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

February 21, 2014

Mr. Richard L. Anderson
Site Vice President
NextEra Energy Duane Arnold, LLC
3277 DAEC Road
Palo, IA 52324-9785

SUBJECT: DUANE ARNOLD ENERGY CENTER - INTERIM STAFF EVALUATION RELATING TO OVERALL INTEGRATED PLAN IN RESPONSE TO ORDER EA-12-049 (MITIGATION STRATEGIES) (TAC NO. MF1000)

Dear Mr. Anderson:

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. ML13063A148), NextEra Energy Duane Arnold, LLC (NextEra, the licensee) submitted its Overall Integrated Plan for Duane Arnold Energy Center in response to Order EA-12-049. By letter dated August 27, 2013 (ADAMS Accession No. ML13242A007), NextEra submitted a six-month update to the Overall Integrated Plan.

Based on a review of NextEra's plan, including the six-month update dated August 27, 2013, and information obtained through the mitigation strategies audit process,[1] the NRC concludes that the licensee has provided sufficient information to determine that there is reasonable assurance that the plan, when properly implemented, will meet the requirements of Order EA-12-049 at Duane Arnold Energy Center. 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 Mr. Randy Hall, Senior Project Manager in the Mitigating Strategies Directorate, at (301) 415-4032.

Sincerely,

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

Docket No. 50-331

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

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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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

NEXTERA ENERGY DUANE ARNOLD, LLC

DUANE ARNOLD ENERGY CENTER

DOCKET NO. 50-331

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], NextEra Energy Duane Arnold, LLC (NextEra or the licensee) submitted the Overall Integrated Plan (hereafter referred to as the Integrated Plan) for compliance with Order EA-12-049 for the Duane Arnold Energy Center (Duane Arnold or DAEC). The Integrated Plan describes the guidance and strategies under development for implementation by NextEra for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. As further required by the order, by letter dated August 27, 2013 [Reference 3], the licensee submitted the first six-month status report since the submittal of the Integrated Plan, describing the progress made in implementing the requirements of the order.

2.0 REGULATORY EVALUATION

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

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

After receiving the Commission's direction in SRM-SECY-11-0124 [Reference 8] and SRM-SECY-11-0137 [Reference 9], the NRC staff conducted public meetings to discuss enhanced mitigation strategies intended to maintain or restore core cooling, containment, and SFP cooling capabilities following BDBEEs. 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

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

construction permit holders use a three-phase approach for mitigating BDBEEs. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment and SFP cooling capabilities. The transition phase requires providing sufficient portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from off site. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. Specific operational requirements of the order are listed below:

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

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

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

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

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

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

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

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

On August 29, 2012, the NRC staff issued the final version of JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" [Reference 19], endorsing NEI 12-06, Revision 0, as an acceptable means of meeting the requirements of Order EA-12-049, and published a notice of its availability in the *Federal Register* (77 FR 55230).

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

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

6. Description of how the portable FLEX equipment will be available to be deployed in all modes.

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

3.0 TECHNICAL EVALUATION

The NRC staff contracted with Mega-Tech Services, LLC (MTS) for technical support in the evaluation of the Integrated Plan for Duane Arnold, submitted by NextEra's letter dated February 28, 2013, as further supplemented. NRC and MTS staff have reviewed the submitted information and held clarifying discussions with NextEra in evaluating the licensee's plans for addressing BDBEEs and its progress towards implementing those plans. By letter dated February 13, 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, in general, that it accurately reflects the state of completeness of the Integrated Plan. The NRC staff therefore adopts the findings of the TER with respect to individual aspects of the requirements of Order EA-12-049.

A simplified description of the Duane Arnold Integrated Plan to mitigate the postulated extended loss of ac power (ELAP) event is that the licensee will remove the core decay heat by using the reactor core isolation cooling (RCIC) system. The steam-driven RCIC pump will supply water to the reactor pressure vessel (RPV) from the condensate storage tank (CST) or the suppression pool, depending on availability. The High Pressure Coolant Injection (HPCI) system is available as a backup to RCIC. Steam from the reactor operates the RCIC (or HPCI) pump turbine, which then exhausts steam to the suppression pool. Following depressurization of the RPV by exhausting steam through the safety relief valves to the suppression pool, a portable diesel-driven FLEX pump will be operated to supply water to the reactor from the circulating water pit, with makeup from the Cedar River, as needed.

A FLEX portable diesel generator will be used to power battery chargers and reenergize selected 480 volt ac load centers. This will allow energizing selected motor control centers so that power is available to critical loads such as required motor-operated valves, direct current (dc) components through the installed battery chargers, and desired ac instrumentation. In the long-term, additional equipment, such as 4160 volt ac diesel generators and diesel driven pumps, will be delivered from one of the Regional Response Centers (RRCs) to provide supplemental accident mitigation equipment.

Duane Arnold plans to use containment venting to maintain containment pressure and temperature within acceptable values. Venting is planned to be initiated in sufficient time to allow for continued RCIC operation and to maintain containment pressure below its design value. The final venting strategy will be developed consistent with the Boiling Water Reactor

Owners Group (BWROG) Emergency Procedure Guideline (EPG)/Severe Accident Guideline (SAG), Revision 3, as endorsed by the NRC staff, and the hardened containment vent modifications to be implemented as required by NRC Order EA-13-109.

In the postulated ELAP event, the SFP will initially heat up due to the unavailability of the normal cooling system. A FLEX pump will be used to add water to the SFP from the circulating water pit via portable hoses. Water will be injected through hoses directly into the pool, through spray nozzles on the refuel floor, or through connections to Residual Heat Removal system piping. This will ensure that a sufficient volume of water remains above the top of the stored fuel assemblies at all times. In the long term, additional equipment provided by the RRC will provide backup portable pumps and generators for SFP level instrumentation and additional SFP water makeup.

4.0 OPEN AND CONFIRMATORY ITEMS

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

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

As discussed in Section 3.0, above, the NRC staff has reviewed MTS' TER for consistency with NRC policy and technical accuracy and finds that, in general, it accurately reflects the state of completeness of the licensee's Integrated Plan. The open and confirmatory items identified in the TER are listed in the tables below, with some NRC edits made for clarity from the TER version. In addition to the editorial clarifications, Confirmatory Item 3.2.1.3.B was deleted, as the issue is addressed by Confirmatory Item 3.2.4.10.A.

The summary tables presented below, as edited, provide a brief description of the issue of concern and represent the NRC's assessment of the open and confirmatory items for Duane Arnold under this review. Further details for each open and confirmatory item are provided in the corresponding sections of the TER, identified by the item number.

4.1 Open Items

Item Number	Description	Notes
None		

4.2 Confirmatory Items

Item Number	Description	Notes
3.1.1.4.A	Off-Site Resources – Confirm the location of the local staging area for the RRC equipment, and that access routes to the site, the method of transportation, and the drop off area have been properly evaluated for all applicable hazards.	
3.1.2.A	Confirm the actual flood hazard level for which reasonable protection and a means to deploy the portable equipment is to be provided.	
3.1.3.1.A	Confirm that the separation of the two FLEX equipment storage buildings is sufficient to reasonably ensure that one set of equipment will be available, accounting for local tornado data (speed and direction), the actual separation distance of the buildings, and the axis between them.	
3.2.1.1.A	From the June 2013, position paper (ADAMS Accession No. ML13190A201), as discussed in the NRC endorsement letter dated October 3, 2013 (ADAMS Accession No. ML13275A318), confirm that benchmarks are identified and discussed which demonstrate that the Modular Accident Analysis Program (MAAP) 4 is an appropriate code for the simulation of an ELAP event at Duane Arnold.	
3.2.1.1.B	Confirm that the collapsed vessel level in the MAAP4 analysis remains above Top of Active Fuel (TAF) and the cool down rate is within technical specification limits.	
3.2.1.1.C	Confirm that MAAP4 is used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013, position paper.	
3.2.1.1.D	Confirm that in using MAAP4, the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236) is justified. This should include response at a plant-specific level regarding specific modeling options and parameter choices for key models that would be expected to substantially affect the ELAP analysis performed for that licensee's plant. Parameters considered important in the simulation of the ELAP event by the vendor/licensee include nodalization, general two-phase flow modeling, modeling of heat transfer and losses, choked flow, vent line pressure losses, and decay heat.	
3.2.1.1.E	Confirm that the specific MAAP4 analysis case that was used to validate the timing of the mitigating strategies in the Integrated Plan is identified. Alternately, a comparable level of information may be included in the supplemental response.	
3.2.1.3.A	The licensee plans to revise its procedures to be consistent with the BWROG recommendations for extending the availability of steam-driven core cooling systems. Confirm that the technical	

Item Number	Description	Notes
	justification for the recommendations is applicable to DAEC.	
3.2.1.8.A	Confirm that the two portable diesel-driven pumps sized in accordance with 10 CFR 50.54(hh)(2) requirements will have sufficient capability to be used as credited in the FLEX strategies implemented pursuant to Order EA-12-049.	
3.2.3.A	Confirm that the DAEC implementation of BWROG EPG/ SAG, Revision 3, including any associated plant-specific evaluations, is completed in accordance with the provisions of the NRC endorsement letter dated January 9, 2014 [Reference 22].	
3.2.4.2.A	Confirm that the updated analyses of room heat-up (and any supporting actions) ensure that adequate cooling is provided to equipment needed during an ELAP event.	
3.2.4.2.B	Confirm that any equipment in the reactor building needed for ELAP mitigation during Phases 2 or 3 will not be compromised by the steam environment caused by SFP boiling.	
3.2.4.4.A	The NRC staff has reviewed the licensee communications assessment (ADAMS Accession No. ML12307A120) and has determined that the assessment and planned upgrades are reasonable (ADAMS Accession No. ML13142A320). Confirm that the upgrades to the site's communications systems have been completed.	
3.2.4.6.A	Confirm that DAEC's plan addresses accessibility and habitability of all plant areas requiring personnel access in sufficient detail to determine if the environmental conditions support the needed operator actions.	
3.2.4.7.A	Confirm that the potential effects of using river water, which may contain suspended solids, for reactor/SFP cooling are addressed.	
3.2.4.9.A	Confirm that a refueling strategy for FLEX equipment has been developed based on a plant-specific analysis. The confirmation should include delivery capabilities, including for an indefinite coping period, and how fuel quality will be assured, if stored for extended periods (including fuel contained in the fuel tanks of Phase 2 equipment).	
3.2.4.10.A	Confirm that the final load shedding analysis has been completed and that the time constraints assumed in the mitigating strategies have been validated, based on the results of that analysis (DAEC Open Action Item 15).	
3.4.A	Offsite resources – Confirm that NEI 12-06, Section 12.2 guidelines 2 through 10, regarding minimum capabilities for offsite resources, have been adequately addressed.	

Based on a review of NextEra's plan, including the six-month update dated August 27, 2013, and information obtained through the mitigation strategies audit process, the NRC concludes that the licensee has provided sufficient information to determine that there is reasonable assurance that the plan, when properly implemented, will meet the requirements of Order EA-12-049 for the Duane Arnold Energy Center. This conclusion is based on the assumption that the licensee will implement the plan as described, including the satisfactory resolution of the open and confirmatory items detailed in this Interim Staff Evaluation and Audit Report.

5.0 SUMMARY

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

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

The NRC staff has reviewed the licensee's plans for additional defense-in-depth measures. With the exception of the items noted in Section 4.0 above, the staff finds that the proposed measures, properly implemented, will meet the intent of Order EA-12-049, thereby enhancing the licensee's capability to mitigate the consequences of a 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 NextEra Energy Duane Arnold, LLC, to NRC, "Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 28, 2013 (ADAMS Accession No. ML13063A148)

3. Letter from NextEra Energy Duane Arnold, LLC, to NRC, "First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated August 27, 2013 (ADAMS Accession No. ML13242A007)

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

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

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

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

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

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

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

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

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

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

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

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

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

17. Nuclear Energy Institute, Comments from Adrian P. Heymer on Draft Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,", July 3, 2012 (ADAMS Accession No. ML121910390)

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

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

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

21. Letter from J. Bowen, Mega-Tech Services, LLC, to E. Bowman, NRC, "Fifth Batch SE Final Revision 0 - 1 Site," dated February 13, 2014 (ADAMS Accession No. ML14045A163), submitting the Technical Evaluation Report for the Duane Arnold Energy Center.

22. Letter from Jack R. Davis (NRC) to Joseph E. Pollock (NEI) dated January 9, 2014, regarding Boiling Water Reactor Containment Venting (ADAMS Accession No. ML13358A206)

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Date: February 21, 2014

Enclosure 2

Technical Evaluation Report

ADAMS Accession No. ML14045A165

MEGA-TECH SERVICES LLC

Mega-Tech Services, LLC

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

Revision 0

February 13, 2014

NextEra Energy Duane Arnold, LLC.
Duane Arnold Energy Center
Docket No. 50-331

Prepared for:

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

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Job Code: J4672
TAC No. MF1000

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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 28, 2013 from Jack R. Davis, Director, Mitigating Strategies Directorate (ADAMS Accession No. ML13234A503).

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

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

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

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

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

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

3.0 TECHNICAL EVALUATION

By letter dated February 28, 2013, (ADAMS Accession No. ML13063A148), and as supplemented by the first six-month status report in letter dated August 27, 2013 (ADAMS Accession No. ML13242A007), NextEra Energy Duane Arnold, LLC (the licensee) provided the Integrated Plan for Compliance with Order EA-12-049 for the Duane Arnold Energy Center (DAEC). The Integrated Plan describes the strategies and guidance under development for implementation by the licensee for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the NRC staff in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the Order.

Attachment 12, "Implementation Action Items," of the Integrated Plan contains a listing of the DAEC Action Items. In cases where the DAEC Action Items are referenced in this evaluation, they will be clearly identified.

3.1 EVALUATION OF EXTERNAL HAZARDS

Sections 4 through 9 of NEI 12-06 provide the NRC-endorsed methodology for the determination of applicable extreme external hazards in order to identify potential complicating factors for the protection and deployment of equipment needed for mitigation of BDBEEs leading to an extended loss of all alternating current (ac) power (ELAP) and loss of normal access to the ultimate heat sink (UHS). These hazards are broadly grouped into the categories discussed below in Sections 3.1.1 through 3.1.5 of this evaluation. Characterization of the applicable hazards for a specific site includes the identification of realistic timelines for the hazard; characterization of the functional threats due to the hazard; development of a strategy for responding to events with warning; and development of a strategy for responding to events without warning.

3.1.1 Seismic Events

NEI 12-06, Section 5.2 states:

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

On page 2 of the Integrated Plan, the licensee stated that the seismic hazard applies to the DAEC. Also on page 2, the licensee stated that the seismic design of DAEC safety related structures are discussed in DAEC UFSAR, Section 3.7. Section 3.7, "Seismic Design," provides the details of DAEC's design-basis earthquake (DBE) and operating-basis earthquake (OBE).

In addition, the licensee stated that seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, are not completed and therefore not assumed in the Integrated Plan. The licensee stated that as the re-evaluations are completed, appropriate issues will be entered into the corrective action process and addressed.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01 and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the seismic hazard, 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 17 and 18 of the Integrated Plan, the licensee stated that the storage building design and construction will be consistent with NEI 12-06, Section 5.3.1.

On page 24 of the Integrated Plan, the licensee stated the two new storage buildings will be considered as commercial grade structures. During the audit process, the licensee stated that the two structures will be constructed to ASCE 7-10 for seismic hazards.

The Integrated Plan did not discuss how large portable equipment will be appropriately secured during a seismic event or how stored equipment and structures would be protected from seismic interactions. During the audit process, the licensee stated large portable equipment will be secured in the storage building and/or separated from unsecured non-seismic equipment or structures in the storage buildings.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protection of FLEX equipment – 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 pages 15 through 18 of the Integrated Plan, the licensee described that paths for deployment will be reviewed to ensure they are not susceptible to significant soil liquefaction during a seismic event. In addition, licensee stated that deployment routes from the staging area will be evaluated based on an assessment of the damage in the affected area and the equipment will be deployed in accordance with this assessment.

Based on the above, it was not clear to the reviewer if all deployment routes have been identified and evaluated for liquefaction potential. During the audit process, the licensee stated that expected deployment routes have been identified. The soil evaluation is in progress under DAEC Action Item 17. A minimum of two deployment routes have been identified from each storage facility.

On page 29 of the Integrated Plan, the licensee stated that portable equipment will be deployed to connection points in the protected area.

The Integrated Plan did not address NEI 12-06, Section 5.3.2, considerations 2, 4, and 5 regarding; FLEX equipment access through seismically robust structures, power requirements to move or deploy the equipment, and protection of the means to move the equipment. During the audit process, the licensee responded that access to connection points is through Class 1 structures with the exception of the turbine building (TB). The licensee stated that the TB is seismically robust, as discussed in UFSAR, Section 3.4.8.3.2. Power is not required for deployment of FLEX equipment. A tow vehicle will be maintained in each storage facility.

There was no discussion in the Integrated Plan regarding seismic protection for the connection for the secondary core cooling injection path for Phase 2. During the audit process, the licensee responded that the secondary core cooling connection point is on seismically qualified piping located in a Class 1 structure.

The Integrated Plan did not discuss seismic protection for the electrical connections to be used for FLEX equipment. During the audit process, the licensee stated that the electrical connections occur in Class 1 structures and are connected to safety-related equipment. The electrical connections are provided with Class 1 connectors.

Per UFSAR Sections 2.4.4, "Potential Dam Failures, Seismically Induced," and 2.4.11, "Low-Water Considerations," the dams on streams within the Cedar River basin have been built primarily for power purposes, either as hydroelectric facilities or as a source of water for thermal plant cooling. These dams all have small impoundments and do not affect either peak discharge during large floods or stream flow regulation during low-flow periods. In addition, the design of the DAEC control dam and intake structure ensures that during periods of low flow all available river flow is diverted to the intake structure. Per UFSAR Table 3.2-3, "Seismic Category 1 Structures," and 9.2.2, "River Water Supply System," the intake structure is a Seismic Category 1 structure and the DAEC control dam was designed and constructed in accordance with Seismic Category 1 criteria. Therefore, consideration 3 is not 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 provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of FLEX equipment – seismic hazard, 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 beyond-design-basis 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. 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 equipment for those plants that could be impacted by failure of a not seismically robust downstream dam.

The Integrated Plan did not provide: reference sources for determining local instrument readings; guidance that included critical actions to perform until alternate indications can be connected; guidance/instructions on how to control critical equipment without control power. During the audit process, the licensee stated that a reference source for instrumentation currently exists in the Technical Support Guidelines (TSGs). This guideline will be reviewed by the licensee under DAEC Action Item 7 to determine if enhancements are warranted with respect to an ELAP event. Guidance exists for how to control reactor core isolation cooling (RCIC), safety relief valves (SRVs), and containment vent valves when control power is not available.

The Integrated Plan did not address Guidelines 2 and 3 regarding the potential for internal flooding due to sources that are not seismically robust and do not require ac power nor mitigating ground water intrusion in critical locations. During the audit process, the licensee stated that no large, non-seismically qualified tanks of water exist internal to buildings that would impair implementation of the FLEX strategies. The licensee's also stated that any small sources of water would flow to lower elevations of buildings and not affect the FLEX strategies. Internal flooding was previously evaluated under the Individual Plant External Event Examination (IPEEE).

Per UFSAR Sections 2.4.4, "Potential Dam Failures, Seismically Induced," and 2.4.11, "Low-Water Considerations," the dams on streams within the Cedar River basin have been built primarily for power purposes, either as hydroelectric facilities or as a source of water for thermal plant cooling. These dams all have small impoundments and do not affect either peak discharge during large floods or stream flow regulation during low-flow periods. In addition, the design of the DAEC control dam and intake structure ensures that during periods of low flow all available river flow is diverted to the intake structure. Per UFSAR Table 3.2-3, "Seismic Category 1 Structures," and 9.2.2, "River Water Supply System," the intake structure is a Seismic Category 1 structure and the DAEC control dam was designed and constructed in accordance with Seismic Category 1 criteria. Therefore, consideration 4 is not 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 provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces – seismic hazard, if these requirements are implemented as described.

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

> Severe seismic events can have far-reaching effects on the infrastructure in and around a plant. While nuclear power plants are designed for large seismic events, many parts of the Owner Controlled Area and surrounding infrastructure (e.g., roads, bridges, dams, etc.) may be designed to lesser standards. Obtaining off-site resources may require use of alternative transportation (such as

air-lift capability) that can overcome or circumvent damage to the existing local infrastructure.

1. The FLEX strategies will need to assess the best means to obtain resources from off-site following a seismic event.

On pages 11 and 12 of the Integrated Plan, the licensee stated that the industry will establish two Regional Response Centers (RRCs) to support utilities during BDBEEs. 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. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's SAFER Response Plan (playbook), is planned to be delivered to the site within 24 hours from the initial request. The licensee stated it has signed a contract with SAFER. The designation of delivery methods and locations in the playbook is identified as Confirmatory Item 3.1.1.4.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to considerations in using offsite resources – seismic hazard, 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 pages 2 and 3 of the Integrated Plan, the licensee stated that the design basis at DAEC includes flooding from the Cedar River as a result of maximum precipitation. Warning time of several days exist for flooding of this nature, based on DAEC UFSAR, Section 3.4. The design basis flood (elevation. 764.1 feet mean sea level [msl]) is above plant grade so FLEX strategies must address deployment with a flood present. The licensee stated that flood re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, are not completed and therefore not assumed in the Integrated Plan. The licensee stated that as the re-evaluations are completed, appropriate issues will be entered into the corrective action process and addressed.

The Integrated Plan did not discuss the limiting flood, the limiting flood sources, and persistence of the flood conditions. During the audit process, the licensee stated that the flood response is explicitly discussed in DAEC UFSAR Section 3.4. The flooding source is the Cedar River following a prolonged extreme rainfall event located upstream of the station. Several days warning time exists prior to the water elevation approaching plant grade. For the design basis flood, river levels will remain above the plant grade for approximately three days.

The reviewer noted that while the DAEC UFSAR, Section 3.4.1.1.1 identifies a "maximum probably flood" with water level of 764.1 feet, it goes on to document that the facility was designed to resist flood waters to an elevation of 767.0 feet in order to allow for wave action and free board. This Section of the UFSAR also documents that further review of the wave action and runup caused by winds resulted in additional requirements by the NRC, listing in a follow on paragraph that temporary protection for openings in safety-related buildings is provided to an elevation of 770.5 feet on the northerly sides; to an elevation of 773.7 feet on the southerly sides; and to 769 feet on all other sides. The DAEC UFSAR, Section 3.4.1.1.3 documents that the design criteria for structures housing Seismic Category I equipment in the event of a maximum probable flood includes an inventory of openings in buildings below 769.0 feet along with methods for closing those openings. Confirmation of the actual level of the flood hazard for which reasonable protection and a means to deploy the equipment are provided is identified as Confirmatory Item 3.1.2.A in Section 4.2.

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

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

> These considerations apply to the protection of FLEX equipment from external flood hazards:
>
> 1. The equipment should be stored in one or more of the following configurations:
>
>   a. Stored above the flood elevation from the most recent site flood analysis. The evaluation to determine the elevation for storage should be informed by flood analysis applicable to the site from early site permits, combined license applications, and/or contiguous licensed sites.
>
>   b. Stored in a structure designed to protect the equipment from the flood.
>
>   c. FLEX equipment can be stored below flood level if time is available and plant procedures/guidance address the needed actions to relocate the equipment. Based on the timing of the limiting flood scenario(s), the FLEX equipment can be relocated [footnote 2 omitted] to a position that is protected from the flood, either by barriers or by elevation, prior to the

arrival of the potentially damaging flood levels. This should also consider the conditions on-site during the increasing flood levels and whether movement of the FLEX equipment will be possible before potential inundation occurs, not just the ultimate flood height.

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

On page 17 of the Integrated Plan, the licensee stated that the storage building design will be consistent with NEI 12-06, Section 6.2.3.1. In addition, the licensee stated that if the storage building is located below the flood level, procedures will be established to move equipment prior to flood levels impacting the equipment. During the audit process, the licensee stated that for flood conditions, there is sufficient warning time to move equipment and that one new storage structure is located above the flood plain.

On page 15 in the Integrated Plan, in the section on maintaining core cooling during Phase 2, the licensee stated that to ensure that the portable equipment can be connected under flooding conditions defined in NEI 12-06, a plant modification is required to establish a flood staging area for portable equipment that preserves the capability to connect this equipment with the design basis flood present.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protection of FLEX equipment – 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 RCP seal leak off, obtaining dewatering pumps, creating temporary flood barriers, etc. These factors can be credited in considering how the baseline capability is deployed.
>
> 2. The ability to move equipment and restock supplies may be hampered during a flood, especially a flood with long persistence. Accommodations along these lines may be necessary to support successful long-term FLEX deployment.

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

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

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

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

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

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

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

On pages 9 and 15 of the Integrated Plan, the licensee stated that existing severe accident management or abnormal procedures will be revised or new procedures developed to reflect deployment locations for portable equipment during floods and strategies for replenishing fuel supplies for portable equipment.

The Integrated Plan did not address deployment of FLEX equipment when a flood is imminent nor where equipment will be moved to and the time margin available from declaration of a flood. During the audit response, the licensee stated that several days warning time exists for a design basis flood. FLEX equipment will be moved into buildings protected from flood, and all required connection points are protected from flood.

The Integrated Plan did not address Guideline 7 regarding the loss of installed sump pumps during an ELAP. UFSAR Section 3.4.1.1.4.1, "Reactor Building," related to Reactor Building flood protection describes that minor seepage from both piping penetrations through exterior walls and at the exterior doors may be easily controlled by sump pumps at the mat elevation and through the use of additional portable water pumps. During the audit process, the licensee stated any small sources of water would flow to lower elevations of buildings and not affect the FLEX strategies. Internal flooding was previously evaluated under the Individual Plant External Event Examination (IPEEE).

The reviewer's engineering judgment is that the licensee's plan to move the equipment when they have warning of the flood protects the means to move the equipment in the event of a flood.

The Integrated Plan did not discuss the permanently installed barriers, or watertight doors. During the audit process, the licensee stated that barriers are installed in accordance with UFSAR Section 3.4, under an existing abnormal operating procedure (AOP 902). To enhance the timing of flood barrier installation in conjunction with deployment of portable FLEX equipment, the licensee stated DAEC will be modified to add a water-tight gate on the turbine building to eliminate the need for stop logs on one access door.

On page 50 of the Integrated Plan, the licensee stated it will evaluate deployment routes for portable equipment.

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

UFSAR Section 3.4.1.1, "Flood Protection Measures for Seismic Category 1 and Nonseismic Structures," discusses how Seismic Category 1 structures and Nonseismic structures housing Seismic Category 1 equipment are designed to withstand the hydraulic head resulting from the "maximum probable flood" to which the site could be subjected. This section also discusses the use of temporary flood barriers, including stoplogs, caulking, and bracing. The subparagraphs list the openings that have to be closed as well as including a discussion of the need to rely on sump pumps and additional portable water pumps.

On page 15 of the Integrated Plan, the licensee stated that existing severe accident management or abnormal procedures will be revised or new procedures developed to reflect deployment locations for portable equipment during floods.

On page 17 of the Integrated Plan, the licensee stated that if FLEX equipment is stored below current flood level, then it will ensure procedures exist to move equipment prior to exceeding flood level. If the storage building is located below the flood level, procedures will be established to move equipment prior to flood levels impacting the equipment.

The Integrated Plan did not discuss the need for additional guidance on deploying equipment during an extreme flood. During the audit process, the licensee stated that the guidance for mitigating extreme floods will primarily be contained in AOPs associated with flooding.

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 – flooding hazard, if these requirements are implemented as described.

3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

On pages 11 and 12 of the Integrated Plan, the licensee stated 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. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook are planned to be delivered to the site within 24 hours from the initial request. The designation of delivery methods and locations in the playbook is combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to considerations in using offsite resources – 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 3 of the Integrated Plan, the licensee stated that the DAEC is located adjacent to the Cedar River approximately 2.5 miles northeast of Palo, Iowa and is not a coastal site exposed to hurricanes. Regional history with tornadoes exists for the DAEC. DAEC location falls in Region 1 of Figure 7.2 of NEI 12- 06. This would correspond to a location with a one in one million probability of tornado winds speeds approaching 200 miles per hour (mph). Therefore, the DAEC screens in for the high wind hazard. The DAEC design basis (300 mph) for safety related structures bounds this value, UFSAR Section 3.3.

The reviewer compared DAEC's location as documented in UFSAR, Section 2.1.1.1 (42° 06' N, 091° 46' W) with NEI 12-06, Figure 7-1 and confirmed that it is north and west of the contour line for a peak-gust hurricane wind speed of 120 mph, which is in the direction of diminishing wind speeds.

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 winds, if these requirements are implemented as described.

3.1.3.1 Protection of FLEX Equipment – High Wind Hazard

NEI 12-06, Section 7.3.1 states:

> These considerations apply to the protection of FLEX equipment from high wind hazards:
>
> 1. For plants exposed to high wind hazards, FLEX equipment should be stored in one of the following configurations:
>
>   a. In a structure that meets the plant's design basis for high wind hazards (e.g., existing safety-related structure).
>
>   b. In storage locations designed to or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* given the limiting tornado wind speeds from Regulatory Guide 1.76 or design basis hurricane wind speeds for the site.
>
>   - Given the FLEX basis limiting tornado or hurricane wind speeds, building loads would be computed in accordance with requirements of ASCE 7-10. Acceptance criteria would be based on building serviceability requirements not strict compliance with stress or

capacity limits. This would allow for some minor plastic deformation, yet assure that the building would remain functional.

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

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

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

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

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

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

On page 17 of the Integrated Plan, the licensee stated that the storage building design will be consistent with NEI 12-06, Section 7.3.1. The buildings will be separated to minimize potential for single tornado path interacting with both buildings. The buildings will accommodate extreme straight winds for the area but tornado winds may damage structure. Portable equipment will be secured against wind.

During the audit process, the licensee stated that the selected locations for the two storage buildings provide approximately 3,400 feet of separation along a largely north-south axis. The predominant path of tornados in Iowa is from the southwest to the north-east. The large spatial separation makes it unlikely that a single tornado will damage both storage locations so severely that both sets of portable FLEX equipment would not be available for use.

Confirmation that the separation will be sufficient is dependent on the local tornado data and the actual separation distance and axis and is identified as Confirmatory Item 3.1.3.1.A in Section 4.2.

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

3.1.3.2 Deployment of FLEX Equipment – High Wind Hazard

NEI 12-06, Section 7.3.2 states:

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

Considerations 1, 2 and 5 do not apply to the DAEC site because the DAEC site is not a coastal site exposed to hurricanes as previously discussed in Section 3.1.3.1.

On page 37 of the Integrated Plan, the licensee identifies two pieces of debris removal equipment among a list of portable equipment to be available during Phase 2. This is the only mention of debris removal or debris removal equipment in the Integrated Plan. The Integrated Plan did not: address the types of debris equipment needed or the protection provided for the debris removal equipment. During the audit process, the licensee stated that final purchase of debris removal equipment has not been completed. The licensee stated that equipment purchased will be sufficient to move debris up to and including a large concrete barrier. The debris removal equipment will typically be stored in the FLEX storage buildings for protection. In addition, the licensee stated that a tow vehicle will be maintained in each storage facility to support moving equipment.

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

3.1.3.3 Procedural Interfaces – High Wind Hazard

NEI 12-06, Section 7.3.3, states:

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

The Integrated Plan did not address procedures for tornadoes. During the audit process, the licensee stated that deployment of FLEX equipment will be controlled by FSGs developed under DAEC Action Item 7. No changes to existing procedures for tornados are currently identified by the licensee.

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

3.1.3.4 Considerations in Using Offsite Resources – High Wind Hazard

NEI 12-06, Section 7.3.4 states:

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

On pages 11 and 12 of the Integrated Plan, the licensee stated 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. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook are planned to be delivered to the site within 24 hours from the initial request. The designation of delivery methods and locations in the playbook is combined with

Confirmatory Item 3.1.1.4.A in Section 4.2.

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

3.1.4 Snow, Ice and Extreme Cold

As discussed in NEI 12-06, Section 8.2.1, all sites should consider the temperature ranges and weather conditions for their site in storing and deploying their 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. NEI 12-06, Section 8.2.1, further specifies that 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 NEI 12-06, Figure 8-2 should address the impact of ice storms.

On pages 2 and 3 of the Integrated Plan, the licensee stated that the snow, ice, and low temperatures hazard applies to the DAEC site and that regional experience with snow, ice and low temperatures exist. From Figure 8.2 of NEI 12-06, DAEC is located in Region 5 corresponding to the highest region for ice severity.

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 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 17 of the Integrated Plan, the licensee stated that storage building design will be consistent with NEI 12-06, Section 8.3.1.

The licensee's plans for the storage and protection of portable equipment from snow, ice and extreme cold did not address the combination of significant snowfall, ice, and extreme cold or which of the three configurations listed in NEI 12-06, Section 8.3.1 will be used by the site to store FLEX equipment. During the audit process, the licensee stated that snow and ice removal will be performed using existing site winter weather practices. The FLEX storage buildings will be constructed consistent with NEI 12-06, Section 8.3.1 consideration 1.b using ASCE 7-10.

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

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

NEI 12-06, Section 8.3.2 states:

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

While the licensee has stated that procedures and programs will be developed relative to the hazards applicable to DAEC, it was not clear that these procedures and programs will successfully deploy portable/FLEX equipment within the required time as described in NEI 12-06, Section 8.3.2 within the context of an extreme event. The Integrated Plan did not address: extreme snow removal; how equipment would be transported in extreme snow and ice; debris removal; or the effects of extreme snow and ice on transportation of equipment to staging areas and to deployment. During the audit process, the licensee stated that snow and ice removal will be performed using existing site winter weather practices. Tow vehicles included in each FLEX storage building will be four-wheel drive and include snow removal blades. Debris other than snow and ice are not anticipated for this event.

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

3.1.4.3 Procedural Interfaces - Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.3, states:

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

The licensee did not address procedural interfaces with respect to the effects of an extreme snow or ice storm in combination with extreme cold on transportation of the FLEX equipment. During the audit process, the licensee stated that no unique procedural interfaces have been identified at this time.

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 - snow, ice and extreme cold hazard, if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.4, states:

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

On pages 11 and 12 of the Integrated Plan, the licensee stated 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. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook are planned to be delivered to the site within 24 hours from the initial request. The designation of delivery methods and locations in the playbook is combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to considerations in using offsite resources – snow, ice and extreme cold hazard, 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 2 of the Integrated Plan, the licensee stated that the high temperature hazard applies to DAEC.

On page 3 of the Integrated Plan, the licensee stated that regional experience with high temperatures exists for DAEC. Environmental design for DAEC electrical equipment is discussed in UFSAR Section 3.11. The normal environmental service conditions for areas containing safety related equipment at DAEC are described in a controlled document, QUALSC101.

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 temperatures, 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 17 in the Integrated Plan, the licensee stated that the storage building design will be consistent with NEI 12-06, Section 5.3.1.

The Integrated Plan did not address storage building ventilation or any consideration for high temperatures. During the audit, the licensee stated that the FLEX storage buildings will be designed to maintain storage temperatures within a specified range for the equipment.

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

The Integrated Plan did not provide sufficient information about the effect of excessive high temperatures on: the capability to deploy FLEX equipment, including consideration of the effects of high temperature on the FLEX storage structures; or manual operations required by plant personnel who would be subject to extreme heat conditions. During the audit process, the licensee stated that no affect on deployment pathways is expected from high temperatures because high temperatures have been routinely experienced at DAEC with no significant concrete buckling on site. The tow vehicles and equipment trailers will be rugged construction types such that minor damage to pathways will not impair the deployment of FLEX equipment. Each storage location has a minimum of two deployment paths available in the event one path is impaired. Deployment of FLEX equipment will not require accessing areas where extreme temperature would be expected.

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

The licensee's plan did not address procedural interfaces in the context of high temperatures for portable FLEX equipment. During the audit process, the licensee stated that procedures for operation of FLEX equipment have not been developed yet, but will include provisions related to area temperatures.

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

3.2 PHASED APPROACH

Attachment (2) to Order EA-12-049 describes the three-phase approach required for mitigating BDBEEs in order to maintain or restore core cooling, containment and SFP cooling capabilities. The phases consist of an initial phase using installed equipment and resources, followed by a transition phase using portable onsite equipment and consumables and a final phase using offsite resources.

To meet these EA-12-049 requirements, Licensees will establish a baseline coping capability to prevent fuel damage in the reactor core or SFP and to maintain containment capabilities in the context of a BDBEE that results in the loss of all ac power, with the exception of buses supplied by safety-related batteries through inverters, and loss of normal access to the UHS. As described in NEI 12-06, Section 1.3, "[p]lant-specific analyses will determine the duration of each phase." This baseline coping capability is supplemented by the ability to use portable pumps to provide reactor pressure vessel (RPV)/reactor makeup in order to restore core or SFP capabilities as described in NEI 12-06, Section 3.2.2, Guideline (13). This approach is endorsed in NEI 12-06, Section 3, by JLD-ISG-2012-01.

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

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

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 2.1, strategies that have a time constraint to be successful should be identified and a basis provided that the time can be reasonably met. NEI 12-06, Section 3 provides the performance attributes, general criteria, and baseline assumptions to be used in developing the technical basis for the time constraints. Since the event is a beyond-design-basis event, the analysis used to provide the technical basis for time constraints for the mitigation strategies may use nominal initial values (without uncertainties) for plant parameters, and best-estimate physics data. All equipment used for consequence mitigation may be assumed to operate at nominal setpoints and capacities. NEI 12-06, Section 3.2.1.2 describes the initial plant conditions for the at-power mode of operation; Section 3.2.1.3 describes the initial conditions; and Section 3.2.1.4 describes boundary conditions for the reactor transient.

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

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

3.2.1.1. Computer Code Used for ELAP Analysis.

NEI 12-06, Section 1.3 states:

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

The licensee provided a Sequence of Events (SOE) Timeline on pages 33 through 35 of their Integrated Plan, which included the time constraints and the technical basis for the site. The time constraints were discussed on pages 6 through 8 of the Integrated Plan. The licensee stated that GE-Hitachi Nuclear Energy (GEH) report NEDO-33771/NEDC-33771P, "GEH Evaluation of the FLEX Implementation Guidelines," Revision 1, (ADAMS Accession No. ML130370742, hereinafter NEDC-33771P), would be reviewed and compared to the coping strategies for core and containment cooling. The licensee referenced their analysis using the Modular Accident Analysis Program (MAAP) computer code in their discussion of the SOE timeline, the time constraints identified in the SOE timeline, and in their discussion of coping strategies to maintain containment cooling in the Integrated Plan.

MAAP4 was written to simulate the response of both current and advanced light water reactors to loss of coolant accident (LOCA) and non-LOCA transients for probabilistic risk analyses as well as severe accident sequences. The code has been used to evaluate a wide range of severe accident phenomena, such as hydrogen generation and combustion, steam formation, and containment heating and pressurization.

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

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

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

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

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

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

   This is identified as Confirmatory Item 3.2.1.1.D in Section 4.2.

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

During the audit process, the licensee stated that DAEC intends to comply with the limitations listed above in performing the final analysis of ELAP under DAEC Action Item 5.

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

3.2.1.2 Recirculation Pump Seal Leakage Models

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

A review was made of the Integrated Plan to verify that the recirculation pump seal leakage models specified by NEI 12-06, Section 3.2.1.5 had been adopted by the licensee in their analysis. The Integrated Plan did not address recirculation pump seal leakage, the seal model used, or any other loss of inventory to the RCS during an ELAP event. During the audit response, the licensee stated that recirculation pump seal leakage will be assumed consistent with the existing station blackout analysis (18 gallons per minute [gpm] per pump at rated pressure).

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

3.2.1.3 Sequence of Events

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

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

> Each site should establish the minimum coping capabilities consistent with unit-specific evaluation of the potential impacts and responses to an ELAP and LUHS. In general, this coping can be thought of as occurring in three phases:
>
> - Phase 1: Cope relying on installed plant equipment.
> - Phase 2: Transition from installed plant equipment to on-site FLEX equipment.
> - Phase 3: Obtain additional capability and redundancy from off-site equipment until power, water, and coolant injection systems are restored or commissioned.

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

The licensee submitted an event timeline and expected time constraints in Attachment 1A, Sequence of Events (SOE) Timeline on pages 33 through 35 of the Integrated Plan. Additionally, the SOE Timeline and time constraints are discussed on pages 6 through 8 in the Integrated Plan. The SOE Timelines did not identify if any of the elapsed times was a time constraint. There is no discussion of the margin between when the actions are to begin and the time by which they must be completed. During the audit response, the licensee stated that DAEC will ensure that the time needed to perform required actions is compatible with the potential range of events and will have time margin. This will be accomplished under DAEC Action Item 4. The licensee stated that operator actions will be condition based, not time based.

On pages 7 and 8 in the Integrated Plan, the licensee stated on behalf of the BWROG, GEH developed a document (NEDC-33771P, Revision 1) to supplement the guidance in NEI 12-06 by providing additional BWR-specific information regarding the individual plant response to the ELAP and loss of UHS events. The document includes identification of the generic event scenario and expected plant response, the associated analytical bases and recommended actions for performance of a site-specific gap analysis. The licensee stated that in the document, GEH utilized their NRC-approved containment analysis code (SHEX) to develop the generic ELAP event response. As part of this document, generic Mark I containment and nuclear steam system supply (NSSS) evaluations were performed. The licensee stated that the analysis is applicable to the DAEC (a BWR Mark I plant) coping strategy because it supplements the guidance in NEI 12-06 by providing BWR-specific information regarding plant response for core cooling, containment integrity, and SFP cooling. The guidance provided in the NEDC-33771P will be used, as appropriate, to develop coping strategies and for prediction of the plant's response. Plant-specific analysis of RPV and containment response and impacts will be performed consistent with the final DAEC strategies as recommended in NEDC-33771P. In response to Institute of Nuclear Power Operations (INPO) IER 11-4, DAEC performed a plant-specific study of the station's capability to cope with an extended SBO using the MAAP code. This study yielded similar results to NEDC 33771P and was used to inform the selection of planned improvements.

In Phase 1, DAEC copes with an ELAP event by relying on existing equipment at the plant. The RCIC system is proposed as the primary means by which the licensee will remove decay heat during an ELAP event. The RCIC system consists of a steam-driven turbine pump unit and associated valves and piping capable of delivering makeup water to the reactor vessel. The steam supply to the turbine comes from the reactor vessel. The steam exhaust from the turbine dumps to the suppression pool. RCIC can take suction from the condensate storage tank (CST) or from the suppression pool. Following any reactor shutdown, steam generation continues due to heat produced by the radioactive decay of fission products. RCIC either starts automatically upon a receipt of a reactor vessel low-low water level signal or is started by the operator from the Control Room. The normal RCIC pump suction source is the CST. The CST at DAEC is not seismic Category 1. It was unclear from the Integrated Plan if the RCIC suction path will automatically transfer to drawing from the suppression pool on low level in the CST or in the event of an extreme seismic event. It was also unclear if the transfer system is or is not seismic Category I. During the audit process, the licensee stated that the instrumentation, logic, and associated motor-operated valves that switch the RCIC pump suction is powered by the 125 and 250 Vac battery banks. In case of an ELAP, the ac power supplies are disrupted, but the batteries would continue to be available. The swap of suction sources would still be automatic, since the necessary power sources are still available. All the associated equipment is inside the reactor building, and therefore it would be protected from flooding and tornados as discussed in the DAEC UFSAR, Sections 3.3, 3.4, and 3.8. The logic and controls are in the control room and also have the same protection. The licensee stated that the equipment, cables, controls, and cabinets are seismically qualified. The licensee concludes that therefore the system is designed to continue functioning if there is a loss of offsite power coincident with a seismic, flood, or tornado event.

The Integrated Plan stated that EOPs will be revised to be consistent with revised BWROG recommendations (BWROG EPG/SAG, Revision 3) to extend the availability of steam-driven core cooling systems. Confirmation that there is an adequate technical justification demonstrating the extended availability of steam-driven core cooling systems and its applicability to DAEC is identified as Confirmatory Item 3.2.1.3.A in Section 4.2.

The licensee stated that at 30 minutes after an ELAP event, operators will begin to depressurize the RPV using the SRVs; however, sufficient pressure will be maintained for steam driven systems (RCIC/HPCI) to operate. The licensee will depressurize the RPV by drawing steam off through the SRVs, which discharge into the suppression pool. The SRVs will be manually controlled from the control room or locally, at containment penetrations, using portable batteries. In Phase 2, depressurization needs to be completed prior to the RCIC pump controls losing dc power. Depressurization is needed so that a portable diesel-driven FLEX pump can be used to inject water into the RPV from the Cedar River.

The Integrated Plan stated in various places that load shedding will begin at 30 minutes after an ELAP, while in other places it states that it will begin two hours after an ELAP event. During the audit process, the licensee stated that in the existing DAEC procedures for SBO, very little load shedding is specified. The licensee explained that the statement in the Integrated Plan that "operators perform additional load shedding" at two hours was intended to represent the fact that more load shedding would be done for an ELAP than an SBO. The licensee stated that load shedding for an ELAP will be performed as a single activity in the revised DAEC procedure. It is unclear from the Integrated Plan and the audit when load shedding will begin and whether there will be a separate load shedding procedure each for an SBO and for an ELAP event. This item is identified as Confirmatory Item 3.2.1.3.B in Section 4.2.

The licensee stated that between 4 and 8 hours after an ELAP, operators will align a portable DG to provide power to the station battery chargers. The licensee stated that existing analysis for 4-hour SBO coping time is detailed in DAEC UFSAR Section 15.3.2. The licensee stated that final plant-specific analysis for an ELAP will be performed with equivalent acceptance criteria with the exception of CST inventory and suppression pool level which will be altered in recognition of the external hazards and revised duration of the mitigating strategies.

In Phase 2, DAEC relies on portable FLEX equipment for longer term mitigation of the event. During Phase 2, core cooling is accomplished by using portable diesel-driven pumps aligned to inject water from the Cedar River to the depressurized RPV. The licensee stated it will provide a second injection path beyond the existing ones that currently are in procedures.

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 sequence of events, if these requirements are implemented as described.

3.2.1.4 Systems and Components for Consequence Mitigation

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

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

And,

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

NEI 12-06, Section 3.2.1.12 states:

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

On pages 10 and 11 of the Integrated Plan, the licensee stated that FLEX equipment will be procured as commercial grade equipment, but with augmented quality requirements. Design requirements for FLEX equipment will be documented and controlled via the existing plant modification process. Existing plant maintenance programs will be used to identify and document maintenance and testing requirements. Preventative Maintenance work orders (PMs) will be established and testing procedures will be developed in accordance with the PM program. Testing and PM frequencies will be established based on type of equipment and considerations made within Electric Power Research Institute (EPRI) PM Template guidelines. The control and scheduling of the PMs will be administered under the existing site work control processes. DAEC will assess the addition of FLEX program description into UFSAR and Technical Requirements Manual.

Phase 2 of the Integrated Plan includes coping strategies using on-site portable equipment. When RCIC can no longer function effectively, a portable diesel-driven pump will inject water to the RPV.

On page 23 of the Integrated Plan, in the section on maintaining containment function during Phase 2, the licensee stated that to add additional assurance of venting capability, provisions will exist to use portable pneumatic supplies to open containment vent valves assuming the loss of the normally installed electrical control power or pneumatic sources. The Integrated Plan did not explain what pneumatic supplies are referred to here and did not address their protection from extreme external events. During the audit process, the licensee stated that the pneumatic supply is a compressed gas cylinder. Cylinders will be stored in the FLEX storage buildings. The final configuration will depend on modifications performed under NRC Order EA-13-109.

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 systems and components for consequence mitigation, if these requirements are implemented as described.

3.2.1.5 Monitoring Instrumentation and Controls

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

> The parameters selected must be able to demonstrate the success of the strategies at maintaining the key safety functions as well as indicate imminent or actual core damage to facilitate a decision to manage the response to the event within the Emergency Operating Procedures and FLEX Support Guidelines or

within the SAMGs. Typically these parameters would include the following:

- RPV Level
- RPV Pressure
- Containment Pressure
- Suppression Pool Level
- Suppression Pool Temperature
- SFP Level

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

On pages 14 and 22 of the Integrated Plan, the licensee listed instrumentation credited in the coping evaluation:

Reactor Pressure Vessel Level
Reactor Pressure Vessel Pressure
Containment Pressure
Suppression Pool Temperature
Suppression Pool Level

In Attachment 6, on pages 43 and 44 of the Integrated Plan, the licensee listed the following required instruments:

Drywell Pressure
Drywell Temperature
Torus Water Level
Torus Water Temperature
RPV Pressure

It was unclear from the Integrated Plan why the listed instrumentation on pages 14, 22, 43, and 44 did not coincide. During the audit process, the licensee stated that it will add Reactor Pressure Vessel Level to the Table in Attachment 6. Attachment 6 contains DAEC-specific names, while the other text uses generic terms for the same instruments (e.g., torus water and suppression pool are equivalent).

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 monitoring instrumentation and controls, if these requirements are implemented as described.

3.2.1.6 Motive Power, Valve Controls and Motive Air System

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

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

And,

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

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

On page 15 of the Integrated Plan, the licensee stated that during Phase 2, core cooling will be ensured by portable diesel-driven pumps aligned to inject water into the RPV. To do this, the reactor must be depressurized using SRVs. Multiple SRVs are available with four dedicated safety related pneumatic accumulators. The accumulators are nominally 200 gallons in size and would allow for extended cycles under the conditions assumed for FLEX. DC power is required for operation of these valves. If for any reason the station batteries and dc power distribution cannot be preserved, existing procedures provide an alternative method of supplying power directly to the SRVs utilizing a battery cart.

The Integrated Plan stated the accumulators would allow for extended cycles under the conditions assumed for FLEX. It was unclear what was meant by "extended cycles under the conditions assumed for FLEX" and if this capacity was adequate for assuring RCS depressurization during the ELAP event. During the audit process, the licensee stated that four accumulators supply six SRVs at a normal pressure of 100 pounds per square inch gauge (psig). The actuator volume is 15 cubic inches. Each SRV cycle consumes a very small fraction of the available volume. Therefore, pneumatic supply is not expected by the licensee to limit the availability of SRVs after an ELAP.

On page 23 of the Integrated Plan, the licensee stated that to add additional assurance of venting capability, provisions will exist to use portable pneumatic supplies to open containment vent valves, assuming the loss of the normally installed electrical control power or pneumatic sources. Electrical control power can be extended using portable 480 volt DGs supplying battery chargers.

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 motive power, valve controls and motive air system, if these requirements are implemented as described.

3.2.1.7 Cold Shutdown and Refueling

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

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

Review of the Integrated Plan for DAEC revealed that the Generic Concern related to shutdown and refueling requirements is applicable to the plant. This Generic Concern has been resolved through the NRC endorsement of NEI position paper entitled "Shutdown/Refueling Modes"

(ADAMS Accession No. ML13273A514); and has been endorsed by the NRC in a letter dated September 30, 2013 (ADAMS Accession No. ML13267A382).

The position paper describes how licensees will, by procedure, maintain equipment available for deployment in shutdown and refueling modes. The NRC staff concluded that the position paper provides an acceptable approach for demonstrating that the licensees are capable of implementing mitigating strategies in all modes of operation. The licensee informed the NRC staff of their plans to abide by this generic resolution. 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 provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the analysis of an ELAP during Cold Shutdown or Refueling if these requirements are implemented as described.

3.2.1.8 Use of Portable Pumps

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

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

NEI 12-06 Section 11.2 states in part:

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

On page 7 of the Integrated Plan in the SOE, the licensee stated that between four and eight hours prior to RCIC failure, operators will manually depressurize the RPV using the SRVs to allow for the RPV injection using the low pressure portable diesel-driven FLEX pumps.

On page 15 of the Integrated Plan, the licensee stated that plant modifications will be required to provide a second injection path beyond that in the existing procedures. To ensure the capability of the diesel-driven pumps to inject requires that the RPV be depressurized.

On page 19 of the Integrated Plan, the licensee stated that during Phase 3, use of Phase 2 strategies can maintain core cooling indefinitely, provided an adequate inventory of water is available. Water can be pumped from the Cedar River to replenish inventories if needed.

On page 37 of the Integrated Plan, the licensee listed two diesel-driven pumps that will be sized according to 10 CFR 50.54(hh)(2) requirements. The Integrated Plan did not relate these requirements to mitigation under ELAP conditions. This item is identified as Confirmatory Item 3.2.1.8.A in Section 4.2.

On page 38 of the Integrated Plan in the section on BWR portable equipment Phase 3, the licensee listed three portable high capacity pumps that are sized to pump water from the Cedar River to the DAEC pump house to support plant cool down.

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

3.2.2 Spent Fuel Pool Cooling Strategies

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

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

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

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

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

On page 26 of the Integrated Plan, the licensee stated that UFSAR, Section 9.1.2.3.2 discusses makeup requirements of 53.05 gpm at approximately 45 hours after a complete loss of cooling assuming a maximum core off-load into the SFP. The licensee stated that cycle-specific evaluations of actual SFP loading indicate that substantially lower make up needs and substantially longer response periods would normally be available to respond to a loss of SFP cooling. During Phase 1, the existing inventory of water in the SFP is relied on to maintain the spent fuel in an adequately cool condition and prevent fuel damage. The licensee stated that the installed configuration of the pool ensures an appropriate volume of water. The normal volume of water in the SFP is approximately 233,000 gallons. Once the SFP begins to boil, large quantities of high temperature moisture will enter the atmosphere in the reactor building. To reduce the potential that this moisture could adversely affect equipment performance or accessibility to the reactor building by personnel, the licensee stated a modification will be made to the refuel floor to create an alternate manual ventilation point that allows moisture to exit the building. The licensee stated that use of the manual ventilation path will impair the secondary containment, but will allow the restoration of secondary containment when the alternate ventilation is no longer needed to vent moisture. The licensee stated that during normal operation inadvertent opening of secondary containment via the alternate ventilation point will be positively precluded via administrative and physical controls.

On page 28 of the Integrated Plan, the licensee stated It expects that no operator actions are needed during the initial response to a loss of ac power to maintain the spent fuel covered with water. Once water inventory in the SFP begins to be depleted, make up using portable pumps can be established via any of several paths. Portable Phase 2 equipment is listed in Attachment 2 in the Integrated Plan. The licensee stated that the capacity of the portable pump will be greater than the boil off rate for SFP.

The Integrated Plan did not provide: specifics as to how makeup using portable pumps will be established for the SFP; identification of primary and alternate strategies for cooling the SFP during Phase 2; a discussion of when makeup has to begin or a discussion on the need for hoses and nozzles; a discussion on whether there are external connections through which the SFP inventory can be restored; a discussion on what sources of water are available for replenishing the SFP inventory. During the audit process, the licensee stated that makeup to the SFP can be accomplished using existing plant procedures directly via portable hoses routed to the refuel floor and into the SFP, with sprays on the refuel floor connected to the hoses previously discussed, or via piping from the residual heat removal (RHR) system. The connection points for RHR are the same as those for RPV makeup and do not require access to the refuel floor for their use. As previously approved by the NRC and listed in USAR Section 9.1.2.3.2, makeup for the design basis maximum heat load in the SFP must begin within 45 hours.

On page 30 of the Integrated Plan, the licensee stated that during Phase 3, off-site resources are expected to be available to replace or augment those SFP cooling capabilities describe in

Phase 1 and Phase 2. The licensee stated that Phase 2 strategies can maintain SFP cooling indefinitely, provided an adequate inventory of water is available. Water can be pumped from the Cedar River to replenish inventories if needed. Restoration of essential 4160 VAC power via a portable DG will be provided in Phase 3. With 4160 VAC power restored, permanently installed equipment required for make-up and cool down of the SFP will again be available.

The Integrated Plan did not discuss the timing of SFP inventory depletion to the point where the SFP level must be restored and did not identify what constitutes the worst-case scenario for inventory depletion. During the audit process, the licensee stated that the timing for a design basis loss of SFP cooling is described in DAEC UFSAR, Section 9.1.2.3.2. The description of the "worst case" is also contained in that section and includes a full core off load. During normal plant operation, decay heat in the SFP is much lower than the "worst case." The time available before the SFP would reach 200 degrees F is reported routinely in the DAEC daily plant status report, ensuring operators will be well aware of the required timing of responding to a loss of SFP 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 SFP cooling strategies, if these requirements are implemented as described.

3.2.3 Containment Functions Strategies

NEI 12-06, Table 3-1 and Appendix C provide a description of the safety functions and performance attributes for BWR containments which are to be maintained during an ELAP as defined by Order EA-12-049. The safety function applicable to a BWR with a Mark I containment listed in Table 3-1 is Containment Pressure Control/Heat Removal, and the method cited for accomplishing this safety function is Containment Venting or Alternative Containment Heat Removal. Furthermore, the performance attributes listed in Table C-2 denote the containment's function is to provide a reliable means to assure containment heat removal. JLD-ISG-2012-01, Section 5.1 is aligned with this position stating, in part, that the goal of this strategy is to relieve pressure from the containment.

On page 21 of the Integrated Plan, the licensee stated that during Phase 1, heat can be removed from containment via existing installed vents via the torus. The vent capacity is sized to accommodate the decay heat required at the time of venting. The licensee stated that DAEC is a Mark 1 containment, and therefore, the vent capability will be upgraded in accordance with NRC Order EA-12-050 to improve the reliability during a beyond design basis event. The licensee stated that containment performance using the venting strategy will be evaluated consistent with generic work performed by the BWROG in NEDC 33771P. Initial containment isolation capability remains unchanged from that described in UFSAR 15.3.2. The licensee stated that current DAEC procedures support the use of containment venting to control containment pressure. Following modifications required by NRC Order EA-12-050, the licensee stated it will revise procedures to be consistent with the updated configuration.

On page 23 of the Integrated Plan, the licensee stated that during Phase 2 no additional strategies are needed beyond those defined in Phase 1. To add additional assurance of venting capability, provisions will exist to use portable pneumatic supplies to open containment vent valves, assuming the loss of the normally installed electrical control power or pneumatic sources. Electrical control power can be extended using portable 480 volt DGs supplying battery chargers as discussed for Phase 2 core cooling strategies.

On page 25 of the Integrated Plan, the licensee stated that during Phase 3, off-site resources are expected to be available to replace or augment those containment cooling capabilities describe in Phases 1 and 2. The licensee stated that Phase 2 strategies can maintain containment indefinitely provided an adequate inventory of water is available. Water can be pumped from the Cedar River to replenish inventories if needed. The licensee stated that restoration of essential 4160 VAC power via a portable DG will be provided in Phase 3. With 4160 VAC power restored, permanently installed, safety related equipment required for make-up and cool down of suppression pool will again be available.

On page 34 of the Integrated Plan in Attachment 1A, the licensee stated that from 8 to 16 hours following an ELAP the operators are to vent the containment prior to exceeding containment limits. An existing containment hardened vent was installed under Generic Letter 89-16. Upgrades to that vent will be required under NRC Order EA-1 2-050. In the August 2013 six-month update, DAEC indicated they will implement requirements of Phase 1 of Order EA-13-109 instead of the rescinded Order EA-12-050.

The Integrated Plan was not clear on how the operator will make the decision to initiate early venting. During the audit process, the licensee stated that the Integrated Plan did not specify, "early venting." DAEC will vent the containment in accordance with EOPs. The current EOPs direct venting based on containment pressure. During the audit process, the licensee indicated DAEC will implement Boiling Water Reactor Owners Group (BWROG) Emergency Procedure Guideline (EPG)/Severe Accident Guideline (SAG) Revision 3, which specifies anticipatory venting under certain conditions. DAEC believes there are significant safety benefits to anticipatory venting. The final procedures for this may be dependent on design changes associated with NRC Order EA-13-109, as the existing hardened vent path for DAEC includes a rupture disc that would limit how the vent is used. In an endorsement letter dated January 9, 2014 (ADAMS Accession No. ML13358A206), the NRC staff concluded that the changes to the BWR venting strategy, as described in the November 21, 2013, position paper submitted by NEI on behalf of the BWROG (ADAMS Accession No. ML13352A057), are acceptable, subject to each licensee addressing the plant-specific implementation of the guidance. With regard to maintaining containment, the implementation of BWROG EPG/SAG, Revision 3, including any associated plant-specific evaluations, must be completed in accordance with the provisions of NRC letter dated January 9, 2014. This is identified as Confirmatory Item 3.2.3.A in Section 4.2.

The Integrated Plan references the use of NEDC-33771P, Revision 1. On page 2 of 77, in NEDC-33771P, it states that one overarching assumption and input to its calculations was that "[f]or the containment venting analysis in this evaluation, containment venting is assumed to start at 4 or 8 hours after the start of the event." On page 34 of the Integrated Plan, the licensee stated that venting would occur between 8 and 16 hours after the beginning of an ELAP event. In addition, on page 21 of 77 in NEDC-33771P, it states "the time to reach the design limit of 281 degrees is approximately 13.6 hours." On page 29 in NEDC-33771P, it states "[f]or RCIC suction from suppression pool, Appendix K shows that the effect on containment response due to the decay heat change from [nominal ANS 5.1 to ANS 5.1 plus 2 sigma] is that [design limits are reached approximately one hour earlier.]" It is not clear why the assumed beginning of venting can be postponed until 8 to 16 hours after an ELAP. During the audit process, the licensee stated that with the current DAEC design, venting via the hard pipe vent will only occur after the rupture disc design pressure is reached. The licensee stated this pressure is not expected to be reached in the first 8 hours of an ELAP event. The licensee stated that once the rupture disc has opened, the containment will vent decay heat as designed under the previous Generic Letter and maintain the containment pressure within specified limits for DAEC. When comparing the DAEC plant response to the generic work performed under NEDC-33771P, the licensee stated it should be noted that the reference plan selected for the Mark 1 containment had substantially larger thermal power rating that the 1912 MWth rating of Duane Arnold. Containment response will be revisited by the licensee in association with containment vent modifications planned under Order EA-13-109. This is combined with Confirmatory Item 3.2.1.3.A in Section 4.2.

On Page 2 of 77, in NEDC-33771P in the section on reactor pressure vessel makeup and cooling, it states:

> All BWR technologies that rely on RCIC for reactor pressure vessel (RPV) makeup will require RCIC to remain in operation at temperatures greater than [[200 degrees F]]. This report assumes that the current industry initiative to qualify RCIC generically up to approximately [[230 degrees F]] suction temperature is successful.

The Integrated Plan did not discuss the applicability of this assumption to DAEC, and did not reference NRC agreement with this assumption. During the audit process, the licensee stated that the DAEC mitigation strategy is to use RCIC as long as it is available. HPCI may be used as an alternative. Portable pumps will need to be aligned for RPV makeup prior to core uncovery, if the installed steam-driven pumps fail. If the CSTs are unavailable, then suppression pool is the required source of water and suppression pool temperature can affect availability of RCIC. The DAEC Action Item 25 will evaluate the effect of suppression pool temperature on RCIC.

On page 9 of 77, in NEDC-33771P in the section on reactor pressure vessel makeup and cooling, it states:

> Time 0-36 hours:
>
> For plants with a RCIC system, runtime mission extension is needed to confirm the BWROG RCIC Feasibility Study for running RCIC either manually or in automatic with DC power and suppression pool temperatures above [[170°F]] Manually running RCIC will also require a site-specific room heatup evaluation to determine operator accessibility to manually control RCIC if DC power is lost.
>
> If relied upon, HPCI runtime mission extension for RPV makeup or RPV pressure control is needed with intermittent DC power for startup (used to start auxiliary oil pump) or in automatic mode with DC power and suppression pool temperatures above [[170°F]] Note: RCIC would be the preferred source of water makeup for RCIC equipped plants for RPV injection. For plants with a HPCI system, using HPCI to augment RPV pressure control can reduce SRV actuations.

The Integrated Plan did not address: the extension of RCIC runtime for suppression pool temperatures above 170 degrees F; whether the RCIC pump is to be run manually or by using dc power; the potential to run HPCI in the same extended runtime conditions as RCIC. During the audit process, the licensee stated that the evaluation of RCIC is being performed under DAEC Action Item 25. RCIC will be run using dc power. HPCI provides defense-in-depth. HPCI would be operated in the batch mode, and no plans exist for "runtime extension."

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

3.2.4 Support Functions

3.2.4.1 Equipment Cooling – 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.

It is not clear from the Integrated Plan whether the diesel-driven FLEX pumps, 480 VAC generators, 220/120 VAC generators, fuel oil transfer pump, portable high capacity pumps, and the 4160 VAC generator are all self-cooled. During the audit process, the licensee stated that the listed portable equipment is self-cooled.

Per UFSAR Section 5.4.6, "Reactor Core Isolation Cooling System," the cooling water for the RCIC system turbine lube-oil cooler and barometric condenser is supplied from the discharge of the pump

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 – 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:

> *Plant procedures/guidance should consider loss of ventilation effects on specific energized equipment necessary for shutdown (e.g., those containing internal electrical power supplies or other local heat sources that may be energized or present in an ELAP.*
>
> ELAP procedures/guidance should identify specific actions to be taken to ensure that equipment failure does not occur as a result of a loss of forced ventilation/cooling. Actions should be tied to either the ELAP/LUHS or upon reaching certain temperatures in the plant. Plant areas requiring additional air

flow are likely to be locations containing shutdown instrumentation and power supplies, turbine-driven decay heat removal equipment, and in the vicinity of the inverters. These areas include: steam driven [auxiliary feedwater] AFW pump room, HPCI and RCIC pump rooms, the control room, and logic cabinets. Air flow may be accomplished by opening doors to rooms and electronic and relay cabinets, and/or providing supplemental air flow.

Air temperatures may be monitored during an ELAP/LUHS event through operator observation, portable instrumentation, or the use of locally mounted thermometers inside cabinets and in plant areas where cooling may be needed. Alternatively, procedures/guidance may direct the operator to take action to provide for alternate air flow in the event normal cooling is lost. Upon loss of these systems, or indication of temperatures outside the maximum normal range of values, the procedures/guidance should direct supplemental air flow be provided to the affected cabinet or area, and/or designate alternate means for monitoring system functions.

For the limited cooling requirements of a cabinet containing power supplies for instrumentation, simply opening the back doors is effective. For larger cooling loads, such as HPCI, RCIC, and AFW pump rooms, portable engine-driven blowers may be considered during the transient to augment the natural circulation provided by opening doors. The necessary rate of air supply to these rooms may be estimated on the basis of rapidly turning over the room's air volume.

Temperatures in the HPCI pump room and/or steam tunnel for a BWR may reach levels which isolate HPCI or RCIC steam lines. Supplemental air flow or the capability to override the isolation feature may be necessary at some plants. The procedures/guidance should identify the corrective action required, if necessary.

Actuation setpoints for fire protection systems are typically at 165-180°F. It is expected that temperature rises due to loss of ventilation/cooling during an ELAP/LUHS will not be sufficiently high to initiate actuation of fire protection systems. If lower fire protection system setpoints are used or temperatures are expected to exceed these temperatures during an ELAP/LUHS, procedures/guidance should identify actions to avoid such inadvertent actuations or the plant should ensure that actuation does not impact long term operation of the equipment.

NEI 12-06, Section 3.2.1.8 states that:

The effects of loss of HVAC in an extended loss of ac power event can be addressed consistent with NUMARC 87-00 or by plant-specific thermal hydraulic calculations, e.g., GOTHIC calculations.

On page 33 of the Integrated Plan, in Attachment 1A, the licensee stated that operators use procedures to maintain adequate room cooling to ensure necessary equipment is maintained functional by opening cabinets and doors. The Integrated Plan references the UFSAR Section 15.3.2 for this analysis for all ELAP areas with the possible exception of inverters that require additional analysis. UFSAR Section 15.3.2 analysis is based on a Station Blackout with four hour coping. The Integrated Plan indicates additional analyses will be performed as part of DAEC Action Item 24. The results of the additional analyses being performed as part of DAEC Action Item 24 need to be available for review. This is identified as Confirmatory Item 3.2.4.2.A in Section 4.2.

NEI 12-06, Section 3.2.1.8 states that the effects of loss of HVAC in an extended loss of ac power event can be addressed consistent with NUMARC 87-00 or by plant-specific thermal hydraulic calculations, e.g., GOTHIC calculations. It is not clear from the Integrated Plan whether if Phase 1 is extended such that the RCIC pump can run longer than the assumed four hours, and if the RCIC pump room will require added ventilation. During the audit process, the licensee stated that existing SBO calculations for temperature in the RCIC and HPCI rooms demonstrate acceptable temperatures for the associated equipment for 24 hours. The temperature profile in the rooms has largely stabilized by 4 hours and is not expected by the licensee to increase significantly in these areas. From this the licensee determined that no additional analysis of these areas is planned.

The Integrated Plan did not address whether other ventilation needs exist for mitigation of loss of SFP inventory due to boiling so that equipment in the Reactor Building will remain adequately cool or remain in an environment for which they are qualified following restoration of limited power to the plant (e.g., from portable DGs) or if ventilation will be needed for operator access to any areas in the SFP area. During the audit process, the licensee stated that a ventilation path on the refuel floor will be added to the DAEC design to allow venting from above the SFP to limit the effects on the reactor building environment to the extent practical. Operator access is not required to the SFP to open the new vent on the refuel floor. The Integrated Plan and the licensee's response to the audit did not directly address whether other equipment in the Reactor Building would be needed for ELAP mitigation (e.g., during Phases 2 or 3) that might be negatively affected by the steam environment caused by SFP boiling. This item is identified as Confirmatory Item 3.2.4.2.B in Section 4.2.

The Integrated Plan did not discuss ventilation of battery rooms, including what would be done to assure battery cell/electrolyte temperature did not drop too low following loss of heat/ventilation in that battery rooms, what criteria would be used to determine if hydrogen buildup required forced ventilation, and how hydrogen concentrations would be measured during an ELAP event. During the audit process, the licensee stated that no hydrogen accumulation is expected prior to the battery chargers being re-established. Once the battery chargers are operating, calculations indicate it would take 36 hours before hydrogen concentration would reach 4 percent in the battery rooms. Doors can be opened allowing ventilation into the corridor separating the battery room from the turbine building, further reducing the concern of hydrogen accumulation. The large volume of the turbine building and the inherent leakage of this structure will preclude significant hydrogen concentration.

NEI 12-06, Section 3.2.2, Guideline 10 states in part that plant areas requiring additional air flow includes the vicinity of the inverters. On page 33 of the Integrated Plan, the licensee stated that existing analysis addresses identified areas for ELAP with the exception of possible impact on instrument inverters that could affect critical instrument. The licensee also stated that additional analysis will be performed in accordance with the milestone schedule. It is unclear whether inverters will have adequate ventilation. During the audit process, the licensee stated that if review of ventilation under DAEC Action Item 24 concludes ventilation is not adequate for an ELAP, appropriate changes will be made to either improve ventilation or if impractical, instrumentation normally powered by the inverters will need to be powered from a portable generator connected to the instrument bus downstream of the inverters, as described in existing DAEC Action Item 18.

The Integrated Plan did not discuss placement of gasoline or diesel-powered portable/FLEX equipment and plans to ventilate indoor locations and monitor air quality in building locations that may be affected by their exhaust. During the audit process, the licensee stated that provisions are being made to allow portable equipment to be vented outside to ensure air quality is not affected by the exhaust of the equipment.

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

3.2.4.3 Heat Tracing.

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

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

The Integrated Plan did not address heat tracing for freeze protection of piping, instrument lines and equipment. This may include portable/FLEX equipment that is deployed outdoors during periods of cold weather. During the audit process, the licensee stated that DAEC FLEX equipment does not rely on heat tracing for the mitigating 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 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.

The Integrated Plan did not address lighting needs following an ELAP event, including portable lighting. The licensee's response to the EA-12-049 Mitigation Strategy Audit stated that the control room lighting includes a lighting uninterruptable power supply (LUPS) for 8 hours of operation. After depletion of the LUPS, portable lighting will be needed.

The Integrated Plan did not discuss the potential need for portable lighting in areas requiring access for instrumentation monitoring or equipment operation. During the audit process, the licensee stated that provisions for portable lighting will be included in the FLEX implementing procedures. Portable lighting such as flashlights will be included with miscellaneous tools in the FLEX storage buildings.

The NRC staff has reviewed the licensee communications assessment (ADAMS Number ML12307A120) required by in response to the March 12, 2012 50.54(f) request for information letter for DAEC and, as documented in the staff analysis (ADAMS Accession No. ML13142A320) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2 Guideline (8) regarding communications capabilities during an ELAP. This has been identified as Confirmatory Item 3.2.4.4.A in Section 4.2 for confirmation that upgrades to the site's communications systems have been completed.

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

3.2.4.5 Protected and Internal Locked Area Access

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

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

The Integrated Plan did not discuss assuring access to protected and internally locked areas following an ELAP event. During the audit process, the licensee stated that security procedures will be developed, as needed, to ensure required areas can be accessed following an ELAP.

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 area access, if these requirements are implemented as described.

3.2.4.6 Personnel Habitability – Elevated Temperature

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

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

Section 9.2 of NEI 12-06 states,

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

The Integrated Plan did not address accessibility of areas requiring personnel access such as the refueling floor and the main control room (MCR) in sufficient detail to determine if the environmental conditions support the needed operator actions. DAEC Abnormal Operating Procedure, AOP 301.1 "Station Blackout", does address blocking doors open. While not specifically stated as the reason for all affected areas, blocking doors open will provide natural ventilation. During the audit process, the licensee stated that RCIC and SRVs can be operated from the MCR and required instrumentation displays are in the MCR. No actions are required in the RCIC room. MCR temperatures will be reviewed under DAEC Action Item 24. FLEX procedure guidance will include provisions for managing heat stress. The licensee's response to the audit did not address accessibility of all areas requiring operator access. This item is identified as Confirmatory Item 3.2.4.6.A in Section 4.2.

The Integrated Plan did not address the environmental conditions to which operators would be subject during Phases 1 and 2. During the audit process, the licensee stated that long-term habitability for operators will be assured by monitoring conditions in the required work areas. Heat stress countermeasures, cold weather countermeasures, and rotation of personnel to the extent feasible, will be employed to ensure operators will be capable of FLEX strategy execution. At DAEC, the effect to habitability would be impacted from elevated temperatures and extreme cold air temperatures. DAEC FSGs will provide guidance to evaluate work area conditions and take actions, as necessary.

The Integrated Plan did not discuss the potential for the RCIC room to reach temperatures that would preclude operators from working in the area of the RCIC pump. During the audit, the licensee stated that no operator actions are required to be performed in the RCIC room. If RCIC fails, the licensee stated that HPCI can be used as a contingency replacement.

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 personnel habitability – elevated temperature, if these requirements are implemented as described.

3.2.4.7 Water Sources

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

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

On page 13 of the Integrated Plan, the licensee stated that if the CSTs are unavailable for RCIC, the suppression pool provides an inventory of water for make up during Phase 1 that is greater than the volume assumed in UFSAR 15.3.2.

On page 25 in the Integrated Plan, the licensee identified the Cedar River as a potential water source. The Integrated Plan did not discuss what pumps would be used to provide this water for replenishing inventories. The Integrated Plan did not discuss water quality from this source (e.g., are there significant suspended solids) and did not provide justification that use of Cedar River water will not result in blockage at the fuel assembly inlets to an extent that would inhibit adequate flow to the core. During the audit process, the licensee stated that the pumps will be high capacity pumps from the RRC and that the water quality is normal river water that will include suspended solids smaller than the suction strainer associated with the pump. Water will be provided to the essential service water pit and/or the circulating water pit where settling of solids can occur prior to being pumped for use in the plant. Water level will be maintained in the RPV above the top of active fuel. The licensee's response to the audit only addressed normal river water and did not address extreme external flooding and its attendant higher proportion of suspended solids and other debris. As such, it is unclear whether use of this river water will result in blockage of fuel assembly inlets or clogging of the suction strainer associated with the pump. This item is identified as Confirmatory Item 3.2.4.7.A in Section 4.2.

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

3.2.4.8 Electrical Power Sources/Isolations and Interactions

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

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

The Integrated Plan did not address local instrumentation or other equipment protection associated with the portable/FLEX electrical generators and electrical power equipment to ensure that: the electrical equipment remains protected (from an electrical power standpoint, e.g., power fluctuations); and that the operator is provided with accurate information to maintain core cooling, containment, and SFP cooling. In addition, the Integrated Plan did not address electrical isolations and interactions to determine how the portable FLEX generators and other loads are isolated to prevent simultaneously supplying power to the same bus from different sources. During the audit process, the licensee stated that portable electrical generators will have standard instrumentation provided by commercial vendors. The battery chargers, powered by the DGs, include the same indication as for normal plant operation. The licensee stated that indications of core, containment, and SFP cooling will be via installed instruments. Electrical isolations will be procedurally controlled by the associated FLEX implementing procedure to prevent supplying the same equipment from different sources.

The Integrated Plan stated on pages 37 and 38 that in Phase 2 it will use portable diesel-driven 480 VAC and 220/120 VAC generators; in Phase 3 it will use 4160 VAC diesel-driven generators. The Integrated Plan did not address the adequacy of the sizing of these generators. During the audit process, the licensee stated that each of the portable DGs will be of sufficient size to readily power required loads, allowing additional margin for other use as a defense-in-depth measure. The 220/120 volt generators are each rated at 6,000 watts. Instruments to be supplied by 1Y11 total 2,293 watts. Instruments to be supplied by 1Y21 total 1908 watts. The 480 volt generators are expected to be at least 350 kW. The required loads on this generator are two 125 Vdc battery chargers, each requiring 74 amperes (amps), and one

250 Vdc battery charger requiring 97 amps. The 4160 Vac generators are expected to be rated at approximately 2000 kW. The sum of required loads on the 4160 Vac bus to establish shutdown cooling is approximately 986 kW.

The Integrated Plan did not address the power source for the Fuel Oil Transfer Pump and the debris removal equipment listed in Attachment 2 and the three portable high capacity pumps listed in Attachment 3. The licensee's response to the EA-12-049 Mitigation Strategy Audit stated that the listed pumps are diesel powered.

On page 10 of 77, in the section in NEDC-33771P on reactor pressure vessel pressure control, it states:

> Time 0-36 hours:
>
> SRVs will generally be used to control RPV pressure and are required to have DC power and pneumatics available past the standard plant SBO coping time. Depending on primary containment environmental conditions during the event, SRV actuation may require a higher than nominal DC voltage to actuate the SRVs. The SRV pilot solenoid coil electrical resistance will increase due to a higher containment temperature with a longer duration event than an existing SBO coping time. Therefore, to achieve the necessary coil current, a higher voltage is needed to overcome the increase in the coil's resistance. Plants should evaluate their SRVs' qualification against the predicted containment response with FLEX implementation to ensure there will be sufficient DC bus voltage during the ELAP event. SRVs with shuttle valves may also require additional pneumatic supply pressure to actuate. This may require a higher pneumatic pressure and the ability to implement would be a plant specific action.

The Integrated Plan did not address the effect on station batteries following an ELAP event due to the potential for SRV actuation requiring higher than nominal dc voltage to actuate, and increased pilot solenoid coil electrical resistance due to higher containment temperature. In addition, there was no discussion in the Integrated Plan of the qualification of the SRVs against the predicted containment response with FLEX implementation. During the audit process, the licensee stated that the DAEC SRV solenoids are qualified to 340 degrees F, and the coil current should not be adversely affected in the qualified temperature range. The drywell temperature is expected to stay within this qualified temperature for the FLEX strategies, and that will be confirmed by the licensee under DAEC Action Item 28.

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 electrical power sources/isolations and interactions, if these requirements are implemented as described.

3.2.4.9 Portable Equipment Fuel

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

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

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

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

On page 15 of the Integrated Plan, the licensee stated that existing severe accident management or AOPs will be revised or new procedures developed to reflect strategies for replenishing fuel supplies for portable equipment.

On page 34 of the Integrated Plan, the licensee stated that actual timing of refueling will vary with timing of use of portable equipment and how heavily loaded but based on typical consumption rates of portable equipment.

On page 37 of the Integrated Plan, the licensee listed two Fuel Oil Transfer Pumps as being available for Phase 2, and that the pumps were sized to refuel portable equipment.

On page 51 of the Integrated Plan, the licensee stated that Implementation of DAEC Action Item 27 is to establish methods to re-fuel portable equipment.

The Integrated Plan did not discuss: fuel needs for portable pumps; how the fuel oil needs were assessed in the plant-specific analysis to ensure sufficient quantities are available; and delivery capabilities. During the audit process, the licensee stated that no fuel is required for Phase 1. In Phase 2 portable equipment has integral fuel tanks that provide several hours of capacity, depending on use. Greater than 35,000 gallons of fuel oil is stored onsite in safety related and protected tanks. Approximately 40,000 gallons of additional fuel oil storage is available on site in non-safety related fuel storage. On site fuel will be used until off site sources are available. The RRC includes provisions for refueling portable equipment. The licensee's response did not describe the refueling strategy for FLEX equipment and discuss fuel oil needs that have been assessed in a plant-specific analysis. The response did not address delivery capabilities, including an indefinite coping period. The response did not explain how fuel quality will be assured, if stored for extended periods (including in the fuel tanks of Phase 2 equipment). This item is identified as Confirmatory Item 3.2.4.9.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 13 of the Integrated Plan, the licensee stated that enhanced battery load shedding guidance will be incorporated into station procedures for loss of ac power to extend the availability of dc power.

On page 33 of the Integrated Plan, in Attachment 1A, the licensee stated that scoping studies indicate it is possible to extend availability of station batteries to approximately 8 hours if load shedding is performed at approximately 2 hours. Final load shedding analysis, revision to procedures, and validation of time constraint will be performed.

On page 40 of the Integrated Plan, in Attachment 5, the licensee stated that a detailed review of battery capacity and potential enhancements to load shedding strategies will be performed as part of FLEX implementation.

On page 50 of the Integrated Plan, in Attachment 12, the licensee stated that it will perform analysis of final load shedding strategy for essential station batteries and implement plant procedures.

The Integrated Plan did not provide the following:

1) The dc load profile for the mitigation strategies to maintain core cooling, containment, and spent fuel pool cooling during all modes of operation.

   (a) did not describe any load shedding that is assumed to occur and the actions necessary to complete each load shed.
   (b) did not 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 necessary and the time to complete each action.
   (c) did not explain which safety functions are lost as a result of shedding each load and discuss any impact on defense-in-depth strategies and redundancy.

2) Any plant components that will change state if vital ac or dc power is lost or de-energized during the load shed. Of particular interest is whether a safety hazard is introduced, such as de-energizing the dc-powered seal oil pump for the main generator and allowing hydrogen to escape, which could contribute to risk of fire or explosion in the vicinity from the uncooled main turbine bearings.

3) Identification of dc breakers that must be opened as a part of the load shed evolution.

4) A discussion whether DAEC intends to rely on a single train of batteries until one battery is depleted and then intends to switch to the other.

5) The minimum dc voltage required to ensure proper operation of all required electrical equipment following an ELAP, and the basis for the minimum voltage on each battery/dc bus during each phase under all modes of operation.

During the audit process, the licensee stated that the evaluation of the resultant effects of the extended load shedding has not been completed (as of December 2013) and is identified as DAEC Action Item 15. This is identified as Confirmatory Item 3.2.4.10.A in Section 4.2.

The licensee stated that the minimum voltage required to ensure proper operation of required electrical equipment will be the same as existing design calculations for all modes of operation. The licensee stated that existing procedure for SBO provides specific guidance for operators to vent generator hydrogen prior to load shedding hydrogen seal oil pumps. The licensee stated that dc loads selected for load shedding are loads that do not affect the primary FLEX strategies, do not affect critical instruments, do not hamper restoration of ac power, and do not complicate operator actions.

During the audit process, the licensee stated that existing labeling is considered by the licensee to be adequate to allow operators to identify the appropriate breakers. In addition, the licensee stated that the panels where load shedding will occur are located in the control building and are readily accessible to operators. The decision to load shed will be based on the potential duration of the loss of ac power event, and will not be based on specific instruments. Emergency lighting is not a load that is stripped in the extended load shedding.

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 load reduction to conserve dc power, if these requirements are implemented as described.

3.3 PROGRAMMATIC CONTROLS

3.3.1 Equipment Maintenance and Testing.

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

> In order to assure reliability and availability of the FLEX equipment required to meet these capabilities, the site should have sufficient equipment to address all functions at all units on-site, plus one additional spare, i.e., an N+1 capability, where "N" is the number of units on-site. Thus, a two-unit site would nominally have at least three portable pumps, three sets of portable ac/dc power supplies, three sets of hoses & cables, etc. It is also acceptable to have a single resource that is sized to support the required functions for multiple units at a site (e.g., a single pump capable of all water supply functions for a dual unit site). In this case, the N+1 could simply involve a second pump of equivalent capability. In addition, it is also acceptable to have multiple strategies to accomplish a function

(e.g., two separate means to repower instrumentation). In this case the equipment associated with each strategy does not require N+1. The existing 50.54(hh)(2) pump and supplies can be counted toward the N+1, provided it meets the functional and storage requirements outlined in this guide. The N+1 capability applies to the portable FLEX equipment described in Tables 3-1 and 3-2 (i.e., that equipment that directly supports maintenance of the key safety functions). Other FLEX support equipment only requires an N capability.

NEI 12-06, Section 11.5 states:

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

2. Portable equipment that directly performs a FLEX mitigation strategy for the core, containment, or SFP should be subject to maintenance and testing[1] guidance provided in INPO AP 913, Equipment Reliability Process, to verify proper function. The maintenance program should ensure that the FLEX equipment reliability is being achieved. Standard industry templates (e.g., EPRI) and associated bases will be developed to define specific maintenance and testing including the following:

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

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

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

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

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

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

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[1] Testing includes surveillances, inspections, etc.

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. The NRC staff will evaluate the resulting program through the audit and inspection processes.

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

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

3.3.2 Configuration Control.

NEI 12-06, Section 11.8 provides that:

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

FLEX equipment.

2. Existing plant configuration control procedures will be modified to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.
3. Changes to FLEX strategies may be made without prior NRC approval provided:
   a) The revised FLEX strategy meets the requirements of this guideline.
   b) An engineering basis is documented that ensures that the change in FLEX strategy continues to ensure the key safety functions (core and SFP cooling, containment integrity) are met.

On pages 10 and 11 of the Integrated Plan, the licensee stated that it will implement a FLEX program containing the necessary administrative procedures to control the FLEX equipment's physical protection, storage, deployment, and quality. The procedure will identify ownership and responsibility, including but not limited to, configuration control, maintenance and testing. FLEX equipment will be procured as commercial grade equipment, but with augmented quality requirements. Design requirements for FLEX equipment will be documented and controlled via the existing plant modification process.

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

3.3.3 Training

NEI 12-06, Section 11.6 provides that:

1. Programs and controls should be established to assure personnel proficiency in the mitigation of beyond-design-basis events is developed and maintained. These programs and controls should be implemented in accordance with an accepted training process.[2]

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

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.

[2] The Systematic Approach to Training (SAT) is recommended.
[3] Emergency response leaders are those utility emergency roles, as defined by the Emergency Plan, for managing emergency response to design basis and beyond-design-basis plant emergencies.

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 11 of the Integrated Plan, the licensee stated that a Systematic Approach to Training (SAT) will be used to evaluate training requirements for station personnel based upon changes to plant equipment, implementation of FLEX portable equipment, and new or revised procedures that result from implementation of the FLEX strategies. Training modules for personnel that will be responsible for implementing the FLEX strategies, and Emergency Response Operation (ERO) personnel will be developed to ensure personnel proficiency in the mitigation of BDBEEs. The training will be implemented and maintained per existing DAEC training programs. The details, objectives, frequency, and success measures will follow the plant's SAT process. The licensee stated that FLEX training will ensure that personnel assigned to direct the execution of mitigation strategies for BDBEEs will achieve the requisite familiarity with the associated tasks, considering available job aids, instructions, and mitigating strategy time constraints.

The Integrated Plan did not discuss considerations 1 through 5 from NEI 12-06, Section 11.6. During the audit process, the licensee stated that application of the SAT will ensure FLEX training is consistent with NEI 12-06, Section 11.6, Guidelines 1 through 5.

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 11 and 12 of the Integrated Plan, the licensee stated 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. Communications will be established between the affected nuclear site and the SAFER team, and required equipment will be moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook are planned to be delivered to the site within 24 hours from the initial request. A contract has been issued to the administrator of SAFER for DAEC participation.

The Integrated Plan did not discuss how NEI 12-06, Section 12.2, considerations 2 through 10 will be met. This has been identified as Confirmatory Item 3.4.A, in Section 4.2.

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

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

ITEM NUMBER	DESCRIPTION	NOTES
None		

4.2 CONFIRMATORY ITEMS

ITEM NUMBER	DESCRIPTION	NOTES
3.1.1.4.A	Off-Site Resources – Confirm RRC local staging area, evaluation of access routes, and method of transportation to the site.	

3.1.2.A	Confirm the actual flood hazard level for which reasonable protection and a means to deploy the portable equipment is to be provided.	
3.1.3.1.A	Confirm that the separation is sufficient dependent on the local tornado data and the actual separation distance and axis.	
3.2.1.1.A	MAAP: From the June 2013 position paper, benchmarks must be identified and discussed which demonstrate that MAAP4 is an appropriate code for the simulation of an ELAP event at the licensee's facility.	
3.2.1.1.B	MAAP: The collapsed RPV level must remain above Top of Active Fuel (TAF) and the cool down rate must be within technical specification limits.	
3.2.1.1.C	MAAP4 must be used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper.	
3.2.1.1.D	In using MAAP4, the licensee must identify and justify the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236). This should include response at a plant-specific level regarding specific modeling options and parameter choices for key models that would be expected to substantially affect the ELAP analysis performed for that licensee's plant. Although some suggested key phenomena are identified below, other parameters considered important in the simulation of the ELAP event by the vendor / licensee should also be included. a. Nodalization b. General two-phase flow modeling c. Modeling of heat transfer and losses d. Choked flow e. Vent line pressure losses f. Decay heat (fission products / actinides / etc.)	
3.2.1.1.E	The specific MAAP4 analysis case that was used to validate the timing of mitigation strategies in the Integrated Plan must be identified and should be available on the ePortal for NRC staff to view. Alternately, a comparable level of information may be included in the supplemental response. In either case, the analysis should include a plot of the collapsed vessel level to confirm that TAF is not reached (the elevation of the TAF should be provided) and a plot of the temperature cool down to confirm that the cool down is within technical specifications limits.	
3.2.1.3.A	Confirm that acceptable technical justification is provided that demonstrates why extended availability of steam-driven core cooling systems is acceptable and discuss its applicability to DAEC.	

3.2.1.3.B	Confirm when load shedding will begin and whether there will be a separate load shedding procedure each for an SBO and for an ELAP event.	
3.2.1.8.A	Confirm that sizing the two diesel-driven pumps that in accordance with 10 CFR 50.54(hh)(2) requirements will bound the needs for the strategies implemented pursuant to EA-12-049.	
3.2.3.A	Confirm that the DAEC implementation of BWROG EPG/SAG, Revision 3, including any associated plant-specific evaluations, is completed in accordance with the provisions of the NRC endorsement letter dated January 9, 2014. Review containment response after licensee implementation of BWROG EAG/SAG Revision 3 and in association with containment vent modifications.	
3.2.4.2.A	Confirm completion of DAEC Action Item 24 to review and update analyses of room heat-up for equipment cooling during an ELAP event.	
3.2.4.2.B	Confirm whether other equipment in the reactor building would be needed for ELAP mitigation (e.g., during Phases 2 or 3) that might be negatively affected by the steam environment caused by SFP boiling.	
3.2.4.4.A	Confirmation that upgrades to the site's communications systems have been completed.	
3.2.4.6.A	Confirm that DAEC's plan addresses accessibility of all areas requiring personnel access in sufficient detail to determine if the environmental conditions support the needed operator actions. Only the control room, refuel floor, and RCIC room were addressed.	
3.2.4.7.A	Confirm that the potential effects of using river water containing suspended solids for reactor/SFP cooling and the potential clogging of fuel channels are addressed.	
3.2.4.9.A	Confirm a refueling strategy for FLEX equipment has been assessed in a plant-specific analysis. The confirmation should include delivery capabilities, including for an indefinite coping period, and how fuel quality will be assured, if stored for extended periods, (including in the fuel tanks of Phase 2 equipment).	
3.2.4.10.A	Confirm that the DAEC evaluation of the resultant effects of the extended load shedding have ben completed (DAEC Open Action Item 15). This needs to be available for review.	
3.4.A	Confirm that the licensee's plan meets NEI 12-06, Section 12.2, considerations 2 through 10 will be met.	

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

Sincerely,

/RA/

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

Docket No. 50-331

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

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