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
Beaver Valley Power Station, Unit Nos.1 and 2
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Technical Evaluation Report

Beaver Valley Power Station, Units 1 and 2
Order EA-12-049 Evaluation

1.0 BACKGROUND

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

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

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

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

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

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

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

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

2.0 EVALUATION PROCESS

In accordance with the provisions of Contract NRC-HQ-13-C-03-0039, Task Order No. NRC-HQ-13-T-03-0001, Mega-Tech Services, LLC (MTS) performed an evaluation of each licensee's Integrated Plan. As part of the evaluation, MTS, in parallel with the NRC staff, reviewed the original Integrated Plan and the first 6-month status update, and conducted an audit of the licensee documents. The staff and MTS also reviewed the licensee's answers to the NRC staff's and MTS's questions as part of the audit process. The objective of the evaluation was to assess whether the proposed mitigation strategies conformed to the guidance in NEI 12-06, as endorsed by the positions stated in JLD-ISG-2012-01, or an acceptable alternative had been proposed that would satisfy the requirements of Order EA-12-049. The audit plan that describes the audit process was provided to all licensees in a letter dated August 29, 2013 from Jack R. Davis, Director, Mitigating Strategies Directorate (ADAMS Accession No. ML13234A503).

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

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

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

The technical evaluation 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 audit 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. ML130640315), and as supplemented by the first six month status report in letter dated August 26, 2013 (ADAMS Accession No. ML13238A260), the FirstEnergy Nuclear Operating Company (the licensee or FENOC) provided the Beaver Valley Power Station, Units 1 and 2 (BVPS) Integrated Plan for Compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by the licensee for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC staff notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the NRC staff in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the Order.

3.1 EVALUATION OF EXTERNAL HAZARDS

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

3.1.1 Seismic Events.

NEI 12-06, Section 5.2 states:

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

On page 2 of the Integrated Plan regarding determination of applicable extreme external hazards, the licensee stated that per the FLEX guidance, seismic impact must be considered for all nuclear plant sites. As a result, the credited FLEX equipment needs to be assessed based on the current Beaver Valley 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. This assessment needs to include documentation ensuring that any storage location and deployment routes meet the FLEX criteria.

The licensee also stated that the seismic re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore was not assumed in the Integrated Plan.

The licensee’s approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to seismic screening, 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 necessary for the mitigating strategies 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 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 equipment such as pumps and power supplies should be secured as appropriate to protect them during a seismic event (i.e., 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 20 of the Integrated Plan the licensee stated that one storage building will be constructed to house the FLEX equipment for BVPS Units 1 and 2. The location for this building has not yet been finalized. The FLEX storage building will be constructed to be seismically robust using the requirements of American Society of Civil Engineers (ASCE) 7-10. Equipment inside the building will be secured in such a way that it will not be damaged by a seismic event.

On page 37 of the Integrated Plan the licensee stated that Phase 2 RCS inventory control equipment for Unit 1/Unit 2 will be permanently stored and staged in the Unit 1/Unit 2 Primary Auxiliary Buildings (PABs). The licensee stated that there is adequate space available on this level to store the small, electric, high pressure, low flow FLEX RCS pump for this function, as well as the supporting hoses and electric cables. The PABs for each unit are protected for all external hazards considered in 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 protection of FLEX equipment considering seismic hazards, if these requirements are implemented as described.

3.1.1.2. Deployment of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.2 states:

> The baseline capability requirements already address loss of non-seismically robust equipment and tanks as well as loss of all AC. So, these seismic considerations are implicitly addressed.

There are five considerations for the deployment of FLEX equipment following a seismic event:

1. If the equipment needs to be moved from a storage location to a different point for deployment, the route to be traveled should be reviewed for potential soil liquefaction that could impede movement following a severe seismic event.

2. At least one connection point for the FLEX equipment will only require access through seismically robust structures. This includes both the connection point and any areas that plant operators will have to access to deploy or control the capability.

3. If the plant FLEX strategy relies on a water source that is not seismically robust, e.g., a downstream dam, the deployment of FLEX coping capabilities should address how water will be accessed. Most sites with this configuration have an underwater berm that retains a needed volume of water. However, accessing this water may require new or different equipment.

4. If power is required to move or deploy the equipment (e.g., to open the door from a storage location), then power supplies should be provided as part of the FLEX deployment.

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

On page 2 of the Integrated Plan the licensee stated that steps have been taken to densify soil in the main plant area and the intake structure area at both Units 1 and 2 to eliminate the concern of liquefaction. All deployment paths will be evaluated for the effects of liquefaction due to the SSE at Beaver Valley.

In the Sequence of Events (SOE) Timeline of the Integrated Plan the licensee stated that at hour 1.0, they would initiate the site damage assessment. This action provides information on which components, structures, and water sources are available to support FLEX strategies, and what debris removal concerns have to be alleviated to deploy FLEX equipment. Beginning this action as soon as an ELAP is declared allows maximum time to remove debris before FLEX equipment must be deployed. At 2.0 hours they would initiate debris removal processes on the deployment paths to move the FLEX water transfer pumps to the Ohio River, and to move the FLEX core cooling pumps to the staging locations adjacent to the primary plant demineralized water storage tank (PPDWST). They would initiate large debris removal equipment deployment at hour 25.0. This equipment will be used to clear a path for transport of other large Regional Response Center (RRC) equipment into the protected area.

On page 10 of the Integrated Plan, the licensee stated that the broad-spectrum deployment strategies are the same for the different operating modes. The deployment strategies from the FLEX storage building to each staging area are identified, as well as the debris removal concerns, security barriers, and lighting needs as they apply to each deployment path. The Beaver Valley site will use deployment paths, which refer to the route from a storage location to the staging location for pumps and generators, and routing paths, which refer to the route from a staging location to the point of connection to existing plant equipment for hoses and cables.

Deployment paths and routing paths are shown in Attachment 3 of this document for all strategies. To ensure that the strategies can be implemented in all modes, areas adjacent to the equipment storage and staging areas, as well as the deployment and hose routing paths will be maintained clear at all times. These requirements will be included in an administrative program.

On pages 22 through 26 of the Integrated Plan, describing the protection of connections for the transition phase of its strategy for maintaining core cooling and heat removal, the licensee stated that for Unit 1 the primary and secondary connections will be located in the Auxiliary Feedwater (AFW) pump room of the safeguards building which is protected from all external hazards considered in NEI 12-06. The connection points are located above the probable maximum flood (PMF) and can be accessed through seismically qualified structures. For Unit 2 the primary/secondary connections and the PPDWST suction and makeup connections are similarly protected from all hazards and are located above the PMF and can be accessed through seismically qualified structures.

During the audit process the licensee stated that for Unit 1 the primary and secondary connection points are located in the same room, the AFW Pump Room, 735' elevation in the engineered Safeguards Building, a Seismic, Category 1 structure. The primary connection ties into the "A" train header, the secondary connection ties into the "B" train header. There is a separate set of AFW throttle valves that control the feed rate to each steam generator on each train of AFW. The two trains for each steam generator then come together and feed into the main feed piping for each steam generator just outside of containment. The discharge of the steam driven pump AFW Pump is also normally aligned to the "A" train header. All three AFW pumps and all six AFW throttle valves are located in the same room. The description for Unit 2 is the same as Unit 1 except that the "A" and "B" motor driven AFW Pumps, as well as the connection points, are in different rooms in the Unit 2 Engineered Safeguards Building. The AFW throttle valves are also in separate rooms.

On page 29 of the Integrated Plan the licensee stated that the deployment paths for equipment received from the RRC would be developed after they and the RRC have agreed upon a location for the near site staging area to receive equipment onto the site. The deployment paths will be evaluated against the potential for damage caused by external hazards.

On page 29 of the Integrated Plan, describing the deployment of portable equipment and protection of connections for its Phase 3 strategy to maintain Core Cooling and Heat Removal, for Unit 1 and Unit 2, the licensee stated that the primary and secondary connections will be located in each Unit's PAB, which are protected for all external hazards considered in NEI 12-06. The licensee also stated that the connection points are located above the PMF and can be accessed through seismically qualified structures. The suction source for this strategy is the Ohio River, which is protected from all external hazards considered in NEI 12-06.

On page 38 of the Integrated Plan the licensee stated that the storage area and the staging area for the FLEX Reactor Coolant System (RCS) pumps are the same, so deployment of the pumps will not be required. The hose and electric cable for this function are also stored with the pumps.

On page 38 through 40 of the Integrated Plan the licensee stated that protection of connections for the transition phase of the strategy to maintain RCS inventory control the primary/secondary connections will be located in charging pump cubicle A/B (respectively) on elevation 722' 6" of the PAB. The pump cubicles are protected for all external hazards considered in NEI 12-06.

The connection point is not located above the PMF, but the charging pump cubicles on elevation 722' 6" of both PABs are waterproofed. The connection can be accessed through seismically qualified structures. The boric acid tank (BAT) suction connection is located in one of the tank cubicles of the PAB, which are protected from all external hazards considered in NEI 12-06. The connection points are located above the PMF and can be accessed through seismically qualified structures. The connection points for Unit 2 are similarly protected.

On page 55 of the Integrated Plan, regarding deployment conceptual design to maintain SFP cooling during the transition phase, the licensee stated that the staging area for SFP makeup at Unit 1 is located between the Unit 1 PPDWST and the Unit I safeguards building. The staging area for this function at Unit 2 is located between the Unit 2 PPDWST and the Unit 2 diesel generator building. The staging area for SFP spray at both Units 1 and 2 is located adjacent to the river, west of the intake structure in an existing parking lot on elevation 680'. The FLEX SFP pump and hoses will be deployed to the staging locations following the blue paths shown on Figure A3-1 of the Integrated Plan. For both the Unit 1 and Unit 2 SFPs the suction source for SFP makeup is the Refueling Water Storage Tank (RWST) and the suction source for SFP spray is the Ohio River. For both units no modifications are required for the primary and spray connections. The secondary connections require the removal of a downstream flange of the SFP heat exchangers and the addition of isolation valves. The modifications required for the RWST connections are the same as for the Phase 2 core cooling strategies.

On page 55 of the Integrated Plan regarding protection of connections to maintain SFP cooling during the transition phase, the licensee stated that all connection points are located above the PMF and can be accessed through seismically qualified structures. For Unit 1: all connections the pool and fuel deck are protected for all external hazards considered in NEI 12-06. The surrounding fuel building is not protected for tornado missiles, so some debris removal may be required. The primary connection will be a hose into the pool from the fuel deck on elevation 766' 6" of the fuel handling building. The secondary connection will be located on elevation 735' 6" of the fuel handling building. SFP spray will be connected on the fuel deck on elevation 766' 6" of the fuel handling building. For Unit 2: all connections, the fuel handling building, the SFP, and the fuel deck, are protected for all external hazards considered in NEI 12-06. The connection point is located above the PMF and can be accessed through seismically qualified structures. The Unit 2 connection point locations are similar to those described for Unit 1.

On pages 74 and 75 Attachment 1 in the Integrated Plan, the licensee listed debris removal equipment and pickup trucks that would be used for core, SFP, instrumentation and accessibility for the portable equipment for implementing FLEX strategies.

During the audit process the licensee stated that seismically robust piping is present in plant areas where FLEX equipment is located and in indoor areas where FLEX strategies are to be implemented. If the Unit 1 turbine building were to flood, the fire/flood seals could potentially allow leakage into the adjoining Unit 1 service building elevation 713'. A portable service building emergency flood control pump would be used to pump out the volume collected behind the service building north wall dike. In an ELAP, one of these pumps can be powered from a portable generator. The licensee also evaluated a downstream dam failure and described the provisions included in the ELAP plan to respond to this possibility.

During the audit process the licensee also stated that the storage for debris removal equipment and equipment needed to deploy FLEX equipment will meet the same requirements provided for FLEX portable equipment storage. The current plan is to store debris removal equipment and trucks in the same storage facility as the FLEX portable equipment.

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

3.1.1.3. Procedural Interfaces - Seismic Hazard

NEI 12-06, Section 5.3.3 states:

> There are four procedural interface considerations that should be addressed.
>
> 1. Seismic studies have shown that even seismically qualified electrical equipment can be affected by 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 (see Section 3.2.1.10). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance should include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power.
>
> 2. Consideration should be given to the impacts from large internal flooding sources that are not seismically robust and do not require ac power (e.g., gravity drainage from lake or cooling basins for non-safety-related cooling water systems).
>
> 3. For sites that use ac power to mitigate ground water in critical locations, a strategy to remove this water will be required.
>
> 4. Additional guidance may be required to address the deployment of equipment for those plants that could be impacted by failure of a not seismically robust downstream dam.

In several sections of the Integrated Plan the licensee described that procedures will be developed to read instrumentation locally, where applicable, using portable instruments, as specified by Section 5.3.3 of NEI 12-06.

On page 11 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 Beaver Valley document control system. Actions that maneuver the plant will remain contained within the typical controlling procedures, and the FSGs will be implemented as necessary to maintain the key safety functions of core cooling, containment, and SFP cooling in parallel with the controlling procedure actions. The overall approach will be symptom-based, meaning that the controlling procedure actions and FSGs are initiated based on actual plant conditions. The licensee stated that they will continue participation in the Pressurized Water Reactors Owners Group (PWROG) project PA-PSC-0965 and will update Beaver Valley procedures upon completion of the PWROG program.

During the audit process the licensee stated that they would adopt FLEX Support Guideline (FSG-7) Loss of Vital instrumentation or Control Power, which is the generic pressurized water reactor (PWR) procedure that addresses loss of instrumentation and control following a BDBEE. This will include the plant specific information and steps required to meet the intent of this procedure. The required reference sources needed to obtain necessary instrument readings will be included. Critical actions are already included in FSG-7 to control AFW until operators can establish control. Plant specific procedures steps to prevent overfill of the steam generators will also be included. During an ELAP, control of AFW throttle valves can only be accomplished locally regardless of whether vital AC/DC is lost or not. Procedures already exist to accomplish these actions. The existing procedures are being reviewed for adequacy under an ELAP and will be modified if 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 seismic procedural interfaces considerations, if these requirements are implemented as described.

3.1.1.4. Considerations in Using Offsite Resources - Seismic Hazard.

NEI 12-06, Section 5.3.4 states:

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

On page 13 of the Integrated Plan, regarding the RRC plan, the licensee stated that the industry would establish two (2) RRCs to support utilities during BDBEE. Equipment will be moved from an RRC to the near site staging area. 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.

On pages 29, 49 and 71 of the Integrated Plan the licensee described the deployment paths for equipment received from the RRC will be developed after FENOC and the RRC have agreed upon a location for the near site staging area to receive equipment onto the site. The deployment paths will be evaluated against the potential for damage caused by external hazards.

During the audit process the licensee stated that they are in the process of developing the playbook in conjunction with the RRC. Primary and secondary staging areas for the RRC equipment have not yet been chosen but will meet the requirements as set forth in the Strategic Alliance for FLEX Emergency Response (SAFER) Response Plan, Section 1.4.1 and Appendix G. The licensee recognizes that terrain, weather and the potential barrier of the Ohio River must be considered for deployment route selection. The licensee plans to identify multiple deployment routes from each staging area to afford the best change of being able to establish a viable over land route between staging area and the site. Additionally, both offsite and in plant staging areas will be selected and planned to accommodate the use of helicopter delivery to the site should this be necessary. Review of the establishment of the primary and secondary staging areas to ensure that they conform to the guidance contained in the SAFER Response Plan is Confirmatory Item 3.1.1.4.A in Section 4.2.

The licensee also stated that coping strategies that make use of the Ohio River water and a secondary heat sink are analyzed to be effective for a minimum of 72 hours. This provides a significant time period to assess and mitigate any issues with deployment of equipment from the staging area to the plant site.

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

3.1.2 Flooding

NEI 12-06, Section 6.2 states:

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

NEI 12-06, Section 6.2.1 states:

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

On pages 2 and 3 of the Integrated Plan, regarding the determination of applicable extreme external hazards, the licensee stated that the flood assessment in the Beaver Valley UFSAR considered flooding due to high levels on the Ohio River, failure of dams on the Ohio River upstream of the site, high rainfall, seismically induced flood, and wind generated waves concurrent with flooding. High tides, hurricane surge, and tsunamis were determined to not affect the site due to the inland location and elevation at greater than 700' above mean sea level (msl). The PMF at the Beaver Valley site is caused by flooding of the Ohio River, along which the site is located, due to high rainfall in the area upstream of the site. The PMF reaches an elevation of 730.0'. Therefore, the Beaver Valley site is not considered a "dry" site and is susceptible to external flooding. Accordingly, FLEX strategies will be developed for consideration of external flooding hazards. In addition, Beaver Valley is also developing procedures and strategies for delivery of off-site FLEX equipment during Phase 3, which considers regional impacts from flooding.

The licensee also stated that the flooding re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, had not been completed and therefore not assumed in the Integrated Plan.

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

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

> These considerations apply to the protection of FLEX equipment from external flood hazards:
>
> 1. The equipment should be stored in one or more of the following configurations:
>
>   a. Stored above the flood elevation from the most recent site flood analysis. The evaluation to determine the elevation for storage should be informed by flood analysis applicable to the site from early site permits, combined license applications, and/or contiguous licensed sites.
>
>   b. Stored in a structure designed to protect the equipment from the flood.
>
>   c. FLEX equipment can be stored below flood level if time is available and plant procedures/guidelines address the needed actions to relocate the equipment. Based on the timing of the limiting flood scenario(s), the FLEX equipment can be relocated 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 20 of the Integrated Plan the licensee stated that one storage building will be constructed to house the FLEX equipment for Beaver Valley Units 1 and 2. The location for this building has not yet been finalized.

On pages 20, 54 and 46 of the Integrated Plan, regarding the strategies for maintaining core cooling, spent fuel pool cooling and safety functions support in the transition phase, the licensee stated that storage/protection of equipment from flooding would be provided by constructing the FLEX storage building in the protected area at approximately elevation 735', which is above the site PMF of 730'.

On page 37 of the Integrated Plan, regarding the strategies for maintaining RCS inventory control in the transition phase, the licensee stated that equipment for this function would be stored on elevation 752' 6" at Unit I and 755' 6" at Unit 2, which is above the site PMF of 730'. If stored below the current flood level then they would ensure procedures exist to move equipment prior to exceeding flood level.

All equipment required for safe shutdown is protected for the PMF; however, it is not all located above this elevation. During the audit process the licensee stated that those safety related structures located below the PMF elevation of 730' protect the safety related components within those structures because the structures are protected from ingress of floodwater. The floors and walls of the flood-protected areas are constructed of concrete. Pipes, cables and conduits that penetrate these areas are embedded in concrete and utilize water stops to prevent in-leakage. Flood protected areas have sumps or curbs along walls containing sealed penetrations. The Unit 1 Auxiliary Building has cubicles, which are designed to protect safety related equipment from flooding.

NRC staff review of the drawing provided in Attachment 3, Figure A3-1, FLEX Equipment Deployment, of the Integrated Plan, for the storage and protection of portable equipment from external flooding hazards, indicates that the elevation of the storage and deployment paths for the FLEX equipment are above the expected maximum flooding level.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protection of FLEX equipment during flood hazards 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 that 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 UHS may be one of the first functions affected by a flooding condition. Consequently, the deployment of the equipment should address the effects of LUHS [loss of normal access to the ultimate heat sink], 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.

Licensee's responses to the nine considerations in NEI 12-06, Section 6.2.3.2 are described below.

In the SOE Timeline, Attachment 1, of the Integrated Plan the licensee stated that at hour 1.0, they would initiate the site damage assessment. This action provides information on which components, structures, and water sources are available to support FLEX strategies, and what debris removal concerns have to be alleviated to deploy FLEX equipment. Beginning this action as soon as an ELAP is declared allows maximum time to remove debris before FLEX equipment must be deployed. At 2.0 hours they would initiate debris removal processes on the deployment paths to move the FLEX water transfer pumps to the Ohio River, and to move the FLEX core cooling pumps to the staging locations adjacent to the PPDWST. They would initiate large debris removal equipment deployment at hour 25.0. This equipment will be used to clear a path for transport of other large RRC equipment into the protected area.

During the audit process the licensee stated that the current flood procedure, "Acts of Nature-Flood," requires the shut down and cool down (including Boration) of both units when river level is 695' and rising and is predicted to exceed 700'. Additionally, there are already many actions of the type described for consideration 1 in this flood procedure. The licensee stated that they are performing a review of the existing "Acts of Nature" off-normal operating procedures in conjunction with the implementation of the FSGs. Any gaps or improvement opportunities related to mitigating strategies, especially relative to how FLEX portable equipment can be pre-staged or used for a flooding or any other situation will be incorporated as part of this effort.

On page 10 of the Integrated Plan, in the section identifying how strategies will be deployed in all modes, the licensee stated that the broad-spectrum deployment strategies are unchanged for the different operating modes. The deployment strategies from the FLEX storage building to each staging area are identified, as well as the debris removal concerns, security barriers, and lighting needs as they apply to each deployment path. The site will use deployment paths, which refer to the route from a storage location to the staging location for pumps and generators, and routing paths, which refer to the route from a staging location to the point of connection to existing plant equipment for hoses and cables. Deployment paths and routing paths are shown in Attachment 3 of the Integrated Plan for all strategies. To ensure that the strategies can be implemented in all modes, areas adjacent to the equipment storage and staging areas, as well as the deployment and hose routing paths will be maintained clear at all times. These requirements will be included in an administrative program. During the audit process the licensee stated that BVPS is located in a river valley with a significant rise in slope to the south of the site. Road access is available to the south for moving equipment and restocking supplies. A prolonged flooding event that isolates the site is not credible.

During the audit process the licensee stated that the phrase "normal access to the UHS" is typically used in mitigating strategies is the inability to credit existing means of accessing the UHS, which for BVPS, would be the Intake Structure and the River Water, Service Water and Fire Pumps located within that structure. The BVPS FLEX strategy does not credit any of the sources located in the Intake Structure. The baseline FLEX strategy assumes a normal river water level (about 665') for the primary staging area that uses the Ohio River as a source. However, there are several terraced levels between the normal riverbank and the protected area fencing that can also be used to stage portable pumps. At the fence line for the protected area, there is another increase in elevation and a sloped area all the way up to the main elevation of the site at approximately 735'. Procedures that govern the deployment of the portable pumps that use the Ohio River as a source will contain the information to stage the pumps appropriately based on river water level.

During the audit process the licensee stated that fuel oil is stored in underground tanks that are maintained nearly full. Access to the fuel oil is at the main grade of the site, approximately the 735' elevation. Additionally, day tanks for the Emergency Diesel Generators are above the 735' elevation. Both are above the PMF.

On pages 22 through 25 of the Integrated Plan for the strategy for maintaining core cooling and heat removal during the final phase (Phase 3), the licensee stated that the primary and secondary connections for both Units are located in their respective PAB where they are protected against all external hazards; are located above the PMF; and, can be accessed through seismically qualified structures. The Mobile Water Purification unit will use connections that are protected from all hazards considered in NEI 12-06. The Mobile Boration unit will use the makeup connections to the RWSTs identified for Phase 2. The connection at Unit 1 is currently protected for all external hazards considered in NEI 12-06. On page 55 of the Integrated Plan, discussing the protection of connections used in the strategy for maintaining SFP cooling during Phase 2, the licensee stated that for both Unit 1 and Unit 2 the primary, secondary and spray connections would be a hose into the pool from different elevations of the fuel handling building. The pool and the fuel deck are protected for all external hazards considered in NEI 12-06. The connection point is located above the PMF and can be accessed through seismically qualified structures. The Phase 2 strategies for SFP cooling will be continued into Phase 3, with additional borated water provided by the mobile Boration unit from the RRC.

During the audit process the licensee stated that implementation of the FLEX strategy does not require access to any structure that has direct communication with the outside below the main elevation of the site. Nevertheless, in some cases, portable sump pumps are already staged in predetermined locations to pump the water in the unlikely event of water intrusion into these areas. Although emergency ac power many not be available for these pumps, BVPS has already purchased several smaller portable ac generators to be used as needed. One of these generators could be used to supply power to the sump pumps.

During the audit process the licensee stated that the current BVPS flooding analysis does not result in the need for flood barriers. Should flood barriers be required in the future, BVPS will store the barriers in a manner that will protect them so they would be available for their intended use.

During the audit process the licensee stated that equipment used to deploy portable FLEX equipment would meet the same storage requirements as provided for the portable 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 deployment of FLEX equipment considering the flooding hazard, if these requirements are implemented as described.

3.1.2.3 Procedural Interfaces – Flooding Hazard.

NEI 12-06, Section 6.2.3.3 states:

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

On page 11 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 Beaver Valley document control system. Actions that maneuver the plant will remain contained within the typical controlling procedures, and the FSGs will be implemented as necessary to maintain the key safety functions of core cooling, containment, and SFP cooling in parallel with the controlling procedure actions. The overall approach will be symptom-based, meaning that the controlling procedure actions and FSGs are initiated based on actual plant conditions. FENOC will continue participation in the Pressurized Water Reactors Owners Group (PWROG) project PA-PSC-0965 and will update Beaver Valley procedures upon completion of the PWROG program.

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

3.1.2.4. Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

On page 13 of the Integrated Plan the licensee stated that the industry would establish two (2) RRCs to support utilities during BDBEE. Each RRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. The licensee has signed a contract with SAFER to meet the requirements of NEI 12-06, Section 12 at the Beaver Valley site.

Review of the licensee's plan for the use of offsite resources did not confirm that it would provide reasonable assurance that the plan will comply with NEI 12-06, Section 6.2.3.4 regarding flooding hazards, due to the absence of identification of the primary and secondary staging areas and a description of the methods to be used to deliver the equipment to the site. This is Confirmatory Item 3.1.2.4.A. in Section 4.2 of this report.

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

On page 2 of the Integrated Plan the licensee stated that Figures 7-1 and 7-2 from NEI 12-06 were used for this assessment. Figure 7-1 indicates that the high wind speed from a hurricane does not exceed 130 mph. Figure 7-2 of NEI 12-06 indicates a maximum wind speed from a tornado of 170 mph for plants in Region 2 of this figure, including Beaver Valley. In summary, based on available local data and Figures 7-1 and 7-2 of NEI 12-06, the licensee stated that BVPS is not susceptible to high wind hazards associated with hurricanes but is susceptible to high wind hazards associated with tornadoes.

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

3.1.3.1. Protection of FLEX Equipment - High Wind Hazard

NEI 12-06, Section 7.3.1 states:

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

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

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

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

        - Given the FLEX basis limiting tornado or hurricane wind speeds, building loads would be computed in accordance with requirements of

ASCE 7-10. Acceptance criteria would be based on building serviceability requirements not strict compliance with stress or capacity limits. This would allow for some minor plastic deformation, yet assure that the building would remain functional.

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

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

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

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

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

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

On page 20 of the Integrated Plan the licensee stated that one storage building will be constructed to house the FLEX equipment for Beaver Valley Units 1 and 2. The location for this building has not yet been finalized.

On pages 21, 37, 54 and 66 of the Integrated Plan stated that the storage and protection of the equipment required for various strategies would be provided by the Unit 1 or Unit 2 PAB or by the FLEX storage building. Each is, or will be, designed to withstand high wind loads and tornado missiles using the site tornado conditions and the requirements of ASCE 7-10. The NRC staff reviewed this information and since ASCE 7-10 does not provide criteria for tornado missile protection, it was unclear whether the new FLEX building will be designed to withstand tornado missiles at a level equal to or greater than the plant's tornado missile design basis. This is Confirmatory Item 3.1.3.1.A in Section 4.2.

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

Because BVPS is not susceptible to hurricanes, considerations 1, 2, and 5 are inapplicable.

In the SOE Timeline, Attachment 1, of the Integrated Plan the licensee stated that at hour 1.0, they would initiate the site damage assessment. This action provides information on which components, structures, and water sources are available to support FLEX strategies, and what debris removal concerns have to be alleviated to deploy FLEX equipment. Beginning this action as soon as an ELAP is declared allows maximum time to remove debris before FLEX equipment must be deployed. At 2.0 hours they would initiate debris removal processes on the deployment paths to move the FLEX water transfer pumps to the Ohio River, and to move the FLEX core cooling pumps to the staging locations adjacent to the PPDWST. They would initiate large debris removal equipment deployment at hour 25.0. This equipment will be used to clear a path for transport of other large RRC equipment into the protected area.

During the audit process the licensee stated that using the guidance provided in Figure 7.1 of NEI 12-06, they determined that Beaver Valley site is not subject to high winds due to hurricanes. Using the guidance in Figure 7.2 of NEI 12-06, the licensee determined that the Beaver Valley site is subject to damage from high winds due to tornados. Although there can be a large amount of warning time to prepare for a hurricane, this is not the case for a tornado which typically has little or no warning. Therefore there are only a few pre-emptive actions in the current procedures, they are only taken in the event of an actual tornado warning or tornado sighted by personnel on site. These actions ensure the integrity of the control room and maximize the availability of the EDG's to perform their function in the event offsite power is lost. For any other wind associated events (tornado warning, severe weather, etc.) the actions are oriented towards management of risk. The licensee also stated that equipment used to deploy FLEX portable equipment will also be protected against all applicable hazards. The current plan is to store equipment used to deploy FLEX portable equipment within the same storage structure as the FLEX portable equipment.

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

3.1.3.3 Procedural Interfaces - High Winds Hazard

NEI 12-06, Section 7.3.3, states:

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

As discussed in their Integrated Plan and during the audit process, and as described in Section 3.1.3.2 of this report, the licensee has considered the interface of existing procedures in their plans to address high wind hazards due to tornados.

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 to address to high wind hazards, if these requirements are implemented as described.

3.1.3.4. Considerations in Using Offsite Resources – High Wind hazard

NEI 12-06, Section 7.3.4 states:

> Extreme storms with high winds can have regional impacts that could have a significant impact on the transportation of off-site resources.

1. Sites should review site access routes to determine the best means to obtain resources from off-site following a hurricane.

2. Sites impacted by storms with high winds should consider where equipment delivered from off-site could be staged for use on-site.

In their Integrated Plan and during the audit process the licensee stated that the site was vulnerable to high winds generated by tornados but not those generated by hurricanes. Therefore the impact of those high winds would be more localized and were not likely to have regional impact on the transportation of off-site resources.

During the audit process the licensee stated that they are in the process of developing the playbook in conjunction with the RRC. Review of the licensee's plan for the use of offsite resources did not confirm that it would provide reasonable assurance that the plan will comply with NEI 12-06, Section 7.3.4 regarding high wind hazards, due to the absence of identification of the primary and secondary staging areas and a description of the methods to be used to deliver the equipment to the site. This is Confirmatory Item 3.1.3.4.A in Section 4.2 of this report.

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

3.1.4 Snow, Ice and Extreme Cold

As discussed in NEI 12-06, Section 8.2.1:

> All sites should consider the temperature ranges and weather conditions for their site in storing and deploying their FLEX equipment consistent with normal design practices. All sites outside of Southern California, Arizona, the Gulf Coast and Florida are expected to address deployment for conditions of snow, ice, and extreme cold. All sites located North of the 35th Parallel should provide the capability to address extreme snowfall with snow removal equipment. Finally, all sites except for those within Level 1 and 2 of the maximum ice storm severity map contained in Figure 8-2 should address the impact of ice storms.

On page 3 of the Integrated Plan the licensee stated that the Beaver Valley site is above the 35th parallel (40 degrees 37 minutes north and 80 degrees 26 minutes west) and 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. On Figure 8-1 of NEI 12-06, the Beaver Valley site is located in the area identified as purple and pink, so 3-day snowfalls up to 36 inches should be anticipated. The maximum 24-hour snowfall recorded between 1870 and 1970 was 17.5 inches. The minimum recorded temperature in the area around the Beaver Valley site between 1870 and 1970 was -20 degrees F. Also on page 3 of the Integrated Plan the licensee stated that the Beaver Valley site is in the Level 3 region of the maximum ice storm severity map of NEI 12-06, Figure 8-2; therefore, the FLEX strategies must consider the impedances caused by ice storms.

Review of the licensee's screening for hazards due to snow, ice and extreme cold provides reasonable assurance that the licensee has appropriately screened in the need to address deployment for conditions of low to medium damage to power lines and/or existence of a considerable amount of ice and the impedances caused by extreme snowfall, as well as the challenges that extreme cold temperatures may present.

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

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

NEI 12-06, Section 8.3.1 states:

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

On pages 21, 54 and 66 of the Integrated Plan regarding the strategies for maintaining core cooling and heat removal, maintaining SFP cooling and safety function support in the transition phase, the licensee stated that protection of associated portable equipment from snow, ice and extreme cold would be provided by the FLEX storage building which would be designed with adequate heating to ensure that extreme cold temperatures do not affect the functionality of the FLEX equipment.

On page 37 of Integrated Plan regarding the strategies for maintaining RCS inventory in the transition phase, FENOC stated that an evaluation will be performed to determine if heating is needed in the PAB at Unit 1 and the PAB at Unit 2 to ensure that extreme cold temperatures will not affect the functionality of the FLEX equipment stored in those structures or the solubility of Boron in the BATs.

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

In the SOE Timeline, Attachment 1, of the Integrated Plan the licensee stated that at hour 1.0, they would initiate the site damage assessment. This action provides information on which components, structures, and water sources are available to support FLEX strategies, and what debris removal concerns have to be alleviated to deploy FLEX equipment. Beginning this action as soon as an ELAP is declared allows maximum time to remove debris before FLEX equipment must be deployed. At 2.0 hours they would initiate debris removal processes on the deployment paths to move the FLEX water transfer pumps to the Ohio River, and to move the FLEX core cooling pumps to the staging locations adjacent to the PPDWST. They would initiate large debris removal equipment deployment at hour 25.0. This equipment will be used to clear a path for transport of other large RRC equipment into the protected area. Procedures will be developed to clear ice and snow from the area around the storage building and the deployment paths.

On page 3 of the Integrated Plan regarding deployment of FLEX equipment the licensee stated that there are no rapids in the vicinity of the Beaver Valley site, so high winds or a rapid drop in air temperature would be required to form frazil ice. A survey of experience along the upper Ohio River yielded no instance of blockage of intake structures with frazil ice. Therefore, frazil ice is not considered to be a hazard for the Beaver Valley site.

On page 11 of the Integrated Plan, regarding how programmatic controls will be met; the licensee stated that equipment associated with these strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control in accordance with Section 11 of NEI 12-06.

On pages 21, 54 and 66 of the Integrated Plan, regarding how portable FLEX equipment is protected or is scheduled to be protected from snow, ice and extreme cold, the licensee stated procedures will be developed to clear ice and snow from the area around the storage building and the deployment paths. On page 37 of the Integrated Plan the licensee stated that an evaluation will be performed to determine if heating is needed in the PABs to ensure that extreme cold temperatures will not affect the functionality of the FLEX equipment or the solubility of boron in the BATs.

During the audit process the licensee stated that BVPS regularly clears plant pathways of ice and snow during the winter to ensure safe passage between buildings and to all parts of the site. When storage locations and portable equipment deployed locations are finalized and proceduralized, deployment routes as well as staging areas will be finalized and physically marked on the site. This will serve to keep these pathways clear of obstruction and also mark the routes and areas that will need to be kept free of snow and ice. Additionally, several trucks will be procured for the primary purpose of deploying equipment; one or more should be configured with the capability of snow removal and salt spreading. This will enable the site to address FLEX deployment in the event of snow and ice regardless of the status of normal snow removal.

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 deployment of FLEX equipment considering the 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 8.3.4, states:

> The only procedural enhancements that would be expected to apply involve addressing the effects of snow and ice on transport of 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 addressed the issue of procedural interfaces in the Integrated Plan and during the audit process as described in Section 3.1.4.2 of this report.

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 enhancement of procedural interfaces regarding snow, ice and extreme cold events, if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.4, states:

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

On pages 29, 49 and 71 of the Integrated Plan the licensee stated that the deployment paths for equipment received from the RRC would be developed after FENOC and the RRC have agreed upon a location for the near site staging area to receive equipment onto the site. The deployment paths will be evaluated against the potential for damage caused by external hazards.

During the audit process the licensee stated that they are in the process of developing the playbook in conjunction with the RRC. Review of the licensee's plan for the use of offsite resources did not confirm that it would provide reasonable assurance that the plan will comply with NEI 12-06, Section 8.3.4 regarding snow, ice and extreme cold hazards, due to the absence of identification of the primary and secondary staging areas and a description of the methods to be used to deliver the equipment to the site. This is Confirmatory Item 3.1.4.4.A in Section 4.2 of this report.

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

3.1.5 High Temperatures

NEI 12-06, Section 9 states:

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

On page 4 of the Integrated Plan, regarding the determination of applicable extreme external hazards, the licensee stated that for selection of FLEX equipment the Beaver Valley site will consider the site maximum expected temperatures in their specification, storage, and deployment requirements, including ensuring adequate ventilation or supplementary cooling, if 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 screening for high temperatures, if these requirements are implemented as described.

3.1.5.1 Protection of FLEX Equipment – High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

On pages 21, 54, and 66 of the Integrated Plan regarding the strategies for maintaining core cooling and heat removal, maintaining SFP cooling and safety functions support, the licensee stated that the FLEX storage building will include adequate ventilation to ensure that high temperatures do not affect the functionality of 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 hazards, 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 4 of the Integrated Plan the licensee stated that for selection of FLEX equipment the Beaver Valley site will consider the site maximum expected temperatures in their specification, storage, and deployment requirements, including ensuring adequate ventilation or supplementary cooling, if 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 deployment of FLEX equipment considering the high temperature hazard, if these requirements are implemented as described.

3.1.5.3 Procedural Interfaces – High Temperature hazard:

NEI 12-06, Section 9.3.3 states:

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

During the audit process the licensee stated that portable equipment will be of rugged construction grade and specified to operate under extreme heat conditions. Flex portable equipment is staged and operated outside with the exception of the motor driven high pressure pumps used to pump borated water into the RCS. The specification of the FLEX pumps, engine and motors will be such that they will be able to operate in high temperature 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 to regard to procedural interfaces for high temperature hazards, if these requirements are implemented as described.

3.2 PHASED APPROACH

Attachment (2) to Order EA-12-049 describes the three-phase approach required for mitigating 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 Inventory Control Strategies

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

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

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

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

3.2.1.1 Computer Code Used for the ELAP Analysis

NEI 12-06, Section 1.3 states in part:

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

The licensee provided a SOE in their Integrated Plan that included the time constraints and the technical basis for the site. That SOE is based on an analysis using the industry-developed NOTRUMP computer code. NOTRUMP was written to simulate the response of PWRs to small-break loss of coolant accident (LOCA) transients for licensing basis safety analysis.

The licensee decided to use the NOTRUMP computer code for simulating the ELAP event. Although NOTRUMP has been reviewed and approved for performing small-break LOCA analysis for PWRs, the NRC staff had not previously examined its technical adequacy for simulating an ELAP event. In particular, the ELAP scenario is differentiated from typical design-basis small-break LOCA scenarios in several key respects, including the absence of normal emergency core cooling system (ECCS) injection and the substantially reduced leakage rate, which places significantly greater emphasis on the accurate prediction of primary-to-secondary heat transfer, natural circulation, and two-phase flow within the RCS. As a result of these differences, NRC staff concern arose associated with the use of the NOTRUMP code for ELAP analysis for modeling of two-phase flow within the RCS and heat transfer across the steam generator tubes as single-phase natural circulation transitions to two-phase flow and the reflux condensation cooling mode.

The NRC staff position is that reliance on the NOTRUMP code for the ELAP analysis of Westinghouse plants is limited to the flow conditions prior to reflux condensation initiation. This includes specifying an acceptable definition for reflux condensation cooling. This is identified as Confirmatory Item 3.2.1.1.A in Section 4.2 below.

During the audit process the licensee provided additional information specifying which analysis performed in WCAP-17601-P is being applied. The licensee also provided a discussion to justify the use of that analysis by identifying and evaluating the important parameters and assumptions demonstrating that they are representative of the site and appropriate for simulating the ELAP transient. The NRC staff will review this information to ensure that it sufficiently justifies the analysis being applied. Additional information may be needed to confirm the appropriate use of the analysis. This has been identified as Confirmatory Item 3.2.1.1.B in Section 4.2.

During the audit process the licensee stated that the plant-specific versions of the FSGs would be developed from Guidelines issued by the PWROG. The plant-specific version will be validated in accordance with 1/2OM-53B.1, “BVPS EOP Executive Volume.” The Guidelines may be validated on the Unit 1 and Unit 2 simulators, by a designated tabletop committee, or by walk down.

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

3.2.1.2 RCP Seal Leakage Rates

NEI 12-06, Section 1.3 states:

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

During an ELAP event, cooling to the RCP seal packages will be lost and water at high temperatures will degrade seal materials, leading to seal leakages from the RCS. Without ac power available to the ECCS, the RCS inventory loss from the seal leakages for an extended time period will result in inadequate core cooling conditions. The ELAP analysis credits operator actions to align the high-pressure RCS makeup sources and replenish the RCS inventory for maintaining the core covered with water. The effect of the seal leakage rates on the results of the ELAP analysis is that the greater values of the seal leakage rates will result in a shorter required operator action time for the operator to align the high pressure RCS makeup water sources.

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

- WCAP-17601-P, Revision 1, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs" dated January 2013 (ADAMS Accession No. ML13042A011 and ML13042A013 (Non-Publically Available)).

- A position paper dated August 16, 2013, entitled "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Reactor coolant (RCP) Seal Leakage in Support of the Pressurized Water reactor Owners Group (PWROG)" (ADAMS Accession No. ML13190A201 (Non-Publically Available)).

After review of these submittals, the NRC staff has placed certain limitations for Westinghouse designed plants. Those limitations and their corresponding Confirmatory Item numbers for this TER are provided as follows:

(1) For the plants using Westinghouse RCPs and seals that are not the SHIELD shutdown seals, the RCP seal initial maximum leakage rate should be greater than or equal to the upper bound expectation for the seal leakage rate for the ELAP event (21 gpm/seal) discussed in the PWROG position paper addressing the RCP seal leakage for Westinghouse plants (Reference 2). If the RCP seal leakage rates

used in the plant-specific ELAP analyses are less than the upper bound expectation for the seal leakage rate discussed in the position paper, justification should be provided. If the seals are changed to non-Westinghouse seals, the acceptability of the use of non-Westinghouse seals should be addressed, and the RCP seal leakage rates for use in the ELAP analysis should be provided with acceptable justification. (This item does not apply because the licensee will install SHIELD shutdown seals).

(2) In some plant designs, such as those with 1200 to 1300 psia SG design pressures and no accumulator backing of the main steam system power-operated relief valve (PORV) actuators, the cold legs could experience temperatures as high as 580 ^{0}F before cooldown commences. This is beyond the qualification temperature (550 ^{0}F) of the O-rings used in the RCP seals. For those Westinghouse designs, a discussion of the information (including the applicable analysis and relevant seal leakage testing data) should be provided to justify that (1) the integrity of the associated O-rings will be maintained at the temperature conditions experienced during the ELAP event, and (2) the seal leakage rate of 21 gpm/seal used in the ELAP is adequate and acceptable. (This item does not apply because the licensee will install SHIELD shutdown seals).

(3) Some Westinghouse plants have installed or will install the SHIELD shutdown seals, or other types of low leakage seals, and have credited or will credit a low seal leakage rate (e.g., 1 gpm/seal) in the ELAP analyses for the RCS response. For those plants, information should be provided to address the impacts of the Westinghouse 10 CFR Part 21 report, “Notification of the Potential Existence of Defects Pursuant to 10 CFR Part 21,” dated July 26, 2013 (ADAMS Accession No. ML13211A168) on the use of the low seal leakage rate in the ELAP analysis. This is identified as Confirmatory Item 3.2.1.2.A in Section 4.2.

(4) If the seals are changed to the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals, the acceptability of the use of the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals should be addressed, and the RCP seal leakages rates for use in the ELAP analysis should be provided with acceptable justification. This is identified as Confirmatory Item 3.2.1.2.B in Section 4.2.

During the audit process the licensee stated that WCAP-17601-P discusses Beaver Valley but the plant-specific analyses are contained in a proprietary Westinghouse calculation. This calculation addressed BVPS RCS inventory control, shutdown margin and boric acid precipitation without using any computer codes (EXCEL was utilized). The summary analysis stated that with the shutdown seals installed, RCP seal leakage is limited to 1-gpm per RCP (plus 1-gpm unidentified RCS leakage). Consequently, two-phase flow does not occur during the boration period. Shutdown margin is established within 24 hours by 10-gpm flow from the BAT into the RCS. Accumulator injection is credited for the RCS volume make-up but not boration. Use of the head vent or another RCS letdown path is not required. The table, “Beaver Valley Plant-Specific Evaluation of Significant PWROG Generic NSS Parameters” contains a comparison between WCAP-17601 and BVPS specific calculations.

During the audit process the licensee stated that BVPS Units 1 and Unit 2 utilize Westinghouse Model 93A RCPs with Westinghouse mechanical seals and high temperature O-rings. This combination of RCP and seal packages complies with the seal leakage model described in

WCAP-17601-P, Section 5.3.1.4 for the Standard 312 design consisting of three loops, 2950 MWt, Model 54F steam generators, High Pressure ECCS, and Model 93A/A-1 RCPs. To support both mitigating strategies for an ELAP and transition to the NFPA 805 Fire Protection Standard, BVPS plans to install new low-leakage RCP seals at each unit to provide a more controllable leak rate if cooling flow is lost to the RCP seals due to an ELAP or a fire. The BVPS-1 and BVPS-2 Fire PRA models currently credit the Westinghouse Electric Company (WEC) SHIELD™ Passive Thermal Shutdown Seal (SDS) for this purpose. However, with the recent failure of the Beaver Valley SDS to actuate when tested following less than one reactor fuel cycle of operation, FENOC is tracking the Westinghouse redesign and qualification testing of their SDS. Alternatives to the WEC SDS are also being evaluated in the event the Westinghouse SDS redesign fails to meet the requirements.

During the audit process the licensee stated that the pressure-dependent RCP seal leakage rates calculated in WCAP-17601-P are based on CN-LIS-11-75, which is a Westinghouse proprietary document. However, another Westinghouse NOTRUMP analysis was performed specifically for BVPS for the ELAP assuming that a 1-gpm/RCP seal leak given that low-leakage seals are to be installed. The licensee also stated that due to installation of the low-leakage seals, the use of this flow rate model should not be challenged by changing flow conditions, since the Westinghouse shutdown seals were tested immediately following actuation of the SDS and were found to maintain their leakage to very small values. This test provided the most challenging conditions for the case where the temperature of the polymer does not reach its softening temperature and the pressure decrease minimizes the ability of the polymer ring to constrict on the sealing surface. Additionally, another analysis performed for BVPS shows that with low-leakage RCP shutdown seals installed, single-phase natural circulation can be sustained by maintaining the collapsed water level in the reactor higher then the top of the hot leg without any external makeup for about 45 hours into the ELAP.

During the audit process the licensee stated that prior to the implementation of FLEX, Beaver Valley would be modified to install low-leakage seals on all RCPs at both units. Each RCP will have a leak rate of less than 1 gpm. The leakage rate from the low-leakage RCP seals is not expected to increase beyond 1 gpm for at least 7 days following an ELAP. The licensee also stated that for a loss of all RCP cooling event in which all cooling water is lost, hot reactor coolant would travel up the pump casing and through the No. 1 seal. This would activate the SDS and stop the flow of all reactor coolant in the pump casing. This essentially prevents reactor coolant water from reaching the RCP seal components downstream of the SDS (i.e., the No. 2 and No. 3 seals). The licensee described the seal package components that are susceptible to thermal shock. The licensee also described in detail the parameters that were used during the extended O-ring qualification testing.

The licensee’s approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the 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 8 of the Integrated Plan, in the sequence of events, item 12 the licensee states:

> RCS cooldown should be initiated at hour 8.0 as allowed by ECA.0-0 with low leakage RCP shutdown seals installed. Cooldown to approximately 400°F will be performed at a rate of 100°F/hr. and as such is expected to take approximately 1.5 hours. However, the cooldown will be given a four-hour window for completion to prevent time pressure while performing a cooldown with local control of the atmospheric steam dump valves and AFW throttle valves.

In item 1 of Attachment 1B of the Integrated Plan, NSSS Significant Reference Analysis Reconciliation Table, the licensee stated that for the Decay Heat Model they used the WCAP-17601-P value ANS 7.9 + 2σ because it is more conservative than the best estimate decay heat curve. FENOC also stated that use of best estimate decay heat to justify the need time for PPDWST makeup based on delayed cooldown is a deviation from WCAP-17601-P and is acceptable per NEI 12-06 and is justified by Westinghouse Report TR-FSE-13-7, Revision 2, "Beaver Valley FLEX Integrated Plan," February 2013.

In item 2 of Attachment 1B of the integrated plan, the licensee addressed Section 5.2.2 of WCAP-17601-P, which provides an equation to determine the makeup needs during the first 24 hours. The licensee stated that the volume in the PPDWSTs would provide makeup to the steam generators until 9 hours after the event (with cooldown initiated at 8 hours after the event), at which time the Unit 2 DWST or Ohio River will be used as a source to reach 24 hours. Use of the best estimate decay heat to justify the need time for makeup to the PPDWST based on the delayed cooldown is a deviation from WCAP-17601-P.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to decay heat, 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 pages 3 and 4 of Attachment 1 of the Integrated Plan the licensee stated that the assumptions are consistent with those detailed in NEI 12-06, Section 3.2.1. The initial plant conditions are assumed to be the following:

- 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.

- At the time of the postulated event, the reactor and supporting systems are within normal operating ranges for pressure, temperature, and water level for the appropriate plant condition.

- No specific initiating event is used. The initial condition is assumed to be a loss of offsite power (LOOP) at a plant site resulting from an external event that affects the offsite power system either throughout the grid or at the plant with no prospect for recovery of offsite power for an extended period. The LOOP is assumed to affect all units at a plant site.

- All installed sources of emergency onsite ac power and SBO Alternate ac power sources are assumed to be not available and not imminently recoverable.

- 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 available.

- Normal access to the UHS is lost, but the water inventory in the UHS remains available and robust piping connecting the UHS to plant systems remains intact. The motive force for the UHS flow, i.e., pumps, is assumed to be lost with no prospect for recovery.

The NRC staff review indicates that licensee's plan for initial plant conditions and initial conditions are consistent with NEI 12-06, Section 3.2.1.2 and 3.2.1.3.

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 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

On pages 16 and 19 of Attachment 1 of the Integrated Plan, the licensee listed the instrumentation credited or recovered for maintaining core cooling and heat removal during Phases 1 and 2 of an ELAP.

- Steam Generator Level-Wide Range
- Steam Generator Pressure
- PPDWST Level
- RCS Wide Range Pressure
- Core Exit Thermocouple Temperature
- Pressurizer Level
- Reactor Vessel Level Instrumentation

The licensee stated that it would develop procedures to read this instrumentation locally, where applicable, using a portable instrument, as required by Section 5.3.3 of NEI 12-06.

During the audit process the licensee stated that the instrumentation listed on pages 16, 18, 28 and 34 of the Integrated Plan is located inside the containment and is environmentally qualified for post-DBA and are not affected by the containment heat-up. The containment temperature, pressure, and humidity were evaluated by an assessment of a calculation that bounds the ELAP mass and energy releases to containment (with steam generators available). This methodology does not use any formal computer codes (only an Excel spreadsheet).

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

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

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

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

> Each site should establish the minimum coping capabilities consistent with unit-specific evaluation of the potential impacts and responses to an ELAP and LUHS. In general, this coping can be thought of as occurring in three phases:
>
> - Phase 1: Cope relying on installed plant equipment.
>
> - Phase 2: Transition from installed plant equipment to on-site FLEX equipment.
>
> - Phase 3: Obtain additional capability and redundancy from off-site equipment until power, water, and coolant injection systems are restored or commissioned.
>
> In order to support the objective of an indefinite coping capability, each plant will be expected to establish capabilities consistent with Table 3-2 (PWRs). Additional explanation of these functions and capabilities are provided in NEI 12-06 Appendix D, "Approach to PWR Functions."

Pages 7 through 10 and Attachment 1A of the Integrated Plan identified the operator actions credited in the ELAP analysis. The SOE and any associated time constraints are identified for Beaver Valley coping strategies for FLEX Phase 1 through Phase 3 when steam generators are available to provide core cooling. These actions are bounding when compared to the steam generators not available for core cooling and full core off-load scenarios as they require the most personnel, actions, and time constraints. The times stated are taken to be the elapsed time after the loss of power due to the external event.

Review of the information provided in their Integrated Plan indicates that the licensee had used a plant-specific analysis, Westinghouse Report TR-FSE-13-7, Revision 2, "Beaver Valley FLEX Integrated Plan," to establish the Attachment 1A, SOE Timeline. In the Integrated Plan the licensee provided a description of the actions required and the time constraints for completing these actions. The licensee stated that the times identified to initiate each action in this section and in Attachment 1A are based on resource loading to allow completion of all actions prior to their individual time constraints. During the audit process the licensee stated that the plant-specific version of the FSGs will be developed from the general Guidelines issued by the PWROG. The plant-specific version will be validated in accordance with 1/2OM-53B.1, BVPS EOP Executive Volume. The Guidelines may be validated on the Unit 1 and Unit 2 simulators, by designated tabletop committee or by walk down. Validations of a time-sensitive nature will be performed in accordance with the applicable proportions of NOP-OP-1013, Time-Critical Operator Actions Control. NOP-OP-1013 contains the instructions for validation of the operator time-critical actions supporting accident analysis, Appendix R and Safe Shutdown, and Station Blackout Rule.

During the audit process the licensee discussed the options they were considering to protect the Unit 1 Turbine Driven Auxiliary Feedwater (TDAFW) pump exhaust stacks from missile hazards. The licensee stated that they understand the importance of a reliable TDAFW pump for implementing the FLEX mitigating strategies and for the overall safety posture of the plant. Licensee completion of their review and finalizing a decision regarding steps to resolve concerns regarding the potential impact that damage the exhaust stacks is identified as Open Item 3.2.1.6.A in Section 4.1 of this report.

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

3.2.1.7 Cold Shutdown and Refueling

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

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

The NRC staff reviewed the licensee's Integrated Plan and determined that the Generic Concern related to shutdown and refueling requirements is applicable to Beaver Valley. This Generic Concern has been resolved generically through the NRC endorsement of NEI position paper entitled "Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514); and has been endorsed by the NRC in a letter dated September 30, 2013 (ADAMS Accession No.

ML13267A382).

The position paper describes how licensees will, by procedure, maintain equipment available for deployment in shutdown and refueling modes. The NRC staff concluded that the position paper provides an acceptable approach for demonstrating that the licensees are capable of implementing mitigating strategies in all modes of operation. The NRC staff will evaluate the licensee's resulting program through the audit and inspection process.

During the audit process the licensee stated that BVPS will abide by the NEI position paper addressing mitigating strategies in shutdown and refueling modes.

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.

In the Integrated Plan the licensee stated that Section 4.3.2 of WCAP-17601-P indicates that one of the acceptance criteria of the ELAP analysis is to show that the core remains subcritical. Case 11 in Table 5.2.2-1 of WCAP-17601-P indicates that the available shutdown margin is 2.3% $\Delta\rho$ at 72 hours when considering a plant cooldown to approximately 300 degrees F (cold leg) during an ELAP.

On page 9 of the Integrated Plan the licensee stated, in Item 14, that at hour 11.0 they would initiate deployment of the hoses and power cables associated with the RCS boration function. The FLEX RCS pump is staged in place, and does not require deployment. The Integrated Plan also stated that 6,105 gallons of highly borated coolant from the BATs is required within 24 hours to maintain subcriticality at the target RCS temperature after cooldown as Xenon decays.

On page 33 of the Integrated Plan the licensee stated that the addition of boron to maintain adequate shutdown margin is not required until 13 hours after the external event. Phase 1 will not involve any operator actions to provide boration.

On page 35 of the Integrated Plan the licensee stated that the transition to Phase 2 strategies is driven by the need to borate the RCS to provide continued subcriticality as xenon decays. It has been determined that RCS boration is not required to be initiated until 13.8 hours following the reactor trip in order to borate the RCS to maintain subcriticality at the target RCS temperature after cooldown assuming that the core is free of xenon within 24 hours. RCS inventory control and boration will be provided by an electric powered FLEX RCS pump to inject borated coolant into the chemical and volume control system (CVCS). The suction source for this function is the BAT at each unit. The quantity of coolant and the boron concentration in these tanks has been shown to be sufficient for Phase 2 without requiring makeup. The inventory in this tank has been shown to provide RCS boration and makeup for approximately 41 hours after the event at Unit I and 48 hours after the event at Unit 2.

On page 41 of the Integrated Plan the licensee stated that at the beginning of Phase 3, Beaver Valley will continue with the strategies for providing RCS inventory control and boration using the FLEX strategies described for Phase 2. The inventory in this BAT has been shown to provide RCS boration and makeup for approximately 41 hours after the event at Unit 1 and 48 hours after the event at Unit 2. This time is sufficient such that another suction source does not have to be used to support the continuation of this strategy into Phase 3.

During the audit process the licensee stated they had used the uniform boron mixing model. Boric acid concentration data were extracted on time intervals greater than 30 minutes, corresponding to the time between injection and the time when mixing between the injected fluid and the RCS mass in the model is representative. The method used is consistent with the PWROG white paper related the boron mixing model. The RCS shutdown seals will maintain low RCS leakage rates throughout the ELAP such that two-phase RCS flow does not need to be considered. The boron concentration in the RCS is considered uniform 30 minutes after addition.

During the audit process the licensee also stated that with the shutdown seals installed, RCS leakage is limited to 1 gpm per RCP (plus 1 gpm unidentified RCS leakage). Consequently, two-phase flow does not occur during the boration period. The results indicate that shutdown margin is established within 24 hours by 10 gpm of 7000-ppm boron flow from the BAT in to the RCS. Head vent or another RCS letdown path is not required. The analyses cover the beginning, middle and end of life cores. The BATs are the sole boration source. The BVPS FLEX strategy does not require the use of any of the installed charging pumps at either unit.

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

The Pressurized Water Reactor Owners Group submitted a position paper, dated August 15, 2013 (withheld from public disclosure due to proprietary content), which provides test data regarding boric acid mixing under single-phase natural circulation conditions and outlined applicability conditions intended to ensure that boric acid addition and mixing would occur under conditions similar to those for which boric acid mixing data is available. In an endorsement letter dated January 8, 2014, the NRC staff concluded that the August 15, 2013, position paper constitutes an acceptable approach for addressing boric acid mixing under natural circulation during an ELAP event, provided that the following additional conditions are satisfied:

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

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

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

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

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

During the audit process, the licensee informed the NRC staff of its intent to abide by all the points presented in the generic approach. However, the delay time of 30 minutes currently used for ensuring uniform boron mixing in the RCS is less than the delay time of 60 minutes indicated in the endorsement letter. As such, resolution of this concern for BVPS is identified as Open Item 3.2.1.8.A in Section 4.1.

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

3.2.1.9. Use of Portable Pumps.

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

> Regardless of installed coping capability, all plants will include the ability to use portable pumps to provide RPV/RCS/SG makeup as a means to provide diverse capability beyond installed equipment. The use of portable pumps to provide 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 that installed equipment degrades or fails. Preparations for reactive use of portable equipment should not distract site resources from establishing the primary coping strategy. In some cases, in order to meet the time-sensitive required actions of the site-specific strategies; the FLEX equipment may need to be stored in its deployed position.

NEI 12-06 Section 11.2 states in part:

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

On pages 14 and 15 of the Integrated Plan the licensee stated that for an event that occurs when the steam generators are available to provide core cooling, Phase 2 is initiated when the FLEX water transfer pump is deployed to maintain adequate level for TDAFWP suction. Although the TDAFWP will continue to provide flow to the steam generators for the duration of the RCS cooldown, the FLEX core cooling pump is deployed in case of a TDAWFP failure during this plant transient. After the cooldown is complete and the operating conditions of the TDAFWP cannot be reliably maintained (such as plant cooldown because of steam extraction), reactor core cooling and heat removal with steam generators available will be provided by using the FLEX core cooling pump to inject water into the auxiliary feedwater (AFW) system. Existing AFW piping will feed all three steam generators at each unit, and the steam generators will remove heat from the RCS. The suction source for this function is the PPDWST at each unit. As the inventory in the PPDWST is exhausted, makeup will be provided by either the Unit 2 demineralized water storage tank (DWST) or the Ohio River. The inventory in each PPDWST has been shown to last approximately 9 hours when RCS cooldown is initiated 8 hours after the event. Three diesel driven pumps will be stored on site to provide core cooling with or without steam generators available to support the N+1 requirement for FLEX. Each unit requires one pump to support the Phase 2 strategies. The FLEX core cooling pump will be sized to provide the bounding hydraulic requirements for all core cooling alignments for both Units. The pump must provide at least 320 gpm of flow at a discharge pressure of 411 psi.

On pages 74 and 75 of the Integrated Plan the licensee provided a table that lists the PWR Portable Equipment required for Phase 2 and Phase 3. This list identifies the uses for these pumps and the performance criteria.

During the audit process the licensee provided additional information on their plans for using portable pumps for maintaining core cooling & heat removal, and RCS inventory control during Phase 2 and Phase 3. The licensee provided information on the required times for the operator to realign each of the pumps and confirm that those times are consistent with the results of the ELAP analysis. The licensee also stated that further details were provided in the Westinghouse proprietary calculations. The licensee also provided information on the required capacities of the portable pumps to show that they were adequate to fulfill their intended functions in time to support their function specified in the integrated plan. These pumps include the Core Cooling pump, the RCS pump, the SFP pump, the water transfer pump, the UHS pump and the submersible UHS pumps (pair).

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 SFP 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 gallons per minute (gpm) per unit (250 gpm to account for overspray). This approach will also provide a vent pathway for steam and condensate from the SFP.

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

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

On page 50 of the Integrated Plan the licensee stated, in part, that the time to boil with an initial SFP temperature of 110 degrees F and the normal decay heat load in the pool is 18.69 hours for Unit 1 and 19.54 hours for Unit 2. It will take approximately 71 hours until the inventory reaches 15 ft. above the top of the fuel racks.

On page 51 of the Integrated Plan the licensee stated that it would perform a modification to install SFP level instrumentation that is in compliance with order EA-12-051 and that it would develop procedures to read this instrumentation locally, where applicable, using a portable instrument as required by Section 5.3.3 of NEI 12-06.

On page 52 of the Integrated Plan the licensee stated that with the plant operating, the transition to Phase 2 strategies would be made as the inventory in the SFP slowly declines due to boiling. The licensee determined that SFP makeup with an intact pool would not be required until 71 hours for a normal decay heat load. The SFP cooling will be provided by using the FLEX SFP pump to inject coolant directly into the pool via the existing SFP cooling piping.

On page 52 of the Integrated Plan the licensee stated, in part, that with fuel in transfer or during a full core off-load, an initial SFP temperature of 140 degrees F and a maximum decay heat load, the time to boil is 2.85 hours for Unit 1 and 2.96 hours for Unit 2. It will take approximately 14.25 hours for the inventory to decrease to 15 ft. above the top of the fuel racks. SFP cooling will be provided by using the FLEX SFP pump to inject coolant directly into the pool via existing SFP cooling piping. Makeup for boil-off applicable to all conditions will be via the use of a portable hose placed directly into the pool. The pool deck is located at elevation 766' 6" of the fuel handling building (FHB) at Unit 1, and elevation 766' 4" of the FHB at Unit 2. The secondary connection at both units is to connect to existing fuel pool cooling piping, downstream of the SFP heat exchangers.

On page 52 of the Integrated Plan the licensee stated that the suction source for the primary and secondary connections for this function (SFP fill) will be the RWST at each unit. The RWSTs are not currently fully protected from tornado missiles. The licensee stated that it may pursue hardening these tanks against tornado missiles. If the site does not pursue this path, then the RWSTs will be used as a suction source for all external hazards considered in NEI 12-06 except for high winds and for high wind events that do not damage the tanks. If the high wind event damages the RWSTs, the suction source will be the Ohio River.

The NRC staff will review the licensee's determination to as whether or not the RWST will need to be further protected against missile hazards. This is identified as Confirmatory Item 3.2.2.A in Section 4.2 below.

On pages 52 and 53 of the Integrated Plan the licensee stated that the SFP cooling through spray will be provided by using the FLEX SFP pump to spray the coolant into the pool using portable FLEX spray nozzles placed on the fuel deck at both units. The suction source for SFP spray will be the Ohio River for all external hazards considered in NEI 12-06. Three diesel driven pumps will be stored on site for this function to support the N+1 requirement for FLEX. Each unit requires one pump to support the Phase 2 strategies. The SFP pump will be sized to provide the bounding hydraulic requirements for all SFP cooling alignments at both Units. The pump must provide at least 250 gpm of flow at a discharge pressure of 120 psi.

On page 59 of the Integrated Plan the licensee stated that the strategies described for Phase 2 can continue for Phase 3 as long as there is sufficient inventory available to feed the strategies. For long term cooling of the SFP, the licensee intends to repower one train of normal pool cooling equipment at each unit. The large Phase 3 FLEX 4160V diesel generator (described in detail in the Phase 3 safety functions support section of this report) will be used to repower one fuel pool cooling pump at each unit. To remove heat, the component cooling water system will be aligned to cool the pool through one SFP heat exchanger. The heat will ultimately be removed to the Ohio River using the river water (at Unit 1) and service water (at Unit 2) FLEX strategies as described in the Phase 3 core cooling section of this report.

During the audit process, the license stated that in a full core offload condition; the maximum SFP heat load requires makeup of boil-off at 86.4 gpm. An iterative spreadsheet using an initial SFP concentration of 2600 ppm, maximum RWST concentration of 2600 ppm, constant SFP boil-off rate of 86.4 gpm, and a constant SFP fluid volume of 25,820 cubic feet (excluding fuel transfer canal and cask pit volume) was developed. The time to boil-off to result in boric acid precipitation (at 30,000 ppm boron) is more than a week.

Review of the licenses Integrated Plan indicated that the licensee's plan for maintaining SFP cooling is consistent with the guidance found in NEI 12-06. The time to boil with an initial SFP temperature of 140 degrees F and the maximum decay heat load in the pool is 2.85 hours at Unit 1 and 2.96 hours at Unit 2. There are no activities required to support SFP cooling during Phase 1; however, SFP area ventilation is established during inspection of SFP condition by actions such as opening doors. FENOC indicated they will perform an evaluation to confirm that opening doors is sufficient to maintain an acceptable environment in the SFP area. This is identified as Confirmatory Item 3.2.2.B in Section 4.2 below. The transition to Phase 2 strategies will be as the inventory in the SFP slowly declines due to boiling. SFP makeup with an intact pool is not required until 14.25 hours for a maximum decay heat load.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to SFP cooling, 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. For example: Containment pressure control/heat removal utilizing containment spray or repowering hydrogen igniters for ice condenser containments.

On pages 44, 46, and 48 of the Integrated Plan, regarding maintaining containment, the licensee stated that containment pressure and temperature are expected to increase during an ELAP due to loss of containment cooling and RCS leakage into containment. With the installation of the low-leakage RCP shutdown seals the pressure and temperature are not expected to rise to levels that could challenge the containment structure. Containment evaluations for all phases will be performed based on the boundary conditions described in Section 2 of NEI 12-06. Based on the results of this evaluation, required actions to ensure maintenance of containment integrity and required instrument function will be developed. Review of the licensee's evaluation and determination of required actions to ensure maintenance of containment integrity and required instrumentation function is identified as Confirmatory Item 3.2.3.A in Section 4.2 below.

To provide long-term support of containment during Phase 3 the licensee will use equipment from the RRC to repower one installed containment air-cooling fan at each unit. The Phase 3 FLEX 4160V diesel generators (described in detail in the Phase 3 safety functions support section of this report) will be used to repower the installed fan. To remove heat, a portable chilled water unit will be connected to the existing system. This unit will access water from the Ohio River.

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

3.2.4 Support Functions

3.2.4.1 Equipment Cooling – Cooling Water

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

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

During the audit process the licensee stated that the FLEX strategies do not require the use of any of the installed charging pumps at either unit and therefore they do not require cooling 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 cooling water, if these requirements are implemented as described.

3.2.4.2 Ventilation – Equipment Cooling

NEI 12-06, Section 3.2.2, Paragraph (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 control room, and logic cabinets. Airflow may be accomplished by opening doors to rooms and electronic and relay cabinets, and/or providing supplemental airflow.
>
> 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 airflow 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.
>
> 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 7 and 8 in the Integrated Plan, regarding SOE, the licensee stated that at hour 0.25; they would initiate monitoring of the control room temperature. Beaver Valley Unit 1/Unit 2 EOP 1OM/2OM-53A.1.ECA-0.0(ISS1C) “Loss of All Emergency 4KV AC power” (ECA-0.0) directs operators to open doors at 104 degrees F, and deploy portable fans at 120 degrees F. These actions can be used to support the FLEX strategies without modification. Also at hour 0.25 operators are directed to initiate deployment of portable fans to the Unit 1 AFW pump room. The AFW throttle valves are located in this room, so temperatures must be maintained below this level to support operator stay time to complete throttling actions. The temperature in the Unit 2 TDAFW pump room may reach 112.3 degrees F. At hour 3.0, operators are directed to initiate action to establish venting of the fuel handling building. ECA-0.0 directs monitoring of the SFP. To ensure condensate build-up from SFP boiling is limited, doors in the building should be opened early in the event, prior to the initiation of boiling in the pool. Deployment of the mobile chilled water unit from the near site staging area to the units will be initiated at hour 48.0. This equipment will be aligned with the installed containment air cooling fans to provide long term cooling in containment.

On pages 14 and 15 of the Integrated Plan, regarding Core Cooling and Heat Removal during Phase 1, the licensee stated that an analysis had determined the loss of ventilation in the TDAFW rooms would cause the temperature in the Unit 1 AFW pump room without steam leakage from the terry turbine to reach 115.9 degrees F for station blackout conditions. The normal emergency ventilation provides 3350 cfm to this room, and portable fans typically provide 5000 cfm, so this strategy will keep the AFW pump room within the normal emergency range. The existing station blackout ventilation calculation for Unit 2 states that the temperature reaches 112.3 degrees F in the AFW pump room without ventilation. This analysis does not take into account the effect of steam leakage from the terry turbine because this phenomenon has not been observed at Unit 2.

During the audit process the licensee discussed how portable fans in the TDAFW pump room would be powered. The licensee stated that Calculation 8700-DMC-2312 shows that the maximum temperature in the AFW room is 142.9 degrees F for equipment operation, which is well below the equipment qualification limit of 200 degrees F for equipment operation. The current plan is to stage a portable fan in the ventilation room adjacent to the space occupied by the TDAFW pump, near the door to the outside. This is also the door that would be used to deploy the hoses for the FLEX back-up pump to the TDAFW pump. A portable generator would be use to power the fan.

The NRC staff noted that the Integrated Plan stated the maximum temperature of the Unit 1/Unit 2 AFW pump rooms would reach 115.9/112.3 degrees F, respectively, while Calculation 8700-DMC-2312, described during the audit process, indicated that the maximum temperature would reach 142.9 degrees F. Clarification of this issue is identified as Confirmatory Item 3.2.4.2.A in Section 4.2.

On page 62 of the Integrated Plan, regarding Safety Function Support for Installed Equipment during Phase 1, the licensee stated establishing control room ventilation per existing SBO event procedure ECA-0.0 supports instrumentation functionality and control room accessibility. Doors should be opened and portable fans should be used to provide ventilation if the temperature in the control room rises to 104 degrees F to maintain temperatures below 120 degrees F.

On page 64 of the Integrated Plan regarding Safety Function Support for Installed Equipment during Phase 2, the licensee stated that during Phase 2, portable FLEX 480V diesel generators will be used to maintain power to critical instrumentation, as well as recharging the vital batteries and powering the vital bus inverters. The FLEX 480V generators will also be used to power existing control room, battery room, and process rack ventilation.

On page 70 of the Integrated Plan, regarding Safety Function Support for Installed Equipment during Phase 3, the licensee stated that during Phase 3, Units 1 and 2 will be aligned to cold shutdown conditions to establish indefinite coping capability. To support cold shutdown, one train of shutdown cooling equipment will be repowered at each unit. Two diesel generators will be requested from the RRC to support this function.

During the audit process the licensee stated that each battery room has a supply duct that connects to the adjacent emergency switchgear room and a ventilation discharge duct that exhausts to the outside. During an ELAP event, it is assumed that little or no heat would be produced by the emergency switchgear in the surrounding room due to the loss of power. This would allow heat being generated by the batteries to dissipate via natural circulation to the surrounding room through the supply duct. With an outdoor temperature of 103 degrees F, the battery room temperature would not reach 120 degrees F before ventilation is reestablished at 13 hours via the 480V FLEX generators. During extreme low temperatures it is not expected that cold outside air would make its way through the exhaust duct work back into the battery room since each exhaust fan has a backdraft damper that is normally closed when the fans rare not operating.

The NRC staff requested that the licensee provide an analysis or calculation to demonstrate that the dissipation of heat generated by the batteries via natural circulation will be adequate to maintain the temperatures in the battery rooms within acceptable levels. The NRC staff also requested that the licensee describe any procedure for monitoring of temperature in the battery rooms to ensure temperature in the battery room remains within acceptable range during ELAP. This is identified as Confirmatory Item 3.2.4.2.B in Section 4.2.

During the audit process the licensee also stated that the loads supported by the FLEX Phase 2 generators will include the normal (installed) safety-related battery room ventilation fans. The licensee stated that use of the battery room ventilation systems will alleviate potential hydrogen accumulation during the recharging of the batteries. Safety related electrical distribution buses would be powered via the Phase 2 generators. Plant personnel will perform selective electrical alignment using procedural direction and Shift Manager guidance. The normal design basis ventilation path will be utilized. Review of current calculations (DMC-3585 & B-211) show that the minimum time to evolve 1% hydrogen by volume in a battery room is 2.5 hours. In order to limit concentration to 1%, the maximum flow required is approximately 13 cfm. The hydrogen evolution time and dilution flow are based on the float current of the batteries on charge (equalize) voltage.

Based in a review of the information provided by the licensee during the audit process, the NRC staff requested the licensee to address how hydrogen concentration will be limited to 1% after 2.5 hours considering that repowering of the battery room ventilation fans using the Phase 2 FLEX 480Vac generator is not scheduled to begin deployment until 9.0 hours after the event. The staff also asked the licensee to clarify whether the batteries would be evolving hydrogen at the assumed rate considering that they will be discharging, not re-charging, during an ELAP. Also, the licensee was asked to clarify if both the battery chargers and battery room ventilation fans would be energized at the same time when the Phase 2 FLEX generator is connected. This is identified as Confirmatory Item 3.2.4.2.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 successful closure of issue related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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.

During the audit process the licensee stated that during Phases 1 & 2 the response is primarily reliant upon the TDAFW pump, which takes suction from the PPDWST. The PPDWST outlet piping is not heat traced because it is underground/indoors and not subject to freezing. The tank and corresponding level instrumentation are not heat traced because they are located in a concrete enclosure that is heated during normal operation. The tanks and level instrumentation would not be subject to freezing during the time they are required since the tank has a relatively large volume and is located in an enclosure. The BATs are located inside so the effects of extreme cold weather are not as prevalent as those for an outdoor tank. The tanks are also insulated. The licensee performed an assessment to show that at a starting temperature of 75 degrees F (tank low temperature alarm setpoint), the temperature of the tanks would not drop to 65 degrees F (the solubility limit of boric acid at 7700ppm) for more then 40 hours after the start of an ELAP. By that time, they would have performed their function.

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 cooling, if these requirements are implemented as described.

3.2.4.4. Accessibility – Lighting and Communications

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

> *Plant procedures/guidance should identify the portable lighting (e.g., flashlights*

or headlamps) and communications systems necessary for ingress and egress to plant areas required for deployment of FLEX strategies.

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

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

On page 7 of the Integrated Plan in the SOE, the licensee stated that at the beginning of the event (hour 0.25), they would initiate establishment of portable lighting in the Unit 1 and Unit 2 control rooms.

On page 10 of the Integrated Plan the licensee stated that the broad-spectrum deployment strategies are unchanged for the different operating modes and that the deployment strategies from the FLEX storage building to each staging area are identified, as well as the debris removal concerns, security barriers, and lighting needs as they apply to each deployment path.

In several sections of the Integrated Plan the licensee stated that area lighting required for outside deployment during the event will be met by the lights on the deployment truck and area lighting at each staging location. Plant personnel will be provided flashlights or headlamps to augment the emergency lighting when they are inside of the plant making connections.

On page 76 of the Integrated Plan, in their Phase 3 Response Equipment/Commodities table, the licensee included: "Portable lighting: flashlights, headlamps, batteries, and exterior light units with diesel generators.

During the audit process the licensee stated that flashlights, head lamps and generator powered temporary lighting will be stored with the FLEX equipment in sufficient quantity to enable execution of the FLEX strategy. Control Room lighting for both Unit 1 and Unit 2 are battery backed from non-safety related batteries. Therefore, although not credited it is probable that the control room lighting will be available for a number of hours. (The applicable non-safety related batteries have a design duty cycle of two hours.) Regardless, flashlights and head lamps will be staged in the Control Room so operators can read instruments, reference procedures and communicate. Once portable generators are staged, temporary lighting can be set up in the control room. Use of flashlights and headlamps will not be proceduralized. Temporary lighting powered by portable generators will be included in appropriate procedures to account for resources usage (operators and loads).

During the audit process the licensee also stated that the primary means of communication would be via the Gaitronics Page/Party system. Communications will not be continuous, nor is continuous occupation of the rooms where the valves are operated required. Procedure 1/2OM-48.1.A, Operations Duties and Responsibilities during EPP Implementation, directs personnel to place their current tasks in a safe condition and report to the Control Room where operators will receive their initial briefing and copy of the necessary procedures. The primary communication will be by use of the page-party system. When communicating with the control room the field operator can communicate from a space adjacent to the main steam valve room or TDAFW pump area:

When operating the Unit 1 atmospheric steam dump valves the operator may communicate from the MCC room (adjacent to the main steam valve room).

When operating the Unit 1 TDAFW pump the operator may communicate from the West Cable Vault (adjacent to the Auxiliary Feedwater Pump Room).

When operating the Unit 2 atmospheric steam dump valves the operator may communicate from the emergency switchgear ventilation room (adjacent to the main steam valve room) or the Cable Vault and & Rod Control Building (under the main steam valve room).

When operating the Unit 2 TDAFW pump the operator may communicate from the South Safeguards area (above the space where the TDAFW pump is located).

The licensee also stated that since these areas are not immediately adjacent to the operating equipment, ambient noise is not a factor. Additionally these communication areas are normally used during power operation when noise levels are at their highest.

The NRC staff has reviewed the licensee communications assessments (ADAMS Accession No. ML12306A131 and ML13053A366) in response to the March 12, 2012 50.54(f) request for information letter for the licensee 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.

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 lighting and portable 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, Paragraph (9) provides that:

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.

On page 10 of the Integrated Plan the licensee stated that the broad-spectrum deployment strategies are unchanged for the different operating modes. The deployment strategies from the FLEX storage building to each staging area were described including the debris removal concerns, security barriers, and lighting needs as they apply to each deployment path. The strategy for maintaining RCS Inventory Control during Phase 2 involves multiple security barriers in the routing paths at both units. Access through these doors must be provided during ELAP conditions. For the strategy for maintaining SFP cooling there are also multiple security barriers in the hose routing paths at both units. The doors in the safeguards buildings are typically accessible using site personnel badges. Access through these doors must be provided during ELAP conditions. The discharge hose for SFP spray at both units must be routed through the protected area fence. The method to route the hoses through the fence will be determined after the fence redesign for the dry cask storage project is complete.

On page 67 of the Integrated Plan, regarding safety function support during Phase 2, the licensee stated that the deployment paths to the staging area for both units are kept clear during normal operation. There are no security barriers in the deployment paths for the generator, and the entirety of the deployment path is within the protected area. However, there is one security barrier in each cable routing path for both units. The doors into the diesel generator buildings are typically accessible using site personnel badges. Access through these doors must be provided during ELAP conditions.

During the audit process the licensee stated that keys and thumb latches would operate all security doors required for implementation of the FLEX strategies. Operators have direct access to key rings with the required keys. Additionally, Security Officers are available with keys and can be assigned to escort operators as needed. The licensee also stated that the FLEX Access requirements are very similar to the Appendix R/Safe Shut Down Access requirements and will be handled similarly.

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

3.2.4.6. Personnel Habitability – Elevated Temperature

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

> *Plant procedures/guidance should consider accessibility requirements at locations where operators will be required to perform local manual operations.*
>
> Due to elevated temperatures and humidity in some locations where local operator actions are required (e.g., manual valve manipulations, equipment connections, etc.), procedures/guidance should identify the protective clothing or other equipment or actions necessary to protect the operator, as appropriate.
>
> FLEX strategies must be capable of execution under the adverse conditions (unavailability of installed plant lighting, ventilation, etc.) expected following a BDBEE 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.

During the audit process the licensee stated that long-term habitability will be assured by monitoring of control room conditions, heat stress counter measures and rotation of personnel to the extent feasible. In addition, site personnel receive heat stress training, which includes recognition of the signs of heat stress and methods to prevent becoming overheated. With an ELAP the heat loads in the control room will be minimal. Control room ventilation will be established by a FLEX 480V generator that is to be deployed by 13 hours. The expected steady state temperature for long term habitability is expected to be less than 110 degrees F when considering the doors will be opened at 104 degrees F, portable fans put in place at 120 degrees F, and normal ventilation established at 13 hours.

During the audit process the licensee stated, with regard to habitability, that access to most indoor areas is on an as needed basis, intermittent basis. Even local control of steam and feed flow does not require continual occupation of an inside area. With few exceptions, hose deployments within the structures are relatively short and the use of standard Storz connections minimizes the time and effort needed to connect to a system. Additionally, during an ELAP, the sources of heat (electrical resistance losses and continual flow of steam and hot fluids) are drastically reduced in most areas, especially the PABs, where the most effort will be required in deploying the high pressure pumps and hoses and using high pressure flanges to complete the connections for RCS Inventory Control (Boration). With low leakage RCP seals the tasks can be spaced over several hours allowing operators time to pace themselves in high temperature situations.

During the audit process the licensee stated that the AFW room in Unit 1 is known to exhibit significant temperature increases when the steam driven AFW pump is operating. Although plans are not complete, it is likely that portable generators and fans will need to be pre-staged in the area to bring in outside air. This is identified as Confirmatory Item 3.2.4.6.A in Section 4.2.

During the audit process the licensee stated that the heat input into the control room will also be greatly reduced due to the ELAP and load shedding to preserve battery life. However this is a continuously occupied area. There are two entrances into the Unit 1/Unit 2 combined control room situated on opposite sides of the room. As needed, cross ventilation using outside air can be established via fans powered by portable generators.

During the audit process the licensee stated that for cold situations, fire brigade bunker gear is available to operators. Also, appropriate human performance aids such as distinctive labels, sketches, maps, photographs, etc., will be used to ensure operator will be able to deploy and connect equipment even under adverse conditions. These will be included in procedures or as stand-alone operator aids, as appropriate.

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 successful closure of issue related to the Confirmatory Item, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to personnel habitability, if these requirements are implemented as described.

3.2.4.7. Water Sources

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

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

In many sections of the Integrated Plan the licensee stated that primary water source of water for the UHS is the Ohio River.

On page 17 of the Integrated Plan the licensee stated that for an event that occurs when the steam generators are available to provide core cooling, Phase 2 is initiated when the FLEX water transfer pump is deployed to maintain adequate level for TDAFW Pump suction. The suction source for this function is the PPDWST at each unit. As the inventory in the PPDWST is exhausted, makeup will be provided by either the Unit 2 demineralized water storage tank (DWST) or the Ohio River.

During the audit process the licensee stated that they have performed plant specific analyses and calculations that support alternate water source use. Several different sources were analyzed and can be used if available. However, the Ohio River is the only alternate source available under all postulated conditions. Use of the Ohio River as an alternate source is analyzed as acceptable out to 72 hours post event. Assumptions, methodology and results and recommendations for all analyzed alternate sources are contained in “BVPS Evaluation of Alternate Cooling Sources,” DAR-SEE-11-12-15, Revision 0 and “BVPS Supporting Chemistry Calculations for Alternate Cooling Sources,” CN-CDME-12-12 Revision 0. FSG-2, 3, 5 and 6 will contain the specific procedural guidance with clear criteria (primarily tank level indications) for transitioning to an alternate water source, and the order of preference for the various potential alternate water sources.

During the audit process the licensee provided additional information on the missile protection of the RWSTs. The licensee stated that the RWSTs are desired but not required to implement the baseline RCS and SFP FLEX strategies. For RCS Injection/Boration, the water sources are the Boric Acid Storage Tanks with inventory loss limited by low leakage RCP seals. The preferred water sources for make up to the SFPs, if needed, are the RWSTs. However, the Ohio River is considered protected against all hazards and would be used if both RWSTs were not available.

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

3.2.4.8. Electrical Power Sources/Isolations and Interactions.

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

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

On page 62 of the Integrated Plan, regarding safety function support during Phase 1, the licensee stated that it might be necessary to use jumper cables to connect between certain electrical panels to maintain power to critical instrumentation or components. If it is determined that this strategy is required, the design of the jumper cables and connection points will be completed during the detailed design phase of FLEX. The licensee stated it will utilize industry developed guidance from the PWROG, Electric Power Research Institute (EPRI), and NEI to develop site specific Guidelines for the deployment and implementation of FLEX strategies, as well as the interfaces for FLEX strategies with existing plant procedures.

On page 64 of the Integrated Plan, regarding safety function support during Phase 2, the licensee stated that the FLEX 480V generator will be connected to the installed electrical distribution system through the motor control centers (MCCs) located in the diesel generator building at each unit. At Unit 1, the primary connection will be the spare breaker in cubicle S of MCC-1-E7, and the secondary connection will be the spare breaker in cubicle S of MCC-1-E8. A connection panel will be installed in this room and the connection panel will be permanently wired to the spare breakers. The FLEX connection will be made to the connection panel. At Unit 2, the primary connection will be the spare breaker in cubicle 6A of MCC*2-E07, and the secondary connection will be the spare breaker in cubicle 6A of MCC*2-E08. A connection panel will be installed in this room, and the connection panel will be permanently wired to the spare breakers. The FLEX connection will be made to the connection panel. The licensee will develop administrative controls for the cables used with the FLEX generator. The controls will be used to support the correct phase-to-phase connection when the generator is aligned with the connection panel.

On page 67 and 68 of the Integrated Plan, regarding safety function support during the transition phase, the licensee stated that for Unit 1 support the FLEX 480V generator will be staged to the south of the diesel generator building. The cable will be routed into the train A room on elevation 735' 6" for the primary connection, and the train B room for the secondary connection. For Unit 2 strategies the FLEX 480V generator will be staged to the east of the diesel generator building. The cable will be routed into the train A room on elevation 735' 6" for the primary connection, and the train B room for the secondary connection. For both Units the cables will connect to a FLEX connection panel installed in the room. The panel will be permanently wired to the spare cubicle in the MCC. Prior to energizing the FLEX generator for either Unit, all breakers in the connected MCCs and substations must be de-energized to prevent the generator from failing due to overload. The necessary loads should then be systematically re-energized.

On pages 71 through 73 of the Integrated Plan regarding Safety Function Support for Phase 3, the licensee provided a similar description for connection of the FLEX 4160V generators for Unit 1 and Unit 2 electrical support. Each generator would be placed near its respective diesel generator building. The cables for the primary and secondary connections would be routed to the train B and train A rooms, respectively. They would be connected to FLEX connections panels, which will be permanently installed in the rooms. The panels will be permanently wired with Class 1E cable through existing cable raceway to the switchgear in the service building. Prior to energizing either FLEX generator, all breakers in the connected MCCs and substations must be de-energized to prevent the generator from failing due to overload. The necessary loads should then be systematically re-energized.

On page 7 of the Integrated Plan, regarding assumptions specific to the Beaver Valley site, the licensee stated that instrumentation on FLEX equipment would be used to confirm continual performance.

During the audit process the licensee stated that portable FLEX generators are not permanently connected to plant equipment. Connections to the Class 1E electrical system are made through Class 1E isolation devices (e.g., breakers, fuses) that are intended to prevent damage to Class 1E components. By procedure, prior to connecting portable generating equipment to the electrical system, other potential sources of electrical power (e.g., offsite power circuits, emergency diesel generators) are isolated from the system by opening their respective circuit breakers. Step 5 of FSG-7 directs the connection of FLEX generators. BVPS has not yet generated those procedures (pending final engineering change packages for the required plant modifications and procurement of the FLEX generators). The procedures will be part of the EOP/FSG procedure network. The licensee also provided the electrical protection information (breaker, relay, etc.) and rating of the electrical equipment on the 480 volt one line diagram.

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

3.2.4.9. Portable Equipment Fuel.

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

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

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

> Fuel for FLEX equipment stored in structures with designs which are robust with

respect to seismic events, floods and high winds and associated missiles, remains available.

On page 9 of the Integrated Plan regarding SOE, the licensee stated that at hour 12.0 they would initiate FLEX equipment refueling. This time was based on the assumption that all Phase 2 FLEX equipment is stored with sufficient diesel fuel inventory in the installed tanks to support operation of the equipment for at least 16 hours after the event. This assumption should be confirmed, and deployment times updated as specific pieces of FLEX equipment are specified and procured. The large fuel truck and a supply of diesel fuel from off-site should be received at the near site staging area and deployment initiated at 68.0 hours. There are 141,450 gallons of diesel in on-site tanks that are protected from all external hazards considered in NEI 12-06. Given the current fuel usage approximations for all FLEX equipment, 23,000 gallons of fuel would be required to operate the equipment until 72.0 hours. This estimate does not include the fuel usage of the Phase 3 equipment received from the RRC, or the towing and debris removal equipment used during Phase 2.

On page 64 of the Integrated Plan regarding safety functions support during Phase 2, the licensee stated that the diesel fuel supply for all FLEX equipment during Phase 2 will be taken from the diesel generator day tanks and the underground diesel storage tanks at each unit. There is a total of 141,450 gallons of fuel available in these tanks on the Beaver Valley site. One day tank is located in each room of each diesel generator building. The underground diesel storage tanks are located in the yard adjacent to the diesel generator buildings. All tanks are protected from seismic, flood, and tornado missile hazards. The requirements for the equipment used to remove the diesel fuel from these tanks and transport it around the site will be developed in the detailed design phase. The amount of fuel available on-site is sufficient to supply all on-site equipment for greater than 72 hours.

On page 70 of the Integrated Plan, regarding safety functions support during Phase 3, the licensee stated that the diesel fuel stored in the diesel generator day tanks and underground storage tanks will continue to supply FLEX equipment during Phase 3. Large fuel trucks will be delivered from the RRC to provide indefinite coping for the fuel supply.

During the audit process the licensee stated that the FLEX Phase 2 refueling can be addressed by using the volumes in the Unit 1 and Unit 2 fuel oil day tanks and engine mounted tanks (approximately 2000 gallons each unit) and in the EDG underground fuel oil storage tanks (35,000 gallons at Unit 1 and 106,450 gallons at Unit 2). Fuel oil distribution to FLEX Phase 2 equipment will be by cans, drums and a truck carrying a fuel oil storage tank. A portable pump (e.g., 12 Vdc) will be used to transfer fuel oil from the underground storage tanks. Access to the Unit 2 underground fuel tanks can be accomplished via a standpipe. Access to the Unit 1 underground tanks requires the use of a portable lifting device to remove the manhole cover. Instructions on how to obtain the fuel will be available to the personnel operating the FLEX equipment. These instructions will be based on current chemistry sampling procedures. The flex equipment will be stored in a fueled condition. Fuel quality will be maintained in accordance with the EPRI preventative maintenance program for 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 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) provides that:

> *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 8 of the Integrated Plan describing the SOE and time constraints, the licensee stated that at hour 0.95 operators should begin the process to declare an ELAP and at hour 1.0, initiate power management strategies for Units 1 and 2. It is time sensitive that one train of batteries be de-energized and isolated by hour 2.0, and load shed completed on the energized train by hour 3.0 to maintain vital bus inverter voltage above 105Vdc until the FLEX generator is placed in service. At hour 9.0 they planned to initiate deployment of the Phase 2 FLEX 480V generator. This is time sensitive because of the requirement to begin providing RCS boration at hour 13.8. The diesel generators will power the electric FLEX RCS pump used to supply borated coolant.

On page 62 of the Integrated Plan the licensee stated that installed vital batteries will be used to maintain the availability of critical instrumentation during Phase 1. The time which vital power will be available is extended by performing a load shed of all loads that are not considered to be critical for monitoring the condition of the plant during an ELAP. The primary means to maintain critical instrumentation is through existing vital 120V ac and 125V dc buses, which are powered by the vital dc batteries and battery inverters. Load shedding to extend battery life is proceduralized in draft procedures "Shedding Non-Required DC Loads during Site Blackout" for Unit 1 and Unit 2. Isolation of one train of batteries must occur by 2 hours after the event. Load shedding on the energized battery train must be completed by 3 hours after the event. These actions are taken to maintain vital bus inverter voltage above 105Vdc. By using each train of batteries in this manner, the battery coping time is 20.6 hours at Unit 1 and 20.3 hours at Unit 2.

Based on a review of the information above, it appears that the licensee is expecting the batteries to be available for more than 20 hours after the ELAP event. The Generic Concern related to extended battery duty cycles, has been resolved generically through the NRC endorsement of NEI position paper entitled "Battery Life Issue" (ADAMS Accession Nos. 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 Order Integrated Plan submittals in a timely manner and on a generic basis, to the extent possible, and provide a consistent review by the NRC. Position papers provided to the NRC by industry further develop and clarify the guidance provided in NEI 12-06 related to industry's ability to meet the intent of Order EA-12-049.

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 the licensee's application of the guidance (calculations and supporting data) in its development of the final Safety Evaluation documenting review of the licensee's Integrated Plan.

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

During the audit process the licensee provided additional information to address the staff concerns. They provided a table listing the dc load profiles for each of the four station batteries at each unit for the time periods 0-1 minute, 1-180 minutes and for greater than 180 minutes. They noted that some of these profiles differ from those used to establish the battery availability time reported in the Integrated Plan. The profiles associated with batteries BAT-1-1, BAT-1-2, BAT-2-1 and BAT-2-2 included additional load for times greater then 180 minutes. Considering these load increases, dc power at each unit is expected to be available for at least 17.5 hours rather than the 20.6 and 20.3 hours stated in the Integrated Plan. The licensee also stated that the "DC Load Shed Operator Action Summary" provided on the portal contains the timelines and plant locations where operator actions are performed. The Unit 1 actions are completed in 81 minutes from event initiation. The Unit 2 actions are completed in 60 minutes. The licensee also provided copies of the procedures for implementing the actions required following a loss of all Emergency 4kV ac power. These procedures provide detailed instructions to the operators on load shedding actions.

During the audit process the licensee provided a summary and a detailed listing of the sizing calculation for the FLEX generators to show that they can supply the loads assumed in Phases 2 and 3. The licensee stated that the electrical loads to be powered from the FLEX generators during Phases 2 and 3 were tabulated and summed. For each phase the total load was confirmed to be less than the rating of the proposed generator. Given that the generators are being sized to accommodate plants with higher loading requirements, Beaver Valley's needs are met with a high degree of margin. The licensee also provided a separate document titled "FLEX DG Load Tabulation" which provided additional details.

During the audit process the licensee stated that the minimum voltage required at the terminals of each component is established in the design calculations for the dc electrical distribution system. These values are typically based on data provided by equipment manufacturers. The minimum dc bus voltage is the minimum voltage necessary to ensure that adequate voltage is available at the terminals of the most limiting component (i.e., the first component for which terminal voltage requirement would not be met during a battery discharge). If adequate voltage is available at the most limiting components, proper operation of the remaining components is assured. For each dc bus the most limiting component is the respective vital bus inverter. The minimum dc bus voltages ensure that at least 105V dc is available at the inverter input terminals.

During the audit process the licensee stated that the load shed strategy for both Units would result in a loss of redundant indication for critical parameters, but at least one channel for all critical parameters would remain in service. Redundant RCS pressure reduction capability via the Pressurizer PORVs would be lost, but at least one PORV remains available for pressure reduction. For Unit 1 only, loss of the minimum recirculation flow control valve for the TDAFW pump would be lost; however, procedures exist to control this function locally. There are no interlocks that disable credited equipment. Direct current power for loads such as the back up airside seal oil pump come from non-safety related batteries. Since the load-shed strategy applies only to safety-related batteries, these loads are not affected. Additionally, the load-shed procedures are in draft form. Prior to approval, the procedures will undergo the normal review and validation process to prevent implementing a procedure that results in an untended consequence.

The NRC staff reviewed the additional information provided by the licensee and concluded that its concerns had been addressed.

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

3.3 PROGRAMMATIC CONTROLS

3.3.1. Equipment Maintenance and Testing.

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

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

capability applies to the portable FLEX equipment described in Tables 3-1 and 3-2 (i.e., that equipment that directly supports maintenance of the key safety functions). Other FLEX support equipment only requires an N capability.

NEI 12-06, Section 11.5 states:

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

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

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

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

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

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

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

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

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

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

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

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

On page 10 and 11 of the Integrated Plan, regarding programmatic controls, the licensee stated that equipment associated with these strategies would be procured as commercial equipment with design, storage, maintenance, testing, and configuration control in accordance with Section 11 of NEI 12-06. The FLEX equipment will be initially tested, or other reasonable method used, to verify that performance conforms to the limiting FLEX requirements. It is expected that the testing will include the equipment and the assembled sub-systems to meet the planned FLEX performance. Additionally, the licensee stated that they would implement the maintenance and testing template at Beaver Valley upon issuance by EPRI.

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 endorsement letter from the NRC staff is dated October 7, 2013 (ADAMS Accession No. ML13276A224).

This Generic Concern involves clarification of how licensees would maintain FLEX equipment such that it would be readily available for use. The technical report provided sufficient basis to resolve this concern by describing a database that licensees could use to develop preventative maintenance programs for FLEX equipment. The database describes maintenance tasks and maintenance intervals that have been evaluated as sufficient to provide for the readiness of the FLEX equipment. The NRC staff has determined that the technical report provides an acceptable approach for maintaining FLEX equipment in a ready-to-use status. The NRC staff will evaluate the resulting program through the audit and inspection processes.

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

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

3.3.2 Configuration Control.

NEI 12-06, Section 11.8 states:

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

On page 12 of the Integrated Plan discussing programmatic controls, the licensee stated that the unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy will be managed using plant equipment control Guidelines developed in accordance with NEI 12-06, Section 11. Programs and controls will be established to assure personnel proficiency in the mitigation of BDBEEs is developed and maintained in accordance with NEI 12-06, Section 11. 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 12 of the Integrated Plan the licensee stated that training plans will be developed for plant groups such as the emergency response organization (ERO), fire, security, emergency planning (EP), operations, engineering, and maintenance. The training plan development will be done in accordance with Beaver Valley procedures using the Systematic Approach to Training, and will be implemented to ensure that the required Beaver Valley staff is trained prior to implementation of FLEX. 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 13 of the Integrated Plan, regarding the RRC plan, the licensee stated that the industry would establish two (2) RRCs to support utilities during beyond design basis events. Each RRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to the near site 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. The licensee has signed a contract with SAFER to meet the requirements of NEI 12-06, Section 12 at the Beaver Valley site.

During the audit process the licensee stated that they are in the process of developing the playbook in conjunction with the RRC.

Review of the licensee’s use of off-site resources did not contain sufficient information to provide reasonable assurance that guidance will be established to conform to considerations (2) through (10) above. This item will remain open pending the licensee’s submittal of additional discussion to show how considerations (2) through (10) of NEI 12-06, Section 12.2 are met. This item is 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 monitoring instrumentation and controls, if these requirements are implemented as described.

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.2.1.6.A	Verify that the licensee has completed their review and finalized a decision regarding steps to resolve concerns regarding the protection of the TDAFW pump exhaust stacks from missile hazards.	
3.2.1.8.A	Verify resolution of the 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 was applicable to BVPS. The licensee informed the NRC staff of its intent to abide	

	by the generic approach, and currently uses 30 minutes as the delay time to ensure uniform boron mixing in the RCS. Clarifications provided in the NRC staff endorsement of the August 15, 2013, position paper indicate a delay time of 60 minutes.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.4.A	Confirm that primary and secondary staging areas for the RRC equipment have selected and will meet the requirements of (SAFER) Response Plan, Section 1.4.1 and Appendix G.	
3.1.2.4.A	Confirm that the primary and secondary staging areas have been identified and that the plan for the use of offsite resources did not would provide reasonable assurance that the plan will comply with NEI 12-06, Section 6.2.3.4 regarding the need to evaluate for flooding hazard and provide a description of the methods to be used to deliver the equipment to the site.	
3.1.3.1.A	Confirm that location of the storage and protection building for FLEX equipment has been identified (Unit 1 or Unit 2 PAB or by the FLEX storage building). Confirm that the FLEX storage building is designed to withstand tornado missiles at a level equal to or greater than the plant's tornado missile design basis.	
3.1.3.4.A	Confirm that the licensee's plan for the use of offsite resources would provide reasonable assurance that the plan will comply with NEI 12-06, Section 7.3.4 regarding high wind hazards considering the locations of the primary and secondary staging areas and a description of the methods to be used to deliver the equipment to the site.	
3.1.4.4.A	Confirm that the licensee's plan for the use of offsite resources would provide reasonable assurance that the plan will comply with NEI 12-06 Section 8.3.4 regarding snow, ice and extreme cold hazards, due to the absence of identifications of the primary and secondary staging areas and a description of the methods to be used to deliver the equipment to the site.	
3.2.1.1.A	Confirm the licensee has verified that reliance on the NOTRUMP code for the ELAP analysis of Westinghouse plants is limited to the flow conditions prior to reflux condensation initiation. This includes specifying an acceptable definition for reflux condensation cooling.	
3.2.1.1.B.	Confirm that the additional information specifying which analysis performed in WCAP-17601 was being applied correctly by the licensee. The licensee also supplied justification for the use of the analysis through identifying and evaluating the important parameters and assumptions demonstrating that they are representative of the site and appropriate for simulating the ELAP transient. The NRC staff is reviewing the information and additional details may need to be submitted by the licensee.	

3.2.1.2.A	Confirm that the licensee plans to the SHIELD shutdown seals and will credit a low seal leakage rate (e.g., 1 gpm/seal) in the ELAP analyses for the RCS response. If so, the licensee should address the impacts of the Westinghouse 10 CFR Part 21 report, "Notification of the Potential Existence of Defects Pursuant to 10 CFR Part 21," dated July 26, 2013 (ADAMS Accession No. ML13211A168) on the use of the low seal leakage rate in the ELAP analysis.	
3.2.1.2.B	Confirm that if the seals are changed to the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals, the acceptability of the use of the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals are addressed, and the RCP seal leakages rates for use in the ELAP analysis should be justified.	
3.2.2.A	Confirm that the licensee has completed their review to determine whether or not the RWST will need to be further protected against missile hazards. The RWSTs are not currently fully protected against tornado missiles.	
3.2.2.B	Confirm licensee has completed evaluation to verify that opening doors provides adequate ventilation for SFP area.	
3.2.3.A	Confirm that Containment evaluations for all phases are performed based on the boundary conditions described in Section 2 of NEI 12-06. Based on the results of this evaluation, confirm that required actions to ensure maintenance of containment integrity and required instrument function have been developed.	
3.2.4.2.A	Confirm that the licensee has clarified why the Integrated Plan stated the maximum temperature of the Unit 1/Unit 2 AFW pump rooms would reach 115.9/112.3 degrees F, respectively, while Calculation 8700-DMC-2312, described during the audit process, indicated that the maximum temperature would reach 142.9 degrees F.	
3.2.4.2.B	Confirm that the licensee has provided an analysis or calculation to demonstrate that the dissipation of heat generated by the batteries via natural circulation will be adequate to maintain the temperatures in the battery rooms within acceptable levels. Describe any procedure for monitoring of temperature in the battery rooms to ensure temperature in the battery room remains within acceptable range during ELAP.	
3.2.4.2.C	Confirm that the licensee has addressed how hydrogen concentration will be limited to 1% after 2.5 hours considering that repowering of the battery room ventilation fans using the Phase 2 FLEX 480Vac generator is not scheduled to begin deployment until 9.0 hours after the event. Discuss whether the batteries would be evolving hydrogen at the assumed rate considering that they will be discharging, not re-charging, during an ELAP. Also, discuss if both the battery chargers and battery room ventilation fans would be re-energized at the same time when the Phase 2 FLEX generator is connected.	

3.2.4.6.A	Confirm licensee has completed review of Unit 1 AFW room and any plans required to maintain a suitable environment.	
3.4.A	Confirm that the license has fully addressed considerations (2) through (10) of NEI 12-06, Section 12.2, Minimum Capability of Off-Site Resources which requires each site to establish a means to ensure the necessary resources will be available from off-site.	