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

February 21, 2014

Mr. Thomas D. Gatlin
Vice President, Nuclear Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
Post Office Box 88, Mail Code 800
Jenkinsville, SC 29065

SUBJECT: VIRGIL C. SUMMER NUCLEAR STATION UNIT 1 - INTERIM STAFF EVALUATION RELATING TO OVERALL INTEGRATED PLAN IN RESPONSE TO ORDER EA-12-049 (MITIGATION STRATEGIES) (TAC NO. MF2338)

Dear Mr. Gatlin:

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. ML13063A150), South Carolina Electric and Gas Company (SCE&G or the licensee) submitted its Overall Integrated Plan for Virgil C. Summer Nuclear Station Unit 1 in response to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13242A273), SCE&G submitted a six-month update to the Overall Integrated Plan.

Based on a review of SCE&G's plan, including the six-month update dated August 28, 2013, and information obtained through the mitigation strategies audit process,[1] the NRC concludes that the licensee has provided sufficient information to determine that there is reasonable assurance that the plan, when properly implemented, will meet the requirements of Order EA-12-049 at Virgil C. Summer Nuclear Station Unit 1. 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.

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

If you have any questions, please contact James Polickoski, Mitigating Strategies Project Manager, at 301-415-5430 or at james.polickoski@nrc.gov.

Sincerely,

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

Docket No. 50-395

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

cc w/encl: Distribution via Listserv

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

SOUTH CAROLINA ELECTRIC AND GAS COMPANY

VIRGIL C. SUMMER NUCLEAR STATION UNIT 1

DOCKET NO. 50-395

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 [Reference 2], South Carolina Electric and Gas Company (the licensee or SCE&G) provided the Overall Integrated Plan (hereafter referred to as the Integrated Plan) for compliance with Order EA-12-049 for Virgil C. Summer Nuclear Station Unit 1 (Summer or VCSNS). The Integrated Plan describes the guidance and strategies under development for implementation by SCE&G for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. As further required by the order, by letter dated August 28, 2013 [Reference 3], the licensee submitted the first six-month status report since the submittal of the Integrated Plan, describing the progress made in implementing the requirements of the order.

2.0 REGULATORY EVALUATION

Following the events at the Fukushima Dai-ichi nuclear power plant on March 11, 2011, the NRC established a senior-level agency task force referred to as the Near-Term Task Force (NTTF). The NTTF was tasked with conducting a systematic and methodical review of the NRC's regulations and processes, and with determining if the agency should make improvements to these programs in light of the events at Fukushima Dai-ichi. As a result of this review, the NTTF developed a comprehensive set of recommendations, documented in SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011 [Reference 4]. These recommendations were enhanced by the NRC staff following interactions with stakeholders. Documentation of the NRC staff's efforts is contained in SECY-11-0124, "Recommended Actions to be Taken without Delay from the Near-Term Task Force Report," dated September 9, 2011 [Reference 5] and SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011 [Reference 6].

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

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

On February 17, 2012, the NRC staff provided SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," [Reference 11] to the Commission, including the proposed order to implement the enhanced mitigation strategies. As directed by SRM-SECY-12-0025 [Reference 12], the NRC staff issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" [Reference 1].

Order EA-12-049, Attachment 2,[1] requires that operating power reactor licensees and construction permit holders use a three-phase approach for mitigating BDBEEs. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment and SFP cooling capabilities. The transition phase requires providing sufficient,

[1] Attachment 3 provides requirements for combined License holders.

portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. Specific operational requirements of the order are listed below:

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

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

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

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

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

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

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

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

On August 29, 2012, the NRC staff issued the final version of JLD-ISG-2012-01, "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 used by the staff in its review, leading to the issuance of this interim staff evaluation (ISE) and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the order. Additional NRC staff review and inspection may be necessary following full implementation of those actions to verify licensees' compliance with the order.

3.0 TECHNICAL EVALUATION

The NRC staff contracted with Mega-Tech Services, LLC (MTS) for technical support in the evaluation of the Integrated Plan for Summer, submitted by SCE&G's letter dated February 28, 2013, as supplemented. NRC and MTS staff have reviewed the submitted information and held clarifying discussions with SCE&G in evaluating the licensee's plans for addressing BDBEEs and its progress towards implementing those plans.

A simplified description of the Summer Integrated Plan to mitigate the postulated extended loss of ac power (ELAP) event is that the licensee will initially remove the core decay heat by using the turbine-driven emergency feedwater pump (TDEFWP) to supply water to the steam generators (SGs) from the protected condensate storage tank (CST) and release steam from the SG power operated relief valves. In order to address reactivity concerns and control reactor coolant system (RCS) inventory loss, the licensee will be installing low-leakage reactor coolant pump (RCP) seals. Additionally, the licensee will commence a cooldown of the RCS within two to three hours of an ELAP. Within 8-16 hours, the FLEX 300 kw (kilo-watt) portable diesel generator (DG) will be aligned to power the installed alternate seal injection pump to provide borated make-up water to the RCS from either the refueling water storage tank or boric acid storage tank in addition to the borated water provided by cold leg accumulator injection resulting from the RCS cooldown. The licensee's longer term core cooling strategy includes utilizing the portable, diesel-driven FLEX SG makeup pump for direct SG injection supported by the portable, diesel-driven FLEX transfer pump for CST make-up or direct to SG makeup pump suction from a number of prioritized water sources. The licensee's longer term RCS inventory control strategy includes utilizing the portable, electric reactor makeup FLEX pump to add borated make-up water from either the refueling water storage tank or boric acid tanks powered by the FLEX 300 kw DG. FLEX 300 kw and 1 MW (Mega-watt) DGs will power the 125 Vdc vital battery chargers and allow energizing critical loads such as required motor-operated valves, direct current components, and desired ac instrumentation. Additional equipment and supplies, such as portable water purification trailers, mobile boration units, and back-up DGs to maintain the core cooling and RCS inventory strategy, will be delivered from one of two Regional Response Centers (RRCs) established by the nuclear power industry to provide supplemental accident mitigation equipment.

With regard to containment, the licensee concluded by analysis that initially, containment will not be challenged prior to the availability of RRC equipment, and will monitor containment conditions. Should long term containment cooling be required, the licensee will utilize either the containment spray system or the portable, diesel-driven FLEX ultimate heat sink (UHS) pump to supply the reactor building cooling unit service water headers for containment cooling with both systems powered by FLEX DGs.

In the postulated ELAP event, the SFP will initially heat up due to the unavailability of the normal cooling system. To provide makeup and cooling water flow to the SFP, the licensee will utilize a connection from the SG FLEX feed header supplied by the FLEX SG makeup pump as discussed above for core cooling. The licensee intends to remove a wall panel to establish ventilation in the SFP area. The licensee is considering additional FLEX and RRC-provided equipment strategy options as well.

By letter dated February 21, 2014 [Reference 21], MTS documented the interim results of the 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, in general, 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 each review item to one of the following categories:

> Confirmatory item – an item that the NRC considers conceptually acceptable, but for which resolution may be incomplete. These items are expected to be acceptable, but 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 for NRC to determine that the issue is on a path to resolution. The intent behind designating an issue as an open item is to document significant items that need resolution during the review process, rather than being verified after the compliance date through the inspection process.

As discussed in Section 3.0, above, the NRC staff has reviewed MTS' TER for consistency with NRC policy and technical accuracy and finds that, in general, it accurately reflects the state of completeness of the licensee's Integrated Plan. The open and confirmatory items identified in the TER are listed in the tables below, with some NRC item characterization changes and minor NRC edits made for clarity from the TER version. 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	ELAP Analysis Computer Code - Identify the codes used for ELAP analysis and verify the adequacy of the technical basis to support the conclusion that the codes are sufficient to predict whether the intended mitigating strategies would adequately cool the reactor core. If the codes and methods were previously approved by NRC, verify that the licensee complies with the restrictions and conditions imposed by the safety evaluations on	

	the use of the codes and methods. Additionally, verify the specific analyses used to demonstrate adequate core cooling are appropriate for VCSNS.	
3.2.1.6.A	Sequence of Events (SOE) – Verify that the finalized SOE is supported by the resolution of the licensee's unresolved issues and future actions.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.2.B	Confirm that at least one connection point for the FLEX equipment will be accessible for a seismic event, or that an acceptable alternative is used.	
3.1.1.3.A	Confirm the licensee develops (1) guidance on critical actions to perform until alternate indications can be obtained; (2) guidance on control of critical equipment without control power; and (3) a reference source to obtain necessary instrument readings.	
3.1.3.1.A	Confirm the analysis for local historical tornado data (width and path axis) has been taken into account with regard building locations.	
3.1.3.2.A	Confirm whether NEI 12-06, Section 7.3.2, considerations 1 and 2 are applicable to VCSNS.	
3.2.1.1.B	Confirm that use of the NOTRUMP code for the ELAP analysis is limited to the flow conditions before reflux condensation initiates. This includes specifying an acceptable definition for the onset of reflux condensation cooling.	
3.2.1.2.A	Confirm the acceptability of the use of the non-Westinghouse RCP seals in the Westinghouse RCPs; provide justification for the RCP seal leakage rates for use in the ELAP analysis; and confirm the acceptability of O-ring performance under high temperature conditions expected during an ELAP event.	
3.2.1.3.A	Confirm the adequacy of the ANS 5.1-1979 + 2 sigma model analysis relative to the VCSNS.	
3.2.1.4.A	Confirm the key initial plant parameters and assumptions from WCAP-17601-P used in the forthcoming plant-specific analyses (discussed in Section 3.2.1.1 of the TER).	
3.2.1.7.A	Confirm the licensee plans to conform to the NEI position paper endorsed by the NRC ("Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514) by NRC letter dated September 30, 2013 (ADAMS Accession No. ML13267A382)) or propose another strategy for shutdown and refueling modes.	
3.2.1.8.A	Core Sub-Criticality – Confirm plans to apply the generic resolution for boron mixing under natural circulation conditions potentially involving two-phase flow, in accordance with the Pressurized-Water Reactor Owners Group position paper, dated	

	August 15, 2013 (ADAMS Accession No. ML13235A135 (non-public for proprietary reasons)), and subject to the conditions provided in the NRC endorsement letter dated January 8, 2014 (ADAMS Accession No. ML13276A183). Alternatively, justify the boric acid mixing assumptions that will ensure adequate shutdown margin exists throughout an ELAP event.	
3.2.1.9.A	Confirm the engineering basis for expected flow performance for mitigation strategies in the use of pumps, hoses, pipe runs, and connection hardware to facilitate the implementation of coping strategies.	
3.2.2.A	Spent Fuel Pool Cooling Strategies – Confirm the storage requirements and control of SFP FLEX equipment, the SFP applicable portable FLEX equipment performance criteria in conformance with NEI 12-06 guidance, and the primary and alternate connection points for portable pumps and hoses as part of Phase 2 for maintaining SFP Cooling.	
3.2.4.2.A	Confirm the licensee's analyses substantiate expected room and area temperature extremes, and the implementation of any temperature mitigation plans in conformance with NEI 12-06, Section 3.2.2, Guideline (10) regarding equipment ventilation.	
3.2.4.3.A	Confirm the licensee addresses the potential for boric acid precipitation in existing equipment and lines that might result from loss of normal building heating in the event of an ELAP, and, if required, develops appropriate mitigation plans.	
3.2.4.4.A	Complete the licensee develops appropriate mitigation plans for lighting.	
3.2.4.4.B	Communication - Confirm that upgrades to the site's communications systems have been completed in accordance with the licensee's Communications Assessment as evaluated by the NRC staff (ADAMS Accession Nos. ML12307A032 and ML13057A111).	
3.2.4.6.A	Personnel Habitability – Elevated Temperature – Confirm the licensee completes room habitability analyses and any modification or mitigation plan changes.	
3.2.4.8.A	Electrical Power Sources/Isolations and Interactions - Confirm that the selected diesel generators are appropriately sized.	
3.2.4.10.A	Load Reduction to Conserve DC Power – Confirm which, if any, components change state when loads are shed. Confirm whether any actions are needed to mitigate hazards resulting from the load shedding (e.g., allowing hydrogen release from the main generator, disabling credited equipment via interlocks) following Flex Support Guideline development.	
3.2.4.10.B	Confirm that the licensee conforms to the generic approach in the NEI position paper on battery life ("Battery Life Issue" (ADAMS Accession Nos. ML13241A186 (position paper) and ML13241A188 (NRC endorsement letter)), as endorsed by the NRC, or provides an acceptable alternative.	

3.4.A	Off-Site Resources – Confirm the licensee's arrangement for off-site resources addresses the guidance of Guidelines 2 through 10 in NEI 12-06, Section 12.2.	

Based on this review of SCE&G's plan, including the six-month update dated August 28, 2013, and information obtained through the mitigation strategies audit process, the NRC concludes that the licensee has provided sufficient information to determine that there is reasonable assurance that the plan, when properly implemented, will meet the requirements of Order EA-12-049 at Summer. 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 ISE 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 BDBEE. These new requirements provide a greater mitigation capability consistent with the overall defense-in-depth philosophy, and, therefore, greater assurance that the challenges posed by BDBEEs to power reactors do not pose an undue risk to public health and safety.

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

The NRC staff has reviewed the licensee's plans for additional defense-in-depth measures. 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 BDBEE that impacts the availability of ac power and the UHS. 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 SCE&G to NRC, "South Carolina Electric & Gas Company's Overall Integrated Plan as Required by 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 February 28, 2013 (ADAMS Accession No. ML13063A150)

3. Letter from SCE&G to NRC, "South Carolina Electric & Gas Company's First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) (TAC No. MF2338)," dated August 28, 2013 (ADAMS Accession No. ML13242A273)

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 Daiichi Lessons Learned," December 16, 2011 (ADAMS Accession No. ML11353A008)

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

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

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

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

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

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

17. NEI industry comments to draft JDL-ISG-2012-01 and document 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision C, July 3, 2012 (ADAMS Accession No. ML121910390)

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

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

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

21. Letter from John Bowen, Mega-Tech Services, LLC, to Eric Bowman, NRC, submitting "Fifth Batch SE Final Revision 3 – 1 Site (VC Summer)" providing revision 3 of the final version of the fifth batch of Safety Evaluation (SEs) (one site) for the Technical Evaluation Reports (TERs) Related to Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, EA 12-049," dated February 21, 2014 (ADAMS Accession No. ML14056A067)

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Date: February 21, 2014

Enclosure 2

Technical Evaluation Report

ML14037A228

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 3

February 21, 2014

South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station Unit 1
Docket No. 50-395

Prepared for:

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

Contract NRC-HQ-13-C-03-0039
Task Order No. NRC-HQ-13-T-03-0001
Job Code: J4672
TAC No. MF2338

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1.0 BACKGROUND

Following the events at the Fukushima Dai-ichi nuclear power plant on March 11, 2011, the U.S. Nuclear Regulatory Commission (NRC) established a senior-level agency task force referred to as the Near-Term Task Force (NTTF). The NTTF was tasked with conducting a systematic, methodical review of NRC regulations and processes to determine if the agency should make additional improvements to these programs in light of the events at Fukushima Dai-ichi. As a result of this review, the NTTF developed a comprehensive set of recommendations, documented in SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011. These recommendations were enhanced by the NRC staff following interactions with stakeholders. Documentation of the staff's efforts is contained in SECY-11-0124, "Recommended Actions to be Taken without Delay from the Near-Term Task Force Report," dated September 9, 2011, and SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011.

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

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

On February 17, 2012, the NRC staff provided SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," to the Commission, including the proposed order to implement the enhanced mitigation strategies. As directed by SRM-SECY-12-0025, the NRC staff issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events."

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

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

As described in Interim Staff Guidance (ISG), JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," the NRC staff considers that the development, implementation, and maintenance of guidance and strategies in conformance with the guidelines provided in NEI 12-06, Revision 0, subject to the clarifications in Attachment 1 of the ISG are an acceptable means of meeting the requirements of Order EA-12-049.

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

2.0 EVALUATION PROCESS

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

- Spent Fuel Pool Cooling Strategies
- Containment Function Strategies
- Programmatic Controls
    - Equipment Protection, Storage, and Deployment
    - Equipment Quality

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

> Confirmatory Item – an item that is considered conceptually acceptable, but for which resolution may be incomplete. These items are expected to be acceptable, but are expected to require some minimal follow up review or audit prior to the licensee's compliance with Order EA-12-049.
>
> Open Item – an item for which the licensee has not presented a sufficient basis to determine that the issue is on a path to resolution. The intent behind designating an issue as an Open Item is to document items that need resolution during the 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 mitigation 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. ML13063A150), and as supplemented by the first six-month status report in letter dated August 28, 2013 (ADAMS Accession No. ML13242A273), South Carolina Electric & Gas Company (SCE&G) (the licensee) provided the Virgil C. Summer Nuclear Station Unit 1 (VCSNS) Integrated Plan for compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by VCSNS 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 NRC 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 (LUHS). 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.

During the audit process, the licensee was requested to discuss what non-safety related installed equipment such as piping, valves and other components were relied upon for mitigation strategies and to discuss whether that equipment is qualified to survive the external hazards of the NEI 12-06 guidance. The licensee responded by stating that there are no non-safety related installed mechanical components or equipment that will be credited in FLEX strategies. The licensee further stated that newly installed non-safety related mechanical components or equipment required for FLEX-strategy implementation will be categorized as quality related and will be qualified to survive ELAP events. The response resolved the concern regarding use of non-safety related equipment.

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, in the section regarding determination of applicable extreme external hazards, the licensee stated that the seismic licensing basis for Seismic Category I structures, systems, and components (SSCs) at VCSNS is detailed in the UFSAR, Section 3.7, Seismic Design. Section 3.7.1.1, Design Response Spectra, states that the maximum horizontal ground acceleration for the Safe Shutdown Earthquake (SSE) is 0.15g at the competent rock foundation elevation and 0.25g for the soil foundation. The licensee further states that, in accordance with the NEI 12-06, the impact of a seismic event must be considered as an applicable hazard for all nuclear plant sites, and therefore, the credited FLEX equipment at VCSNS will be assessed as required by NEI 12-06 to ensure the equipment remains available and deployable following the prescribed seismic event. The licensee also stated, on page 8, that the seismic re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore was not assumed in the Integrated Plan.

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

3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

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

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

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

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

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

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

On pages 19, 24, 28, 34, and 44 of the Integrated Plan, in the sections regarding the strategies for maintaining core cooling and heat removal, reactor coolant system (RCS) inventory control, maintaining containment, SFP cooling, and safety function support, respectively, the licensee discussed the protection of associated portable equipment from seismic hazards. The licensee stated that FLEX equipment will be stored in either an existing structure meeting VCSNS seismic design basis, or a structure designed to or evaluated equivalent to seismic requirements of ASCE 7-10. FLEX Equipment will be stored in a manner to preclude damage as a result of seismic interaction from non-seismic components.

During the audit, the licensee indicated that the current proposed FLEX buildings include the Emergency Response Building, FLEX storage building, Containment Access Ramp, Electrical Building and Auxiliary Electrical Building. For these FLEX buildings, the licensee indicated that they will be protected from the extreme external events. In addition, the licensee provided a diagram with an aerial view of the site layout depicting the locations of deployment/access routes from FLEX equipment storage locations to connection points.

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 protection of equipment considering the seismic hazard, 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 11 of the Integrated Plan, in the section describing the strategy deployment, the licensee stated that VCSNS will establish the route from a storage location to the deployment location. These routes will be followed to transport the FLEX equipment to the required deployment locations and will be followed to connect the FLEX equipment to the associated plant SSCs to allow the strategies to be implemented. The licensee further stated that the routes and paths will be maintained clear and that access to the portable equipment protected storage buildings will be maintained in all modes of operation. These requirements will be included in an administrative program and appropriate implementing procedure.

The reviewer noted that the discussion above satisfies the guidance of consideration 1 above, with the exception of addressing the potential for soil liquefaction. During the audit process the licensee addressed the potential for soil liquefaction stating that haul paths are over seismically prepared soils along the west embankment of the safety-related service water pond on the east side of the plant, and for the west side, along diverse haul paths for the west side of the plant. In addition, the licensee provided an aerial view diagram of the site layout that depicts access routes from FLEX equipment storage locations to connection points and identifies deployment paths that are robust and provide protection against soil liquefaction.

The licensee provided several statements in the Integrated Plan with regard to protection of access points. For example, on page 20 and 21 of the Integrated Plan, in the section regarding Phase 2 of maintaining core cooling and heat removal, protection of connections, the licensee stated that piping and valves for FLEX will all be enclosed within a Seismic Category 1 structure. New FLEX piping will be installed to meet necessary seismic requirements. Connection points for the suction and discharge will be outside and designed to withstand the applicable hazards. Similar wording was used in other sections of the Integrated Plan. Although this information addresses protection of access points, it was not clear to the reviewer whether at least one connection point for the FLEX equipment will only require access through seismically robust structures. Further review is required to confirm access to the connection points in accordance with the guidance of consideration 2 above. This is identified as Confirmatory Item 3.1.1.2.B in Section 4.2 below.

The licensee provided additional information during the audit process regarding the potential for loss of a water source that is not seismically robust, e.g., a downstream dam. The licensee stated that VCSNS is not subject to impact from a non-seismically robust downstream dam. Based on information provided, the guidance of consideration 3 above is adequately addressed. There is no discussion in the strategy deployment sections of the Integrated Plan regarding the guidance of consideration 4 above, which identifies the need to consider power supplies if necessary to access or move equipment. During the audit response, the licensee provided additional information and stated that the auxiliary building rollup door (north), the turbine building door (south), and emergency response building rollup doors, used to access FLEX equipment deployment areas and connection points, are designed to allow for manual operation with existing mechanisms and chain falls. The licensee further stated that new doors on the proposed FLEX Structures that support FLEX strategy deployment will be designed to allow for manual operation. Thus, the guidance provided by NEI 12-06, Section 5.3.2, consideration 4, is adequately addressed.

There was no equipment identified on pages 54 through 56 of the Integrated Plan, in Attachment 3, FLEX Portable Equipment, to transport FLEX equipment and to have that equipment in a storage facility protected from the site hazards. During the audit process the licensee was asked to address consideration 5. In its response the licensee stated that debris removal and transport equipment will be available and will be stored in protected storage buildings, thus addressing consideration 5 above.

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

The Integrated Plan did not contain information to address the potential for loss of instrumentation due to a seismic event as discussed in NEI 12-06, Section 5.3.3, consideration 1. There was no discussion in the Integrated Plan regarding identification of reference sources for coping strategy instrument readings, plans to develop procedure/guidelines on critical actions to perform until alternate indications can be connected (measured), or development of procedures/guidelines on how to control critical equipment without control power. Therefore, the licensee's plan did not provide sufficient information that these aspects of consideration 1 were addressed. This is identified as Confirmatory Item 3.1.1.3.A, in Section 4.2 below.

During the audit process, the licensee was requested to address considerations 2, 3 and 4 and in its response, the licensee provided the following information.

The licensee stated that large non-seismically robust internal flooding sources do not impact equipment required for FLEX mitigation strategies, thus addressing consideration 2 above.

With regard to consideration 3 above, the licensee stated that portable sump pumps will be provided to minimize the impact and to mitigate groundwater intrusion in critical locations. The licensee provided a description of the capabilities of the portable sump pumps being considered and discussed the method for providing temporary power for the pumps.

And finally, with regard to consideration 4 above, the licensee stated that there is no impact from non-seismically robust downstream dams.

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

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

On page 13 of the Integrated Plan, in the section regarding the regional response plan, the licensee stated that the industry will establish two Regional Response Centers (RRCs) to support utilities during beyond-design-basis events. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested; the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local assemble area, established by the Strategic Alliance for FLEX Emergency Response (SAFER) team and the utility. First arriving equipment, as established during development of the nuclear site's SAFER Response Plan (playbook) will be delivered to the site within 24 hours from the initial request.

Although the Integrated Plan addressed obtaining off-site equipment, insufficient detail was provided in the plan to demonstrate that the equipment arrival sites and transport routes to the site have been evaluated for seismic impacts. During the audit process, the licensee addressed this issue and stated that overland transport will be utilized if available following the event. The licensee further stated that if overland routes are not available due to seismic or other hazards, airlift transport would be available to transport equipment from the offsite staging area (Columbia Metropolitan Airport SCANA terminal) to the onsite staging area at the site. As noted previously in this Technical Evaluation Report, transport from the onsite staging area to the area of deployment will utilize seismically robust haul paths.

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 off-site resources, 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, in the section regarding general Integrated Plan elements, the licensee stated that there are no major potential external sources that could result in flooding on site. The site is protected from flooding and wave run-up on the north side from the adjacent Monticello Reservoir by a properly designed exterior revetment barrier consisting of an embankment with protective stone riprap. The normal maximum water elevation of Monticello Reservoir is 425.0 feet. Plant yard grade is raised to 438 feet directly adjacent to the embankment at Monticello Reservoir creating, in effect, a minor levee referred to as the North Berm. The North Berm, including the elevation and riprap protected embankment, are designed to protect the site at a maximum elevation of 436.5 feet from postulated storm water-related flood conditions, plus wave run-up, from Monticello Reservoir, as described in Chapter 2 of the VCSNS UFSAR.

The licensee further stated that the VCSNS site is susceptible to brief water build-up due to a local intense precipitation event. FLEX equipment will be stored either within structures designed to protect the equipment from the flood elevations or above the flood elevation of the most recent site flooding analysis. Local ponding onsite due to local intense precipitation (i.e. probable maximum precipitation or PMP) event will be considered when storage locations, equipment connections, and deployment routes are selected, and also when the timing of the FLEX implementation is determined. In summary, the licensee stated that only external flooding as a result of local intense precipitation will be considered at VCSNS.

On page 8 of the Integrated Plan, in the section regarding assumptions for the site, the licensee stated that the flood re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 were not completed and therefore not assumed in the Integrated Plan. The licensee further stated that as the re-evaluations are completed, appropriate issues will be entered into the corrective action system and addressed on a schedule commensurate with other licensing bases changes. During the audit response, the licensee stated that the flooding evaluations for VCSNS Unit 1 were provided in a written response to the NRC pursuant to the requirements in 50.54(f) letter dated March 12, 2012, as applicable to VCSNS. The flooding evaluations used insights from the Units 2/3 combined licenses (COLs) evaluations and were performed in accordance with NUREG-0800 and NUREG-7046. The reviewer noted that the licensee provided the Flood Hazard Reevaluation Report by letter dated March 12, 2013 (ADAMS Accession No. ML130730176, withheld from public disclosure pursuant to 10 CFR 2.390) which will be used in consideration for the Safety Evaluation.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to screening for flood 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 19, 24, 29, 34, and 44 of the Integrated Plan, in the sections regarding maintaining core cooling and heat removal, RCS inventory control, containment, spent fuel pool cooling and safety function support, respectively, the licensee stated that FLEX equipment will be stored, and associated connections will be located, either above the elevation of recent site flooding analysis, or in a structure designed to protect equipment from the flood elevation (e.g. existing Category 1 structure).

During the audit, the licensee indicated that the current proposed FLEX buildings include the Emergency Response Building, FLEX storage building, Containment Access Ramp, Electrical Building and Auxiliary Electrical Building. For these FLEX buildings, the licensee indicated that they will be protected from the extreme external events. In addition, the licensee provided a diagram with an aerial view of the site layout depicting the locations of deployment/access routes from FLEX equipment storage locations to connection points.

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

3.1.2.2 Deployment of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.2 states:

> There are a number of considerations which apply to the deployment of FLEX equipment for external flood hazards:
>
> 1. For external floods with warning time, the plant may not be at power. In fact, the plant may have been shut down for a considerable time and the plant configuration could be established to optimize 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 reactor coolant pump (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 loss of ultimate heat sink (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.

Because the screening process for the VCSNS site determined that only "local ponding" is applicable as a flood hazard, the reviewer finds that only considerations 2, 5, 7, 8, and 9 are relevant to the VCSNS site. These are considerations for: 2) deployment routes, 5) viability of connection points, 7) sump pump dewatering, 8) use of temporary flood barriers, and 9) transport of equipment, respectively.

In the Integrated Plan, only consideration 5 regarding connection points for portable equipment is specifically addressed. As an example, on page 20 in the Integrated Plan in the section regarding protection of connections for FLEX equipment for maintaining core cooling and heat removal, the licensee stated that piping and valves for FLEX will all be enclosed within a Seismic Category 1 structure. The licensee also stated that all connections will be above the VCSNS flood level and will either be located Seismic Category 1 structures or outside, above the ground. The intention is to keep connections off the ground to not be impacted by a run-off or pooling from precipitation. This approach meets the guidance of NEI 12-06, Section 6.2.3.2, consideration 5.

However, there is insufficient information provided in the Integrated Plan to address the other applicable considerations. During the audit process, the licensee provided additional information to address these issues:

With regard to consideration 2, the licensee stated that the ability to move equipment and restock supplies is not impacted by the local intense precipitation (LIP) ponding level. VCSNS will have debris removal and FLEX equipment transportation equipment capable of operating at the maximum site ponding level (~18" on West Side of Plant and ~7" on East Side of Plant). Additionally, the licensee stated that the flood duration is not a long persistence event and in general, the site has drained to approximately grade level within 12 hours from initiation of the event.

With regard to consideration 7, the licensee stated that water extraction pumps and associated hoses will be provided to remove water, primarily groundwater, from structures required to perform FLEX strategies.

With regard to consideration 8, the licensee stated that the location of temporary flood barriers is procedurally controlled on site to ensure the temporary flood barriers are capable of being deployed to provide required protection. Per the licensee's response to the audit, this is directed in site procedure OAP109.1 “Guidelines for Severe Weather,” Section 6.5, Enclosure A for Hurricane preparation, and Enclosure E for other predicted heavy rains.

And finally, with regard to consideration 9, the licensee stated that VCSNS will have FLEX equipment transportation and debris removal equipment available, and the equipment will be stored in diverse locations and will be reasonably protected from ELAP events in conformance with the guidance of NEI 12-06.

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

3.1.2.3 Procedural Interfaces – Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

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

On page 12 of the Integrated Plan, in the section regarding programmatic controls, the licensee stated that VCSNS will develop procedures and programs to address storage structure requirements and deployment/haul path requirements relative to the hazards applicable to VCSNS. Also, as noted above, the licensee stated that the location of temporary flood barriers is procedurally controlled by OAP109.1 "Guidelines for Severe Weather."

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 considering the flooding hazard, if these requirements are implemented as described.

3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

On page 13 of the Integrated Plan, in the section regarding regional response plan, the licensee stated that the industry will establish two RRCs to support utilities during beyond-design-basis events and that equipment will be moved from an RRC to a local assemble area, established by the SAFER team and the utility. The issue of transport of equipment from the RRCs to the site has been previously addressed in this report. The licensee will utilize normal transportation routes and methods if available and if not, airlift will be utilized.

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 off-site resources considering the flooding hazard, if these requirements are implemented as described.

3.1.3 High Winds

NEI 12-06, Section 7, provides the NRC-endorsed screening process for evaluation of high wind hazards. This screening process considers the hazard due to hurricanes and tornadoes. The first part of the evaluation of high wind challenges is determining whether the site is potentially susceptible to different high wind conditions to allow characterization of the applicable high wind hazard.

The screening for high wind hazards associated with hurricanes should be accomplished by comparing the site location to NEI 12-06, Figure 7-1 (Figure 3-1 of U.S. NRC, "Technical Basis for Regulatory Guidance on Design Basis Hurricane Wind Speeds for Nuclear Power Plants," NUREG/CR-7005, December, 2009); if the resulting frequency of recurrence of hurricanes with wind speeds in excess of 130 mph exceeds 10^{-6} per year, the site should address hazards due to extreme high winds associated with hurricanes.

The screening for high wind hazard associated with tornadoes should be accomplished by comparing the site location to NEI 12-06, Figure 7-2, from U.S. NRC, "Tornado Climatology of the Contiguous United States," NUREG/CR-4461, Rev. 2, February 2007; if the recommended tornado design wind speed for a 10^{-6}/year probability exceeds 130 mph, the site should address hazards due to extreme high winds associated with tornadoes.

On page 6 of the Integrated Plan, in the section regarding the determination of applicable extreme external hazards, the licensee stated that the VCSNS design and licensing basis, as presented in the UFSAR Chapter 3.3 and 3.5, details wind loadings used in the design of VCSNS Category 1 structures. A hurricane wind speed of 100 mph, a tornado wind speed of 360 mph, and corresponding generated missiles were used for design of VCSNS Category 1 structures. The licensee further stated that VCSNS is located at latitude 34° 17' 54.1" north and longitude 081° 18' 54.6" west. Per NEI 12-06 Figure 7.1 and Figure 7.2, VCSNS is subjected to a peak gust wind speed of 160 mph and tornado wind speeds of 200 mph, which are expected to occur at a rate of 1×10^{-6} per year. The licensee concluded that as defined in NEI 12-06, these values indicate that VCSNS has the potential to experience severe hurricane and tornadic winds with the capacity to do significant damage. These winds are generally considered to be in excess of 130 mph. In summary, the high wind hazard is applicable for VCSNS and protection and deployment of FLEX equipment will be provided in accordance with requirements of NEI 12-06.

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 high wind hazard screening, if these requirements are implemented as described.

3.1.3.1 Protection of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.1 states:

> These considerations apply to the protection of FLEX equipment from high wind hazards:

1. For plants exposed to high wind hazards, FLEX equipment should be stored in one of the following configurations:

   a. In a structure that meets the plant's design basis for high wind hazards (e.g., existing safety-related structure).

   b. In storage locations designed to or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* given the limiting tornado wind speeds from Regulatory Guide 1.76 or design basis hurricane wind speeds for the site.

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

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

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

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

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

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

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

On page 19, 25, 29, 35 and 44 of the Integrated Plan, in the sections describing core cooling and heat removal, RCS inventory control, containment, spent fuel pool cooling and safety function support, respectively, regarding storage and protection of equipment, the licensee stated that FLEX equipment will be stored in either a structure meeting the VCSNS design basis for high wind hazards (hurricane, tornado, and wind generated missiles), or in a structure designed to or evaluated equivalent to, ASCE 7-10 given the limiting tornado wind speed of 230 mph per RG 1.76, Design Basis Tornado for Nuclear Power Plants, or design basis hurricane wind speed (100 mph). Furthermore, the licensee stated that in situations where the storage buildings do not meet the requirements for protection against tornado winds, the FLEX equipment storage locations will be sufficiently separated as outlined in NEI 12-06 Section 7.3.1.c. In the case of the latter, the final plans will need to be reviewed to confirm local historical tornado data has been taken into account with regard to separation and axis of building locations. This is identified as Confirmatory Item 3.1.3.1.A in Section 4.2 below.

On page 17 of the Integrated Plan, in the section regarding core cooling and heat removal, the licensee stated that the primary and alternate diverse injection point connections will be at either end of a seismically qualified FLEX feed header (the primary connection on the east side of the plant, the alternate on the north side of the plant). Figure 8, on page 67 of the Integrated Plan, indicates that the north feed connection header terminates just inside rollup door. It was not clear from the information provided whether the north and east connection points to the FLEX feed header will be protected against high winds and associated missiles, and against seismic hazards. The licensee addressed this during the audit process and stated that the auxiliary building rollup door (north) is protected from high winds and associated missiles. Additionally, diversity of locations between the north and east connection points provide additional defense in depth for missile protection for the FLEX S/G feed connection points. The licensee also noted that both the north and east connection points to the FLEX feed header will be seismically robust.

During the audit, the licensee indicated that the current proposed FLEX buildings include the Emergency Response Building, FLEX storage building, Containment Access Ramp, Electrical Building and Auxiliary Electrical Building. For these FLEX buildings, the licensee indicated that they will be protected from the extreme external events. In addition, the licensee provided a diagram with an aerial view of the site layout depicting the locations of deployment/access routes from FLEX equipment storage locations to connection points.

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 protection from high wind hazards, if these requirements are implemented as described.

3.1.3.2 Deployment of FLEX Equipment - High Winds 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.

Although general information was presented in the Integrated Plan with regard to establishing deployment routes, no information was provided regarding the considerations noted above. This issue was discussed during the audit process and the licensee provided the following supplemental information. The licensee performed a review of NEI 12-06, Section 7.3.2 considerations and determined that only considerations 3, 4, and 5 are applicable to VCSNS. The method used to address each of the applicable considerations is presented individually below:

With regard to consideration 3, VCSNS will have debris removal equipment. The equipment will be stored in diverse locations and will be reasonably protected from ELAP events. VCSNS plans to have track-type vehicles that can be used for debris removal. Currently, it is planned to have two of these track vehicles; one being stored in the emergency response building (ERB), and the other in the FLEX storage building.

With regard to consideration 4, the licensee stated that VCSNS will have FLEX equipment transportation equipment. The equipment will be stored in diverse locations and reasonably protected from ELAP events required to be considered by NEI 12-06. A fire truck and other transportation equipment will be stored in the ERB. The above mentioned track vehicles can also act to transport equipment, both in their beds and by towing

And with regard to consideration 5, the licensee stated that the ability to move equipment and restock supplies will be addressed by use of debris removal and equipment/supply transfer equipment.

During the audit response, the licensee addressed considerations 3, 4, and 5 as discussed above, but concluded that considerations 1 and 2 were not applicable. It was not clear to the reviewer why these considerations were not applicable. Further review will be necessary to assess whether these considerations are applicable, and if they are, whether the licensee's mitigation plans adequately addresses them. This is Confirmatory Item 3.1.3.2.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 if these requirements are implemented as described.

3.1.3.3 Procedural Interfaces - High Winds Hazard

NEI 12-06, Section 7.3.3, states:

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

On page 12 of the Integrated Plan, in the section regarding programmatic controls and as discussed in previous sections, the licensee stated that VCSNS will develop procedures and programs to address storage structure requirements and deployment/haul path requirements relative to the hazards applicable to VCSNS.

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 considering the high winds hazards, if these requirements are implemented as described.

3.1.3.4 Considerations in Using Offsite Resources – High Winds Hazard

NEI 12-06, Section 7.3.4 states:

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

On page 13 of the Integrated Plan, in the section regarding the regional response plan, the licensee stated that the industry will establish two RRCs to support utilities during beyond-design-basis events and that equipment will be moved from an RRC to a local assemble area, established by the SAFER team and the utility. The issue of transport of equipment from the RRCs to the site has been previously addressed in this report. The licensee will utilize normal transportation routes and methods if available and if not, airlift will be utilized.

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 off-site resources considering the high winds hazard, if these requirements are implemented as described.

3.1.4 Snow, Ice and Extreme Cold

As discussed in part 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 page 6 of the Integrated Plan, regarding the determination of applicable extreme external hazards, the licensee noted that NEI 12-06 guidance states all sites should consider the effects of extreme cold temperatures and weather conditions for their site. VCSNS is located at latitude 34° 17' 54.1" north and longitude 081° 18' 54.6" west. Per NEI 12-06, sites located below the 35th Parallel are not expected to experience significant snowfall with the ability to impact the deployment of FLEX equipment. Therefore the FLEX Strategies screen out of the impedances caused by extreme snowfall. NEI 12-06 assumes the same basic trend applies to extreme low temperatures; hence low temperature hazards are not applicable at VCSNS.

In the passage above from NEI 12-06, "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." Although the licensee did not address this in the screening section of the Integrated Plan, page 6, the licensee did discuss the deployment for conditions of snow, ice and extreme cold in other sections of the Integrated Plan and during the audit process. This is discussed in Section 3.1.4.2 of this Technical Evaluation Report below.

The licensee further states that Figure 8.2 of NEI 12-06 provides a visual representation of the potential for ice storms across the U.S. VCSNS is located within a region of a Level 5 Ice Storm Severity as shown on Figure 8.2. This severity level is defined as a catastrophic destruction of power lines and/or existence of extreme amount of ice. In summary, VCSNS will consider the impacts of ice storms on FLEX strategies.

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 screening for snow, ice and extreme cold, if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.1 states:

> These considerations apply to the protection of FLEX equipment from snow, ice, and extreme cold hazards:

1. For sites subject to significant snowfall and ice storms, portable FLEX equipment should be stored in one of the two configurations.

   a. In a structure that meets the plant's design basis for the snow, ice and cold conditions (e.g., existing safety-related structure).

   b. In a structure designed to or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* for the snow, ice, and cold conditions from the site's design basis.

   c. Provided the N sets of equipment are located as described in a. or b. above, the N+1 equipment may be stored in an evaluated storage location capable of withstanding historical extreme weather conditions such that the equipment is deployable.

2. Storage of FLEX equipment should account for the fact that the equipment will need to function in a timely manner. The equipment should be maintained at a temperature within a range to ensure its likely function when called upon. For example, by storage in a heated enclosure or by direct heating (e.g., jacket water, battery, engine block heater, etc.).

On page 20, 25, 29, 35 and 44 of the Integrated Plan, in the sections regarding maintaining core cooling and heat removal, RCS inventory control, maintaining containment, spent fuel pool cooling and safety function support, respectively, the licensee stated that FLEX equipment will be stored in either existing Category 1 structures (i.e. Nuclear Safety Related Structures) or structures designed to or evaluated equivalent to ASCE 7-10. The licensee further stated that FLEX equipment storage will consider effects of icing, and equipment will be protected as required.

During the audit, the licensee indicated that the current proposed FLEX buildings include the Emergency Response Building, FLEX storage building, Containment Access Ramp, Electrical Building and Auxiliary Electrical Building. For these FLEX buildings, the licensee indicated that they will be protected from the extreme external events. In addition, the licensee provided a diagram with an aerial view of the site layout depicting the locations of deployment/access routes from FLEX equipment storage locations to connection points.

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 equipment considering 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 FLEX equipment from storage to its location for deployment.

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

On page 5 of the Integrated Plan, in the section regarding determination of applicable hazards, the licensee stated that VCSNS has reviewed the NEI FLEX guidance and determined that FLEX equipment should be protected from all applicable hazards. VCSNS has determined the functional threats from each of these hazards and identified FLEX equipment that may be affected. The FLEX equipment is being purchased commercial grade and VCSNS is developing procedures and processes to further address plant strategies for responding to these various hazards. This plan addresses consideration 1 above.

On page 7 of the Integrated Plan, in the section regarding screening for extreme cold, the licensee stated that deployment of FLEX equipment will consider impedances associated with ice accumulation. In addition, as previously stated, the licensee plans to have tracked vehicles available for equipment transport. These plans address consideration 2 above.

With regard to consideration 3, the licensee stated on page 6 of the Integrated Plan, that low temperature hazards are not applicable to VCSNS.

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

During the audit process, the licensee stated that tracked type vehicles will be available and can be fitted with a frontal blade. On page 12 of the Integrated Plan, in the section regarding programmatic controls, the licensee stated that VCSNS will develop procedures and programs to address deployment/haul path requirements relative to the hazards applicable to VCSNS. These plans adequately address the guidance 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 considering snow, ice, and extreme cold hazards, if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.4, states:

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

On page 13 of the Integrated Plan, in the section regarding regional response plan, the licensee stated that the industry will establish two RRCs to support utilities during beyond-design-basis events and that equipment will be moved from an RRC to a local assemble area, established by the SAFER team and the utility. The issue of transport of equipment from the RRCs to the site has been previously addressed in this report. The licensee will utilize normal transportation routes and methods if available and if not, airlift will be utilized.

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 off-site resources considering snow, ice, and extreme cold hazards, if these requirements are implemented as described.

3.1.5 High Temperatures

NEI 12-06, Section 9.2 states:

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

On page 7 of the Integrated Plan in the section regarding the determination of applicable extreme external hazards, the licensee stated that as per NEI 12-06, "all sites will address high temperatures." VCSNS will address extreme heat conditions with administrative controls if temperature exceeds design basis. The extreme high temperature hazard is applicable for VCSNS.

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 high temperature screening, if these requirements are implemented as described.

3.1.5.1 Protection of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

On page 20, 25, 29, 35 and 44 of the Integrated Plan, in the sections regarding maintaining core cooling and heat removal, RCS inventory control, maintaining containment, spent fuel pool cooling and safety function support, respectively, the licensee stated that FLEX equipment will be stored and operated within the manufacturer limitations of the equipment. Any additional ventilation or other protection from high temperatures will be provided as required.

During the audit, the licensee indicated that the current proposed FLEX buildings include the Emergency Response Building, FLEX storage building, Containment Access Ramp, Electrical Building and Auxiliary Electrical Building. For these FLEX buildings, the licensee indicated that they will be protected from the extreme external events. In addition, the licensee provided a diagram with an aerial view of the site layout depicting the locations of deployment/access routes from FLEX equipment storage locations to connection points.

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 equipment considering the high temperature hazard, if these requirements are implemented as described.

3.1.5.2 Deployment of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

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

Although the Integrated Plan included general statements regarding the development of procedures related to FLEX strategies, there was insufficient information provided in the plan to demonstrate that high temperature was addressed for the deployment of equipment per the guidance of NEI 12-06 Section 9.3.2 regarding factors such as those identified above. The licensee addressed this issue during the audit process and stated that engineering change requests that specify FLEX related SSCs will consider extreme temperatures per FLEX Hazards Design Calculation (DC00080-001), which will serve as a design input to the various designs needed for FLEX. In regard to personnel, current plant processes and procedures, such as ISP-005, "Heat Stress Control" will be utilized to ensure measures are taken for the potential for deploying equipment in the design basis outdoor max temp of 107 degrees F.

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

3.1.5.3 Procedural Interfaces – High Temperature Hazard

NEI 12-06, Section 9.3.3 states:

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

On page 5 of the Integrated Plan, in the section regarding determination of applicable hazards, the licensee stated that VCSNS has determined that FLEX equipment should be protected from all applicable hazards. VCSNS has determined the functional threats from each of these hazards and identified FLEX equipment that may be affected. VCSNS is developing procedures and processes to further address plant strategies for responding to these various hazards.

Furthermore, on pages 12 and 13 of the Integrated Plan in the section describing how the programmatic controls will be met, the licensee stated that VCSNS will develop procedures and programs to address storage structure requirements and deployment/haul path requirements relative to the hazards applicable to VCSNS.

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 considering the high temperature hazard, if these requirements are implemented as described.

3.2 PHASED APPROACH

Attachment (2) to Order EA-12-049 describes the three-phase approach required for mitigating BDBEEs in order to maintain or restore core cooling, containment and 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 SFP and to maintain containment capabilities in the context of a BDBEE that results in the loss of all ac power, with the exception of buses supplied by safety-related batteries through inverters, and loss of normal access to the UHS.

As discussed in NEI 12-06, Section 1.3, plant-specific analysis 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 reactor core cooling and heat removal, and RCS inventory control strategies. This approach uses the installed TDEFW 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 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.

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 should perform a thermal-hydraulic analysis for an event with a simultaneous loss of all alternating current (ac) power and loss of normal access to the ultimate heat sink for an extended period (the ELAP event).

During the NRC audit process the licensee was requested to specify which analysis performed in WCAP-17601-P is being applied to VCSNS. Additionally, the licensee was requested to justify the use of that analysis by identifying and evaluating the important parameters and assumptions demonstrating that they are representative of VCSNS and appropriate for simulating the ELAP transient. Although the licensee responded by stating that the WCAP-17601-P Westinghouse plant analyses are applicable to VCSNS, they did not specify which analyses performed in WCAP-17601-P was applied. This is issue is included in more detail in Open Item 3.2.1.1.A 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 the specific analyses applied to the ELAP transient if these requirements are implemented as described.

3.2.1.1 Computer Code Used for the ELAP Analysis

NEI 12-06, Section 1.3 states:

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

local infrastructure to enable delivery of equipment and resources from offsite.

It was not clear from the information provided in the Integrated Plan what computer codes and thermal-hydraulic analyses were utilized as the basis for the plant-specific decision making. During the audit process, the licensee was requested to specify which analysis performed in WCAP-17601-P is being applied to VCSNS. The licensee was also asked to justify the use of that analysis by identifying and evaluating the important parameters and assumptions demonstrating that they are representative of VCSNS and appropriate for simulating the ELAP transient. The licensee responded to these questions by stating that with the use of the current, standard Westinghouse RCP seals, the Westinghouse plant analyses in WCAP-17601-P are directly applicable at VCSNS. The licensee further stated that VCSNS will be installing FlowServe N9000 RCP seals and will perform plant-specific FLEX analyses to supplement the generic Pressurized Water Reactor Owners Group (PWROG) work.

To facilitate a review of the plant-specific analyses and supporting information described above, the licensee should include the following information:

a) Identification of the codes utilized for ELAP analysis of the VCSNS plant and adequate technical basis to support the conclusion that the codes are sufficient to predict whether the intended mitigating strategies would adequately cool the reactor core. The justification may include discussion of the adequacy of the code's relevant models and correlations, benchmarking of code calculations against relevant experimental data, and relevant comparisons to calculations with state-of-the-art thermal-hydraulic codes. If the codes and methods were previously approved by NRC, provide the references to the safety evaluations (SEs) approving the codes and methods, and address compliance with the restrictions and conditions imposed in the SEs on the use of the codes and methods.

b) Identify and provide the specific analyses used to demonstrate adequate core cooling for VCSNS. Alternately, please identify specific analyses relied upon by VCSNS that are contained in documents already available to the staff.

The two items above, a) and b), are identified as Open Item 3.2.1.1.A in Section 4.1 below.

Although the licensee referenced WCAP-17601-P, the licensee did not clearly identify the code(s) and thermal-hydraulic analysis relied upon to support the Integrated Plan. It appears likely that the generic Westinghouse calculations with the NOTRUMP code informed the development of the Integrated Plan for VCSNS. Although NOTRUMP has been reviewed and approved for performing small break loss of coolant accident (LOCA) analysis for pressurized water reactors (PWRs), the NRC staff had not previously examined its technical adequacy for simulating an ELAP event. In particular, the ELAP scenario is differentiated from typical design-basis small-break LOCA scenarios in several key respects, including the absence of normal emergency core cooling system (ECCS) injection and the substantially reduced leakage rate, which places significantly greater emphasis on the accurate prediction of primary-to-secondary heat transfer, natural circulation, and two-phase flow within the RCS. As a result of these differences, concern arose associated with the use of the NOTRUMP code for ELAP analysis for modeling of two-phase flow within the RCS and heat transfer across the SG tubes as single-phase natural circulation transitions to two-phase flow and the reflux condensation cooling mode. Although the above discussion focuses on the NOTRUMP code, regardless of the specific thermal-hydraulic code and analysis on which the VCSNS's Integrated Plan is based, analogous concerns regarding the adequacy of code predictions of the time to reflux condensation cooling would remain applicable. Based upon the licensee's current plan to install low-leakage RCP seals, the NRC staff expects that the licensee will be readily able to provide primary makeup to avoid transitioning to reflux condensation cooling. Nevertheless, to ensure that the issue is understood and addressed by the licensee, the staff has designated the following Confirmatory Item:

(1) Reliance on the NOTRUMP code for the ELAP analysis of Westinghouse plants is limited to the flow conditions prior to reflux condensation initiation. This includes specifying an acceptable definition for reflux condensation cooling. This is identified as Confirmatory Item 3.2.1.1.B 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 and Open Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to use of computer codes for ELAP analysis if these requirements are implemented as described.

3.2.1.2 RCP 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 the audit process, the licensee was asked to address the following items regarding RCP seals. For clarity, the licensee's response is indicated following each item:

a. Provide the value of the maximum leak-off for each RCP seal in gallons per minute (gpm) assumed in the ELAP analysis.

   Response: To address NFPA-805, VCSNS is installing FlowServe N9000 RCP Seals in RF-22 (Fall of 2015). The characteristics of these low leakage seals are being addressed in ECR-50799. It is anticipated that the FlowServe N9000 Seals will have a maximum leak rate of 8.3 gpm per RCP which is expected for a relatively short duration (between 8 and 72 hours after ELAP), and a long term maximum of 4.3 gpm per RCP, beginning at approximately 72 hrs after ELAP.

   The FlowServe N9000 seal response will be an element of the plant-specific FLEX response analysis.

b. Discuss how the pressure-dependent RCP seal leakage rates are calculated. If the analysis uses the equivalent size of the break area based on the initial total RCP leakage rate and a specific flow model to calculate the pressure-dependent RCP seal leakage rates during the ELAP, discuss and justify the flow rate model used. Discuss whether the size of the break area is changed or not in the analysis for the ELAP event. If the size is changed, discuss the changed sizes of the break area and address the adequacy of the sizes. If the break size remains unchanged, address the adequacy of the unchanged break size throughout the ELAP event in conditions with various pressure, temperature (considering that the seal material may fail due to an increased stress induced by cooldown) and flow conditions that may involve two-phase flow which is different from the single phase flow modeled for the RCP seal tests that are used to determine the initial total RCP seal leakage rate assumed in the ELAP analysis.

Response: FlowServe N9000 seals leak rate varies proportionally to the square root of the RCS pressure. At 300 psig RCS pressure, the leakage would be ... 1.6 gpm per RCP.

The FlowServe N9000 seal response will be an element of the plant-specific FLEX response analysis.

c. Section 4.4.1 of WCAP-17601 states, in part, that, "The NRC Information Notice (IN) 2005-14 has accepted the use of a 21 gpm assumption in deterministic analyses to develop coping analyses to show compliance with Appendix R. Given that the 50.63 Station Blackout (SBO) transient is similar with regard to seal performance, the 21 gpm should also be acceptable for developing ELAP strategies; this has not been called into question by the NRC in inspections (e.g., Component Design Basis Inspections)."

It is stated in IN 2005-14 that, "For the Westinghouse RCP seals, as discussed in a recently submitted document on RCP seal performance, a leakage rate of 21 gpm per RCP may be assumed in the licensee's safe shutdown assessment following the loss of all RCP seal cooling. Assumed leakage rates greater than 21 gpm are only warranted if the increase seal leakage is postulated as a result of deviations from seal vendor recommendations."
It is also stated in IN 2005-14 that, "Even if seal cooling is not reestablished, degradation of the seals for leakage rate to significantly increase is not expected for an indefinite period of time if the RCPs are secured before the seal temperature exceeds 235 degrees F. Restoration of seal cooling may result in cold thermal shock of the seal and possibly cause increased seal leakage."

Address the applicability of the above statements from IN 2005-14 to the ELAP analysis.

Response: FlowServe N9000 Seals are being installed per ECR-50799 in RF-22 (Fall of 2015). The 21 gpm leakage per RCP does not apply.

d. Section 4.4.1.1 of WCAP-17601 states that "... In some plant designs, such as those with 1200 to 1300 psia SG design pressures and no accumulator backing of the main steam system PORV actuators, the cold legs could experience temperatures as high as 570 °F before cooldown commences". It further states "this is beyond the qualification temperature [550 °F] of the O-rings but it is judged that the O-rings will remain intact for at least several hours at this temperature and normal operating pressure." Address the applicability of the above statements to the ELAP analysis, and justify that the integrity of the associated O-rings will remain for a specified time period.

Response: FlowServe N9000 Seals are being installed per ECR-50799 in RF-22 (Fall of 2015). The O-ring concern does not apply.

The plant-specific FLEX response analyses will address the N9000 seal response prior to and during the cooldown period.

e. Section 5.7.1 of WCAP-17601 discusses the analyses for the RCS response with RCP safe shutdown/low leakage seals. In the analyses, the assumed RCS leakage is reduced to one gpm/seal plus one gpm of unidentified allowable Technical Specification leakage. Discuss the analysis used to determine the RCP seal leakage of one gpm/seal for the safe shutdown/low leakage seals, and address adequacy of the analysis including computer code/methodology and assumptions used, and supporting testing data applicable to the ELAP conditions. The NRC staff noted that the NRC previously reviewed and approved the use of the Westinghouse SHIELD shutdown seal data for the Model 93A RCP in the plant PRA model. If the Model 93A RCP is used, address the compliance of Sections 3.5 and 4.0 of the NRC safety evaluation (ADAMS Accession Nos.: ML110880122 and ML110880131) approving the use of the shutdown seal with Model 93A RCP in the plant PRA model. If different RCP models are used, specify the RCP models for each applicable plant, and address the acceptability of using the SHIELD shutdown seal with these RCP models in the plant PRA model, since the NRC has not yet issued a safety evaluation approving the use of the SHIELD shutdown seal with other models in the plant PRA model. Westinghouse has issued a 10 CFR Part 21 report, "Notification of the Potential Existence of Defects Pursuant to 10 CFR Part 21," dated July 26, 2013 (ADAMS No. ML13211A168). Discuss how this Part 21 Report impacts the use of a seal leakage of one gpm in the ELAP analysis.

   Response: FlowServe N9000 Seals are being installed per ECR-50799 in RF-22 (Fall of 2015). Use of the SHIELD shutdown seal does not apply.

   The plant-specific FLEX response analyses will address the N9000 seal response prior to and during the cooldown period.

f. Provide the manufacturer's name and model number for the reactor coolant pumps and the reactor coolant pump seals. Discuss whether or not the reactor coolant pump and seal combination complies with a seal leakage model described in WCAP-17601.

   Response: The RCPs are Model 93A. FlowServe N9000 Seals are being installed per ECR-50799 in RF-22 (Fall of 2015). With pending installation of the FlowServe N9000 low leakage seals, plant-specific analysis will be completed following acceptance of the forthcoming topical report on the new seals.

g. Confirm that the primary ELAP strategy is to perform a symmetric cooldown using all RCS loops.

   Response: The primary ELAP strategy is to provide symmetric cool down in all three RCS loops.

The issue of RCP seal leakage rates was identified as a Generic Concern and was 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 [Nuclear Steam Supply System] Designs" dated January 2013 (ADAMS Accession Nos. ML13042A011 and ML13042A013 (Non-Publicly Available)).

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

After reviewing these submittals, the NRC staff identified the following Confirmatory Item applicable to VCSNS:

(1) Since VCSNS will install FlowServe N-9000 seals (non-Westinghouse RCP seals) in the existing Westinghouse RCPs, the acceptability of the use of the non-Westinghouse RCP seals in the Westinghouse RCPs should be addressed, acceptable test results or other justification for adequate O-ring performance under high-temperature conditions expected during an ELAP should be provided, and the RCP seal leakage rate as a function of pressure for use in the plant specific ELAP analysis should be demonstrated to be valid via the results of acceptable testing. This is identified as Confirmatory Item 3.2.1.2.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 the reactor coolant pump seal leakages rates, if these requirements are implemented as planned.

3.2.1.3 Decay Heat

NEI Section 3.2.1.2 states in part:

> The initial plant conditions are assumed to be the following:
>
> (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 pages 14 and 15 of the Integrated Plan, describing Phase 1 core cooling and heat removal, and on page 17 and 18 of the plan, describing Phase 2 core cooling and heat removal, the licensee describes the sequence of actions to be taken to maintain core cooling and heat removal following an ELAP event. On page 21, Phase 3 is presented as a continuation of these actions. These actions and the sequence and the timing of these actions are dependent on decay heat rate, which is derived from the thermal hydraulic analyses utilized at the VCSNS plant.

The licensee has indicated that WCAP-17601-P is applicable to the VCSNS. Assumption 4, on page 4-13 of WCAP-17601-P, indicates that 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 VCSNS ELAP analysis, additional information is necessary to assess the adequacy of the analysis relative to the VCSNS. Specifically, the following information should be provided for NRC staff review: The range within which the decay heat model is applicable for 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). The need to review the information above is identified as Confirmatory Item 3.2.1.3.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 decay heat, 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.) should conform. When considering the code used by the licensee and its use in supporting the required event times for the sequence of events (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 licensee's Integrated Plan, the licensee stated that the assumptions are consistent with those detailed in NEI 12-06, Section 3.2.1. In addition, the licensee has stated that WCAP-17601-P is applicable to the VCSNS. However, the licensee should confirm that the key initial plant parameters and assumptions used in the forthcoming plant-specific analyses (discussed in Section 3.2.1.1 of this report) are consistent with the appropriate values from NEI 12-06, Section 3.2, or justify deviations. This is identified as Confirmatory Item 3.2.1.4.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 initial values for key plant parameters and assumptions, if these requirements are implemented as described.

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states in part:

> The parameters selected must be able to demonstrate the success of the strategies at maintaining the key safety functions as well as indicate imminent or actual core damage to facilitate a decision to manage the response to the event within the Emergency Operating Procedures and FLEX Support Guidelines or within the severe accident management guidelines (SAMGs). Typically, these parameters would include the following:
>
> - SG Level
> - SG Pressure
> - RCS Pressure
> - RCS Temperature
> - Containment Pressure
> - SFP Level

> The plant-specific evaluation may identify additional parameters that are needed in order to support key actions identified in the plant procedures/guidance or to indicate imminent or actual core damage.

On page 15, and referred to again on pages 19, 21, 22, 24, and 26 of the Integrated Plan, the licensee provides the following list of instrumentation to support Phases 1, 2 and 3 coping strategies for maintaining core cooling and heat removal and RCS inventory control:

> SG Level: Steam Generator Level (Wide Range)
>
> SG Pressure: □Steam Generator Pressure
>
> RCS Temperature: Core Exit Thermocouples; Thot, Tcold; Sub cooling/Sat
>
> RCS Pressure (Wide Range)
>
> Containment Pressure
>
> Additional Instrumentation: Safety Injection Accumulator Pressure; Pressurizer level; Emergency Feedwater (turbine-driven pump) flow to each SG.

Also, the VCSNS August 2013 six-month update added the Reactor Vessel Level Indication System to the instrumentation list.

On page 27, and referred to on pages 28 and 31 of the Integrated Plan, in the section regarding maintaining containment, the licensee provides the following information:

> Pressure and temperatures are read on MCB panels XCP-6103, 6104, and 6105 Pressure is read on PI-950, 951, 952, and 953; with 951 & 952 being PAMS instruments. Temperature is read on TI-9201A and 9203A.

On page 33 of the Integrated Plan, the licensee stated that key spent fuel pool parameters would be provided by instrumentation in accordance with NRC Order EA 12-051, Reliable Spent Fuel Pool Instrumentation.

The list of instruments as presented in the paragraphs above includes those delineated by NEI 12-06. However, as previously discussed Section 3.1.1.3 of this report, NEI 12-06 guidelines discuss the need to consider that some instrumentation may be affected during a seismic event. This was identified previously as Confirmatory Item 3.1.1.3.A in Section 4 below.

During the audit process, the licensee was requested to address instrumentation that will be used to monitor portable/FLEX electrical power equipment including their associated measurement tolerances/accuracy to ensure that: 1) the electrical equipment remains protected (from an electrical power standpoint – e.g., power fluctuations) and 2) the operator is provided with accurate information to maintain core cooling, containment, and spent fuel cooling. The licensee responded by stating that the engineering design change process will include design calculations to show that, analytically, the equipment will perform its intended functions. The licensee further stated that the design engineer must take into account the impact on existing SSCs with regard to the planned use of the FLEX equipment. The design process will ensure that existing SSCs will be operated within current design parameters or within acceptable limits. Continuing, the licensee stated that the procurement specifications (a design output document) for portable equipment will include instrumentation and indication so that important parameters may be monitored, such as output voltage, output frequency, flow-rate, pressure, etc. And finally, if any FLEX-equipment operating limits are required to ensure protection of installed SSCs, they will be presented in the change documents to ensure that any limitations will be translated into the FLEX Support Guidelines (FSGs), as applicable.

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 monitoring instrumentation and controls, 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.

The sequence of events is presented on pages 49 through 51 of the Integrated Plan on Attachment 1A. As discussed in detail in Section 3.2.1.1 of this report, there are unresolved issues regarding the thermal hydraulic analyses utilized in the development of this timeline. These issues were previously identified as Open Item 3.2.1.1.A and Confirmatory Item 3.2.1.1.B in Section 4.0 below.

In addition, on pages 9 through 11 of the Integrated Plan, in the section regarding the sequence of events, and in Attachment 1A, the licensee identified a number of unresolved issues for the sequence of events. Examples include: On page 9, "Further evaluation is required for boration calculations, as specified in WCAP-17601-P objective 4." On page 10, Table Item 5, "Local Emergency Feed control time line requires further evaluation." In Attachment 1A, Table Item 6, "Step 21 of EOP (Emergency Operating Procedure) 6.0 (Station Blackout) needs further review." And in Attachment 1A, Table items 12-15, doors and temporary ventilation, "While development of temporary ventilation procedures is in progress, it is probable that at least opening the doors will be a short term item. Further analysis is required."

Following the completion of these future actions by the licensee, and following completion of the licensee's validation of the SOE by walkdown or other suitable means, additional review of the timeline will be required to verify these and similar issues are resolved and that the final sequence of events conforms to NEI 12-06, Section 3.2.1.7. This is identified as Open Item 3.2.1.6.A in Section 4.2 below.

Use of the TDEFW pump is a key element in the sequence of events. The licensee was asked to discuss the potential of external hazards, most notably the seismic hazard, to damage or crimp the turbine driven emergency feed water pump (TDEFW) pump minimum flow recirculation line, which is a line not usually qualified as a seismic component. The licensee responded by stating that a design change, ECR-50157A, will upgrade the emergency mini-flow line and associated pipe supports from non-nuclear safety to Quality Related. This will ensure that the line is qualified such that it is not subject to crimping. In addition, the configuration of the minimum flow path to the condensate storage tank (CST) will be assessed for breaching during the Expedited Seismic Evaluation Process (ESEP) as required 10 CFR 50.54(f) letter (Near-Term Task Force Recommendations - Fukushima Daiichi Accident). VCSNS has committed to performing the ESEP as an interim seismic measure with a due date of December 2014.

On page 14 of the Integrated Plan, the licensee stated that the turbine driven emergency feedwater pump (TDEFWP) and the CST were protected from a seismic event but did not discuss the wind hazard. During the audit process, the licensee was requested to address the wind hazard protection for these components. The licensee responded by stating that current VCSNS design basis calculations and evaluations show that the CST, EFW Turbine exhaust and steam generator PORV exhausts are not susceptible to damage from tornado missiles. Thus, the reviewer noted that these components relied upon for the licensee's FLEX strategies will be protected and will be available following a beyond design basis high wind event that results in an ELAP/LUHS.

Another key element in the sequence of events is the use of the steam generator power operated relief valves (S/G PORVs). During the audit process, the licensee was asked to discuss whether the steam generator power operated relief valves (S/G PORVs) and the upstream piping are safety related components, thus protected from external hazards. The licensee responded by stating that the main steam PORVs are safety-related, ASME Code Class 2, Seismic 1 valves and the main steam piping on the upstream side of the PORVs is safety-related, ASME Code Class 2, Seismic 1. The licensee also stated that the PORVs and upstream piping are housed in safety-related structures and are protected from all hazards including tornadoes.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory and Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 Generic Concern related to shutdown and refueling requirements is applicable to VCSNS. This generic concern has been resolved generically through the NRC endorsement of NEI position paper entitled "Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514) by letter dated September 30, 2013 (ADAMS Accession No. ML13267A382).

The position paper describes how licensees will, by procedure, maintain equipment available for deployment in shutdown and refueling modes. The NRC staff concluded that the position paper provides an acceptable approach for demonstrating that the licensees are capable of implementing mitigating strategies in all modes of operation. The licensee's strategy for shutdown and refueling modes was not ascertained during the audit process. Therefore the licensee's plan to conform to the NEI position paper or propose another strategy for shutdown and refueling modes is necessary to resolve this concern. This is identified as Confirmatory Item 3.2.1.7.A in Section 4.2 below. The NRC staff will evaluate the licensee's resulting program through the audit and inspection processes.

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 cold shutdown and refueling, if these requirements are implemented as described.

3.2.1.8 Core Sub-Criticality

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

> All plants provide means to provide borated RCS makeup.

The NRC staff reviewed the licensee's Integrated Plan and determined that a 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 is applicable to VCSNS.

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

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

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

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

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

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

a mixing delay period of one hour following the addition of the targeted quantity of boric acid to the reactor coolant system to be appropriate.

During the audit process, the licensee was requested to address the following:

1) Discuss whether the uniform boron mixing model was used in the ELAP analysis. If the perfect boron mixing model was used, address the compliance with the recommendations discussed in a PWROG whitepaper related to the boron mixing model. If a different model was used, address the adequacy of the use of the boron mixing model in the ELAP analysis 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, discuss how the boron concentration in the borated water added to the RCS is considered in the cooldown phase of the ELAP analysis, considering that it needs time for the added borated water to mix with water in the RCS.

2) Discuss the results of the plant-specific boration analysis and show that the core will remain sub-critical throughout the ELAP event for the limiting condition with respect to shutdown margin. Note that the limiting conditions with respect to shutdown margin may be different than for the core cooling analysis (e.g., no seal leakage versus the maximum postulated value).

The licensee responded by stating that this is a generic industry concern or question and that the nuclear industry will resolve this concern generically through the Nuclear Energy Institute (NEI) and the applicable industry groups (e.g., PWROG, EPRI, etc.). The licensee further stated that once this concern is resolved, VCSNS will provide an update to the information provided in the Integrated Plan and during the audit, as part of a periodic six-month update to the Integrated Plan. It is presently anticipated that VCSNS will ensure that all required boron is inserted (1) at least one hour prior to the time it is needed for reactivity control; and (2) at least one hour prior to onset of reflux cooling. The details of the flow modeling and timing will be provided in the plant-specific FLEX response analysis.

At the time the audit was conducted, the licensee had neither (1) committed to abide by the generic approach discussed above, including the additional conditions specified in the NRC's endorsement letter, nor (2) identified an acceptable alternate approach for justifying the boric acid mixing assumptions in the analyses supporting its mitigating strategy. As such, resolution of this concern for VCSNS is identified as Confirmatory 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 Confirmatory 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

> RPV/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.

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.

NEI 12-06, Section 3.2.2, includes the following paragraph on page 23 following Guideline (15) with regard to the quantity of equipment necessary:

> 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.

On page 17 of the Integrated Plan, in the section describing core cooling, the licensee stated that Phase 2 requires a baseline capability for reactor core cooling strategy to connect a portable pump for injection into the steam generators in the event that the TDEFW pump fails or when ample steam is no longer available to drive the TDEFW pump's turbine. To allow for defense-in-depth actions in the event of an unforeseen failure of the TDEFW pump, the FLEX SG Makeup pump should be staged and made ready for service as resources become available following the ELAP event. The reviewer noted that the SG Makeup pump will discharge to diverse connections which will be at either end of a seismically qualified FLEX feed header (primary connection on the EAST side of the plant and the alternate on the NORTH side of the plant). Page 17 and 18 of the Integrated Plan further explains that the flow through the FLEX feed header will be directed to three separate Main Feed Water connections, one per steam generator, located downstream of the Main Feed Isolation Valves. Furthermore, the use of hoses, which will be stored in the vicinity of these connection points, will provide the final connection from the FLEX Feed header to the Main Feedwater piping.

During the audit, the licensee stated that north connection point is protected from high winds and associated missiles. Additionally, diversity of locations between the north and east connection points provide additional defense in depth for missile protection for the FLEX S/G feed connection points. The licensee confirmed that both the north and east connection points to the FLEX feed header will be seismically robust. However, also during the audit process, the licensee discussed a revised strategy to use four 1MW diesel generators during Phase 2 and 3 and provided conceptual electrical and mechanical diagrams. In addition, the licensee indicated as part of its revised FLEX strategy, an installed MDEFW pump would be repowered and the need for a permanently installed FLEX feed header is eliminated. The licensee clarified that the back-up strategy to repowering the MDEFW pump for Phase 2 of Core Cooling is to use hoses from an installed manifold through the east pen wall to hook-up with existing connections, which will be supplied by a FLEX SG make-up pump.

In addition, on page 23 of the Integrated Plan, in the section regarding Phase 2, maintaining RCS inventory control, the licensee describes the use of the alternate seal injection (ASI) pump and reactor makeup (RXMU) FLEX pump to discharge into the existing charging pump discharge header that will be modified to accept discharge from either pump. However, for this configuration, it appears that there will only be one injection point for maintaining RCS inventory control. During the audit process, the licensee stated that the strategy has been changed since the August 2013 update to the Integrated Plan. In the revised plan, there are two diverse connection points for RCS make-up and boration, both of which are in safety-related structures, protected from all hazards. One connection is in the auxiliary building at the 400 ft. elevation (near the ASI pump) and one in auxiliary building at the 436 ft. elevation.

Also on page 23 of the Integrated Plan, in the section regarding RCS inventory control, the licensee stated that it is "preliminarily planned to store the RXMU FLEX pump in the Auxiliary Building." However, later in the Integrated Plan, there is conflicting information. On page 55 of the Integrated Plan, Attachment 3, the licensee states that there will be one pump in the emergency response building (ERB) and one in FLEX storage building (FSB), but also states there is only "One (1) RXMU FLEX Pump." During audit process, the licensee was requested to clarify the discrepancy in terms of the number of pumps, and if there is only one pump, to discuss how this meets the NEI 12-06 guidance for N+1 FLEX pumps, as noted above. The licensee responded by stating that the strategy has been changed since the August 2013 update to the Integrated Plan. In the revised plan, there will be one RXMU FLEX pump stored in either the ERB or the FSB. The ASI pump is located in the auxiliary building at the 400 ft. elevation. The licensee concluded that the ASI pump and RXMU FLEX pump satisfy the guidance of NEI 12-06, Section 3.2.2, with regard to the "N+1" provisions. During the audit, the licensee indicated that the dedicated ASI pump diesel generator is located outside and has an external exhaust. The on-site stored backup diesel generator is stored in the auxiliary building, which is protected from external hazards, at the point of deployment and has an external exhaust.

There are numerous references in the Integrated Plan to the use of pumps, hoses, pipe runs and connection hardware to facilitate the implementation of coping strategies. However, there was insufficient information provided regarding calculations and analyses to verify adequate flow would be delivered to meet strategy objectives. Additional review is necessary to verify adequate supporting analysis has been completed to validate flows and pressures will be achieved and maintained. This is identified as Confirmatory Item 3.2.1.9.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 the use of portable pumps, if these requirements are implemented as described.

3.2.2 Spent Fuel Pool Cooling Strategies

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

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

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

On page 34 of the Integrated Plan, in the section regarding Phase 2, maintain spent fuel pool cooling, the licensee stated that the primary strategy is to begin supplying water to the pool to provide level makeup and cooling. The licensee also stated that no modifications are necessary for this strategy. Guidance exists in plant procedure BDMG-1.0, Spent Fuel Pool Makeup and Spray Strategies, for the connection of fire service to a check valve (bonnet removed with adapter installed) on the reactor makeup water SF pool supply check valve. This is an internal connection. The fire service could come from a FLEX Transfer pump and routed hoses in the auxiliary building. The licensee further stated that if installed equipment is available to provide clean water it will be used, and lake or UHS water is the backup water source. Continuing, the licensee made references to plant procedures such as the "Loss of Spent Fuel Pool Cooling" and to "Spent Fuel Pool with the Fuel Transfer Canal Transfer Tube Valve Closed." And finally, the licensee referenced "Spent Fuel Pool Makeup and Spray Strategies." The licensee summarized that the first two procedures provide immediate operator actions, and the last procedure referenced provides both internal and external makeup to the pool utilizing existing installed and staged equipment. During the audit process, the licensee was asked to provide a discussion regarding how the referenced plant procedures and the equipment utilized is appropriate for the ELAP and/or LUHS conditions. The licensee was also requested to address how the external hazards are mitigated for the equipment, power and connections utilized.

The licensee responded by stating that the procedures were referenced in the Integrated Plan for clarity and were not intended to take the place of FSGs. VCSNS intends to develop FSGs to address spent fuel pool makeup strategies during an ELAP. Additionally some FLEX equipment and connections will be used to support or enhance "B.5.b" strategies. (Author's Note: The reference to "B.5.b" is related to strategies that the licensee 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.")

The licensee further stated that a single program document is envisioned that will address the unique storage requirements and control for each major piece of B.5.b. and FLEX equipment. In most cases, VCSNS intends to store B.5.b equipment in FLEX storage buildings that meet NEI 12-06 structural requirements. In addition, on page 56 of the Integrated Plan the licensee identified spray nozzles for SFP spray and required hoses for portable FLEX equipment; however, the performance criteria was not identified. Further review of the licensee's implementing procedures to implement strategies for spent fuel pool cooling, including any applicable portable FLEX equipment performance criteria, will be required to verify conformance with NEI 12-06 guidance. In addition, during the audit process, the licensee stated that the SFP FLEX strategy had been revised and that the need for a permanently installed FLEX feed header, which was meant to tie into SFP hard piping, was eliminated. As part of its revised FLEX strategy, the licensee did not identify the primary and alternate connection points for portable pumps as part of Phase 2 for maintaining SFP Cooling. In addition, the license did not indicate whether these connection points will be protected from extreme external events such that at least one connection is available. This is identified as Confirmatory Item 3.2.2.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 spent fuel pool cooling, 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. One of these acceptable approaches is by analysis.

On page 27 of the Integrated Plan, in the sections regarding Phase 1 strategies for maintaining containment, the licensee stated that an analysis has been developed that models the containment response to a postulated ELAP and loss of LUHS event. The reviewer determined that the licensee's Calculation DC00020-245, "Long-Term Containment Response - Response to INPO IER L1-11-4," was presented to demonstrate the containment response. This calculation was prepared to determine the expected increase in containment pressure and temperature, taking into account ambient heat loses with and without RCP seal leakage. The licensee utilized CONTEMPT-LT/28 computer code for the analyses. The licensee stated that the analyses demonstrates that the event does not challenge the containment design pressure or temperature conditions until well after availability of RRC equipment and implementation of long term strategies to control pressure and temperature.

On page 30 of the Integrated Plan, in the section regarding maintaining containment, Phase 3, the licensee stated that the primary strategy is to provide cooling water flow to one train of the reactor building cooling unit (RBCU) cooling, utilizing the FLEX pump. Permanent connections will be made on both the "A" and "B" train common service water supply headers that feed the RBCUs. The discharge of the direct-engine-driven FLEX UHS pump will be connected to either the "A" or "B" train service water connection via flexible hoses to provide the needed cooling flow.

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 containment cooling, 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 made no reference in the Integrated Plan regarding the need for, or use of, additional cooling systems necessary to assure that coping strategy equipment functionality could be maintained. During the audit process, the licensee was asked to discuss the necessary strategy and environmental conditions for the TDEFW Pump room to ensure continuous and proper operation of the TDEFW pump. In its response, the licensee indicated that the TDEFW pump requires no support systems (no DC power, instrument air, or additional cooling is required) and that the pump is cooled by the pumped fluid. Nonetheless, the only portable equipment used for coping strategies identified in the Integrated Plan that would require some form of cooling are portable diesel powered pumps and generators. These self-contained commercially available units would not be expected to require an external cooling system nor would they require ac power or normal access to the UHS for cooling.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable

assurance that the requirements of Order EA-12-049 will be met with respect to equipment – cooling 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 degrees 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 10 of the Integrated Plan regarding a discussion of time constraints, the licensee stated the development of temporary ventilation procedures is in progress. The licensee further stated that it is probable that opening the doors, at a minimum, will be a short term item but, as noted in Table Items 12-15, further analysis is required. The

"Table items 12-15" being referred to are items on the event timeline (page 50) directing the opening of doors to cool the intermediate building, the control room, relay room and battery and charger rooms.

Because the licensee had indicated that the evaluation of critical room and area temperatures was not completed at the time the Integrated Plan was prepared, the licensee was requested to provide additional information during the audit process with regard to ventilation. Additional information was requested as follows:

1) From a general perspective, the licensee was requested to provide a discussion of room heat up and required ventilation in areas critical to mitigation strategy success.

2) Specifically, the licensee should verify that room temperature will not exceed the temperature limit of any instrumentation credited with monitoring the reactor and the reactor coolant boundary.

3) The licensee should address the ventilation requirements of the battery rooms to a) preclude hydrogen buildup, and b) to address the potential for high or low temperature impacts on the batteries.

During the audit, the licensee reiterated that area and room temperature evaluations were on-going. The licensee did address item 3, b) by stating that due to the operation of the turbine-driven emergency feedwater pump (on the east side of the intermediate building (IB), elevation 412 ft.), extreme low temperatures are not expected to occur in the IB following an ELAP event.

For high temperatures, the sensitive equipment in the battery and charger rooms are the distribution panels (not the batteries themselves), which, ideally, require an ambient temperature of no greater than 104 degrees F to ensure thermal overloads do not trip. The extreme scenario is that 107 degrees F air could be pulled into the battery and charger rooms; therefore, the FSGs will have provisions for by-passing the thermal overloads in this case.

Because the room and area temperature evaluations are not yet complete, further review is required to demonstrate conformance with NEI 12-06, Section 3.2.2, Guideline (10), regarding equipment ventilation. In light of the fact that the licensee evaluations also address temperature impact relative to habitability and area accessibility, review for conformance with NEI 12-06, Section 3.2.2, Guideline (11), Accessibility Requirements, will need to be addressed as well. The subject of habitability/accessibility will be discussed in more detail in Section 3.2.4.6 of this report. The issue of equipment ventilation (not habitability/accessibility) is identified as Confirmatory Item 3.2.4.2.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 equipment ventilation, 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.

On page 6 of the Integrated Plan, in the section discussing the screening of the extreme cold hazard, extreme cold was excluded as an expected hazard at VCSNS. As such, NEI 12-06, Guideline (12) is not applicable at VCSNS with regard to extenuating and unexpected (i.e. abnormal) freezing conditions that would impact the implementation of mitigation strategies. However, during the audit process, the NRC staff requested that the licensee discuss the possibility of boric acid precipitation due to low temperature since high concentrations of boric acid can lead to precipitation at temperatures in the range of 50 to 60 °F (e.g., installed piping, instrument lines, and tanks; FLEX piping and hoses, FLEX equipment used to prepare additional borated coolant). The licensee responded by stating that this potential hazard will be addressed in the design inputs for the FLEX engineering change request process. Calculations and other design output documents regarding boric acid precipitation due to low temperatures will be produced from the appropriate FLEX design changes. Although this response addressed new equipment design, it was not clear to the reviewer that this response addressed the potential for boric acid precipitation in existing equipment and lines that might result from loss of normal building heating provisions in the event of an ELAP. Further review is required to assess the potential for boric acid precipitation effects in existing equipment. This is identified as Confirmatory Item 3.2.4.3.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 heat tracing, if these requirements are implemented as described.

3.2.4.4 Accessibility – Lighting and Communications

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

Plant procedures/guidance should identify the portable lighting (e.g., flashlights or headlamps) and communications systems necessary for ingress and egress to plant areas required for deployment of FLEX strategies.

Areas requiring access for instrumentation monitoring or equipment operation may require portable lighting as necessary to perform essential functions.

Normal communications may be lost or hampered during an ELAP. Consequently, in some cases, portable communication devices may be required to support interaction between personnel in the plant and those providing overall command and control.

On page 39 of the Integrated Plan, in the section regarding safety function support, the licensee stated that with regard to the main control room and plant direct current (dc) powered lighting, the lighting strategy is to provide LED lighting for all phases of the FLEX response. The LED lighting will be provided either through temporary installations or replacement of current lighting LED bulbs. This plan will decrease the dc load requirements and enhance the expected dc battery life.

From the information presented above and from information in the Phase 3 response equipment list on page 58 of the Integrated Plan, it is apparent that the licensee has considered the need for portable lighting equipment. However, it is also apparent that the plans and/or modifications are still under development. Further review of the lighting provisions is identified as Confirmatory Item 3.2.4.4.A, in Section 4.2 below.

The NRC staff has reviewed the licensee communications assessment (ADAMS Accession Nos. ML12307A032 and ML13057A111) in response to the March 12, 2012 50.54(f) request for information letter for VCSNS and, as documented in the staff analysis (ADAMS Accession No. ML13135A257) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2, Guideline (8) regarding communications capabilities during an ELAP. Verification that any required modifications are implemented is identified as Confirmatory Item 3.2.4.4.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 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's Integrated Plan for the development of guidance and strategies did not address access to the protected area and internal locked areas. During the audit process, the licensee was requested to provide information on access to the protected area and internal locked areas as it relates to FLEX strategy implementation. In response, the licensee stated that operators have keys for emergency access to all areas required for equipment access and operator actions. In addition, plant security will establish a protocol for protected area access under ELAP conditions.

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 protected and internal locked areas, if these requirements are implemented as described.

3.2.4.6 Personnel Habitability – Elevated Temperature

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

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

Section 9.2 of NEI 12-06 states, in part:

> 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 10 of the Integrated Plan, in the section regarding the sequence of events and technical basis, the licensee stated that room temperature profiles with loss of ventilation have been calculated for the main control room, the relay room, and the turbine driven emergency feed pump room. The licensee further stated that additional work remains to be done for maintaining habitability in these areas and in the penetration areas and emergency feed mezzanine during the event.

On page 37 of the Integrated Plan, in the section regarding spent fuel pool cooling, the licensee stated that wall panel removal for ventilation is an existing strategy. However, the licensee also stated that more detailed FLEX guidance may be prepared for these actions replacing the existing strategies.

During the audit process, the NRC staff requested additional information regarding personnel habitability, in general, for areas critical to mitigation strategy implementation; and information, specifically, to address the TDEFW pump room and the area of the power operated relief valves. The licensee responded to the habitability concern in the TDEFW pump room by stating that TDEFW pump operation usually requires no operator action; it starts and runs at the preset speed. The only time procedures call for local speed control is if the flow control valves are impaired. The licensee also reiterated that evaluations to address habitability are still in progress.

Because the habitability evaluations are not complete, further review is required to determine conformance with NEI 12-06 with regard to elevated temperature impact on habitability. This is identified as Confirmatory Item 3.2.4.6.A in Section 4.2 below.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect personnel access and 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/UHS at their nominal capacities. Water in robust UHS piping may also be available for use but would need to be evaluated to ensure adequate net positive suction head (NPSH) can be demonstrated and, for example, that the water does not gravity drain back to the UHS. Alternate water delivery systems can be considered available on a case-by-case basis. In general, all CSTs should be used first if available. If the normal source of makeup water (e.g., CST) fails or becomes exhausted as a result of the hazard, then robust demineralized, raw, or borated water tanks may be used as appropriate.
>
> Heated torus water can be relied upon if sufficient NPSH can be established. Finally, when all other preferred water sources have been depleted, lower water quality sources may be pumped as makeup flow using available equipment (e.g., a diesel driven fire pump or a portable pump drawing from a raw water source). Procedures/guidance should clearly specify the conditions when the operator is expected to resort to increasingly impure water sources.

On page 18 of the Integrated Plan, in the section regarding core cooling and heat removal the licensee addressed using the CST as the primary water source. On page 14 of the Integrated Plan, the licensee stated that the CST is protected from a seismic event and during the audit, the licensee also confirmed that based on the current design basis the CST is not susceptible to damage from tornado missiles. To provide makeup, the licensee stated that the makeup strategy for the CST is first to supply water from the demineralized water storage tank (DWST) and the filtered water storage tank (FWST), if they are available. However, neither tank is seismically qualified. The licensee further stated that water from Monticello Reservoir could be utilized as makeup using either the installed diesel driven fire pump and fire header or the FLEX Transfer pump. If none of the previously mentioned sources are available, CST makeup will be supplied by a portable FLEX UHS pump from the seismically qualified UHS.

Based on the discussions as noted above, the licensee has developed a number of water sources for the VCSNS coping strategies and has identified primary and alternate priorities. During the audit process, the licensee was requested to discuss the quality of water during an ELAP event and any need for filtering to prevent damage to the FLEX UHS pump. The licensee responded that water straining would be part of the FLEX UHS pump system. The licensee also clarified the use of UHS water for steam generator feedwater is part of the present licensing basis, which is discussed in FSAR Section 10.4.9. In addition, Phase 3 strategies will deploy a water treatment system for indefinite coping.

The reviewer noted that the RWST and BATs are relied upon as the borated water sources for Phase 2 of maintaining RCS inventory. In addition, the reviewer noted that these tanks are located in the auxiliary building, which the licensee indicated is protected from all external hazards.

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 water sources, if these requirements are implemented as described.

3.2.4.8 Electrical Power Sources/Isolations and Interactions.

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

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

On page 23 of the Integrated Plan, the licensee stated "the installed ASI pump is powered from an installed, dedicated diesel generator, which may not to be available after the event. Therefore an on-site stored, backup diesel generator can be utilized to provide power to the ASI pump or to the on-site stored electric-driven RXMU FLEX pump, as necessary." During the audit process, the licensee was requested to describe the location, ability and pathway to vent diesel exhaust if the dedicated diesel is operated in this enclosed space; and to discuss the availability of these pathways during an ELAP event. The licensee responded by stating that the dedicated ASI pump diesel generator is located outside and has an external exhaust. Also during the audit process, the licensee was asked to describe the location/staging area of the on-site stored, backup diesel generator, and discuss the ability and pathway to vent diesel exhaust if it is operated in this enclosed space. The licensee responded to this request by stating that the on-site stored backup diesel generator is stored in the building at the point of deployment and has an external exhaust. The August 2013 six-month update confirmed and clarified this information by stating that this generator will be located in the electrical equipment building (EEB).

On pages 42 of the Integrated Plan, in the section on safety function support, the licensee stated that for the power requirements, electrically powered equipment items required during Phase 2 are the vital instrumentation, the ASI pump and the RXMU FLEX pump aligned for

RCS inventory control, lighting, and the alternate battery charger. Energizing these loads will be accomplished using a 300 kilowatt FLEX generator connected to 480 VAC breakers in the EEB. The licensee further stated that within 8 hours after the initiation of the ELAP event, the portable FLEX generator will be deployed from a storage area to the staging area east of the EEB (if the backup EEB DG is not operational). A set of FLEX cables will be stored with each generator and will be deployed on the generator trailer. The FLEX generator will be grounded via a flexible cable to a ground plant ground grid connection at the EEB.

Although the Integrated Plan addressed the use of backup diesel powered generators to provide backup power, the plan did not discuss how electrical isolation will be maintained such that a) Class 1E equipment is protected from faults in portable/FLEX equipment and b) multiple sources do not attempt to power electrical buses. The licensee responded to this issue during the audit process by stating that a) the switchgear breakers aligned for FLEX feeds will be maintained open and racked down and the output breakers of FLEX generators will remain open until utilized. The licensee stated for b), paralleling multiple power sources will be controlled through plant procedures through the use of the already installed synchronizing equipment.

During the audit process, the licensee was also requested to provide a summary of the sizing calculations for the FLEX generators to show that they can supply the loads assumed in Phases 2 and 3. The licensee responded by stating that analyses to support sizing calculations for the FLEX generators are under development. This is identified as Confirmatory Item 3.2.4.8.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 electrical power sources and isolations, 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 43 of the Integrated Plan, in the section regarding safety function support, the licensee stated that the FLEX generators will be stored on site with fuel for the 80KW units (approx. 12 hours), and built-in fuel of 24 hours for one 300 KW FLEX unit [Authors Note: Generator capacity cited in the Integrated Plan was revised from 250 to 300 KW in the August six-month update.] Once deployed to the staging area, the FLEX generators will be fueled as needed from a refueling truck or from a FLEX fuel tanker. The strategy to transfer fuel is to use a portable 120V, 10 gpm pump to transfer fuel from the safety related 7-day tanks to a refueling truck that delivers to each of the FLEX diesels (pumps and generators). The FLEX fuel tanker trailer is equipped with a portable diesel generator for powering the transfer pump motor. In addition, the licensee lists a fuel tanker and fuel supplies in the Phase 2 and Phase 3 equipment lists on pages 56, 57 and 58 of the Integrated Plan.

During the audit process, the licensee was requested to provide information regarding fuel supply locations and capacities and strategies for fuel delivery to the portable FLEX equipment and to clarify whether or not the fuel is stored in structures with designs which are robust with respect protection from external hazards. Also, the licensee was requested explain how fuel quality will be assured if stored for extended periods of time.

The licensee responded by providing the following information: The primary sources of diesel fuel available during an ELAP are: (1) DG Fuel Oil Underground Storage Tanks (two at 52,000 gallons each) located east of the RB, and approximately 50 feet northeast of the DG building. These tanks remain available during all events and account for the 104,000 gallons expected to be initially available following an event. (2) Auxiliary Boiler Fuel Oil Storage Tank (one at 500,000 gallons) southeast of the reactor building, and approximately 500 feet southeast of the DG building. This tank is robust with respect to flooding. In addition, in its response the licensee provided detailed full load fuel oil consumption rates for FLEX equipment necessary to support an ELAP/LUHS event. The licensee's assessment estimated a maximum consumption of 73,008 gallons over 7 days (168 hrs), which is only 70% of the robust on-site safety-related storage capacity available. Thus, the reviewer noted that based on the amount of fuel oil expected to initially available following an event from a protected source there is sufficient margin to support the licensee's FLEX strategies until off-site resources can arrive at the site. Futhermore, the reviewer noted in the consumption rate assessment the licensee did not account for fuel oil that would already be built-in for the FLEX equipment.

The licensee further stated that station procedure CP-0401, "Diesel Fuel Oil Sampling Procedure," will be used for ensuring fuel oil quality for both on-site and delivered fuel oil. The licensee clarified that the fuel oil transfer trailer to be used to deliver and refill portable FLEX equipment has a 900 gallon capacity. Page 43 of the Integrated Plan states that the strategy to transfer fuel is to use a portable 120V, 10 gpm pump to transfer fuel from the safety related 7-day tanks to a refueling truck that delivers to each of the FLEX diesels (pumps and generators). The licensee also clarified that the FLEX fuel tanker trailer is equipped with a portable diesel generator for powering the transfer pump motor.

In addition, during the audit process, the licensee specifically stated that four 1MW diesel generators will be employed to power the electrical loads during Phase 2 and 3. Thus, any means to supply fuel to the four 1MW diesel generators, whether truck or trailer, should possess the necessary capacity.

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

3.2.4.10 Load Reduction to Conserve DC Power.

NEI 12-06, Section 3.2.2, 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 39 of the Integrated Plan regarding safety function support, the licensee stated that load shedding will be required to begin approximately one hour after the initiation of the ELAP event if connection and operation of portable power to the battery chargers has not been successfully completed. The licensee also stated that load shedding is to be completed within two hours following the ELAP event in order to extend battery life to beyond 24 hours and that initial timeline evaluation for load shedding indicate that the manual actions can be completed within 30 minutes. Continuing, the licensee stated that this will be further documented as procedure revisions are developed.

During the audit process, the licensee was requested to address the following items. The licensee's response is shown following each topic:

1) Provide the direct current (dc) load profile with the required loads.

   Response: Engineering calculation DC08320-019 provides the load profiles for before, during, and after the initiating event; and the load profile after load shedding is completed. The calculation conservatively assumes full DC load until load shedding is complete. Assuming initiation of load shedding at T=1 hour after the start of the event, the results indicate an estimated minimum battery life of greater that 24 hours. Assuming initiation of load shedding at T= 2 hours results in an estimated minimum batter life of 16 hours.

2) Provide a detailed discussion on the loads that will be shed from the dc bus, the equipment location (or location where the required action needs to be taken), and the required operator actions needed to be performed and the time to complete each action. In your response, explain which functions are lost as a result of shedding each load and discuss any impact on defense in depth and redundancy.

   Response: Engineering calculation DC08320-019 lists the breakers that need to be opened and fuses that need to be pulled. Station electricians have performed timed walk downs to confirm these actions can be completed within one hour of initiation.

3) Provide the basis for the minimum dc bus voltage that is required to ensure proper operation of all required electrical equipment.

   Response: Due to the extreme load shedding provided in DC08320-019 noted above, the power transmission losses are nearly zero for all cables. The major load on the 125VDC system is the class IE inverters that have an operating profile below 105VDC (battery low voltage limit imposed by DC08320-019). These inverters produce 120VAC as long as input DC is in the operating range (therefore no voltage analysis necessary for 120VAC system – DC08340-002). The few loads remaining on 125VDC are within the range for the voltage drop analysis of calculation DC08320-010.

4) Discuss which components change state when loads are shed and actions needed to mitigate resultant hazards (for example, allowing hydrogen release from the main generator, disabling credited equipment via interlocks, etc.).

   Response: Component state changes will be addressed and incorporated as part of FSG development.

Because the issue of changing state of components during load shed, item 4) above, has not yet been resolved and will be addressed later during FSG development, this is identified as Confirmatory Item 3.2.4.10.A in Section 4.2 below.

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 Nuclear Energy Institute (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.

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's position regarding the NEI Generic resolution was not ascertained during the audit process. Therefore, it is necessary that the licensee either conform to the NEI position paper or propose an alternate strategy to address battery life to resolve this concern. This is identified as Confirmatory Item 3.2.4.10.B in Section 4.2 below.

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

3.3 PROGRAMMATIC CONTROLS

3.3.1 Equipment Maintenance and Testing.

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

> 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 and cables, etc. It is also acceptable to have a single resource that is sized to support the required functions for multiple units at a site (e.g., a single pump capable of all water supply functions for a dual unit site). In this case, the N+1 could simply involve a second pump of equivalent capability. In addition, it is also acceptable to have multiple strategies to accomplish a function (e.g., two separate means to repower instrumentation). In this case the equipment associated with each strategy does not require N+1. The existing 50.54(hh)(2) pump and supplies can be counted toward the N+1, provided it meets the functional and storage requirements outlined in this guide. The N+1 capability applies to the portable FLEX equipment described in Tables 3-1 and 3-2 (i.e., that equipment that directly supports maintenance of the key safety functions). Other FLEX support equipment only requires an N capability.

NEI 12-06, Section 11.5 states:

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

2. Portable equipment that directly performs a FLEX mitigation strategy for the core, containment, or SFP should be subject to maintenance and testing[1] guidance provided in INPO AP 913, Equipment Reliability Process, to verify proper function. The maintenance program should ensure that the FLEX equipment reliability is being achieved. Standard industry templates (e.g., Electric Power Research Institute (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

[1] Testing includes surveillances, inspections, etc.

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 [Preventive Maintenance] 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.

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.

On page 12 of the Integrated Plan, VCSNS committed to utilize the standard EPRI industry PM process for establishing the maintenance and testing actions for FLEX components. The NRC staff will evaluate the resulting program through the audit and inspection processes.

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 7 of the Integrated Plan, discussing key site assumptions to implement NEI 12-06 strategies, the licensee stated that specific strategies are being developed and these pre-planned strategies will be incorporated into the unit EOPs in accordance with established EOP change processes. Their impact to the design basis capabilities of the unit will be evaluated under 10 CFR 50.59.

On page 12 of the Integrated Plan regarding programmatic controls, the licensee stated that VCSNS will implement an administrative program for implementation and maintenance of the FLEX strategies in accordance with NEI 12-06 guidance and that the equipment for ELAP will have unique identification numbers.

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 Training, 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]

2. Periodic training should be provided to site emergency response leaders[3] on beyond design-basis emergency response strategies and implementing guidelines. Operator training for beyond-design-basis event accident mitigation should not be given undue weight in comparison with other training requirements. The testing/evaluation of Operator knowledge and skills in this area should be similarly weighted.

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 regarding training, the licensee stated that new training of general station staff and the emergency response organization (ERO) will be performed in 2015, prior to the final design implementation of the FLEX modifications. The training will be developed and implemented in accordance with the requirements of NEI 12-06, Revision 0, Section 11.6. In addition, an assessment to determine training needs will be performed for all ERO personnel responsible for the implementation of the FLEX Support Guidelines in accordance with the Systematic Approach to Training process. The training will be integrated into existing training and qualification programs in a manner such that the training for beyond-design-basis events will not be given undue weighting in comparison with other training and qualification requirements.

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

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

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

3.4 OFFSITE RESOURCES

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

1) A capability to obtain equipment and commodities to sustain and backup the site's coping strategies.
2) Off-site equipment procurement, maintenance, testing, calibration, storage, and control.
3) A provision to inspect and audit the contractual agreements to reasonably assure the capabilities to deploy the FLEX strategies including unannounced random inspections by the Nuclear Regulatory Commission.
4) Provisions to ensure that no single external event will preclude the capability to supply the needed resources to the plant site.
5) Provisions to ensure that the off-site capability can be maintained for the life of the plant.
6) Provisions to revise the required supplied equipment due to changes in the FLEX strategies or plant equipment or equipment obsolescence.
7) The appropriate standard mechanical and electrical connections need to be specified.
8) Provisions to ensure that the periodic maintenance, periodic maintenance schedule, testing, and calibration of off-site equipment are comparable/consistent with that of similar on-site FLEX equipment.
9) Provisions to ensure that equipment determined to be unavailable/non-operational during maintenance or testing is either restored to operational status or replaced with appropriate alternative equipment within 90 days.
10) Provision to ensure that reasonable supplies of spare parts for the off-site equipment are readily available if needed. The intent of this provision is to reduce the likelihood of extended equipment maintenance (requiring in excess of 90 days for returning the equipment to operational status).

On pages 13 of the Integrated Plan in the section discussing the RRC, the licensee reiterated that the industry will establish two RRCs to support utilities during beyond-design-basis events. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested; the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local assemble area, established by the SAFER team and the utility.

The review of the Integrated Plan determined that insufficient information was provided to demonstrate conformance with NEI 12-06, Section 12.2, Guidelines 2 through 10, above. During the audit process, the licensee stated that the nuclear industry will resolve this concern generically through the NEI and SAFER and that SAFER establishes the requirements for operation of the RRCs. As this process does not demonstrate site specific conformance with NEI 12-06, Section 12.2, Guidelines 2 through 10, this has been identified as Confirmatory Item 3.4.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 provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to offsite resources, if these requirements are implemented as described.

4.0 SUMMARY OF CONFIRMATORY AND OPEN ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.2.1.1.A	ELAP Analysis Computer Code - Confirm the identification of the codes utilized for ELAP analysis and the adequacy of the technical basis to support the conclusion that the codes are sufficient to predict whether the intended mitigating strategies would adequately cool the reactor core. If the codes and methods were previously approved by NRC, provide the references to the safety evaluations (SEs) approving the codes and methods, and address compliance with the restrictions and conditions imposed in the SEs on the use of the codes and methods. Additionally, confirm the specific analyses used to demonstrate adequate core cooling for VCSNS.	
3.2.1.6.A	Sequence of Events (SOE) – Complete the unresolved issues and future actions needed to finalize the sequence of events for time constraint validation.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.2.B	In regards to protection of connection access points, confirm whether at least one connection point for the FLEX equipment will only require access through seismically robust structures accordance with the guidance of consideration 2 of NEI 12-06, Section 5.3.2.	
3.1.1.3.A	Confirm the analysis for critical actions to perform until alternate indications can be connected (measured), how to control critical equipment without control power, and the development of a reference source to obtain necessary instrument readings.	
3.1.3.1.A	Confirm the analysis for local historical tornado data (width and path axis) has been taken into account with regard building locations.	
3.1.3.2.A	Confirm why NEI 12-06, Section 7.3.2, considerations 1 and 2 are not applicable to VCSNS.	
3.2.1.1.B	Confirm that any use of the NOTRUMP code for the ELAP analysis of Westinghouse plants is limited to the flow conditions before reflux condensation initiates. This includes specifying an acceptable definition for reflux condensation cooling.	

3.2.1.2.A	Confirm the acceptability of the use of the non-Westinghouse RCP seals in the Westinghouse RCPs and provide acceptable test results or other justification for adequate O-ring performance under high-temperature conditions expected during an ELAP. The RCP seal leakage rate as a function of pressure for use in the plant specific ELAP analysis should be demonstrated to be valid via the results of acceptable testing.	
3.2.1.3.A	Confirm the adequacy of the ANS 5.1-1979 + 2 sigma model analysis relative to the VCSNS. Specifically, specify the range within which the decay heat model is applicable for 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).	
3.2.1.4.A	Confirm the key initial plant parameters and assumptions from WCAP-17601-P used in the forthcoming plant-specific analyses (discussed in Section 3.2.1.1 of this report) are consistent with the appropriate values from NEI 12-06, Section 3.2, justify deviations, and validate they are appropriate for simulating the ELAP transient..	
3.2.1.7.A	Confirm plans to conform to the NEI position paper endorsed by the NRC ("Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514) by NRC letter dated September 30, 2013 (ADAMS Accession No. ML13267A382)) or propose another strategy for shutdown and refueling modes.	
3.2.1.8.A	Core Sub-Criticality – Confirm plans to apply the generic resolution for boron mixing under natural circulation conditions potentially involving two-phase flow, in accordance with the Pressurized-Water Reactor Owners Group (PWROG) position paper, dated August 15, 2013 (ADAMS Accession No. ML13235A135 (non-public for proprietary reasons)), and subject to the conditions provided in the NRC endorsement letter dated January 8, 2014 (ADAMS Accession No. ML13276A183). Alternatively, justify the boric acid mixing assumptions that will ensure adequate shutdown margin exists through all 3 phases of an ELAP event.	
3.2.1.9.A	Confirm the analysis to substantiate expected flow performance for mitigation strategies in the use of pumps, hoses, pipe runs, and connection hardware to facilitate the implementation of coping strategies. Additional review is necessary to verify adequate supporting analysis has been completed to validate flows and pressures will be achieved and maintained.	
3.2.2.A	Spent Fuel Pool Cooling Strategies – Confirm the unique storage requirements and control of SFP FLEX equipment, applicable portable FLEX equipment performance criteriato verify conformance with NEI 12-06 guidance, primary and alternate connection points for portable pumps as part of Phase 2 for maintaining SFP Cooling, and whether the connection	

	points will be protected from extreme external events such that at least one connection is available.	
3.2.4.2.A	Confirm the necessary analyses to substantiate expected room and area temperature extremes, and the effectiveness of any temperature mitigation plans in conformance with NEI 12-06, Section 3.2.2, Guideline (10) regarding equipment ventilation..	
3.2.4.3.A	Confirm analyses to address the potential for boric acid precipitation in existing equipment and lines that might result from loss of normal building heating provisions in the event of an ELAP, and, if required, develop mitigation plans to address this concern.	
3.2.4.4.A	Complete the analyses regarding the need for additional lighting and, if required, develop mitigation plans. Further review of the lighting provisions is necessary.	
3.2.4.4.B	Communication - Confirm that upgrades to the site's communications systems have been completed in accordance with the licensee's Communications Assessment and as evaluated by the NRC staff (ADAMS Accession Nos. ML12307A032 and ML13057A111).	
3.2.4.6.A	Personnel Habitability – Elevated Temperature - Complete room habitability analyses and any modification or mitigation plan changes needed as part of the implemented Integrated Plan for conformance to NEI 12-06.	
3.2.4.8.A	Electrical Power Sources/Isolations and Interactions - Confirm that the selected diesel generators are sized in accordance with sizing calculations.	
3.2.4.10.A	Load Reduction to Conserve DC Power – Confirm which components change state when loads are shed and the actions needed to mitigate resultant hazards (for example, allowing hydrogen release from the main generator, disabling credited equipment via interlocks, etc.) following FSG development.	
3.2.4.10.B	Confirm conformance to the generic approach in the NEI position paper on battery life ("Battery Life Issue" (ADAMS Accession No. ML13241A186 (position paper) and ML13241A188 (NRC endorsement letter)), as endorsed by the NRC, or provide an acceptable alternative.	
3.4.A	Off-Site Resources – Confirm the licensee's arrangement for off-site resources addresses the guidance of Guidelines 2 through 10 in NEI 12-06, Section 12.2.	

If you have any questions, please contact James Polickoski, Mitigating Strategies Project Manager, at 301-415-5430 or at james.polickoski@nrc.gov.

Sincerely,

/RA/

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

Docket No. 50-395

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

cc w/encl: Distribution via Listserv

DISTRIBUTION
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MSD R/F
RidsNrrDorlLpl2-1 Resource
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JPolickoski, NRR/MSD
JBowen, NRR/MSD

ADAMS Accession Nos. Pkg ML14034A335, Letter/ISE ML14034A339, TER ML14037A228 *via email

OFFICE	NRR/MSD/MSPB/PM	NRR/MSD/LA	NRR/MSD/SA	NRR/MSD/MSPB/BC
NAME	JPolickoski	SLent	EBowman	JBowen
DATE	2/21/14	2/21/14	2/21/14*	2/21/14*
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NAME	SBailey	SWhaley	JDavis (JBowen for)	JBowen
DATE	2/21/14*	2/21/14*	2/21/14*	2/21/2014

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