a varied array of wheeled vehicles, e.g., forklifts, small tractors, and a backhoe, that could be used for debris removal. However, the licensee did specify if this equipment would be protected from high wind and other hazards.	
3.1.3.2.B	The licensee also specified that primary access to the UHS is via the openings in the CW Discharge Structure (plant outfall) located on the waterfront 10 ft. elevation north of the Sewage Treatment Building. An alternate UHS location has not been established; however the licensee has identified an open item to implement a design change to install a protected alternate means of accessing the UHS for all BDBEEs, including installing necessary modifications to meet required deployment times. The strategy must also address how debris in the UHS will be filtered / strained and how the resulting debris will effect core cooling.	
3.1.4.2.A	On pages 8 and 12 of 109 in the integrated plan, the licensee identified open items to evaluate deployment strategies and deployment routes to ensure they are assessed for and address applicable hazards impact, and to provide an administrative program governing the FLEX deployment strategy, marking of setup locations, including primary and alternate pathways, maintaining the pathways clear, and clearing the pathways. The licensee did not address procurement requirements to ensure	

	that the FLEX equipment can be operated in extreme hot or cold temperature environments or how hot or cold temperature will affect manual actions.	
3.1.4.2.B	Deployment of FLEX equipment has not been addressed for conditions of snow, ice and extreme cold. The current screening omits a discussion of deployment of FLEX equipment for hazards due to ice blockage or formation of frazil ice on the UHS. However, the discussion notes that CCNPP's location is within the level 4 region of NEI 12-06, Figure 8-2, which corresponds to the Level 4 ice storm severity region, and that as such, would require consideration of an ice or snow storm impact on the coping strategies for this hazard.	
3.2.1.2.A	The RCP seal initial maximum leakage rate should be greater than or equal to the upper bound expectation for the seal leakage rate for the ELAP event discussed in the PWROG white paper addressing the RCP seal leakage for CE plants. If the RCP seal leakage rate used in the plant-specific ELAP analysis is less than upper bound expectation for the seal leakage rate discussed in the white paper, justification should be provided.	
3.2.1.5.A	During the audit process the licensee specified that the aspects to this question regarding plant instrumentation are: the effects of an ELAP event on containment integrity, equipment qualification (EQ), and the adequacy of inputs, assumptions, and methods. The licensee specified that containment integrity is maintained and the reference "CCNPP Containment Analyses" contains relevant information regarding this issue. The review of these analyses is needed to confirm instruments are reliable and accurate in the containment harsh conditions with high moisture levels, temperature and pressure during the ELAP event.	
3.2.1.6.A	The following references used as basis for several SOE Action Time constraints were not available for review. These include: CCN0012-17-STUDY-001, and CCNPP FLEX Strategy Table Top.	
3.2.1.6.B	The licensee has not completed final analysis regarding validation of the action times reported in the Sequence of Events. The licensee was requested to provide a discussion regarding the SOE analysis when complete, and to provide if necessary, a revised sequence of events (SOE) for the plant specific ELAP analysis used to support the FLEX mitigation strategies, noting any revised action times that may result from ongoing analysis. Additionally, the licensee was requested to discuss any SOE changes that may result from ongoing evaluations for; RCP seal leakage, plant specific CENTS analysis, and any revised battery load shed analysis. During the audit process the licensee specified that they will provide information from the validation of the action items and any additional information as it becomes available.	
3.2.1.7.A	The Generic Concern related to the shutdown and refueling modes, required clarification of CCNPP's approach to	

	demonstrate that the strategies can be implemented in all modes. During the audit, the licensee informed the NRC of their plans to abide by this generic resolution. The implementation of these plans is identified as Confirmatory Item 3.2.1.7.A.	
3.2.1.9.A	The FLEX AFW pump is deployed at T+1 hour based on WCAP recommendations to commence early deployment in case of some unforeseen failure of the installed TDAFW pump. CCNPP will perform a time study to determine how long it takes to deploy the FLEX AFW pump in Phase 1 and 2.	
3.2.1.9.B	Deployment of a 185 SCFM air compressor is an alternate strategy to restoration of power to the installed emergency Saltwater Air compressors to restore safety related instrument air. The deployment of the air compressor is uncomplicated and the hose run small and light. These air compressors will be deployed after deployment of the portable diesel generators and the CST makeup pump. The licensee will perform a time study to determine how long it takes to deploy the FLEX air compressor in Phase 2.	
3.2.1.9.C	Phase 3 Pump Deployment which includes, 2 FLEX pumps with a minimum flow rate of 500 gpm and maximum pressure of 500 psi, a FLEX high pressure pump with a flow rate of 60 gpm for the pressure range from 1000 to 3000, and 2 FLEX pumps with a flow rate of 2500 gpm and maximum pressure of 300 psi. An analysis will be provided in future six month updates as detailed engineering evaluations are performed for each FLEX component and modification strategy.	
3.2.1.9.D	The licensee has provided strategies using portable pumps for RCS cooling described above. The licensee provided an open item, to perform engineering analysis to determine that there is sufficient decay heat generated for TDAFW operation 36 hours after shutdown. The licensee also noted that a CCNPP Engineering Calculation has been requested to confirm the assumption that the TDAFW pumps can operate reliably provided there is greater than 65 psia steam pressure in one of the S/Gs.	
3.2.2.A	The licensee did not discuss the impacts of salt/brackish water on the structures and components of the SFP system, and the fuel. During the audit process the licensee specified that they will perform an analysis to determine the effects of salt/brackish water on the structures and components (including instrumentation) of the SFP system and the stored fuel. The results of this analysis will be provided as soon as it becomes available.	
3.2.2.B	SFP ventilation will consist of a cross-area air flow path on the 69-ft. elevation that can be established by; opening the doors to the AB Supply Ventilation air plenum, opening the northeast door from the SFP area to the Unit 1 containment access areas, opening the door to the Unit 1 main vent fan room, and finally opening the hatch on the Unit 1 main ventilation exhaust system plenum. The licensee will perform an analysis to verify that the	

	above strategy will provide sufficient air flow to vent steam from the SFP Area. The result of this analysis will help determine whether or not natural air circulation is sufficient to vent steam and condensate from the SFP or whether forced ventilation provided by FLEX equipment will be required.	
3.2.3.A	The licensee specified that an analysis of the Containment response during the ELAP event indicated that the Containment would not require additional cooling. The licensee provided a document titled CCNPP Containment Analysis that was based on the GOTHIC code, however it did not have an approved date, or author approvals, and the tabulated results did not match those transmitted in the August 2013 6-month update.	
3.2.3.B	The licensee specified that no portable equipment is expected to be required to maintain containment in Phases 1 and 2. On page 38 of the OIP the licensee states that the Phase 2 strategy for containment integrity is to continue to monitor containment parameters and if necessary initiate containment spray via a FLEX pump. Additionally, the CCNPP Containment Calculation document concluded that given a choice between recovering containment fan coolers or containment spray, the recovery of containment fan coolers is preferred. With these seemingly conflicting directions, the licensee did not provide a clear position on the use of FLEX pumps and equipment during Phase 2 to maintain containment integrity.	
3.2.4.1.A	Charging Pump Room ventilation is provided by the NSR AB Supply and Exhaust Ventilation System. Air flow is into the rooms from the AB -10 foot elevation central hallway and then out via room exhaust ventilation ducts. An evaluation will be performed to determine if the Charging Pumps can meet their mission time without room ventilation.	
3.2.4.2.A	The licensee identified an open item to perform an analysis to determine the Control Room temperature response over a period of 72 hours.	
3.2.4.2.B	The licensee identified an open item to develop strategies for use of the Control Room and Cable Spreading Room Appendix R Ventilation System during an ELAP.	
3.2.4.2.C	The licensee identified an open item to perform an analysis to evaluate hydrogen buildup in the battery rooms during charging and room temperature profiles.	
3.2.4.2.D	The licensee identified an open item to perform an analysis to determine the Switchgear Room temperature response following the reenergizing of buses and assuming various 480 VAC load center and 4160 VAC bus loadings over a period of 72 hours.	
3.2.4.2.E	The AB 69 ft. elevation West Electrical Penetration Rooms have supply and exhaust ventilation provided by the AB supply and exhaust ventilation system. The AB 45 ft. elevation West Electrical Penetration Rooms have supply air provided from the general area of the 45 ft. elevation of the AB and exhaust ventilation provided by the Penetration Room exhaust	

	ventilation system. The West Electrical Penetration Rooms will begin to heat up after the Reactor MCCs are re-energized from the FLEX 480 VAC DGs, therefore, they will need to be evaluated for limiting temperatures for equipment survivability.	
3.2.4.4.A	On page 56 of the Integrated Plan, the licensee identified five open items to; 1) investigate changing Appendix R lighting batteries to a longer life battery or new battery technology to lengthen the duration of lighting available in vital areas of the plant, 2) procure battery operated hardhat mounted lights ("miners" lights) for on-shift and ERO personnel, 3) to procure a sufficient quantity of hand-held battery operated hardhat lanterns for on-shift and ERO personnel, 4) to procure six (6) portable diesel generator powered exterior lighting units with 30 ft. masts and a minimum 400,000 lumens, and 5) to change Appendix R lighting from incandescent to LED to lengthen the duration of lighting available in vital areas of the plant.	
3.2.4.4.B	The NRC staff reviewed the licensee communications assessment and 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. Confirmation that upgrades to the site's communications systems have been completed will be accomplished at a late date.	
3.2.4.5.A	During the audit process the licensee specified that CCNPP currently has two access points into the Protected Area (PA) that support deployment of FLEX equipment. The licensee also specified that the access path into the Protected Area (PA) is through the existing vehicle access point that has features that may need to be defeated due to loss of power to allow for rapid access but the details of loss of power effects on selected features and alternate actions have not been evaluated at this time. Additionally, the licensee specified that the second access point is via a normally blocked off road near the facility Main Gate. A new third access point into the PA is under evaluation. Some infrastructure for this route currently exists, however an existing road will need to be extended a short distance to the PA boundary.	
3.2.4.6.A	The licensee has identified an open item to perform an analysis to determine the temperature profile over 72 hours in the area around the ADV enclosures.	
3.2.4.6.B	The licensee identified an open item to perform an analysis to determine the Cable Spreading Room temperature response over a period of 72 hours.	
3.2.4.6.C	The licensee identified two open items to perform an analysis to determine the possible effects of BDB external events on the TB structure and the potential effect on access to the TDAFW Pump Room, and to develop an alternate access strategy for access into the TDAFW Pump Room.	

3.2.4.8.A	The medium voltage 4160VAC generators and the low voltage 480VAC 800kW generators that will arrive from the RRC will have protective devices as specified in AREVA document 51-9199717-000. An evaluation will be performed to verify the internal protection is adequate to protect the 1E buses.	
3.2.4.8.B	One 480VAC/675KVA diesel generator set will be deployed for each unit to connect to one vital 480 VAC Load Center on that unit. The 480VAC/125KVA diesel generators are intended as an alternate strategy to connect to one of two vital reactor MCCs on each unit. The supplied reactor MCC can be cross-connected to the redundant train reactor MCC on that unit. An evaluation to validate the intended use of these diesel generators is pending.	
3.2.4.9.A	The licensee identified Open items to perform an analysis of the fuel consumption rate for all of the FLEX equipment that could be in operation during an ELAP for a period of 72 hours to determine a conservative refueling interval, and to develop strategies to reduce the transport time for fuel oil loading and delivery.	
3.2.4.10.A	On page 19 of the Integrated Plan, the licensee identified Open Items: to implement a design change to clearly identify the set of dc load breakers that will either be left energized or load shed by identifying the selected breakers by their unique numbers and load title; to implement a procedure or FSG to perform the dc load shedding; and to complete a time-motion study to validate that DC load shedding can be accomplished on each unit in one hour.	
3.2.4.10.B	Maintenance of vital 125 VDC power will include aligning the Reserve Battery to one of the four vital 125 VDC buses via bus work and disconnects that are currently being installed under an existing plant modification, ECP-11-000293 and the similar ECP-11-000294 for Units 1 and 2. The Unit 1 portion of this modification will be completed during the Unit 1 2014 refueling outage (RFO) and on Unit 2 during the 2015 RFO. This action will extend the coping time for one vital 125 VDC bus to greater than 20 hours. The licensee needs to provide a copy of the analysis/calculations which shows aligning the Reserve Battery to one of the four 125VDC buses can extend the coping time for one vital 125 VDC bus to greater than 20 hours.	
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. The licensee did not address the remaining minimum capabilities of Section 12.2.	

If you have any questions, please contact Mr. Randy Hall, Senior Project Manager in the Mitigating Strategies Directorate, at (301) 415-4032.

Sincerely,

/RA/

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

Docket Nos. 50-317 and 50-318

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

cc w/encl: Distribution via Listserv

Mr. George H. Gellrich, Vice President
Calvert Cliffs Nuclear Power Plant, LLC
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657-4702

Mr. Edmund M. Tyler
Constellation Fleet Licensing
Constellation Energy Nuclear Group, LLC
100 Constellation Way, Suite 200C
Baltimore, MD 21202

DISTRIBUTION:
PUBLIC
LPL1-1R/F
RidsNrrDorlLpl1-1 Resource
RidsNrrPMCalvertCliffs Resource
RidsNrrLASLent Resource
RidsAcrsAcnw_MailCTR Resource
RidsRgn1MailCenter Resource
JHall, NRR/MSD
JBowen, NRR/MSD

ADAMS Accession Nos.: Pkg ML13347B218, Letter/ISE ML13225A566, TER ML13338A646 * via e-mail

OFFICE	NRR/MSD/PM	NRR/MSD/LA	NRR/MSD/SA	NRR/MSD/MSPB/BC
NAME	JHall	SLent	EBowman*	JBowen
DATE	12/16/2013	12/16/2013	12/17/2013	12/16/2013
OFFICE	NRR/MSD/MESB/BC	NRR/MSD/MRSB/BC	NRR/MSD/D	NRR/MSD/MSPB/BC
NAME	SBailey*	SWhaley*	JDavis* (SWhaley for)	JBowen
DATE	12/16/2013	12/16/2013	12/16/2013	12/17/13

OFFICIAL RECORD COPY