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 2

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FirstEnergy Nuclear Operating Company
Davis-Besse Nuclear Power Station
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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

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

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

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

Additionally, for the purpose of this evaluation and the NRC staff's interim staff evaluation (ISE), licensee statements, commitments, and references to existing programs that are subject to routine NRC oversight (Updated Final Safety Analysis Report [UFSAR] program, procedure program, quality assurance program, modification configuration control program, etc.) will generally be accepted. For example, references to existing UFSAR information that supports the licensee's overall mitigating strategies plan, will be assumed to be correct, unless there is a specific reason to question its accuracy. Likewise, if a licensee states that they will generate a procedure to implement a specific 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 27, 2013 (ADAMS Accession No. ML13064A243), and as supplemented by the first six-month status report in letter dated August 26, 2013 (ADAMS Accession No. ML13238A260), FirstEnergy Operating Company, (the licensee or FENOC) provided Davis-Besse Nuclear Power Station's (Davis-Besse or DBNPS) Integrated Plan for compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by FENOC for the maintenance or restoration of core cooling, Containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the NRC staff in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the Order.

3.1 EVALUATION OF EXTERNAL HAZARDS

Sections 4 through 9 of NEI 12-06 provide the NRC-endorsed methodology for the determination of applicable extreme external hazards in order to identify potential complicating factors for the protection and deployment of equipment needed for mitigation of beyond-design-basis external events leading to an extended loss of all alternating current (ac) power 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 pages 3 and 4 of the Integrated Plan, the licensee stated that there are two design earthquakes that are identified for DBNPS: the Maximum Possible Earthquake and the Maximum Probable Earthquake. The Maximum Possible Earthquake (larger) produces a vibratory ground motion for which structures, systems, and components important to safety are designed to remain functional. The Maximum Probable Earthquake (smaller) produces the vibratory ground motions used in the design of structures and equipment whose failure would not result in the release of significant radioactivity and would not prevent reactor shutdown. The reviewer noted that the larger of the two design earthquakes, the Maximum Possible Earthquake, corresponds to the larger of the two typical earthquake nomenclatures, the Safe Shutdown Earthquake (SSE), which is used in NEI 12-06 as the earthquake hazard.

On page 7 of the Integrated Plan, 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 this submittal. The licensee stated that as the re-evaluations are completed, the appropriate issues will be entered into the corrective action system.

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 page 4 of the Integrated Plan, the licensee stated that the credited FLEX equipment needs to be assessed based on the current seismic licensing basis to ensure that the equipment remains accessible and available after a BDBEE and that the FLEX equipment does not become a target or source of a seismic interaction from other systems, structures or components. The licensee stated this assessment needs to include documentation ensuring that any storage location meets the FLEX criteria.

On page 9 of the Integrated Plan, the licensee stated that specific locations for the storage buildings will be identified during the detailed design development and will be provided in the six-month updates of the Integrated Plan.

On page 23, 40, 62, and 74 of the Integrated Plan, regarding storage/protection of portable equipment for maintaining RCS core cooling and heat removal, maintaining RCS inventory control, maintaining SFP cooling, and safety function support, respectively, the licensee stated the preferred and alternate storage structures will be designed or evaluated equivalent to American Society of Civil Engineers (ASCE) 7-10, "Minimum Design Loads for Buildings and Other Structures." Large portable FLEX equipment will be secured as appropriate during an SSE and will be protected from seismic interactions from other components. No components will be stacked or at a raised elevation as to cause interference with the deployment of any of the FLEX equipment.

On page 50 and 51 of the Integrated Plan, regarding storage/protection of equipment for maintaining containment, the licensee provided that the FLEX 480v service water (SW) pump will be staged in place at the intake structure and the FLEX diesel-driven SW pump will be stored in a FLEX storage location. This structure will be designed or evaluated equivalent to ASCE 7-10 and will be protected from a seismic event. During the audit process the licensee indicated that both of the SW pumps would be trailer-mounted and diesel-driven and that storage and deployment plans were still in development. The NRC understands that the licensee still plans to comply with the provisions of NEI 12-06 regarding storage and deployment of these pumps. Once those plans are developed they will need to be evaluated against the provisions of NEI 12-06. This is identified as Confirmatory Item 3.1.1.1.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 from a 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.

The licensee provided conceptual sketches in the Integrated Plan depicting the deployment paths from the storage location to the staging location for pumps and generators, and routing paths from the staging location to the point of connection to existing plant equipment for hoses and cables.

On page 25 of the Integrated Plan, the licensee stated that the deployment strategies will utilize the roadway that travels the perimeter of the plant inside the Protected Area (PA). Equipment deployed from outside the PA will access the PA via the normal west plant access entrance. DBNPS currently has procedures in place for moving equipment in and out of the PA during station blackout conditions and these procedures will be incorporated into the FLEX deployment strategies. Soil liquefaction along the perimeter of the path inside the PA at is not a concern.

On page 25 of the Integrated Plan, the licensee stated that all major FLEX equipment not already staged in place will be trailer mounted or on wheels for ease of deployment. The licensee stated this will give tow vehicles the capability to move all major FLEX equipment and that most of these vehicles may be used for both the movement of FLEX equipment and debris removal. The licensee also stated that because of the large size of the roadway and the geography of the site, it is likely that deployment vehicles will be able to move around any debris. However, FENOC has purchased debris removal equipment, which will be stored onsite in the FLEX storage locations.

In the various sections of the Integrated Plan regarding protection of connections, the licensee described that at least one, and in most case all connection points are protected from all external hazards. However, the licensee's Integrated Plan did not address whether the access routes that plant operators will have to access to deploy and control the strategy will only require access through seismically robust structures. This is identified as Confirmatory Item 3.1.1.2.A in Section 4.2

The Integrated Plan did not address whether power will be required to open the FLEX storage building doors or if the doors will be equipped with manual overrides to permit manual door opening. This is identified as Confirmatory Item 3.1.1.2.B in Section 4.2.

The plant is located on the shore of Lake Erie and thus the failure of a downstream dam is not a hazard for DBNPS.

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

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

> There are four procedural interface considerations that should be addressed.
>
> 1. Seismic studies have shown that even seismically qualified electrical equipment can be affected by 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.

On multiple pages in the Integrated Plan, the licensee stated it will develop procedures to read instrumentation locally, where applicable, using a portable instrument.

During the audit, the licensee was requested to provide a discussion of consideration 1 regarding obtaining local instrument readings.

In response, the licensee stated that operating procedure OP-02521, “Loss of AC Bus Power Sources” provides parameters available to operators in the control room (CR). Other than SFP level and temperature, all key parameters are seismically qualified and are available in the CR. The new seismically qualified SFP self-contained SFP level indicators will be added to OP-02521 once they are installed in the plant. As a result, non-CR readouts are not required. Since the installed plant instruments powered from station batteries will be available for greater than 24 hours, there are no critical actions that need to be performed until alternate indications can be connected (measured). While instrumentation providing SG level will remain available to CR operators, implementing load shed will disable the automatic control of SG level, but procedures exist that provide two methods of local control of the turbine-driven auxiliary feedwater (TDAFW) pump to control SG level. The reviewer noted that this discussion only addresses the potential for loss of electrical power to the instrumentation and omits the potential for damage to the instrumentation itself, which is the subject of consideration 1. The licensee’s statements that it will develop procedures to read instrumentation locally, where applicable, using a portable instrument partially addresses this aspect of consideration 1, but does not include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power, which is the remainder of that portion of the guidance. The need for guidance on critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power is identified as Confirmatory Item 3.1.1.3.A in Section 4.2.

During the audit, the licensee was requested to address consideration 2 regarding the impact from large internal flooding sources that are not seismically robust and do not require ac power.

In response, the licensee stated that review of USAR Section 3.6.2.7, Protection Against Environmental Effects Outside the Containment Vessel, determined that internal floods will not disable both a primary and alternate FLEX mitigation strategy.

During the audit, the licensee was requested to address consideration 3 regarding the need to address mitigating ground water intrusion in critical locations. In response, the licensee determined during walkdowns that ground water intrusion is residual or relatively minor. The licensee concluded that given the location of equipment, dewatering due to ground water intrusion can be suspended for several hours pending restoration of ac power without any adverse effect. Installation of the FLEX Phase 2 480 Vac diesel generator (DG) will restore power to sump pumps. Emergency core cooling system (ECCS) and containment normal sump pumps are powered by essential buses and the pumps are located in seismic category 1 structures. The licensee stated a temporary dewatering pump will be included in the FLEX equipment.

As previously stated, the site is not at risk for the failure of a downstream dam due to its location on the shore of Lake Erie.

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

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

On page 16 of the Integrated Plan, the licensee stated the industry will establish two Regional Response Centers (RRCs) to support utilities during BDB events. Equipment will be moved from an RRC to a local assembly staging 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), will be delivered to the site within 24 hours from the initial request. This 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 page 4 of the Integrated Plan in the section on determining extreme external events, the licensee stated the calculated probable maximum flood (PMF) level is 583.7 feet. All on-grade station floors are at elevation 585 feet. The AB and containment vessel have no access openings below ground floor elevation 585.0 feet. Consequently, the licensee concludes that a PMF level of 583.7 feet does not have adverse effects on these structures. The structures are protected from water intrusion by a complete waterproof envelope below Elevation 583.6 feet. However, DBNPS relies on permanently installed barriers and watertight doors to keep a water level due to wave run up of 590.5 feet from affecting safe shutdown equipment. Therefore, per NEI 12-06, DBNPS is not a "dry" site and screens in for external flood hazard.

On page 7 of the Integrated Plan regarding site assumptions specific to the DBNPS site, the licensee stated that flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, are not completed and therefore not assumed in this submittal. As the re-evaluations are completed, the licensee stated appropriate issues will be entered into the corrective action system.

The reviewer noted that the licensee has screened in for susceptibility to the external flood hazard, but has not characterized the applicable external flooding threat. The DBNPS UFSAR, Section 2.4.2.2.1 describes a maximum probable flood due to lake flooding based on the combination of a wind tide and lake water at its maximum high monthly mean level, but does not provide a discussion of the warning time available or the persistence of this flood. Identification of the warning time available and the persistence of the external flood hazard is needed to inform and evaluate the plant response actions for DBNPS and 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:
>
> a. 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 4 of the Integrated Plan, the licensee stated that FLEX Phase 1 and Phase 2 strategies are designed so that a set of FLEX equipment will be available despite a PMF event.

On pages 23 and 24, 40, 62, 74 and 75 of the Integrated Plan, in the section regarding protection of portable equipment for maintaining core cooling and heat removal, maintaining RCS inventory control, maintaining SFP level, and safety function support, respectively, the licensee stated the preferred and alternate storage locations for FLEX equipment will be sited above the PMF level. The licensee stated that diversity of the preferred and alternate storage buildings along with the considerable warning time associated with a flood as defined in NEI 12-06 will provide reasonable assurance that N sets of FLEX equipment will remain deployable should an extreme flooding event occur.

On page 51 of the Integrated Plan, in the section on maintaining containment, the licensee stated the FLEX 480v SW pump will be staged in place at the intake structure and will be protected from external flooding events. The FLEX diesel-driven SW pump will be stored in the preferred FLEX storage location and protected from a flood event. During the audit process the licensee indicated that both of the SW pumps would be trailer-mounted and diesel-driven and that storage and deployment plans were still in development. This is combined with Confirmatory Item 3.1.1.1.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 – 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 23 and 24 of the Integrated Plan, in regards to protection against flooding, the licensee stated that the preferred and alternate storage locations will be sited above the PMF level at Elevation 585'-0". However, the deployment route from the locations outside the PA could be adversely affected by flooding. The licensee further stated that diversity of the preferred and alternate storage buildings along with the considerable warning time associated with a flood as defined in NEI 12-06 will provide reasonable assurance that N sets of FLEX equipment will remain deployable following a flood event. The reviewer doesn't agree that diversity of the storage buildings would necessarily provide assurance that N sets of FLEX equipment would be deployable following a flooding event because, as stated, the deployment route could be adversely affected by flooding. However, a flooding event with considerable warning time would provide the licensee the opportunity to deploy the FLEX equipment prior to the deployment route being impacted by flooding. Further, during the audit, the licensee indicated that the flood re-analysis is in progress. Once completed, the results will be used as input to the FLEX deployment strategy. The status of the updating of the deployment strategy will be communicated in a six-month update. This is identified as Confirmatory Item 3.1.2.2.A in Section 4.2.

During the audit, the licensee was requested to address protection of fuel storage tanks that could be inundated by the flood or above ground tanks that could be damaged by the flood. In response, the licensee stated that the fuel oil storage tanks are located above grade level and are outside. The licensee stated that all piping enters the diesel storage tanks through the top.

In the various section of the Integrated Plan discussing protection of connections for FLEX equipment for maintaining core cooling and heat removal, maintaining RCS inventory control, maintaining containment, maintaining SFP cooling, and safety function support, respectively, the licensee stated that all connections are protected against an external flooding event.

During the audit, the licensee was requested to address whether the site is "limited by storm-driven flooding" per consideration 6. In response the licensee stated that DBNPS is affected by storm-driven flooding. The flooding reanalysis being completed for the 10 CFR 50.54(f) letter will determine new flood levels. Flooding mitigation strategies and the effect of flooding on FLEX equipment deployment will have to be re-examined. The licensee stated that any consideration or new construction (e.g., Storage and Emergency Feedwater Buildings) will include flooding re-evaluation results. This area will be updated in a future six-month update.

During the audit, the licensee was requested to address dewatering needs due to an ELAP per consideration 7. In response, the licensee stated the site walkdowns determined that ground water intrusion is residual or relatively minor. The licensee concluded that given the location of equipment, dewatering due to ground water intrusion can be suspended for several hours pending restoration of ac power without any adverse effect. Operation of the FLEX Phase 2 480v DG will restore power to sump pumps. A temporary dewatering pump will be included in the FLEX equipment.

As previously stated, structures are protected from water intrusion by a complete waterproof envelope below elevation 583.6 feet. The licensee further stated that DBNPS relies on permanently installed barriers and watertight doors to keep a water level due to wave run up of 590.5 feet from affecting safe shutdown equipment.

On page 25 of the Integrated Plan, the licensee stated that all major FLEX equipment not already staged in place will be trailer mounted or on wheels for ease of deployment. The licensee stated this will give tow vehicles the capability to move all major FLEX equipment and that most of these vehicles may be used for both the movement of FLEX equipment and debris removal. The licensee also stated that because of the large size of the roadway and the geography of the site, it is likely that deployment vehicles will be able to move around any debris. However, FENOC has purchased debris removal equipment, which will be stored onsite in the FLEX storage locations.

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

3.1.2.3 Procedural Interfaces – Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

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

On pages 14 and 15 of the Integrated Plan, the licensee stated that procedures and guidance to support deployment and FLEX strategy implementation, including interfaces with emergency operating procedures (EOPs), special events procedures, abnormal operating procedures (AOPs) , and system operating procedures, will be coordinated within the site procedural framework. The procedural documentation will be auditable, consistent with generally accepted engineering principles and practices, and controlled within the DBNPS document control system.

In particular, the licensee stated it is a participant in the PWROG project PA-PSC-0965 and will develop the FSGs in a timeline to support the implementation of FLEX by the spring of 2016.

FENOC will update procedures based on the FSGs. NSSS-specific guidelines are currently being developed by the PWROG and FENOC will follow those guidelines.

In the various section of the Integrated Plan discussing protection of connections for FLEX equipment for maintaining core cooling and heat removal, maintaining RCS inventory control, maintaining containment, maintaining SFP cooling, and safety function support, respectively, the licensee stated that all connections are protected against an external flooding event.

On page 4 of the Integrated Plan, the licensee stated that structures are protected from water intrusion by a complete waterproof envelope below elevation 583.6 feet. The licensee further stated that DBNPS relies on permanently installed barriers and watertight doors to keep a water level due to wave run up of 590.5 feet from affecting safe shutdown 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 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 page 4 in the section of the Integrated Plan on determining extreme external events, the licensee stated FENOC is developing strategies for delivery of offsite FLEX equipment during Phase 3 which considers regional effects from flooding.

On page 16 of the Integrated Plan regarding the regional response plan, the licensee stated the industry will establish two RRCs to support utilities during BDB events. Equipment will be moved from an RRC to a local assembly staging 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, will be delivered to the site within 24 hours from the initial request. This 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 was 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.

High wind event guidelines are to be treated in four primary areas: protection of portable equipment, deployment of portable equipment, procedural interfaces, and considerations in using off-site resources. These areas are discussed further in Sections 3.1.3.1 through 3.1.3.4, below.

On page 4 of the Integrated Plan, the licensee stated that Figures 7-1 and 7-2 from the NEI 12-06 were used for high wind assessment. Figure 7-1 indicates that the high wind speed from a hurricane does not exceed 130 mph; therefore, DBNPS screens out for hurricane winds. Figure 7-2 indicates a maximum tornado wind speed of 200 mph; therefore DBNPS screens in for the potential to experience damaging tornado winds.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to screening for severe storms with 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 pages 24, 40, 62 and 75 of the Integrated Plan, in the sections on maintaining core cooling and heat removal, maintaining RCS inventory control, maintaining SFP cooling, and safety support function, respectively, the licensee stated the preferred and alternate storage buildings for FLEX equipment will be sufficiently robust to withstand high wind loads using the site tornado conditions and the requirements of ASCE 7-10. The buildings will not be protected from design basis high wind missiles. However, the diverse locations of the preferred and alternate storage buildings will provide reasonable assurance that N sets of FLEX equipment will remain deployable following the high wind event. Confirmation that the chosen storage locations are sufficiently separated in distance and axially from the typical tornado path as compared to the local tornado data for tornado width is identified as Confirmatory Item 3.1.3.1.A in Section 4.2.

On page 51 of the Integrated Plan in the section on maintaining containment, the licensee stated that the FLEX 480v pump will be staged in place at the intake structure and protected from high wind events and tornado induced missiles. The FLEX diesel driven pump will be stored in a FLEX storage location, which will be sufficiently robust to withstand high wind loads using the site tornado conditions and the requirements of ASCE 7-10. The building will not be protected from high wind missiles. During the audit process the licensee indicated that both of the SW pumps would be trailer-mounted and diesel-driven and that storage and deployment plans were still in development. This is combined with Confirmatory Item 3.1.1.1.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 Items, 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.

DBNPS screens out for hurricane winds, thus considerations 1,2 and 5 are not applicable.

On page 25 of the Integrated Plan, the licensee stated that all major FLEX equipment not already staged in place will be trailer mounted or on wheels for ease of deployment. The licensee stated this will give tow vehicles the capability to move all major FLEX equipment and that most of these vehicles may be used for both the movement of FLEX equipment and debris removal. The licensee also stated that because of the large size of the roadway and the geography of the site, it is likely that deployment vehicles will be able to move around any debris. However, FENOC has purchased debris removal equipment, which will be stored onsite in the FLEX storage locations.

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 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 licensee was requested to address procedural interfaces for high wind events. In response, the licensee stated that procedure RA-EP-02810, "Tornado or High Winds," describes the actions to be taken when weather conditions favor the formation of tornadoes, thunderstorms, and during periods of high winds. This procedure will be revised, as necessary, to implement the FLEX strategies.

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

Offsite delivery will be evaluated when the DBNPS playbook is complete. This 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. All sites located north of the 35^{th} Parallel should provide the capability to address extreme snowfall with snow removal equipment. Finally, all sites except for those within Level 1 and 2 of the maximum ice storm severity map contained in Figure 8-2 should address the impact of ice storms.

On pages 4 and 5 of the Integrated Plan, the licensee stated that DBNPS is above the 35th parallel (41° 35' 49" N); therefore, the FLEX strategies must consider the impedances caused by extreme snowfall with snow removal equipment, as well as the challenges that extreme cold temperatures may present. DBNPS is in a Level 3 region as defined by Figure 8-2 of NEI 12-06; therefore, the FLEX strategies must consider the impedances caused by ice storms.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to screening for snow, ice and extreme cold, 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 pages 24, 40, 62, and 74 of the Integrated Plan regarding storage/protection of portable equipment for maintaining RCS core cooling and heat removal, maintaining RCS inventory control, maintaining SFP cooling and safety function support, the licensee stated the FLEX storage buildings will be designed with adequate heating to ensure that extreme cold temperatures do not affect the functionality of the stored FLEX equipment. Procedures will be developed to clear ice and snow from the area around the storage building and the deployment paths.

On page 51 of the Integrated Plan regarding storage/protection of portable equipment for maintaining containment, the licensee stated that the intake structure and the FLEX storage buildings will be adequately heated to ensure that extreme cold temperatures do not affect the functionality of the stored FLEX equipment. Procedures will be developed to clear ice and snow from the area around the storage building and the deployment paths.

The licensee stated that FLEX equipment will be housed in a building constructed to ASCE 7-10 standards for snow, ice and cold conditions from the DBNPS design basis.
.
The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect protection of 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.

On page 4 of the Integrated Plan the licensee stated that the equipment procured will be suitable for considering conditions caused by ice, snow and extreme cold temperatures.

On page 14 of the Integrated Plan, the licensee stated that equipment associated with these strategies will be procured as commercial equipment with design in accordance with Section 11 of NEI 12-06.

On page 25 of the Integrated Plan, the licensee stated that maintenance activities keep the station roadways clear of ice throughout the winter season.

The Integrated Plan did not address specific snow removal equipment. During the audit, the licensee stated that dedicated snow removal equipment is being purchased to support the relocation of FLEX equipment and the purchasing specifications for the dedicated equipment will ensure that the equipment will be stored and function under extreme cold conditions.

During the audit, the licensee was requested to discuss frazil ice buildup on the UHS. In response the licensee stated that frazil ice might affect access to the UHS. The licensee is evaluating a portable pump with booster pumps to be placed in the UHS, which must be compatible with frazil ice formation. In addition, the licensee stated that OP-06913, "Seasonal Plant Preparation Checklist," provides guidance for addressing frazil ice conditions.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 was requested to address procedural interfaces with respect to the effects of snow, ice or extreme cold conditions on the transportation of the FLEX equipment.

In response the licensee stated that two site procedures, DB-OP-06913 and RA-EP-02870, provide for actions to be taken for snow, ice and extreme cold conditions. The licensee stated that these procedures will be revised, as necessary, to implement the FLEX strategies.

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

Offsite delivery of Phase 3 equipment will be evaluated when the DBNPS playbook is complete. This 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 Open 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 5 of the Integrated Plan, the licensee stated based on the available local data DBNPS does not experience extreme high temperatures. However, per NEI 12-06, all sites will address high temperatures. Therefore, for selection of FLEX equipment, FENOC will consider the site maximum expected temperatures in their specification, storage, and deployment requirements, including ensuring adequate ventilation and 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 screening for high temperature hazard, if these requirements are implemented as described.

3.1.5.1 Protection of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

On pages 24 40, 62, and 75 of the Integrated Plan, in the section on storage/protection of FLEX equipment for maintaining core cooling and heat removal, maintaining RCS inventory control, maintaining SFP cooling, and safety function support, respectively, the licensee stated the FLEX storage buildings will include adequate ventilation to ensure that high temperatures do not affect the functionality of stored FLEX equipment.

On page 51 in the DBNPS Integrated Plan, in the section on maintaining Containment function, the licensee stated the Intake Structure and the FLEX storage buildings will include adequate ventilation to ensure that high temperatures do not affect the functionality of stored FLEX 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 from 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.

On page 5 in the section of its Integrated Plan, the licensee stated that when selecting FLEX equipment, they will consider the site maximum expected temperatures in the specification, storage, and deployment requirements, including ensuring adequate ventilation and cooling.

The licensee stated that based on the historic temperatures at the site, it is reasonable to assume that the dedicated tow vehicle will be able to move the FLEX equipment in a high temperature hazard.

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

On page 5 of the Integrated Plan, the licensee stated that when selecting FLEX equipment, it will consider the site maximum expected temperatures in the specification, storage, and deployment requirements, including ensuring adequate ventilation and 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 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, plant-specific analyses will determine the duration of each phase.

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

NEI 12-06, Table 3-2 and Appendix D summarize one acceptable approach for the reactor core cooling & heat removal, and RCS inventory control strategies. This approach uses the installed auxiliary feedwater (AFW)/ emergency feedwater (EFW) system to provide SG makeup sufficient to maintain or restore SG level in order to continue to provide core cooling for the initial phase. This approach relies on depressurization of the SGs for makeup to the RCS with a portable injection source in order to provide core cooling for transition and final phases. This approach accomplishes RCS inventory control and maintenance of long term subcriticality through the use of low-leakage reactor coolant pump (RCP) seals and/or borated high pressure RCS makeup with a letdown path.

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

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

06, Section 1.3, as the purpose of FLEX; and 2) prevention of recriticality as discussed in Appendix D, Table D-1.

RCS Cooling Strategy

In the Integrated Plan, the licensee stated that core cooling is maintained by heat removal through the SGs using the atmospheric vent valves (AVVs), which are mounted on the steam outlet piping between each SG and its main steam isolation valve (MSIV). During a loss of ac power event, the AVVs fail closed but can be manually operated by the use of reach rods located in adjacent rooms. Existing plant procedures provide instructions for manually operating the AVVs.

The licensee also stated that if the CST is available, the installed TDAFW pumps will provide makeup to the SGs. If the CST is not available or once the inventory in the CST is depleted, operators will switch to SG makeup using a new installed diesel-powered EFW pump and a new emergency water storage tank (EWST). For Phase 2, the AVVs will continue to maintain heat removal from the SGs. To maintain a makeup source to the SGs, the licensee's Integrated Plan provides a primary and alternate makeup strategy for filling the EWST using a FLEX water transfer pump drawing from other qualified water sources. During Phase 2, the licensee's primary strategy for feeding the SGs is the capability to use a portable FLEX SG pump to supply makeup water to the SGs from the EWST. Use of the EFW pump or the SG FLEX pumps will continue to provide SG makeup until Phase 3 begins. At the beginning of Phase 3, operators will continue with the strategies for providing core cooling using the Phase 2 strategies. The licensee's Integrated Plan stated that a water purification unit from the RRC may support continued makeup to the EWST.

As Phase 3 continues, operators will gradually transition to the long-term core cooling strategy. This strategy involves cooling the core with one train of installed decay heat removal (DHR) equipment, one train of component cooling water (CCW) equipment, and using a large UHS pump provided by the RRC to supply water to the service water system (SWS) to cool one CCW heat exchanger to support heat removal via the DHR system.

RCS Inventory Control Strategy

On page 36 of the Integrated Plan, the licensee stated that RCS inventory control during Phase 1 is provided by isolation of the letdown and seal return lines and by the low-leakage RCP seals. Based on these assumptions, the licensee stated that the leakage from the RCS will be minimal and that strategies to provide makeup inventory to the RCS are not required during Phase 1.

On page 38 of the Integrated Plan, the licensee stated that the Phase 2 activities for RCS inventory control involve aligning an RCS FLEX charging pump to provide borated RCS makeup to support plant cooldown and to maintain subcriticality. The RCS inventory control strategy relies on protected borated water sources. The licensee was requested to discuss borated water sources during the audit. In response, the licensee stated that sufficient borated water inventory will be maintained in the clean water receiver tank (CWRT) and borated water storage tank (BWST) to allow cooling down to permit decay heat pump operation.

On page 44 of the Integrated Plan, the licensee stated that for Phase 3, reactor level and subcriticality is adequately maintained via the Phase 2 strategy; however, borated water sources may be limited to some extent, depending on the strategy selected for a protected source of borated water. Phase 3 deployment of a unit capable of generating borated water from the intake canal can further extend coping times with respect to RCS inventory management.

On page 94 of the Integrated Plan, the licensee indicated that RCS cooldown begins at hour 8. Section 5.3.3 of WCAP-17601-P, “Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs,“ describes the RCS cooldown as beginning as early as two hours after the event, as described in the optimal case from the generic Babcock and Wilcox (B&W) analysis. During the audit, the licensee was requested to discuss the delay in starting cooldown until 8 hours into the event.

In response, the licensee stated that a proprietary draft technical report, WCAP-17792-P, “Emergency Procedure Development Strategies for Extended Loss of AC Power Event for all Domestic Pressurized Water Reactor Designs,” evaluated plant performance during an ELAP and determined that the RCS inventory will be sufficient to maintain coolant level in the pressurizer until RCS inventory replenishment occurs. Core cooling will begin with initiation of EFW flow shortly after the ELAP event begins. Until RCS charging capability is established, the core cooling (via the EFW system and AVVs) will be controlled to maintain a stable RCS temperature. The licensee determined that it will delay cooldown in order to establish 480 Vac power for instrumentation, pressurizer heater operation, and the establishment of RCS inventory injection and boration capability. The licensee stated that testing of the type of RCP seals used at DBNPS provides confidence that the assumed seal leakage rate is conservative. The licensee stated that a test has demonstrated near zero leakage over an eight-hour duration with representative station blackout conditions (RCP seal leakage is evaluated further in Section 3.2.1.2 of this report).

During the audit, the licensee was requested to discuss asymmetric cooldown. In response, the licensee stated that asymmetric cooldown remains under review. The licensee considered an asymmetric cooldown preferable if RCS makeup capability cannot be established. However, the licensee’s discussions with AREVA indicate that a symmetrical cooldown is preferred. AREVA has not provided formal resolution of this issue. The licensee stated that a final analysis and resolution will be communicated in a 6-month update. The need for the licensee to finalize its cooldown strategy is reflected in Open Item 3.2.1.1.B in the following section of this report. Additional interfacing issues associated with the implementation of an asymmetric cooldown strategy are noted in several additional confirmatory and open items in this report.

During the audit, the licensee was requested to discuss the actions necessary to prevent introduction of nitrogen from the core flood tanks (CFTs) into the RCS. In response, the licensee stated that the mitigation strategy is to establish boration capability via a FLEX RCS charging pump prior to plant cooldown. Since sufficient borated water inventory will be provided via the FLEX RCS charging pump to support boration and cooldown, the CFTs will be isolated prior to injection. Prior to cooldown, 480 Vac power via FLEX DGs will be established. The 480 Vac power will be used to monitor plant indications and provide for operation of the CFT isolation valves. The site is evaluating contingency plans to partially deploy a 480 Vac FLEX DG shortly after an ELAP event (i.e., approximately at one hour after an ELAP occurs). This deployment strategy would relax dc load stripping requirements and permit reallocation of the operators to other deployment activities (i.e., 480 Vac restoration for cooldown.) While this capability will be considered, the mitigation strategy continues to be based on the worst case (i.e., the current timeline for 480 Vac deployment). The licensee stated that the status of the mitigation strategy with respect to partial 480 Vac deployment will be communicated in future six-month updates.

During the audit, the licensee was requested either to provide (1) adequate basis that the capability of the pressurizer heaters can be restored under ELAP conditions or (2) a summary of thermal-hydraulic analysis demonstrating the effectiveness of a mitigating strategy that does not credit the operation of the pressurizer heaters. The licensee responded that Seismic Qualification User Group reviews have determined that the essential pressurizer heaters may be credited for safe shutdown. The licensee further stated that reviews associated with the Expedited Seismic Equipment List will determine if additional modifications are required to maintain pressurizer heater capabilities following the bounding seismic event as a part of the response to the seismic re-evaluation pursuant to the 10 CFR 50.54(f) request for information of March 12, 2012.

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

3.2.1.1 Computer Code Used for the ELAP Analysis

NEI 12-06, Section 1.3 states:

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

The licensee was requested to address the computer code used to evaluate the ELAP response. In response, the licensee stated that the evaluation of the ELAP response for Davis-Besse was performed using the RELAP5/MOD2-B&W code. The licensee stated that this computer code has been approved for use for loss of coolant accident (LOCA) analyses in topical report BAW-10192PA, “BWNT Loss of Coolant Accident Evaluation Model for Once-Through Steam Generator Plants,” Revision 0. The licensee considered the ELAP transient as essentially a small-break LOCA due the RCP seal leakage. The licensee considered ELAP conditions to fall within the approved range of applicability for use of this computer code, noting that RELAP5/MOD2-B&W has been approved in BAW-10192 for small break LOCA analysis. The licensee stated that draft technical report WCAP-17792-P provides generic analyses of a B&W reactor in an ELAP scenario, including consideration of the RCS makeup strategy and shutdown margin. The licensee stated that DBNPS has entered into discussions with AREVA to resolve differences in the implementation plan and the generic B&W analysis. Differences identified by the licensee include that SG makeup was accomplished in the analysis using installed TDAFW pumps rather than the EFW pump that Davis-Besse will credit in its mitigating strategies, and that initial SG feed for Davis-Besse will be to one SG rather than to two SGs as in the analysis (because the EFW pump at Davis-Besse is automatically aligned to SG 1). The licensee stated that the status of WCAP-17792-P and resolution of differences between the implementation plan and the generic analysis will be communicated in future six-month updates.

The licensee elected to use the RELAP5/MOD2-B&W computer code for simulating thermal-hydraulic behavior in the reactor coolant system during the ELAP event. The NRC staff did not fully concur with the licensee's assessment above regarding the applicability of the RELAP5/MOD2-B&W code to an ELAP event. Although the RELAP5/MOD2-B&W code has been reviewed and approved for performing LOCA and non-LOCA transient analysis, the NRC staff had not previously examined the technical adequacy of this code for simulating an ELAP event. In particular, the ELAP scenario is differentiated from typical design-basis small-break LOCA scenarios in several key respects, including the absence of normal ECCS injection and the substantially reduced leakage rate, which places significantly greater emphasis on the accurate prediction of primary-to-secondary heat transfer, natural circulation, and two-phase flow within the RCS. As a result of these differences, concern associated with the use of the RELAP5/MOD2-B&W code for ELAP analysis arose regarding the modeling of two-phase flow within the RCS and heat transfer across the steam generator tubes as single-phase natural circulation transitions to two-phase flow and boiler condenser cooling. Therefore, the need for the licensee to confirm that reliance on the RELAP5/MOD2-B&W code in the ELAP analysis for B&W plants is limited to the flow conditions prior to boiler-condenser cooling initiation is designated as Confirmatory Item 3.2.1.1.A in Section 4.2.

Furthermore, the licensee referenced generic analysis from a draft technical report, WCAP-17792-P, as the basis for demonstrating the efficacy of its mitigating strategy. The NRC staff had not previously reviewed this report, nor was it available to the NRC staff during the audit. Subsequent to this phase of the audit, the PWROG has provided WCAP-17792-P to the NRC for information only. The NRC staff further noted that the licensee had not yet identified an applicable reference case from WCAP-17792-P. For example, as previously observed in Section 3.2.1 of this report, the licensee had not determined whether the cooldown of the reactor coolant system would involve one or both steam generators. The selection of a cooldown strategy may affect a number of technical issues discussed in this report, from RCP seal temperatures to boric acid mixing. The NRC staff's review of the specific analyses credited by Davis-Besse is necessary to ensure that the licensee's mitigating strategy is acceptable. Therefore, the need for the licensee to (1) identify the specific analysis case(s) from WCAP-17792-P that are being referenced as the basis for demonstrating the acceptability of the mitigating strategies for Davis-Besse, and (2) provide justification that the analyses from WCAP-17792-P that are being credited for Davis-Besse are adequately representative of the actual plant design, FLEX equipment, and planned mitigating strategies is identified as Open Item 3.2.1.1.B in Section 4.1.

Regarding item (2) above, inasmuch as it is the only currently operating plant of its specific design, the staff expects that Davis-Besse should generally be well-represented by the generic B&W raised-loop analysis cases. However, this conclusion requires verification by the licensee; for example, the staff observed a minor discrepancy during the audit in that the assumed power level for the B&W raised-loop analysis cases in WCAP-17601-P did not reflect a 2008 measurement uncertainty power uprate for Davis-Besse.

During the audit, the licensee was requested to provide information concerning the degree of realism in the modeling of operator responses and actions to control processes associated with primary-to-secondary heat transfer, such as AVV and EFW flows and the interruption of flow during the transition from the EFW pump to the FLEX SG feed pump. This issue was of concern due to the consequential impact of primary-to-secondary heat transfer on the continuity of natural circulation within the RCS, as well as the observation that SG pressure would not be a monitored parameter during the ELAP. The licensee attempted to address the staff's question, but because the ELAP analysis for Davis-Besse was not available, the validity of the licensee's arguments could not be evaluated during the audit. Therefore, the need for the licensee to demonstrate the adequacy of the modeling of operator actions associated with primary-to-secondary heat transfer is identified as Confirmatory Item 3.2.1.1.C in Section 4.2.

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

3.2.1.2 RCP Seal Leakage Rates

NEI 12-06, Section 1.3 states:

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

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

Providing adequate justification for the assumed RCP seal leakage rates during an ELAP event was identified as a generic concern for PWRs by the NRC staff. This concern was partially addressed by the industry in the following submittals:

- WCAP-17601-P, Revision 1, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs" dated January 2013 (ADAMS Accession No. ML13042A011 and ML13042A013 (Non-Publicly Available)).
- A position paper dated August 16, 2013, entitled "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Reactor Coolant Pump (RCP) Seal Leakage in Support of the Pressurized Water Reactor Owners Group (PWROG)" (ADAMS Accession No. ML13235A151 (Non-Publicly Available)).

After reviewing these submittals, the NRC staff placed certain limitations on B&W-designed plants with respect to RCP seal leakage rates. Those limitations and their applicability are discussed below in light of design-specific information pertaining to Davis-Besse:

(1) B&W plants use a variety of RCPs, seals, and motors. Some plants rely on procedures to maintain RCS temperatures below the design temperatures of the limiting components (i.e., elastomers), and thus, keep RCP seal leakage low. For those plants,

information should be provided to justify that the procedures are effective at keeping the RCS temperatures within the limits of the seal design temperatures, and to address the adequacy of the seal leakage rate (2 gpm/seal) used in the ELAP analysis.

(2) Some plants have installed low-leakage seals to limit the initial maximum leakage rate to 2 gpm/seal in the ELAP analyses. For those plants, a discussion of the information (including seal leakage testing data) should be provided to justify the use of 2 gpm/seal in the ELAP analysis.

(3) If the seals are changed to a low-leakage seal design, the acceptability of the use of the new seal design should be addressed, and the RCP seal leakage rates for use in the ELAP analysis should be provided with acceptable justification.

(4) If Westinghouse RCPs are used with non-Westinghouse RCP seals, the acceptability of the use of the non-Westinghouse RCP seals in the Westinghouse RCPs should be addressed, and the RCP seal leakages rates for use in the ELAP analysis should be provided with acceptable justification.

During the audit, the licensee was requested to discuss the following: 1) the analysis used to determine the RCP seal initial maximum leakage rate, the adequacy of the analysis including computer code/methodology and assumptions used, supporting testing data applicable to the ELAP conditions, and the means for isolating the RCP seal return line, 2) the time required to isolate the seal return line, and the use of the isolation time in the ELAP analysis; and 3) calculation of pressure-dependent seal leakage rates during the ELAP, justification for the flow rate model used, and modeling of the seal leak area and whether it is varied during the analysis of the ELAP event.

The licensee indicated that WCAP-17792-P used a maximum RCS leakage rate of 9 gpm. The licensee stated that the RCS leakage rate assumed therein was based on AREVA Document 51-9205369-001 “B&W Plants Technical Basis for Extended Loss of AC Power Guidance,” which assumes a seal leakage rate of 2 gpm per RCP plus one gpm of operational leakage from the RCS. The licensee stated the basis for the leakage rate of 2 gpm per RCP is a test of the Byron-Jackson N-9000 (FlowServe) seal under station blackout conditions. The licensee indicated that this test was conducted at 575 degrees F, reached a maximum pressure of 2500 pounds per square inch gauge (psig), and included a controlled bleed off flow of 1.5 gpm. The licensee further stated that RCP seal leakage is a pressure-dependent function that is evaluated in calculation C-ME-064.02-243 (draft). The licensee stated that the basis for this function is supported by the N-9000 RCP seal station blackout performance testing. The licensee stated that its evaluation of plant performance is documented in draft technical report WCAP-17792-P. As discussed in Section 3.2.1.1 of this report, reference cases simulating the response of a B&W plant to an ELAP event were performed using the RELAP5/MOD2-B&W code. The licensee stated that analysis in WCAP-17792-P identified that natural circulation would be present in both loops even if the plant were cooled down asymmetrically. The licensee indicated that the seal leakage rate assumed in its thermal-hydraulic analysis was specified conservatively to ensure margin in the RCS makeup inventory. The licensee stated that, ultimately the site makeup inventory controlling basis was the boration requirements and that any seal leakage would have to increase by several factor to become limiting. Therefore, the licensee concluded that the site mitigation plan includes charging capacity with significant margin, sufficient makeup inventory for a significant increase in leakage, and a mitigation strategy for containment integrity with significant margin.

During the audit, the NRC staff performed a limited review of the basis for the leakage rate the licensee assigned to the N-9000 RCP seals. Although some documentation of station blackout performance testing for the N-9000 seals was made available for the NRC staff's review during the audit, the staff concluded that the review of additional documents would be necessary to justify the proposed leakage rate, including WCAP-16175-P[1], C-ME-064.02-243, and WCAP-17792-P. The latter two documents, in particular, were not available to the NRC staff during the audit. As such, it was not possible for the NRC staff to confirm a number of the licensee's statements in the previous paragraph, including those regarding the sensitivity of the required time for initiating RCS makeup to variations in the assumed seal leakage rate. However, based on a limited review of information in the N-9000 RCP seal station blackout testing audit materials and WCAP-16175-P, the NRC staff made the following observations:

(1) Additional basis is necessary to justify that the plant conditions predicted for Davis-Besse during an ELAP event would be consistent with or bounded by the test conditions for the N-9000 RCP seal station blackout performance test. Relevant parameters include temperature, pressure, subcooling, etc. In particular, due to the potential importance of RCS subcooling on seal leakage, adequate basis should be provided for analytical assumptions concerning ambient heat losses for the actual plant condition (e.g., particularly regarding sensitive locations such as the pressurizer steam space).

(2) Additional basis is necessary to justify that the pop-open failure mechanism of the RCP seals resulting from hydraulic instability discussed in WCAP-16175-P and WCAP-17601-P would not occur or would be bounded by the assumed leakage rate. Analysis for CE-designed reactors with an RCP / seal combination similar to the corresponding equipment at Davis-Besse indicates that pop-open failures may occur if adequate RCS subcooling cannot be maintained. Although the licensee touched briefly upon the topic during the audit, because the ELAP analysis for Davis-Besse was not available, inadequate basis was provided to demonstrate that sufficient RCS subcooling would be maintained to support the assumed seal leakage rate. In particular, although single-phase flow may be maintained in the RCS loops, as the licensee stated, pressure drop associated with the transit of fluid through the seal package could still lead to two-phase hydraulic instability; hence the criterion for adequate RCS subcooling, rather than merely single-phase flow in the RCS.

(3) A comprehensive discussion is necessary regarding the adequacy of the assumed leakage rate of 2 gpm per RCP for Davis-Besse. Although evidence from a single-test condition was presented during the audit, based on a broader set of information considered in WCAP-16175-P and WCAP-17601-P, a leakage rate of 15 gpm per RCP was selected for Combustion Engineering (CE)-designed reactors with a similar RCP / seal combination. The discussion should further address the generic industry recommendation that a prompt cooldown be established for all PWRs.

(4) Additional justification is necessary to support modeling of the pressure-dependence assumed for the RCP seal leakage rate.

[1] WCAP-16175-P-A, Rev 0, "Model for Failure of RCP Seals Given Loss of Seal Cooling in CE NSSS Plants," includes discussion of the performance of RCPs and seals similar to those installed at Davis-Besse.

(5) Additional justification is necessary to demonstrate that the N-9000 seal design will be robust under stresses induced by the cooldown of the RCS. The justification should specifically address whether seal cooling will be restored during the ELAP event.

Providing additional information to address the above issues identified with the basis for the assumed seal leakage rate is identified as Open Item 3.2.1.2.A. Furthermore, to the extent that the licensee seeks to resolve some or all of the above issues by demonstrating that, with respect to determining the necessary timing for providing RCS makeup, boration requirements readily bound expected variations in seal leakage rates, adequate basis and auditable documentation should be provided to support this position.

Regarding isolation of the RCP seal return line in audit question 40, the licensee stated that valve MU38 on the seal return line is shut from the main control room to isolate RCP seal leakage, thereby minimizing RCS inventory loss. Valve MU38 is an air-operated globe valve that is spring closed with RCS pressure assist. The licensee indicated that the valve could be closed at the onset of an ELAP event within 30 minutes; however, the licensee further noted that load stripping could remove control power to this valve within 15-30 minutes. The licensee stated that DBNPS will evaluate proceduralizing the closure of valve MU38 to reduce the RCS inventory losses prior to securing power to support direct current (dc) load stripping. The licensee stated that the status of this item will be in future six-month updates. Therefore, the need to confirm that either (1) closure of valve MU38 will not be credited in the ELAP analysis for Davis-Besse or (2) procedures to close valve MU38 prior will be implemented to provide assurance that its closure can be credited in the ELAP analysis is identified as Confirmatory Item 3.2.1.2.B in Section 4.2.

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

3.2.1.3 Decay Heat

NEI Section 3.2.1.2 states in part:

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

On page 6 of the Integrated Plan regarding initial plant conditions, the licensee stated that prior to the event the reactor has been operating at 100 percent rated thermal power for at least 100 days or has just been shut down from such a power history as required by plant procedures in advance of the impending event.

During the audit, the licensee was requested to discuss the applicability of assumption 4 on page 4-13 of WCAP-17601-P to DBNPS. The licensee was requested to include in the discussion whether the ANS 5.1-1979 + 2 sigma model is used in the ELAP analysis and address the adequacy of the use of the decay heat model in terms of the plant-specific values of the following key parameters:

1) initial power level, 2) fuel enrichment, 3) fuel burnup, 4) effective full power operating days per fuel cycle, 5) number of fuel cycles, if hybrid fuels are used in the core, and 6) fuel characteristics (addressing whether they are based on the beginning of the cycle, middle of the cycle, or end of the cycle).

In response, the licensee stated that for the DBNPS site-specific analysis the decay heat generation was delineated by calculation C-NSA-037.01-001, "Condensate Storage Tank Capacity for DHR and Sensible Heat Removal". The total decay heat fraction was found by adding the heavy metal total and the fission product decay. The decay heat was based on 102 percent reactor power for two years at end of cycle and the current core configuration. The calculation was revised to incorporate DBNPS's latest power uprate. The calculation references Branch Technical Position ASB-9, Residual Decay Heat Energy for Light-Water Reactor for Long-Term cooling, from NUREG-0800, Section 9.2.5 (ADAMS Accession No. ML052350549), as the basis for the equation used to calculate the integrated decay heat.

Based on the licensee's response, the NRC staff identified the following issues for resolution:

(1) The licensee's response did not address the decay heat modeling assumptions present in the analysis credited for Davis-Besse in WCAP-17792-P, which was not available to the staff during the audit. Furthermore, the staff's previous review of WCAP-17601-P had identified that the requested information was generally not provided in that document; furthermore, it is not clear whether descriptions in WCAP-17601-P would apply to the analysis in WCAP-17792-P.
(2) Calculation C-NSA-037.01-001 should be made available for future audit review.

This is identified as Confirmatory Item 3.2.1.3.A in Section 4.2.

During the audit, the licensee was requested to discuss the capability of one SG to release the flow of steam to match decay heat one hour after reactor trip at the target SG pressure following an ELAP. In response, the licensee stated that a single AVV has sufficient capacity to remove decay heat generated one hour after shutdown. However, the information provided by the licensee during the audit did not fully address the staff's question regarding the ability of an AVV to cool the plant down and continue to remove decay heat at the post-cooldown target SG pressure. External uncertainty further affected this issue during the audit, in that it was not clear whether the cooldown for Davis-Besse would involve one or both SGs and because the ELAP analysis for Davis-Besse, which would specify the post-cooldown target SG pressure, was not available for review. Therefore, the need for the licensee to demonstrate that the cooldown directed by the Davis-Besse mitigating strategy is consistent with the capability of the AVVs is identified as Confirmatory Item 3.2.1.3.B in Section 4.2.

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

3.2.1.4 Initial Values for Key Plant Parameters and Assumptions

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

On page 5 of the Integrated Plan, the licensee stated that the assumptions in the Integrated Plan are consistent with those detailed in NEI 12-06, Section 3.2.1. Analysis has been performed consistent with the recommendations contained within the Executive Summary of the "PWROG Core Cooling Position Paper" (ADAMS Accession No. ML130420011) and assumptions from that document are incorporated into the plant-specific analytical bases.

The licensee was requested to discuss its evaluation of how the parameters used in WCAP-17601-P represent DBNPS, and to provide validation of the gaps and recommendations in the PWROG Core Cooling Position Paper, with respect to DBNPS. In response, the licensee stated that rather than using WCAP-17601-P, it used the analysis of WCAP-17792-P (draft). The licensee also referred to the PWROG Core Cooling Position Paper as being included as Attachment D to WCAP-17792-P.

In any case, the licensee stated that WCAP-17792-P considers scenarios more consistent with DBNPS's FLEX implementation strategy, whereas WCAP-17601-P considered the coping time for an ELAP with RCS leakage without incorporating RCS makeup from a FLEX RCS charging pump. The licensee stated it is using the guidance of WCAP-17792-P, recognizing the document is draft and has not been reviewed by the NRC. The licensee stated that any differences between the draft version and the issued version will be addressed by the DBNPS implementation plan. The licensee is evaluating the parameters in the gaps for the development of the design changes as well as the procedures. For the gaps identified in the PWROG Core Cooling Position Paper, the licensee stated that only the FLEX SG Pump capacity has not been specified for procurement and the method of RCS venting is under review and still being evaluated. The licensee stated that site-specific differences are being addressed with AREVA to determine if further plant-specific analysis is required. The licensee defined this as an Open Item and stated that the status of these issues will be communicated in a future six-month update. As the licensee is currently in the process of completing this task, sufficient documentation was not available during the audit to support closure of issues associated with addressing industry-identified gaps and recommendations applicable to the generically developed mitigating strategies proposed for Davis-Besse (e.g., those documented in WCAP-17792-P and the appropriate revision of the PWROG Core Cooling Position Paper). Resolution of this issue is identified as Open Item 3.2.1.4.A.

The licensee stated that the status of WCAP-17792-P and resolution of differences between the implementation plan and the generic analysis will be communicated in future six-month updates.

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

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states in part:

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

- SG Level
- SG Pressure
- RCS Pressure
- RCS Temperature
- Containment Pressure
- SFP Level

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

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

- SG Level (Narrow Range)
- AFW/EFW Flow Indication
- CST/EWST Level
- RCS Wide Range Pressure
- Core Exit Thermocouple Temperature
- Reactor Vessel Level Instrumentation (DBNPS uses a continuous vent line in conjunction with a Hot Leg Level Monitoring System (HLLMS) to provide gross indication of Reactor Vessel Level)

On page 37 of the Integrated Plan, the licensee stated that all the following instruments, listed for the Maintain RCS Inventory Control function, will be available following an ELAP:

- RCS Hot Leg Temperature (T_{hot})
- RCS Cold Leg Temperature (T_{cold})
- RCS Wide Range and Narrow Range Pressure
- Core Exit Thermocouple
- Pressurizer Level
- Reactor Vessel Level Instrumentation (DBNPS uses a continuous vent line in conjunction with a HLLMS to provide gross indication of Reactor Vessel Level)

On pages 19 and 20 of the Integrated Plan, the licensee stated that FENOC will develop procedures to read this instrumentation locally, where applicable, using a portable instrument.

On page 19 of the Integrated Plan, the licensee identified that flow distribution instrumentation will be installed to provide indication of balanced flow to the two SGs during 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 monitoring instrumentation and controls, if these requirements are implemented as described.

3.2.1.6 Sequence of Events (SOE)

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

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

The SOE is discussed in the Integrated Plan on pages 10 to 13 and in Attachment 1A on pages 91 through 96. On page 10, the licensee stated that the SOE and any associated time constraints are identified for Modes 1 through 4 strategies for FLEX Phase 1 through Phase 3. During the audit, the licensee stated that the new borated water storage tank would not be installed and that RCS makeup would be provided from the BWST or the CWRT, which is reflected in the second and fifth bullet below.

The plan identifies five time constraints that must be met:

- Declaring an ELAP by 0.9 hour after an ELAP is the first time constraint. This declaration allows actions to be taken that place plant systems, structures, and components (SSCs) outside current licensing basis**.** Declaration of an ELAP is time sensitive.

- The second time constraint involves aligning and starting the RCS makeup pump from the BWST or CWRT by 4.5 hours after an ELAP. The RCS makeup pump need time is time critical to support the initiation of boration at 6 hours. The pump will be needed to makeup for contraction and leakage and to add boron to maintain shutdown margin.

- The third time constraint is aligning the SFP makeup pump or initiating BWST gravity flow by 10 hours after an ELAP. At 64 hours after an ELAP, the SFP will have boiled from its nominal water level to 9.5 feet above the fuel. There is a time constraint that this pump be aligned within 64.2 hours, when the coverage of fuel in the SFP decreases below 9.5 feet above top of the fuel racks.

- The fourth time constraint involves aligning the alternate coolant source (ACS) Makeup FLEX pump from next available source by 13 hours after an ELAP. This need time assumes CSTs are unavailable and SG makeup has been via EFW pump. The EWST is estimated to last a minimum of 16 hours. Operators will have a prioritized list of alternate suction sources based on an ACS evaluation. Inventory will be transferred from available sources. The Intake Canal is the only ACS protected from all external hazards. Makeup to the EWST must be established before 16 hours to prevent the tank from being emptied.

- The fifth time constraint involves aligning makeup to the BWST or CWRT at 50 hours after an ELAP event. The time is based on a credited volume of 90,000 gallons and an RCS makeup pump of 60 gpm. The expected depletion time is based on makeup to offset 70 gpm of letdown for 10 minutes and 10 gpm of leakage for the event duration; it further provides for a makeup flow of 60 gpm for 2 hours prior to cooldown and 13 hours during cooldown.

On page 38 of the Integrated Plan, the licensee stated that Phase 2 activities for RCS inventory control involve aligning a FLEX charging pump to provide borated coolant for RCS makeup to support plant cooldown and to maintain the reactor subcritical. The FLEX charging pump will be available to inject borated water into the RCS within 6 hours after the event is initiated. The licensee assumed that providing borated RCS makeup at this juncture would be conservative relative to requirements for maintaining reactor core subcriticality. The licensee stated that a thermal-hydraulic analysis will be performed to provide the analytical basis for this time. The licensee's thermal-hydraulic analysis will obviously require adequate specification and modeling of core characteristics and reactivity parameters. This is identified as Confirmatory Item 3.2.1.6.A in Section 4.2.

The licensee was requested to provide validation for assumed operator action times. In response the licensee stated that this task would be performed to the extent practical to determine the time required to implement the task in question and to confirm the direction provided obtains the desired actions. The licensee stated that the time would then be compared to the allowed time to ensure margin exists with respect to the required implementation time. The licensee further stated that if the allowed time could not be met, then the direction or assumed staffing requirements would be altered until satisfactory performance could be assured.

During the audit, the NRC staff observed that the licensee had not finalized its plans regarding cooldown strategy (i.e., symmetric or asymmetric). The staff also observed that some significant analyses have yet to be completed (e.g., thermal-hydraulic analysis, shutdown margin calculation). As the results of these ongoing efforts may have a significant impact on the actions and timings in the ELAP mitigating strategy, the need for the licensee to provide a revised sequence of events that is consistent with its final analyses is identified as Open Item 3.2.1.6.B in Section 4.1.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Open and 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.

3.2.1.7 Cold Shutdown and Refueling

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

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

The NRC staff reviewed the licensee's Integrated Plan and determined that the generic concern related to shutdown and refueling requirements is applicable to Davis-Besse. This generic concern has been resolved via the submittal of an NEI position paper entitled "Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514), which 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 licensees are capable of implementing mitigating strategies in all modes of operation. During the audit, FENOC informed the NRC of its plan 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 Core Sub-Criticality

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

> All plants provide means to provide borated RCS makeup.

The NRC staff reviewed the licensee's Integrated Plan and determined that a generic concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the RCS under natural circulation conditions potentially involving two-phase flow is applicable to DBNPS.

The PWROG submitted a position paper, dated August 15, 2013 (withheld from public disclosure due to proprietary content), which provided test data regarding boric acid mixing under single-phase natural circulation conditions and outlined applicability conditions intended to ensure that boric acid addition and mixing would occur under conditions similar to those for which boric acid mixing data is available. However, at the time audit discussion occurred, the NRC staff had not endorsed this position paper.

During the audit, the licensee provided the following information regarding the modeling of boric acid mixing:

> The site implementation strategy has been evaluated by WCAP-17792-P as maintaining single-phase conditions in the RCS. Based on initiation of charging within 8 hours of the event and not commencing cool down until RCS charging capability is established, the analysis determined an inventory will remain in the pressurizer.
>
> 1) The perfect mixing model was utilized. Davis-Besse has two unique aspects.
>
>   - Because of the lack of shutdown margin associated with he control rods, the plant cooldown following the BDBEE will not commence until RCS makeup and boration capability is established.
>   - The raised loop design promotes natural circulation and natural circulation promotes mixing.

Therefore the site BDBEE mitigation plan maintains the RCS single phase.
WCAP 17792 identifies:

> *Maintaining natural circulation minimizes, if not eliminates, the potential for deborated water to accumulate and suddenly move to the core region. This mitigates potential reactivity additions that could not otherwise be countered by a normal boric acid addition evolution.*
>
> *Make-up restoration has clear benefits during an ELAP. Makeup flow maintains the loops in a water-solid state and keeps natural circulation going for the duration of the transient. The analyzed makeup start time of 8 hours (LL) and 6 hours (RL) hours after the event initiation were shown to be adequate. The boron injection is sufficient to maintain the core in a subcritical state under the analyzed conditions.*

2) WCAP-17792-P, which is presently in draft, reflects the analysis of a B&W plant with makeup available and with seal leakage and 1 gpm of plant leakage postulated.

3) The requirements for RCS makeup and boration delineated in WCAP-17792-P consider seal leakage and plant unidentified leakage as well as the venting requirements in the event of no RCS leakage.

The license considered the modeling of boric acid mixing as an open item to be communicated in a 6-month update.

Meanwhile, industry activities to generically resolve the boric acid mixing issue were ongoing during the Davis-Besse audit, and the NRC staff issued a letter endorsing the PWROG's position paper during the preparation of the present report. In the endorsement letter dated January 8, 2014 (ADAMS Accession No. ML13276A183), the NRC staff concluded that the August 15, 2013, position paper constitutes an acceptable approach for addressing boric acid mixing under natural circulation during an ELAP event, provided that the following additional conditions are satisfied:

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

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

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

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

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

As a consequence of the contemporaneous events discussed above, at the time the audit was conducted, the licensee had neither (1) committed to abide by the generic approach discussed above, including the additional conditions specified in the NRC's endorsement letter, nor (2) identified an acceptable alternate approach for justifying the boric acid mixing assumptions in the analyses supporting its mitigating strategy. Furthermore, as discussed previously, the licensee had not ruled out the use of an asymmetric cooldown in the ELAP mitigating strategy for Davis-Besse. Use of an asymmetric cooldown is beyond the scope of the generic effort outlined in the PWROG's August 15, 2013, position paper, which had assumed a symmetric cooldown. Although the licensee stated that WCAP-17792-P identified that natural circulation will continue in both loops under asymmetric cooldown, absent NRC staff review of the analytical results, it remains unclear whether the circulation through the uncooled loop is consistent with the range of flow rates presented in the PWROG's position paper that was used to define a representative boric acid mixing delay time. Resolution of the above issues associated with the modeling of boric acid mixing is identified as Open Item 3.2.1.8.A, in Section 4.1 of this report.

During the audit, the staff observed that analysis demonstrating adequate shutdown margin for ELAP scenarios (1) with the highest applicable reactor coolant system leakage and (2) with no reactor coolant system leakage was not available for review. In addition, the licensee had not discussed whether core reload calculation procedures would ensure that these shutdown margin calculations remain bounding for future fuel cycles. Resolution of the above issues associated with shutdown margin calculations is designated as Confirmatory Item 3.2.1.8.B.

During the audit, the licensee was requested to discuss an RCS vent strategy as recommended in the "PWROG Core Cooling Position Paper." In response to a request from the NRC staff during the audit, the licensee stated that, due to the lack of shutdown margin, DBNPS plans to defer cooling down until RCS boration capability is established via FLEX RCS charging. The licensee stated that boric acid injection is required prior to cooling down to less than 350 degrees F in the RCS. The licensee stated that, as the analysis documented in draft report WCAP-17792-P identifies, B&W plants have limited venting capability. The licensee stated that DBNPS is evaluating the WCAP-recommended RCS venting plan, and that, since the borated makeup provided by the FLEX RCS Charging Pumps will have a concentration as low as 2,600 parts per million (ppm), the boration flow rates may require greater venting capacity than identified in the WCAP-17792-P analysis. The licensee stated that the WCAP-17792-P analysis addressed venting requirements for the ELAP with no RCS leakage. For additional capacity DBNPS is evaluating RCS venting via the Low Temperature Overpressure Relief Valve. The licensee stated that the status of the additional venting will be communicated in a future six-month update. The staff noted that neither WCAP-17792-P nor licensee-specific analysis regarding RCS venting in support of ensuring adequate shutdown margin were available for review during the audit. Resolution of these issues is identified as Confirmatory Item 3.2.1.8.C, in Section 4.2.

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

3.2.1.9 Use of Portable Pumps

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

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

During the audit, the licensee was requested to clarify the nomenclature of the pumps used to feed the SGs. In response, the licensee provided the following information concerning these pumps:

1) TDAFW pump. There are two installed TDAFW pumps. While these pumps start automatically in the event of a loss of off-site power (LOOP), the water sources (SW and CSTs) are assumed to be unavailable in some ELAP scenarios and the pumps were therefore not credited for FLEX mitigation.

2) EFW pump. This is the diesel-driven emergency feedwater pump the licensee is planning to install. The pump capacity will be comparable to the current AFW pumps. The EFW pump is the credited Phase 1 SG makeup pump.

3) FLEX SG pumps. Two diesel-driven SG makeup pumps. These pumps will support Phase 2 SG makeup. One pump will be staged in the EFW facility and the alternate pump will be stored in the FLEX storage building.

On page 21 of the Integrated Plan, the licensee stated that preferred and alternate strategies for Phase 2 heat removal involve staging a portable pump (SG FLEX pump) outside the Auxiliary Building (AB) and connecting to the EFW System. For both strategies, suction will be taken from the EWST and discharged by the SG FLEX pump(s) to the connection points.

On page 38 of the Integrated Plan, the licensee stated that the Phase 2 activities for RCS inventory control involve aligning an RCS FLEX charging pump to provide borated coolant for RCS makeup to support plant cooldown and to maintain the reactor sub-critical. The RCS FLEX charging pump will be available to inject borated water into the RCS within 6 hours after the event is initiated.

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

3.2.2 Spent Fuel Pool Cooling Strategies

NEI 12-06, Table 3-2 and Appendix D summarize one acceptable approach for the SFP cooling strategies. This approach uses a portable injection source to provide 1) makeup via hoses on the refuel deck/floor capable of exceeding the boil-off rate for the design basis heat load; 2) makeup via connection to 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 gpm per unit (250 gpm to account for overspray). This approach will also provide a vent pathway for steam and condensate from the SFP.

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

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

On page 58 of the Integrated Plan, the licensee stated it evaluated SFP sloshing and determined a water level loss of 0.03 feet in the pool due to a north/south seismic event for the worst-case scenario. Assuming no other reduction in coolant inventory other than the sloshing, the nominal water level would remain at 23.67 feet above the SFP racks. This level would result in a time to boil of 7.03 hours assuming the most conservative critical damping and an initial bulk water temperature in the pool of 140 degrees F. This value was calculated using the normal operating decay heat load. For the maximum credible heat load, the time to boil is 3.76 hours assuming the most conservative critical damping and an initial bulk water temperature in the pool of 140 degrees F.

The licensee stated it had an established procedure for gravity draining from the BWST to the SFP. This passive strategy may be used to make up SFP inventory as long as the BWST is available and elevation head is present between the BWST and the SFP level. All piping along the path is seismic and assumed to be available following the BDBEE.

The licensee also stated that current procedures provide instruction for enhancing natural air circulation during emergency conditions. Various doors will be opened to promote passive ventilation of the bulk air space above the SFP.

On page 11 of the Integrated Plan, in regards to the SOE, the licensee stated that venting of the SFP area must be accomplished by 3 hours after an ELAP event. This task represents travel to the subject location and establishing ventilation. Timing is based on 30-minute operator action for manual operation. This action is required prior to the most limiting case for SFP boiling. The licensee stated that procedures exist to promote passive ventilation of the bulk air space above the SFP.

On page 59 of the Integrated Plan, the licensee stated that normal and long-term power source needs will be determined after modifications are made for SFP level instrumentation to be in compliance with Order EA-12-051.

On page 60 of the Integrated Plan, the licensee stated that once the SFP water begins to boil, the SFP is assumed to be at saturated conditions. In order to maintain SFP level, a FLEX diesel-driven pump will be used for makeup. The required volumetric flow rate for the worse case SFP condition is calculated to be 63.78 gpm for maximum credible heat load to account for any boil off losses in the SFP. The SFP FLEX pump must be aligned prior to 34.3 hours after an ELAP event (when the coverage of fuel in the SFP decreases below 9.5 feet above top of the fuel racks) for normal heat load conditions.

The licensee stated the BWST, if available, will be aligned to the suction of a portable FLEX pump and injected into the SFP. If the BWST is unavailable, suction will be taken from the intake canal. The preferred strategy will involve routing a new header directly to the SFP just above the normal water level. The header will be routed outside via a penetration through the fuel handling area west wall and will terminate in a blind flange or Storz quick connection. Access to the fuel handling area will be required to manipulate an isolation valve on the line and align the makeup system. The alternate connection strategy will involve using a flexible hose routed directly from the FLEX pump discharge to the SFP. Flexible hose will be deployed to the SFP early in the event before the onset of SFP boiling creates a hazardous environment for personnel.

The licensee stated a permanent modification to install spray nozzles in the Fuel Handling Building will be made. These nozzles will be mounted on the walls approximately 20 feet above the deck, and pointed at the pool. A hard pipe line will be routed from the nozzles to the installed header for the preferred SFP makeup strategy and will use the same connection point located outside the AB. Suction will be taken from the Intake Canal for this strategy.

The licensee stated that an alternative to use of the spray header would be to use a portable oscillating fire hose nozzle. This could be permanently staged in a location on the deck with a hose or pipe routing to a convenient location or be manually placed at the end of a flexible hose configuration. DBNPS has an established procedure for SFP makeup via Blitzfire nozzles. If radiation levels around the SFP allow access, then the nozzles are staged inside the train bay door and set up in an oscillating spray pattern. Each nozzle is capable of spraying approximately 200 gpm.

During the audit, the licensee addressed a concern about spray nozzles being clogged by the intake canal water by stating that nozzle clearance will be determined and installation of a duplex strainer is planned. If SW filtration is accomplished and the clearances are sufficient, no SFP filtration will be required. The licensee stated the status of this effort would be communicated in a future six-month update.

On page 68 in the section of its Integrated Plan in regards to maintaining SFP cooling in Phase 3, the licensee stated that the Phase 2 SFP cooling strategies will continue into Phase 3. SFP makeup will continue from the BWST (if available), EWST (if in Modes 5 or 6), or Intake Canal. During Phase 3, DBNPS personnel will transition to long term SFP cooling. Installed plant equipment will be repowered and aligned to establish SFP cooling. Once long term cooling is established, SFP makeup will no longer be required.

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

3.2.3 Containment Functions Strategies

NEI 12-06, Table 3-2 and Appendix D provide some examples of acceptable approaches for demonstrating the baseline capability of the Containment strategies to effectively maintain Containment functions during all phases of an ELAP. One of these acceptable approaches is by analysis.

On page 47 and 48 of the Integrated Plan, the licensee stated that Phase 1 actions will involve isolating containment. Currently, there is at least one point of closure for every penetration either using operators to position valves or relying on check valves to close the penetration. Current procedures provide instructions to operators for isolating containment.

The licensee further described that containment pressure and temperature are expected to increase during an ELAP due to loss of containment cooling and RCS leakage into containment. The licensee stated that by crediting the performance of the low leakage RCP seals, containment pressure and temperature are not expected to rise to levels that could challenge the containment structure.

On page 49 of the Integrated Plan, the licensee stated that for Phase 2 containment pressure and temperature are expected to increase in containment during an ELAP due to RCP seal leakage into containment as well as ambient losses combined with the loss of normal cooling. However, crediting low leakage RCP seals at DBNPS, the pressure and temperature are not expected to rise to levels which could challenge the containment structure during Modes I through 4 assuming adequate secondary heat removal functions are provided. The licensee stated that FENOC will perform an analysis to demonstrate that the pressure and temperature after an event initiated in Modes 1 through 4 will stay at acceptable levels during Phase 2, and that no additional installed equipment or operator actions are required to maintain containment integrity.

On page 55 of its Integrated Plan, the licensee stated that FENOC will perform analysis to demonstrate that the pressure and temperature after an event initiated in Modes 1 through 4 will stay at acceptable levels until transition to the Phase 3 strategy utilizing the DHR system.

The licensee stated that FENOC will perform an analysis to demonstrate that the pressure and temperature after an event initiated in Modes 1 through 4 will stay at acceptable levels during Phase 1, 2, and 3, and that no additional installed equipment or operator actions are required to maintain containment integrity. This has been identified as Confirmatory Item 3.2.3.A in Section 4.2.

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

3.2.4 Support Functions

3.2.4.1 Equipment Cooling – Cooling Water

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

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

The Integrated Plan did not address if the DHR pump is cooled by CCW or is self-cooled, and does not address whether the FLEX pumps for Phases 2 and 3 are self-cooled. During the audit the licensee was requested to address cooling requirements for these pumps. In response, the licensee stated that the EFW pump has not been procured, but plans to procure a pump using comparable bearing cooling to the AFW pumps. The FLEX pumps have not been procured, but the plan is for these pumps to be capable of operation without additional support (i.e., self-contained pumps). The licensee stated this is an open Item and its status will be communicated during a future six-month update. The DHR pumps require CCW for bearing cooling. Restoration of CCW is planned for Phase 3 following restoration of 4160 Vac power and prior to initiation of DHR pump operation.

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 in part:

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

systems. If lower fire protection system setpoints are used or temperatures are expected to exceed these temperatures during an ELAP/LUHS, procedures/guidance should identify actions to avoid such inadvertent actuations or the plant should ensure that actuation does not impact long term operation of the equipment.

On pages 10 and 11 of the Integrated Plan, the licensee stated that it will establish heating, ventilation, and air conditioning and lighting in the EWST building. This action assumes a building is constructed around the EFW pump and EWST. Power for ventilation, heating and lighting in the EWST building will be from either current battery strategies, new batteries, or a DG depending on EWST building design. Operators will need to verify proper ventilation in the EWST building while the EFW pump is operating. At four hours after an ELAP, the licensee will deploy the 480V FLEX DG. This time constraint is driven by requirements to support RCS injection at 6 hours and pressurizer heaters and control & battery room ventilation/lighting at 8 hours.

On page 72 of the Integrated Plan, the licensee stated that support for the safety functions is provided by continued observation of plant conditions by operators in the CR using specific instruments and coordinating activities from the CR. During Phase 2, portable 480V FLEX DGs will be used to power existing battery room and CR ventilation along with CR lighting. Ventilation for the battery room will be provided for the removal of hydrogen. This will require the use of an installed ventilation fan and damper. Ventilation for the switchgear room will be provided to limit temperatures that the substation will experience. This will require the use of an installed ventilation fan and damper. Ventilation of the CR will require the use of an installed ventilation fan and damper.

During the audit, the licensee was requested to discuss what criteria would be used to determine if hydrogen buildup required forced ventilation in the battery room during battery recharging in Phase 2 and 3, and how hydrogen concentrations would be measured during an ELAP event. The licensee was also asked to include a description of the exhaust path if it is different from the design basis. In response, the licensee stated that it has no plans to monitor for hydrogen. The hydrogen generation will not commence until restoration of the battery chargers, which will be restored concurrently with the battery room ventilation.

During the audit the licensee was requested to provide information on the adequacy of the ventilation provided in the battery room to protect the batteries from the effects of extreme low temperatures. The licensee stated that it recognizes it has to evaluate the battery room temperature performance for low temperature conditions during the period that ventilation will be secured. The licensee stated that either an analysis supporting the condition or a mitigation strategy for battery room temperature during the period that ac power is unavailable will be developed. Licensee provided calculation C-ISE-028.1-002 on the e-portal showing the temperature would not drop below 60°F with a design basis minimum outdoor temperature of -10°F.

During the audit, the licensee was requested to provide a discussion on inverter area temperature in regards to ventilation. In response, the licensee stated that a historical calculation of equilibrium room temperature for battery and low voltage switchgear rooms following a loss of ventilation as a result of station blackout resulted in temperatures less than 121 degrees F (assuming an ambient temperature of 110 degrees F). Since dc load stripping will be implemented to support the FLEX mitigation strategy and since this reduces the load on the inverter, the licensee concluded that the calculation provides reasonable confidence there is adequate ventilation.

During the audit process, the licensee was requested to provide a detailed summary of the analysis and/or technical evaluation performed to demonstrate the adequacy of the ventilation provided in the TDAFW pump room to support equipment operation throughout all phases of an ELAP. In response, the licensee stated that they are not taking credit for operation of the TDAFW pumps because the water sources to the TDAFW pumps are the CSTs, which may not survive the event. In addition, there are elevated temperatures concerns in the TDAFW pump rooms without ventilation. Calculation 057.004 determined that an equilibrium temperature of 152˚F is attained in the TDAFW pump room in about 11 minutes of system operation without ventilation. The limiting temperature of 150˚F is based on 104˚F ambient temperature. The diesel-powered EFW pump will be credited as the Phase 1 FLEX SG makeup pump taking suction from the EWST. If the condensate storage tanks survive the event, the TDAFW pump can be used, however without power to the room ventilation the room temperature will exceed 150˚F, which exceeds the qualification temperature for the equipment. The licensee also stated the EFW pump and its associated auxiliaries are located in the emergency feedwater facility and this equipment will be qualified to FLEX temperatures and designed to have adequate ventilation during 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 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 licensee was requested to address heat tracing loss during the ELAP. In response, the licensee stated that based on calculations, the boron concentration maintained in the BWST is sufficient to preclude precipitation. The majority of components relied upon for FLEX mitigation is located in the AB or other existing structures. The licensee stated these locations would need to be without power for a sustained period for freezing to occur there. The BWST is located external to the AB and is insulated and the level instruments have insulation and weather enclosure. Piping from the BWST to the FLEX RCS charging pump is located below grade and afforded weather protection by the BWST piping tunnel. Given the volume of water in the BWST, the piping is below grade; and the flow will be initiated from the BWST via decay heat piping and FLEX RCS charging within 8 hours, the volume, insulation, and flow will ensure the primary flow path will not be challenged with interruption due to freezing in the event of an extended duration of a loss of ac power. The licensee further noted, however, that freeze protection will be required on stagnant lines, including the level instruments.

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.

<u>Lighting</u>

During the audit the licensee was requested to discuss what type of portable lighting was to be used in the CR following a seismic event. In response , the licensee stated that it has not been determined that dedicated portable lighting is necessary for the CR. It is anticipated that additional portable lighting, if determined to be necessary based on the time required to restore power to installed lighting, would be self-contained battery powered LED lighting. The CR has non-essential powered ac lights, essential powered ac lights, and dc-powered lights. In addition, the CR has battery pack lights with a minimum operating time of 8 hours. These battery pack lights are periodically tested. Currently, it is anticipated that implementation of the FLEX strategies would restore power to essential 480V MCCs, which would restore essential light ac-powered lights and allow restoration of dc-powered lights prior to depletion of the battery pack lights. If portable battery lighting is required, there is a storage room inside the CR that could hold the portable lights. Any equipment stored there would be appropriately restrained to be available following a seismic event.

On page 70 of the Integrated Plan, the licensee stated that emergency lighting in plant areas needed for safe shutdown is provided by individual units. These units have their own individual batteries, battery chargers and are powered from various sources. The licensee also stated that per discussion with site personnel during a walkdown, these battery-powered lights are designed to operate for 8 hours after an ELAP.

On pages 72 and 73 of the Integrated Plan, the licensee stated that during Phase 2, portable 480V FLEX DGs will be used to power CR lighting. This will be for all scenarios except seismic events. Under the seismic scenario, if the CR lights may fail, portable lighting will be used.

On pages 10 and 11 of the Integrated Plan, the licensee stated at 45 minutes after an ELAP, it will establish lighting in the EWST building. This action assumes a building is constructed around the EFW pump and EWST. Power for lighting in the EWST building will be from either current battery strategies, new batteries, or a DG depending on EWST building design. At four hours after an ELAP, the licensee will deploy its 480V FLEX DG to provide CR lighting.

During the audit, the licensee was requested to discuss portable lighting needed in other parts of the plant, in response, the licensee stated that there are over 150 battery pack lights located in various plant areas. These battery pack lights have a minimum operating time of 8 hours and are periodically tested. Currently, the licensee anticipates it will restore power to essential 480 Vac MCCs prior to depletion of the battery pack lights. The plant also has supplemental lights that could be supplied from a small portable diesel-driven emergency generator. Operators also carry a tool belt that includes a flashlight. Additional portable Captains Lanterns are available in the Fire Brigade Room. The licensee stated it recognizes that supplemental lighting at specific locations may be necessary to implement FLEX strategies during non-daylight hours. The FLEX strategies will include supplemental lighting, as required. The licensee stated there are many flashlights available on site should any individual's flashlight fail. Portable 120 Vac lights powered by diesel-driven emergency generators will have significant fuel supplies available to them, so that length of light operation should not be fuel limited.

<u>Communication</u>

The NRC staff has reviewed the licensee communications assessment (ADAMS Accession Nos. ML12306A131 and ML13053A366) in response to the March 12, 2012 50.54(f) request for information letter for DBNPS and, as documented in the staff analysis (ADAMS Accession No. ML13170A334) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2 (8) regarding communications capabilities during an ELAP. Confirmation of the proposed communications enhancements has been identified as Confirmatory Item 3.2.4.4.A in Section 4.2.

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

3.2.4.5 Protected and Internal Locked Area Access

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

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

specified in ELAP response procedures/guidance may require additional actions to obtain access.

During the audit, the licensee was requested to address protected and internal locked area access. In response, the licensee stated that currently designated on-shift security and operations personnel are issued keys such that if an ELAP were to occur, they can access plant rooms/equipment. The turnover of these keys is part of the shift formal turnover 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 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 3.2.1.9, states that areas requiring personnel access should be evaluated to ensure that conditions will support the actions required by the plant-specific strategy for responding to the event.

NEI 12-06, Section 3.2.2, Guideline 11 states,

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

Section 9.2 of NEI 12-06 states,

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

On pages 10 and 11 of the Integrated Plan, the licensee provided information on the restoration of HVAC in the new EWST building, 45 minutes after an ELAP event

On page 11 of the Integrated Plan, the licensee provided information on the venting of the SFP are and stated that procedures exist to promote passive ventilation of the bulk air space above the SFP.

On page 72 of the Integrated Plan, the licensee stated that during Phase 2, portable 480V FLEX diesel generators will be used to power existing battery room and CR ventilation.

Although the TDAFW pumps are not credited for FLEX mitigation, the licensee recognizes that they will auto start on an ELAP and provide makeup to the SGs from the CST, when available. On page 18 of the Integrated Plan, the licensee stated that during Phase 1 the AFW pump rooms were postulated to experience elevated environmental temperatures during an ELAP event that could preclude operator access. Operability limits were being determined for the TDAFW pumps. If it was determined that elevated environmental temperatures may challenge the operation of the TDAFW pumps or operator access, temporary motor driven ventilation fans would be designated for this area. If the CSTs survive the ELAP event, the TDAFW pumps can be sustained. However, without power for the AFW pump room ventilation, the temperature of the room will exceed 150˚F in about 11 minutes of system operation without ventilation. The equipment is qualified for the ambient temperatures. The room temperatures will limit operator access without temporary ventilation.

On page 93 of the Integrated Plan, the licensee stated, that if the preferred SFP strategy is unavailable, hoses will be routed prior to SFP boiling in order to avoid a need for personnel access to the Fuel Handling Area during hazardous environmental conditions.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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/UHS at their nominal capacities. Water in robust UHS piping may also be available for use but would need to be evaluated to ensure adequate NPSH can be demonstrated and, for example, that the water does not gravity drain back to the UHS. Alternate water delivery systems can be considered available on a case-by-case basis. In general, all CSTs should be used first if available. If the normal source of makeup water (e.g., CST) fails or becomes exhausted as a result of the hazard, then robust demineralized, raw, or borated water tanks may be used as appropriate.

> … Finally, when all other preferred water sources have been depleted, lower water quality sources may be pumped as makeup flow using available equipment (e.g., a diesel driven fire pump or a portable pump drawing from a raw water source). Procedures/guidance should clearly specify the conditions when the operator is expected to resort to increasingly impure water sources.

The licensee addressed water sources for coping strategies in its Integrated Plan for makeup to the SGs. Makeup flow is immediately established to the SG during the initial phase of the ELAP strategies.

On page 12 of the Integrated Plan, the licensee describes the water sources to be use to provide makeup to the SGs. If the CST is available, the TDAFW pumps will provide makeup to the SGs with steam being released from the SGs through the AVVs. If the CST is unavailable, SG makeup will be from the EFW pump taking suction from the EWST. In the audit process the licensee clarified that the EFW pump taking suction from the EWST is the credited source of water to the steam generators. The operators will have a list of alternate suction sources based on the alternate coolant source evaluation performed in Westinghouse Report TR-FSE-13-8, Revision 2, "Davis-Besse Nuclear Power Station FLEX Integrated Plan," February 2013. The only alternate cooling source available that is protected from all external events is the intake canal. The licensee stated that makeup to the EWST must be established before 16 hours to prevent the tank from emptying. On page 21 of the Integrated Plan the licensee describes the use of a FLEX water transfer pump for transferring water from the alternate cooling sources. In Phase 3, the licensee intends to continue makeup to the SGs through the EFW pump (or SG FLEX pump(s) using the EWST, which will be refilled by a mobile water purification unit from the RRC. The unit will process water from the Intake Canal to remove particulate and demineralize the water.

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

3.2.4.8 Electrical Power Sources/Isolations and Interactions

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

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

On pages 10 and 11 of the Integrated Plan, the licensee stated by 45 minutes after an ELAP it will establish the EWST building DG. At 4 hours after an ELAP event, the licensee will have deployed the 480v FLEX DG to support RCS injection at 6 hours and pressurizer heaters and control & battery room ventilation/lighting at 8 hours.

On page 72 of the Integrated Plan, the licensee stated that during Phase 2, two 500kW portable 480v FLEX DGs will be used to maintain power to critical instrumentation, as well as recharging the vital batteries and powering the vital bus inverters. The generators will also be used to power existing battery room and CR ventilation along with CR lighting.

On page 79 of the Integrated Plan, the licensee stated that a 4160v generator will provide adequate power to supply Phase 3 loads.

During the audit process, the licensee was requested to provide a summary of the sizing calculations for the FLEX generators, and address how portable vent fans and other small equipment will be powered. In response, the licensee stated that the preliminary conceptual design developed determined that the 480v portable DG should be sized at 600 kW for Phase 2. This was determined by developing a list of loads required to cope with the BDBEE. The 4160 Vac load list is in development and comments were provided on the design of the 4160 Vac portable DG to ensure the size is adequate for station loads. The powering of small components will be a factor considered in the mitigation strategy. Depending on the event and condition of the plant, the small loads may use plant power. However, contingencies and procedures will be developed to delineate FLEX load control and equipment deployment strategies, including the options for portable temporary power for small loads. Other items (lighting and particularly external lighting) will rely on portable generators. The reviewer noted the discrepancy between the Integrated Plan stated size of the Phase 2 480v portable DGs (500kW) and the stated size of the Phase 2 480v portable DGs in response to the sizing audit question (600kW). This is identified as Confirmatory Item 3.2.4.8.A in Section 4.2.

During the audit, the licensee was requested to describe how electrical isolation will be maintained such that (a) Class 1E equipment is protected from faults in portable/FLEX equipment and (b) multiple sources do not attempt to power electrical buses. In response, the licensee stated that Class 1E equipment will be protected from faults in the portable/FLEX equipment by a breaker provided with the FLEX generator. The proposed 4160v connection configuration between the portable/FLEX equipment and the Class 1E switchgear will use a similar design, with a protective device on the FLEX generator. As the FLEX generator for the 4160v is being provided by the RRC and its design is not complete, the licensee stated the specific protective device cannot be determined at this time. Procedures that direct implementation of portable/FLEX equipment to restore power to electrical buses have not been developed. The licensee stated it recognized that the configuration of that equipment, as well as the plant electrical switchgear equipment being re-energized, must be controlled to prevent inadvertently powering this equipment from multiple sources. The licensee also recognized that some of these normal power sources include automatic responses to restore power to plant electrical switchgear. DBNPS plans to develop procedures to prevent energizing buses from multiple sources.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 6 of the Integrated Plan, the licensee stated that fuel for FLEX equipment stored in structures with designs that are robust with respect to seismic events, floods, and high winds and associated missiles remains available.

On page 12 of the Integrated Plan, the licensee stated it will establish an alternate fuel supply by 15 hours after an ELAP event. The licensee stated that this time constraint conservatively assumes the depletion of the diesel fuel tank that will be installed near the EFW pump.

On page 73 of the Integrated Plan, the licensee stated diesel fuel will be required to support the FLEX equipment for the FLEX strategies. Fuel will be provided from a diesel fuel tank that will be located in the new facility surrounding the EWST. As inventory in the diesel fuel tank is depleted, fuel will be transferred from the Emergency Diesel Generator (EDG) day tanks to the EWST diesel fuel tank, to fuel transfer equipment, or directly to equipment using a small electric powered transfer pump. A connection will be made to a drain line located on the supply line to the EDG from the associated EDG day tank. 480v Fuel Transfer Pumps will be repowered by the FLEX diesel generator, and will transfer inventory from the EDG week tanks to the EDG day tanks as needed. Conceptual drawings for diesel fuel are provided in Attachment 3 (Figure A3-10 and Figure A3-11). This fuel strategy will be consistent for all of the FLEX strategies. During the audit, the licensee stated that the diesel fuel oil tank has a capacity of 40,000 gallons and a minimum fuel oil storage requirement of 32,000 gallons.

In addition, in response to an audit question on fuel capability, the licensee stated that the design of the EFW facility fuel oil storage tank will require fuel storage for 72 hours of continuous fully loaded operation of the EFW pump and the 500kW FLEX DG.

During the audit, the licensee was requested to address fuel quality for FLEX equipment. In response, the licensee stated that diesel fuel quality will be maintained through the Diesel Fuel Oil Program. The program maintains the fuel oil quality at the site for installed and temporary plant support equipment. The trailer/portable equipment diesel fuel tanks will be maintained consistent with manufacturer and EPRI recommendations.

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

3.2.4.10 Load Reduction to Conserve DC Power

NEI 12-06, Section 3.2.2, Guideline 6 states:

Plant procedures/guidance should identify loads that need to be stripped from the plant dc buses (both Class 1E and non-Class 1E) for the purpose of conserving dc power.

DC power is needed in an ELAP for such loads as shutdown system instrumentation, control systems, and dc backed AOVs and MOVs. Emergency

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

On page 10 of the Integrated Plan, the licensee stated that by 15 minutes after an ELAP event it will begin shedding loads. The load shedding will be according to existing procedures. A portion of the load shed must be completed within 30 minutes after the start of an ELAP and the remaining completed within 1 hour after the start of an ELAP.

On page 70 of the Integrated Plan, the licensee stated that during Phase 1, installed vital batteries will be used to maintain the availability of critical instrumentation. Battery systems provide dc electrical power to Class 1E loads of vital instrumentation. The time which vital power will be available is extended by performing a load shed of all loads which are not considered to be critical for monitoring the condition of the plant during an ELAP. The station batteries will provide the necessary dc power for the first hour of the ELAP. After the first hour of the ELAP, battery IP will provide the necessary dc power for approximately 18 hours. Battery 2P will then provide the necessary dc power for approximately 19 hours. To achieve these extended discharge duty cycles and preserve stored energy in the isolated station batteries, the licensee stated that special battery load shedding evolutions will be directed by procedures. Load shedding will be based on Station Battery Discharge Analysis For Beyond Design Basis Events. The licensee stated this should provide sufficient margin because a 480V FLEX generator will be installed into the system prior to 8 hours after the start of the event. Load shedding will begin within 15 minutes after the start of ELAP and be completed within 30 minutes of the start of the ELAP.

On page 91 of the Integrated Plan, the licensee stated that load shedding will be according to existing procedures and will begin within 15 minutes after the start of an ELAP. A portion of the load shed must be completed within 30 minutes after the start of an ELAP and the remaining completed within 1 hour after the start of an ELAP.

The licensee was requested to address the inconsistency in load shed timing, for example on page 70 the licensee stated that load shedding will be completed within 30 minutes, while on page 91 it stated that load shedding will be completed within 1 hour. In response, the licensee stated that portions of the load shed must be completed within 30 minutes, while the remaining portions of the load shed must be completed within 60 minutes of an ELAP event. On loss of ac power, the operators would place the SBO DG in service and restore power to an essential 4160v bus. In accordance with the SBO Rule, this action is required to be performed within 10 minutes of an SBO event. Assuming the SBO DG fails to restore power, the operators would then perform load shed. To bound the calculations that support the load shed, the licensee allowed 15 minutes from the start of the SBO event until the beginning of the load shed. Assuming the load shed is initiated at the 15-minute point, the first set of loads must be de-energized by 30 minutes into the ELAP event, with the remaining loads de-energized no later than one hour following the event.

During the audit, the licensee was requested to provide a detailed discussion on the loads that will be shed from the dc bus, the equipment location (or location where the required action needs to be taken), and the required operator actions needed to be performed and the time to complete each action. The licensee responded by stating procedure DB-OP-02521, "Loss of AC Bus Sources," provides direction for performing the dc bus load shed. The location of the breakers to perform the load shed are located in the control room, or #1 and #2 low voltage switchgear rooms.

Also during the audit, the licensee was requested to discuss the safety consequences of performing a load shed on the dc buses, to include the strategy to prevent an uncontrolled hydrogen release from the main generator if the backup seal oil pump is to be shed. The licensee responded by stating that hydrogen release from the main generator during a load shed is addressed in procedure DB-OP-02521, "Loss of AC Bus Power Sources, Attachment 5, Selective Battery Load Shedding, Step 4."

The NRC staff reviewed the licensee's Integrated Plan and determined that the generic concern related to battery duty cycles beyond 8 hours is applicable to the plant. This generic concern has been resolved generically through the NRC endorsement of NEI position paper entitled "Battery Life Issue" (ADAMS Accession No. ML13241A186 (position paper) and ML13241A188 (NRC endorsement letter)).

The purpose of the generic concern and associated endorsement of the position paper was to resolve concerns associated with Integrated Plan submittals in a timely manner and on a generic basis, to the extent possible, and provide a consistent review by the NRC staff. Position papers provided to the NRC by industry further develop and clarify the guidance provided in NEI 12-06 related to industry's ability to meet the requirements of Order EA-12-049.

The generic concern related to extended battery duty cycles required clarification of the capability of the existing vented lead-acid station batteries to perform their expected function for durations greater than 8 hours throughout the expected service life of the battery. The position paper provided sufficient basis to resolve this concern by developing an acceptable method for demonstrating that batteries will perform as specified in a plant's Integrated Plan. The methodology relies on the licensee's battery sizing calculations developed in accordance with the Institute of Electrical and Electronics Engineers Standard 485, "Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations," load shedding schemes, and manufacturer data to demonstrate that the existing vented lead-acid station batteries can perform their intended function for extended duty cycles (i.e., beyond 8 hours).

The NRC staff concluded that the position paper provides an acceptable approach for licensees to use in demonstrating that vented lead-acid batteries can be credited for durations longer than 8 hours. The NRC staff will evaluate a licensee's application of the guidance (calculations and supporting data) in its development of the final Safety Evaluation documenting review of the licensee's Integrated Plan. FENOC informed the NRC of their plan to abide by this generic resolution.

During the audit process, the licensee was requested to provide the basis for the minimum dc bus voltage that is required to ensure proper operation of all required electrical equipment. The licensee responded by stating that calculation C-EE-002.01-016, "Station Battery Discharge

Analysis for Beyond Design Basis Event," identifies the required equipment needed to be powered from the station dc battery during a BDBE and provides the basis for the minimum voltage on the dc bus to ensure proper operation of required equipment. The minimum voltage to ensure required equipment operates properly for inverter YV1 and YV2 is 103 Vdc, for Disconnect Switch Cabinet CDE 12A-1 and CDF 12A-1 is 100 Vdc, and Disconnect Switch Cabinet CDF 11C is 76.3 Vdc.

During the audit process, the licensee was requested to provide the direct current (dc) load profile with the required loads for the mitigating strategies to maintain core cooling, containment, and SFP cooling. The licensee responded by stating that calculation C-EE-002.01-016 provides the dc load profile for equipment to be powered from the station dc batteries. The licensee also stated that a FLEX procedure and dc load profile for the new Emergency Feedwater system (ECP-13-0195 and ECP-13-0196) will be developed and is independent of the station batteries.

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 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

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.

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

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

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

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

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

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

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

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

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

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

3.3.2 Configuration Control

NEI 12-06, Section 11.8 states:

1. The FLEX strategies and basis will be maintained in an overall program document. This program document will also contain a historical record of previous strategies and the basis for changes. The document will also contain the basis for the ongoing maintenance and testing programs chosen for the FLEX equipment.
2. Existing plant configuration control procedures will be modified to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.
3. Changes to FLEX strategies may be made without prior NRC approval provided:
   a) The revised FLEX strategy meets the requirements of this guideline.
   b) An engineering basis is documented that ensures that the change in FLEX strategy continues to ensure the key safety functions (core and SFP cooling, containment integrity) are met.

On pages 14 through 16 of the Integrated Plan, the licensee stated that procedures and guidance to support deployment and FLEX strategy implementation, including interfaces with EOPs, special events procedures, AOPs, and system operating procedures, will be coordinated within the site procedural framework. The procedural documentation will be auditable, consistent with generally accepted engineering principles and practices, and controlled within the DBNPS document control system. The FLEX strategies and basis will be maintained in an overall program document. Existing plant configuration control procedures will be modified to ensure that changes to the plant design, physical plant layout, road, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies in accordance with NEI 12-06, Section 11.8.

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

3.3.3 Training

NEI 12-06, Section 11.6, Training, states:

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

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

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

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

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

On page 16 of the Integrated Plan in regards to training, the licensee stated that training plans will be developed for plant groups such as the ERO, fire, security, Radiation Protection, operations, engineering, and maintenance. The training plan development will be done in accordance with DBNPS procedures using the SAT, and will be implemented to ensure that the required DBNPS staff is trained prior to implementation of FLEX. The licensee stated the training program will comply with the requirements outlined in Section 11.6 of NEI 12-06.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 page 16 of the Integrated Plan regarding the RRC plan, the licensee stated that the industry will establish two RRCs to support utilities during BDB events. Equipment will be moved from an RRC to a local Assembly Staging 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, will be delivered to the site within 24 hours from the initial request. FENOC has negotiated and executed a contract with SAFER that will meet the requirements of NEI 12-06, Section 12.0.

The licensee's plans for the use of off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies, item 1 above. However, the licensee did not address the remaining items, 2 through 10 of Section 12.2. This has been identified as Confirmatory Item 3.4.A., in Section 4.2.

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

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.2.1.1.B	Confirm that the licensee has (1) Identified the specific analysis case(s) from WCAP-17792-P that are being referenced as the basis for demonstrating the acceptability of the mitigating strategies for Davis-Besse, and (2) Provided justification that the analyses from WCAP-17792-P that are being credited for Davis-Besse are adequately representative of the actual plant design, FLEX equipment, and planned mitigating strategies.	
3.2.1.2.A	Provide additional information, as discussed further in Section 3.2.1.2 of this report, to: (1) Justify that the Davis-Besse plant condition during an ELAP is bounded by the seal leakage test conditions with respect to relevant parameters. (2) Justify that the pop-open failure mechanism resulting from hydraulic instability that is discussed in WCAP-16175-P and WCAP-17601-P would not occur or would be bounded by the assumed leakage rate. (3) Provide a comprehensive basis for the assumed leakage rate of 2 gpm in light of recommendations for a larger value of leakage for similarly designed RCPs and seals discussed in WCAP-16175-P and WCAP-17601-P. (4) Describe and provide justification for the modeling of the pressure-dependence of the seal leakage rate. (5) Provide justification that the seal design would be robust under stresses induced by the cooldown of the RCS.	
3.2.1.4.A	Provide sufficient basis to demonstrate acceptable closure of issues associated with industry-identified gaps and recommendations applicable to the generically developed mitigating strategies proposed for Davis-Besse (e.g., those documented in WCAP-17792-P and the appropriate revision of the PWROG's Core Cooling Management Interim Position Paper).	
3.2.1.6.B	Provide a revised sequence of events that is consistent with the final ELAP analyses.	

3.2.1.8.A	At the time the EA-12-049 Mitigation Strategy Audit was conducted, the licensee had neither (1) committed to abide by the generic approach endorsed by the NRC, including the additional conditions specified in the NRC's endorsement letter, nor (2) identified an acceptable alternate approach for justifying the boric acid mixing assumptions in the analyses supporting its mitigating strategy.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.1.A	Confirm that the diesel-driven SW pumps have deployment and storage plans developed in accordance with the provisions of NEI 12-06.	
3.1.1.2.A	Procedural Interfaces – Seismic Hazard. While the licensee's Integrated Plan describes that at least one connection will be protected against all applicable events for FLEX deployment, the licensee's Integrated Plan did not address whether the access routes that plant operators will have to access to deploy and control the strategy will only require access through seismically robust structures.	
3.1.1.2.B	If power is required to operate the storage building doors, confirm that either power supplies will be available to operate the doors or the doors will be equipped with manual overrides to permit manual door opening.	
3.1.1.3.A	Confirm that guidance is provided for critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power.	
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 that the licensee has identified the warning time and persistence of the external flooding hazard.	
3.1.2.2.A	Deployment – Flooding Hazard. The Integrated Plan did not address deployment consideration 1 and 2 of NEI 12-06, Section 6.2.3.2. Review the licensee plans to conform to deployment consideration 1 and 2 of NEI 12-06, Section 6.2.3.2	
3.1.3.1.A	Confirm that the chosen storage locations are sufficiently separated in distance and axially from the typical tornado path as compared to the local tornado data for tornado width.	
3.2.1.1.A	Confirm that reliance on the RELAP5/MOD2-B&W code in the ELAP analysis for B&W plants is limited to the flow conditions prior to boiler-condenser cooling initiation.	
3.2.1.1.C	Demonstrate the adequacy of the modeling of operator actions associated with primary-to-secondary heat transfer to confirm the continuity of natural circulation.	
3.2.1.2.B	Confirm that either (1) closure of valve MU38 will not be credited in the ELAP analysis for Davis-Besse or (2) procedures to close valve MU38 prior will be implemented to provide assurance that its closure can be credited in the ELAP analysis.	

3.2.1.3.A	Address the following issues regarding decay heat: (1) The licensee's response did not identify and provide the basis for the decay heat modeling assumptions present in the analysis credited for Davis-Besse in WCAP-17792-P, which was not available to the staff during the audit. (2) Calculation C-NSA-037.01-001 should be made available for future audit review.	
3.2.1.3.B	Demonstrate that the cooldown directed by the Davis-Besse mitigating strategy is consistent with the capability of the AVVs.	
3.2.1.6.A	Confirm licensee's hydraulic analysis supports that injecting borated water into the RCS within 6 hours after the event is initiated will maintain subcriticality.	
3.2.1.8.B	Provide for audit review analysis demonstrating adequate shutdown margin for ELAP scenarios (1) with the highest applicable reactor coolant system leakage and (2) with no reactor coolant system leakage. In addition, clarify whether core reload calculation procedures would ensure that these shutdown margin calculations remain bounding for future fuel cycles.	
3.2.1.8.C	Confirm that adequate RCS venting capability exists to support the ELAP mitigating strategy for Davis-Besse and provide a description and justification for this conclusion. Provide the analysis of RCS venting for audit review.	
3.2.3.A	The licensee stated that they will perform an analysis to demonstrate that the pressure and temperature after an event initiated in Modes 1 through 4 will stay at acceptable levels during Phases 1, 2, and 3 and that no additional installed equipment or operator actions are required to maintain containment integrity.	
3.2.4.4.A	Communications - Confirm that upgrades to the site's communications systems have been completed.	
3.2.4.8.A	The reviewer noted the discrepancy between the Integrated Plan stated size of the Phase 2 FLEX 480v portable DGs (500kW) and the stated size of the Phase 2 FLEX 480v portable DGs in response to the sizing audit question (600kW). Verify an update to the Integrated Plan clarifies the sizing of the Phase 2 FLEX 480v DGs.	
3.4.A	The licensee's plans for the use of off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies, item 1. The licensee did not address the remaining items, 2 through 10 of Section 12.2.	