Mega-Tech Services, LLC

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

Revision 1

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Entergy Operations Inc.
Arkansas Nuclear One Units 1 and 2
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Technical Evaluation Report

Arkansas Nuclear One 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 (hereinafter, the Integrated Plan) describing their course of action for mitigation strategies that are to conform with the guidance of NEI 12-06, or provide an acceptable alternative to demonstrate compliance with the requirements of Order EA-12-049.

2.0 EVALUATION PROCESS

In accordance with the provisions of Contract NRC-HQ-13-C-03-0039, Task Order No. NRC-HQ-13-T-03-0001, Mega-Tech Services, LLC (MTS) performed an evaluation of each licensee's Integrated Plan. As part of the evaluation, MTS, in parallel with the NRC staff, reviewed the original Integrated Plan and the first 6-month status update, and conducted an audit of the licensee documents. The staff and MTS also reviewed the licensee's answers to the NRC staff's and MTS's questions as part of the audit process. The objective of the evaluation was to assess whether the proposed mitigation strategies conformed to the guidance in NEI 12-06, as endorsed by the positions stated in JLD-ISG-2012-01, or an acceptable alternative had been proposed that would satisfy the requirements of Order EA-12-049. The audit plan that describes the audit process was provided to all licensees in a letter dated August 28, 2013 from Jack R. Davis, Director, Mitigating Strategies Directorate (ADAMS Accession No. ML13234A503).

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

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

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

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

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

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

3.0 TECHNICAL EVALUATION

By letter dated February 28, 2013, (ADAMS Accession No ML13063A151) Entergy Operations, Inc. (hereinafter referred to as the licensee) provided the Integrated Plan for Compliance with Order EA-12-049 for Arkansas Nuclear One, Units 1 and 2 (ANO). By letter dated August 28, 2013, (ADAMS Accession No ML13241A415) the licensee provided a completely revised Integrated Plan as Enclosure 2 to the letter, however plant connection point drawings and deployment route drawings are only available in the initial February 28 Integrated Plan. The August 28, 2013 revised Integrated Plan (hereinafter referred to as the Integrated Plan) describes the strategies and guidance under development for implementation by the licensee for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the NRC staff

in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the Order.

3.1 EVALUATION OF EXTERNAL HAZARDS

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

3.1.1 Seismic Hazard

NEI 12-06, Section 5.2 states that:

> 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 1 of the Integrated Plan, the licensee stated that:

> Per Safety Analysis Report (SAR) seismic input, the seismic criteria for ANO includes two design basis earthquake spectra: operating basis earthquake (OBE) and design basis earthquake (DBE).
>
> The site-specific design response spectra define the vibratory ground motion of the OBE and DBE. The maximum horizontal acceleration for the DBE is 0.20g and the OBE has a maximum horizontal acceleration of 0.10g.
>
> The seismic hazard applies to ANO.

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

3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

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

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

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

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

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

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

On page 1 of the Integrated Plan, the licensee stated that the seismic hazard applies to ANO, and as a result, the credited FLEX equipment will be assessed based on the current ANO seismic licensing basis to ensure that the equipment remains accessible and available after a BDBEE and that the FLEX equipment does not become a target or source of a seismic interaction from other systems, structures, or components. The licensee also stated that FLEX strategies developed for ANO will include documentation ensuring that any storage locations and deployment routes meet the FLEX seismic criteria.

On page 14 of the Integrated Plan, the licensee stated that the FLEX equipment storage location(s) will withstand the NEI 12-06 hazards as applicable to ANO.

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 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:

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 10 of the Integrated Plan, the licensee stated that:

> The turbine-driven [emergency feedwater] EFW pumps will be utilized by both units to provide feedwater flow from an event-qualified source to supply the SGs. The turbine-driven EFW pumps are located in the auxiliary building (AB). The AB is designed to withstand the effects of earthquakes, tornadoes, floods, external missiles, and other appropriate natural phenomena.

On page 12 of the Integrated Plan, the licensee stated that:

> The ANO-1 and ANO-2 primary and secondary connection points for the SG FLEX feed pump discharge during Modes 1 through 4 would be accessible locations on the EFW system.

On page 14 of the Integrated Plan, the licensee stated that:

> In all external events, a deployment strategy is planned that will deliver FLEX equipment to the appropriate staging area.
>
> Any portable FLEX equipment will be trailer-mounted or on wheels for ease of deployment. This will give the current vehicles at ANO the capability to move any portable FLEX equipment. Available forklifts or pickup trucks will be utilized for deploying any portable FLEX equipment. Most of this equipment will be utilized for both the movement of any portable FLEX equipment and debris removal.

On pages 14 and 15 of the Integrated Plan, the licensee stated that:

> The primary and secondary piping connections [to the EFW system and ["Q"

condensate storage tank] (QCST) are located to be protected from the event specific conditions.

The FLEX connections will be constructed to withstand the NEI 12-06 … hazards as applicable to ANO.

The licensee was requested to discuss the potential for soil liquefaction. During the audit the licensee stated that; soil borings were taken along the primary travel path from each FLEX equipment storage building to the deployment locations, that it has been determined that liquefaction is not a concern based on test results of soil borings, and that this ensures that at least one pathway would not be susceptible to soil liquefaction.

The licensee was requested to address the potential failure of downstream dams. During the audit the licensee stated that Calculation 97-R 001C-15 concludes that failure of the Dardanelle Dam, the dam which forms the UHS for ANO, as a result of earthquake loads would not occur.

Per consideration 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. The licensee did not provide sufficient information regarding the potential need for a power source to move the equipment. This has been identified as Confirmatory Item 3.1.1.2.A. in Section 4.2.

The licensee was requested to provide a discussion of the protection to be afforded any FLEX equipment moving vehicles from seismic hazards. During the audit the licensee stated that a transport vehicle is stored in each FLEX equipment storage location to deploy the equipment along with a large piece of debris removal equipment (e.g., heavy equipment with multiple attachments).

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

3.1.1.3 Procedural Interfaces - Seismic Hazard

NEI 12-06, Section 5.3.3 states:

There are four procedural interface considerations that should be addressed.

1. Seismic studies have shown that even seismically qualified electrical equipment can be affected by BDB seismic events. In order to address these considerations, each plant should compile a reference source for the plant operators that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (see Section 3.2.1.10). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance should include critical actions to perform until alternate indications

can be connected and on how to control critical equipment without associated control power.

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

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

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

The licensee was requested to address determination of necessary instrument readings to support the implementation of the mitigating strategies in the event that seismically qualified electrical equipment is affected by beyond-design-basis seismic events. During the audit the licensee stated that, currently, Attachment 5 of SAS-008, Unit 1 severe accident mitigation guideline (SAMG) Developed Strategy, and Attachment 3 of SAS-007, Unit 2 SAMG Developed Strategy, contains this information; however, these will be replaced by new FLEX Support Guidelines (FSGs) that are being drafted.

The licensee was requested to discuss any seismic hazards associated with large internal flooding sources that are not seismically robust and do not require ac power, the use of ac power to mitigate ground water in critical locations, or the existence of non-seismically robust downstream dams. During the audit the licensee provided the following information regarding these issues:

- For ANO-2, final safety analysis report (FSAR) Section 3.6.4.4 provides a summary of an evaluation to determine the effects of flooding resulting from a postulated failure of liquid storage tanks. Each tank located outside containment but in the Auxiliary Building was evaluated and determined to not pose a threat from flooding of any safety-related equipment in the area.
- FSAR Table 3.6-25 lists all ANO-2 liquid storage tanks located outside the confines of the ANO-2 buildings. These tanks are located at ground level and are not considered a flood hazard to safety equipment contained within the ANO-2 buildings (FSAR Section 3.6.4.4.3).
- During an ELAP scenario, with no ac power, turbine building flooding from a circulating water system (CWS) component failure inside the turbine building could also be a concern since the cooling tower basin water level elevation and the CWS pump discharge piping elevations are above the lowest point of the CWS connections to the main condenser water boxes in the turbine building, allowing gravity drain of the system and the basin to the turbine building. However, the initial water level elevation in the cooling tower basin is at approximately elevation 348’ 0”, which would be the maximum gravity drain flood level in the turbine building, significantly lower than the postulated worst case flood with CWS pumps operating per FSAR Section 10.4.5.3.
- FSAR 10.4.5.3 states that to prevent degradation of the engineered safety features (ESF) due to a break in the circulating water pipe, condenser expansion joints or

condenser water boxes, all ESF equipment is located in watertight portions of the auxiliary building.

- Regarding the fire protection water systems [FPS] piping failure in conjunction with a spurious start of the diesel-driven fire pump during an ELAP, the following is relevant. FSAR Section 9.5.1.3.4 states that those portions of the FPS (Category 2) installed within ESF equipment rooms and Corridor No. 2139, west of the Control Room are supported in accordance with Seismic Category 1 requirements.
- FSAR Section 9.5.1.3.5 states that the design of firefighting systems is such that their rupture or inadvertent operation will not jeopardize the capability of safety-related structures, systems, and components. … The potential for degradation of ESF equipment by flooding due to failures in fire water piping was considered in the design of the FPS and in the design of the rooms and buildings containing ESF equipment.
- ANO-1 is a once-through cooling plant (normal plant heat sink) and therefore flooding from a cooling tower basin is not a concern.
- FSAR Section 5.1.2 provides classifications of SSCs (systems, structures, and components); the condensate storage tank (referred to as the QCST - T41B) is seismic Category 1, and the (non-Q) condensate storage tank and Reactor makeup water tank are seismic Category 2.
  These tanks (both the QCST and the non-Q CST) are located at ground level and therefore the failure of the tanks is not considered a flood hazard to safety equipment contained within the Unit 1 buildings. Design criteria for the fire protection system piping similar to that for ANO-2 was implemented for ANO-1.

Regarding the need for ac power to mitigate groundwater intrusion, an active dewatering system is not required at the ANO site per ANO-1 FSAR Section 5.1.10, and ANO-2 FSAR Section 2.4.13.

Regarding downstream dam failure, the licensee stated that Calculation 97-R 001C-15 concludes that failure of the Dardanelle Dam (which forms the UHS for ANO) as a result of earthquake loads would not occur.

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

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

On page 9 of the Integrated Plan, the licensee stated that:

> The industry is expected to establish two Regional Response Centers (RRCs) to support utilities during beyond design basis events. Each RRC is expected to hold five sets of equipment; four of which should be able to be fully deployed when requested; the fifth set would have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local assembly area, established by the Strategic Alliance for FLEX Emergency Response (SAFER) team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's [SAFER Response Plan] playbook, is expected to be delivered to the site within 24 hours from the initial request.
>
> Entergy will negotiate and execute a contract with the SAFER for the ANO site which will meet the requirements of NEI 12-06 (Reference 2, Section 12).

The licensee has not identified the local staging area and did not provide a description of the methods to be used to deliver the equipment to the site. This has been identified as Confirmatory Item 3.1.1.4.A. in Section 4.2.

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

3.1.2 Flooding Hazard

NEI 12-06, Section 6.2 states:

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

NEI 12-06, Section 6.2.1 states in part:

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

On page 2 of the Integrated Plan, the licensee stated that:

> The types of events evaluated to determine the worst potential flood included (1) probable maximum flood (PMF) due to flood flow at Dardanelle Dam yielding a water level at 358 feet (ft.) mean sea level (MSL), (2) catastrophic failure of the

closest dam upstream of Dardanelle Dam yielding a water level of 361 ft. MSL, and (3) the effect of wind induced waves.

The maximum plant site flood level from any cause is Elevation 361 ft. MSL. A flood of the magnitude of the maximum probable flood will be forecast about five days prior to its arrival at the plant site. The plant will be shut down by the time the flood level reaches 354 ft. which is the elevation where flooding of the turbine building would commence. The plant will be shut down using normal shutdown procedures and, during the flood, the operators will maintain the plant in a safe shutdown condition.

In summary, the ANO site is not considered a "dry" site and the flooding hazard is screened in.

The licensee estimated flood warning time, but did not provide an estimation of the persistence of the PMF in accordance with the guidance of NEI 12-06 Table 6-1, “Flood Warning and Persistence Considerations.” During the audit, the licensee provided the following information regarding site flooding:

- As noted in the ANO-1 FSAR (Section 2.4.4.2): Nominal plant grade elevation is 353 feet and ground floor elevation for the buildings is 354 feet. A flood of the magnitude of the maximum probable flood will be forecast about five days prior to its arrival at the plant site. The plant will be shut down by the time the flood level reaches 354 feet, which is the elevation where flooding of the turbine building would commence. The plant will be shut down using normal shutdown procedures and, during the flood, the operators will maintain the plant in a safe shutdown condition. Access to the plant would be by boat and/or helicopter.
- As noted in the ANO-2 FSAR (Section 3.4.4): During the PMF, the distance between the plant and nearest high ground is never more than 2,000 feet…Boat landing is possible on the second floor of the administration building. Passageways from the administration building above flood level provide access to all Seismic Category 1 equipment in the auxiliary building and in the containment.
- As noted in the ANO-2 FSAR (Section 9.5.4.1): After the Design Basis Earthquake (DBE) and a simultaneous nuclear accident, three and one-half days emergency supply of diesel oil will be available even in the unlikely event one emergency storage tank has failed. Within this period additional fuel could be delivered to the plant site by any one of three methods; truck delivery, rail car delivery or delivery by barge from the river. In the highly unlikely event that all three of these normal supply routes are unavailable because of the earthquake, fuel could be airlifted to the plant site via helicopter. Based on conservative estimates from the Corps of Engineers it is expected that the PMF could be above plant grade (elevation 353 feet) for two to five days.
- Due to the relatively long warning time for the limiting flood at ANO (approximately 5 days), sufficient time is available to obtain any offsite personnel, equipment or supplies prior to plant access potentially becoming limited. The RRC can provide equipment in 72 hours (3 days) or less and will have provisions for air lifting RRC supplied equipment to the site. Additionally, the current FLEX strategy has the capability to extend the use of the Phase 2 strategies well beyond 72 hours. As stated in ANO-2 FSAR Section 9.5.4.1, the persistence of the flooding is expected to be limited to two to five days. Therefore, based on the relatively long warning time, ample time to pre-state FLEX equipment, sufficient time to obtain offsite resources prior to the site potentially

> becoming isolated, the relatively short period of time the site would potentially be isolated, and the ability to extend Phase 2 coping strategies, a flooding event is not expected to adversely affect the plant's ability to cope with a BDBEE.

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

3.1.2.1 Protection of FLEX Equipment - Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

> These considerations apply to the protection of FLEX equipment from external flood hazards:
>
> 1. The equipment should be stored in one or more of the following configurations:
>
> a. Stored above the flood elevation from the most recent site flood analysis. The evaluation to determine the elevation for storage should be informed by flood analysis applicable to the site from early site permits, combined license applications, and/or contiguous licensed sites.
>
> b. Stored in a structure designed to protect the equipment from the flood.
>
> c. FLEX equipment can be stored below flood level if time is available and plant procedures/guidance address the needed actions to relocate the equipment. Based on the timing of the limiting flood scenario(s), the FLEX equipment can be relocated [footnote 2 omitted] to a position that is protected from the flood, either by barriers or by elevation, prior to the arrival of the potentially damaging flood levels. This should also consider the conditions on-site during the increasing flood levels and whether movement of the FLEX equipment will be possible before potential inundation occurs, not just the ultimate flood height.
>
> 2. Storage areas that are potentially impacted by a rapid rise of water should be avoided.

On page 14 of the Integrated Plan, the licensee stated that the FLEX equipment storage location(s) will withstand the NEI 12-06 hazards as applicable to ANO.

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 flooding 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 which apply to the deployment of FLEX equipment for external flood hazards:

1. For external floods with warning time, the plant may not be at power. In fact, the plant may have been shut down for a considerable time and the plant configuration could be established to optimize 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 [Reactor Coolant System], isolating accumulators, isolating reactor coolant pump (RCP) seal leak off, obtaining dewatering pumps, creating temporary flood barriers, etc. These factors can be credited in considering how the baseline capability is deployed.

2. The ability to move equipment and restock supplies may be hampered during a flood, especially a flood with long persistence. Accommodations along these lines may be necessary to support successful long-term FLEX deployment.

3. Depending on plant layout, the UHS [ultimate heat sink] 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 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 loss of all ac power, plants should consider the need to provide water extraction pumps capable of operating in those conditions and hoses for rejecting accumulated water for structures required for deployment of FLEX strategies.

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

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

On page 14 of the Integrated Plan, the licensee stated that:

> In all external events, a deployment strategy is planned that will deliver FLEX equipment to the appropriate staging area.
>
> In the specific case of a flooding event, it is expected that several days' notice will be given before a flood level will approach either plant grade and/or the magnitude of the PMF. Therefore, it is assumed that at least 24 hours is available for the deployment of the FLEX equipment for the flooding scenario (i.e., primary connection). It is also assumed that power is available during this time. Deployment of portable FLEX equipment for the flooding scenario consists of transporting all required equipment from the storage location(s) to the FLEX equipment flood platform. All paths and roads on-site are assumed to be maintained as unobstructed in this scenario, so the easiest path will used.
>
> Any portable FLEX equipment will be trailer-mounted or on wheels for ease of deployment.

On pages 14 and 15 of the Integrated Plan regarding SG makeup, the licensee stated that:

> ANO-1 and ANO-2 primary and secondary connections are required to the EFW system and the QCST piping.
>
> The primary and secondary piping connections are located to be protected from the event specific conditions.
>
> The FLEX connections will be constructed to withstand the NEI 12-06 (Reference 2) hazards as applicable to ANO.

On pages 22 and 23 of the Integrated Plan regarding RCS makeup, the licensee stated that:

> For ANO-1, the ANO-2 charging pumps require connection to the ANO-1 HPI piping.
>
> ANO-2 FLEX RCS makeup pump requires primary and secondary connections to the HPSI/charging piping and the refueling water tank (RWT) or borated water storage tank (BWST).
>
> The FLEX connections will be constructed to withstand the NEI 12-06 (Reference 2) hazards as applicable to ANO.

The licensee was requested to provide a discussion of the protection to be afforded any FLEX equipment moving vehicles from flood hazards. During the audit the licensee stated that a transport vehicle is stored in each FLEX equipment storage location to deploy the equipment along with a large piece of debris removal equipment (e.g., heavy equipment with multiple attachments).

The licensee was requested to discuss any plans for the development of mitigating strategies with respect to fuel oil storage tanks that could be inundated or damaged by a flood and any need for dewatering equipment when installed sump pumps are not available. In response the

licensee provided the following information regarding fuel supplies.

- In the specific case of a flooding event it is expected that several days' notice will be given before a flood level will approach either plant grade and/or the magnitude of the PMF, therefore, it is assumed that at least 24 hours is available for the deployment of the FLEX equipment for the flooding scenario.
- During a flood event, fuel oil is provided directly to the portable diesel-driven FLEX equipment by repowering the existing safety related diesel fuel oil transfer pumps with a portable FLEX generator to pump fuel oil via hose to the portable diesel-driven FLEX equipment.
- During the pre-flood deployment, hose(s) would be connected and routed from the connection point through an opening in the fuel oil storage building above the flood elevation directly to diesel-driven FLEX equipment that have been deployed on permanently installed elevated platforms to support FLEX strategies during a flooding event. This allows the hose(s) to exit the fuel oil storage building without opening the flood doors.
- The hydraulic requirements for providing fuel to the diesel-driven FLEX equipment or portable fuel oil tank via the existing fuel oil transfer pumps are bounded by the hydraulic requirements for the fuel oil transfer pumps to move fuel oil from the storage tanks to the existing emergency diesel generator day tanks.

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

3.1.2.3 Procedural Interfaces - Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

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

On page 11 of the integrated plan the licensee stated that existing procedures, strategies, and guidelines will be revised to consider FSGs.

On page 14 of the Integrated Plan, the licensee stated that:

> In the specific case of a flooding event, it is expected that several days' notice will be given before a flood level will approach either plant grade and/or the

> magnitude of the PMF. Therefore, it is assumed that at least 24 hours is available for the deployment of the FLEX equipment for the flooding scenario (i.e., primary connection). It is also assumed that power is available during this time. Deployment of portable FLEX equipment for the flooding scenario consists of transporting all required equipment from the storage location(s) to the FLEX equipment flood platform. All paths and roads on-site are assumed to be maintained as unobstructed in this scenario, so the easiest path will used.

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

3.1.2.4 Considerations in Using Offsite Resources - Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

On page 9 of the Integrated Plan, the licensee stated that Entergy will negotiate and execute a contract with the SAFER for the ANO site which will meet the requirements of NEI 12-06, Section 12.

The licensee has not identified the local staging area and did not provide a description of the methods to be used to deliver the equipment to the site. This has been combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to use of off-site resources following flooding 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 hazard associated with tornadoes should be accomplished by comparing the site location to NEI 12-06, Figure 7-2, from U.S. NRC, "Tornado Climatology of the Contiguous United States," NUREG/CR-4461, Rev. 2, February 2007; if the recommended tornado design wind speed for a 10^{-6}/year probability exceeds 130 mph, the site should address hazards due to extreme high winds associated with tornadoes.

On page 2 of the Integrated Plan, the licensee stated in part that:

> Figures 7-1 and 7-2 from NEI 12-06 … were used for this assessment.
>
> The ANO site is located at 35° - 18' N (References 4a and 4b, Sections 2.2.1 and 2.1.1, respectively); therefore, ANO is not susceptible to hurricanes based on its location in Arkansas. The plant site is north of the final contour line shown in Figure 7-1 of NEI 12-06.
>
> It was determined that the ANO site has the potential to experience damaging winds caused by a tornado exceeding 130 mph. Figure 7-2 of NEI 12-06 indicates a maximum wind speed of 200 miles per hour (mph) for Region 1 plants, including ANO, which is located at 35°-18' N, 93°-13' W. Therefore, high-wind hazards are applicable to the ANO site.
>
> In summary, (1) based on Figure 7-1 of NEI 12-06, ANO is not susceptible to hurricanes so the hazard is screened out and (2) based on local data and Figure 7-2 of NEI 12-06, ANO has the potential to experience damaging winds so the hazard is screened in.

The reviewer noted that the ANO site location is not north of the entirety of the final contour line on NEI 12-06, but is north and west of that line. This is in the direction of diminishing peak-gust hurricane wind speeds and indicates that ANO is not susceptible to the hurricane hazard.

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

3.1.3.1 Protection of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.1 states:

> These considerations apply to the protection of FLEX equipment from high wind hazards:
>
> 1. For plants exposed to high wind hazards, FLEX equipment should be stored in one of the following configurations:
>
> a. In a structure that meets the plant's design basis for high wind hazards (e.g., existing safety-related structure).

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

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

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

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

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

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

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

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

On page 1 of the Integrated Plan, the licensee stated that the high hazard applies to ANO, and as a result, the credited FLEX equipment will be assessed based on the current ANO high wind

licensing basis to ensure that the equipment remains accessible and available after a BDBEE. The licensee stated that FLEX storage locations will provide the protection required from high wind hazards.

On page 14 of the Integrated Plan, the licensee stated that the FLEX equipment storage location(s) will withstand the NEI 12-06 hazards as applicable to ANO.

During the audit process the licensee provided the following additional information regarding storage for the high wind hazard:

- ANO intends to locate the FLEX equipment storage buildings in accordance with NEI, 12-06 Section 7.3.1.1.c (ASCE 7-10 and local building codes) to address high wind design criteria.
- Additionally, to provide reasonable assurance that at least one of the storage buildings would not be damaged by tornado missiles, the two buildings are being separated based on a site specific evaluation and installed on an axis that is approximately perpendicular to the axis of the predominant path for tornadoes in the area of the site.
- The currently selected building separation is based on a preliminary analysis of historical tornado data for the region surrounding the ANO site.

The need to verify that the axis of separation and distance between the buildings provides assurance that the path of a single tornado would not impact both is identified as Confirmatory Item 3.1.3.1.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and, subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protection of FLEX equipment during 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 which apply to the deployment of FLEX equipment for high wind hazards:
>
> 1. For hurricane plants, the plant may not be at power prior to the simultaneous ELAP and LUHS condition. In fact, the plant may have been shut down and the plant configuration could be established to optimize FLEX deployment. For example, the portable pumps could be connected, tested, and readied for use prior to the arrival of the hurricane. Further, protective actions can be taken to reduce the potential for wind impacts. These factors can be credited in considering how the baseline capability is deployed.
>
> 2. The ultimate heat sink may be one of the first functions affected by a hurricane due to debris and storm surge considerations. Consequently, the evaluation should address the effects of ELAP/LUHS, along with any other equipment that would be damaged by the postulated storm.
>
> 3. Deployment of FLEX following a hurricane or tornado may involve the need to

remove debris. Consequently, the capability to remove debris caused by these extreme wind storms should be included.

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

5. The ability to move equipment and restock supplies may be hampered during a hurricane and should be considered in plans for deployment of FLEX equipment, and should be considered in plans for deployment of FLEX equipment.

On page 14 of the Integrated Plan the licensee stated that:

> In all external events, a deployment strategy is planned that will deliver FLEX equipment to the appropriate event-determined staging area.
>
> Any portable FLEX equipment will be trailer-mounted or on wheels for ease of deployment. ....
>
> A strategy to clear debris for FLEX coping strategies will be implemented.

During the audit the licensee stated that onsite debris removal equipment will be available immediately following an event. A transport vehicle is stored in each FLEX equipment storage location to deploy the equipment along with a large piece of debris removal equipment (e.g., heavy equipment with multiple attachments). A debris removal assessment has been performed to ensure that the FLEX equipment can be deployed in a timeframe that complements the overall FLEX Strategy including the need to repower the battery chargers with a FLEX generator in 8 hours following a high-wind event that results in debris along the deployment route.

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

3.1.3.3 Procedural Interfaces - High Wind Hazard

NEI 12-06, Section 7.3.3, states:

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

On page 7 of the Integrated Plan the licensee stated:

> Procedures and guidance to support deployment and FLEX coping 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 Entergy document control system.

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

3.1.3.4 Considerations in Using Offsite Resources - High Wind Hazard

NEI 12-06, Section 7.3.4 states:

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

On page 9 of the Integrated Plan, the licensee stated that Entergy will negotiate and execute a contract with the SAFER for the ANO site which will meet the requirements of NEI 12-06, Section 12.

The licensee has not identified the local staging area and did not provide a description of the methods to be used to deliver the equipment to the site. This has been combined with Confirmatory Item 3.1.1.4.A. in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 part in NEI 12-06, Section 8.2.1:

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

On page 3 of the Integrated Plan, the licensee stated per NEI 12-06, plants above the 35th

parallel should provide the capability to address the impedances caused by extreme snow and cold. The ANO site is located marginally above the 35th parallel at 35°-18' N (References [19] and [20], Sections 2.2.1 and 2.1.1, respectively); therefore, the FLEX strategies must consider the impedances caused by extreme snowfall with snow removal equipment, as well as the challenges that extreme cold temperature may present.

The ANO site, located at 35° '18 N, and 93° 13' W, is not a Level 1 or 2 region as defined by Figure 8-2 of NEI 12-06; therefore, the FLEX strategies must consider the hindrances caused by ice storms.

In summary, based on the available local data and Figures 8-1 and 8-2 of NEI 12-06, the hazards of snow, ice, and extreme cold temperatures are screened in for the ANO 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 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 N+1 equipment may be stored in an evaluated storage location capable of withstanding historical extreme weather conditions such that the equipment is deployable.
>
> 2. Storage of FLEX equipment should account for the fact that the equipment will need to function in a timely manner. The equipment should be maintained at a temperature within a range to ensure its likely function when called upon. For example, by storage in a heated enclosure or by direct heating (e.g., jacket water, battery, engine block heater, etc.).

On page 1 of the Integrated Plan, the licensee stated that this high hazard applies to ANO, and as a result, the credited FLEX equipment will be assessed based on the current ANO snow, ice and extreme cold hazards licensing basis to ensure that the equipment remains accessible and available after a BDBEE. The licensee stated that FLEX storage locations will provide the protection required from snow, ice and extreme cold hazards.

On page 14 of the Integrated Plan, the licensee stated that the FLEX equipment storage location(s) will withstand the NEI 12-06 hazards as applicable to ANO.

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

On page 14 of the Integrated Plan, the licensee stated, in part:

> In all external events, a deployment strategy is planned that will deliver FLEX equipment to the appropriate event-determined staging area.
>
> Any portable FLEX equipment will be trailer-mounted or on wheels for ease of deployment. This will give the current vehicles at ANO the capability to move any portable FLEX equipment. Available forklifts or pickup trucks will be utilized for deploying any portable FLEX equipment. Most of this equipment will be utilized for both the movement of any portable FLEX equipment and debris removal.
>
> A strategy to clear debris for FLEX coping strategies will be implemented.

Similar statements are made on pages 22, 30, 35 and 38 of 51 in the sections of its integrated plan describing how strategies will be deployed for phase 2 of the strategies for maintaining RCS inventory control, SFP cooling, and safety functions support, and phase 3 of the strategy for safety functions support.

The licensee was requested to discuss plans for implementation of the strategies to deploy portable equipment in the context of snow, ice, and extreme cold. During the audit, the licensee stated that the onsite FLEX equipment includes a large piece of debris removal equipment (e.g., heavy equipment with multiple attachments), which along with existing plant capabilities and procedures, ensures the ability to mitigate ice and snow accumulation. A debris removal assessment has been performed to ensure that the FLEX equipment can be deployed in a timeframe that supports the overall FLEX Strategy.

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

3.1.4.3 Procedural Interfaces - Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.3 states:

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

The licensee was requested to discuss plans for implementation of the strategies to deploy portable equipment in the context of snow, ice, and extreme cold. During the audit, the licensee stated that the onsite FLEX equipment includes a large piece of debris removal equipment (e.g., heavy equipment with multiple attachments), which along with existing plant capabilities and procedures, ensures the ability to mitigate ice and snow accumulation. A debris removal assessment has been performed to ensure that the FLEX equipment can be deployed in a timeframe that supports the overall FLEX Strategy.

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

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

NEI 12-06, Section 8.3.4, states that:

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

On page 9 of the Integrated Plan, the licensee stated that Entergy will negotiate and execute a contract with the SAFER for the ANO site which will meet the requirements of NEI 12-06, Section 12.

The licensee has not identified the local staging area and did not provide a description of the methods to be used to deliver the equipment to the site. This has been previously identified as

Confirmatory Item 3.1.1.4.A in Section 4.2.

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

3.1.5 High Temperature Hazard

NEI 12-06, Section 9 states:

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

On pages 3 and 4 the Integrated Plan, the licensee stated in part that,

> Per NEI 12-06, all sites must 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 degrees F. All sites will consider the impacts of these conditions on the FLEX equipment and its deployment.
>
> The event considered herein is a loss of all alternating current (AC) power as a result of short extreme high temperatures coincident with high electrical grid demands, resulting in regional blackout. During this type of event, with the equipment and water inventories in the units operating within the technical specification (TS) limits, no additional limitations on initial conditions/failures/abnormalities are expected. … Therefore, the extreme heat hazard is screened in for ANO.

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

3.1.5.1 Protection of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.1, states that:

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

On page 14 of the Integrated Plan, the licensee stated that the FLEX equipment storage location(s) will withstand the NEI 12-06 hazards as applicable to ANO.

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 and storage of FLEX equipment for 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 14 of the Integrated Plan, the licensee stated that in all external events, a deployment strategy is planned that will deliver FLEX equipment to the appropriate event-determined staging area, and that any portable FLEX equipment will be trailer-mounted or on wheels for ease of deployment. This will give the current vehicles at ANO the capability to move any portable FLEX equipment. Available forklifts or pickup trucks will be utilized for deploying any portable FLEX equipment.

Similar statements are made on pages 22, 30, 35 and 38 of 51 in the sections of its integrated plan describing how strategies will be deployed for phase 2 of the strategies for maintaining RCS inventory control, SFP cooling, and safety functions support, and phase 3 of the strategy for safety functions support. On page 40 of 51, in the section listing PWR Portable Equipment for phase 2, Entergy identified Debris Removal Equipment.

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

3.1.5.3 Procedural Interfaces - High Temperature Hazard

NEI 12-06, Section 9.3.3 states that:

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

On page 7 of the Integrated Plan, 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 NEI 12-06.

The licensee was requested to provide a discussion regarding FLEX equipment operation in any areas of the plant where extremely high temperatures may exist. During the audit the licensee

stated that procedures will address the effects of high temperature extremes on FLEX equipment and will meet the requirements of NEI-12-06, Section 9.3.3 for effects of high temperatures in the areas where equipment is operating. ANO is planning to consider the temperatures in the areas where equipment will be operated and procure the FLEX equipment accordingly and have procedures in place to control the operation of the FLEX equipment. Additionally, heat and exhaust dissipated from the FLEX equipment during operation will be accounted for in the location where the FLEX equipment will be operated. The equipment specifications for procurement of this equipment will specify these extreme conditions. The majority of the large FLEX equipment, including the large FLEX diesel-driven equipment, is planned to be deployed and operated in ambient outdoor conditions. Some electric powered FLEX equipment and small FLEX generators will be deployed indoors.

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

3.2 PHASED APPROACH

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

To meet the requirements of Order EA-12-049, licensees will establish a baseline coping capability to prevent fuel damage in the reactor core or SFP and to maintain containment capabilities in the context of a BDBEE that results in the loss of all ac power, with the exception of buses supplied by safety-related batteries through inverters, and loss of normal access to the UHS.

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

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

NEI 12-06, Table 3-2 and Appendix D summarize one acceptable approach for 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 RCS inventory control and maintenance of long term subcriticality through the use of low-leakage RCP seals and/or borated high pressure RCS makeup with a letdown path.

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 2.1, strategies that have a time constraint to be successful should be identified and a basis provided that the time can be reasonably met. NEI 12-06, Section 3 provides the performance attributes, general criteria, and baseline assumptions to be used in developing the technical basis for the time constraints. Since the event is a beyond-design-basis event, the analysis used to provide the technical basis for time constraints for the mitigation strategies may use nominal initial values

(without uncertainties) for plant parameters, and best-estimate physics data. All equipment used for consequence mitigation may be assumed to operate at nominal setpoints and capacities. NEI 12-06, Section 3.2.1.2 describes the initial plant conditions for the at-power mode of operation; Section 3.2.1.3 describes the initial conditions; and Section 3.2.1.4 describes boundary conditions for the reactor transient.

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

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

The licensee was requested to provide a discussion regarding; (a) the cooldown rate, (b) the duration of the cooldown, (c) the number of steam generators used in the cooldown. The analyses performed in WCAP-17601-P include scenarios where no cooldown is assumed, a cooldown beginning at 2 hours using the loop opposite the pressurizer, and a cooldown beginning at 2 hours using both loops. None of the scenarios presented in WCAP-17601-P include makeup capability. The licensee was also requested to describe whether the cooldown plan matches those presented in the WCAP.

During the audit, the licensee provided the response for ANO-1 as follows:

(a) Cooldown rate for ANO-1 is 20 degrees F/hour.
(b) The duration of cooldown to 350 degrees F is approximately 11 hours (19 hours after the event).
(c) The ANO-1 strategy is based on a cooldown strategy starting at 8 hours following the event. This is most similar to the analysis described in Section 5.3.3.4 of WCAP-17601-P (Babcock and Wilcox (B&W)) LL & RL Cooling & Feeding both OTSGs). However, based on a plant specific analysis, the ANO-1 strategy establishes a required RCS makeup @ 35 gpm 6 hours following the event. Cooldown utilizing the ADVs and re-powered pressurizer heaters is initiated two hours after start of makeup. The FLEX diesel generator is sized to re-power 168 kW of ANO-1 pressurizer heaters, or four groups of heaters, from their normal power sources. A minimum nominal capacity of 126 kW for the pressurizer heaters ensures that RCS pressure can be maintained (Reference ANO-1 Technical Specifications B3.4.9). This strategy ensures natural circulation is maintained during the cooldown. The ANO-2 charging pumps with suction from the Boric Acid Makeup Tanks (BAMTs), RWT, BWST or the new borated water tank will provide this function.

The licensee was requested to: 1) clarify the motive force(s) that would be used to operate the atmospheric depressurization valves (ADVs) for both ANO-1 and 2, 2) provide an analysis that supports their continued operation for the duration of the event, and 3) determine how many ADV cycles are expected and how many are supported by the existing on-site capabilities, 4) clarify the time at which manual operation of the ADVs will be required for ANO-1 and ANO-2, 5) describe the accuracy with which steam generator pressure and level would be controlled via

manual ADV operation, and 6) provide adequate basis to justify that manual operation of the ADVs would not significantly alter the coping times determined in the existing analysis.

During the audit, the licensee provided the following information regarding ADV operation:

- Page 10 of the Integrated Plan indicates that during a SBO and following loss of remote control of the ADV, local manual action is possible and will be used to continue plant control consistent with current procedures.
- The following procedures provide instructions on local manual operation of the ADVs which would be used in an ELAP (SBO) condition.
- ANO-1 procedure 1203.002, “Alternate Shutdown,” Exhibit A, “Local Operation of ADVs at Mode 3, >525 degrees F,”
- ANO-1 procedure OP-1202.008, “Blackout”
- ANO-2 procedure OP-2202.008, “Station Blackout”
- ANO-2 procedure OP-2203.014, “Alternate Shutdown”
- ANO-2 procedure OP-2105.008, Steam Dump and Bypass Control System Operation, Exhibit 2, “Manual Operation of Upstream Atmospheric Dump Valves”
- Operations personnel utilize job performance measures to simulate local manual operation of the ADVs, however, the valves are not actually operated with the handjack mechanisms during the simulation. The ADVs are subject to a preventative maintenance program to ensure availability to function as required.
- Local manual operation of the ADVs (upstream ADVs for ANO-2) is credited to accommodate safety issues, such as being able to maintain hot shutdown conditions for loss of AC power conditions or the Appendix R safe shutdown, which allows manual action for cooldown.
- The ANO-1 ADVs are not safety related, and are not qualified for seismic events. The ANO-2 ADVs upstream of the MSIVs are not safety-related but are classified seismic Category 1.

The licensee should perform an analysis to verify that the ADVs and associated piping are sufficiently robust and will remain functional during a seismic event. This has been identified as Confirmatory Item 3.2.1.A in Section 4.2.

- ANO-2 Station Blackout procedure, OP-2202.008, indicates that SG level should be maintained between 10% and 90%, and pressure from 950 psia to 1050 psia in accordance with “Manual Operation of Upstream Atmospheric Dump Valves” Exhibit 2 of procedure OP-2105.008, “Steam Dump and Bypass Control System Operations.” Exhibit 2 of this procedure also provides instruction for local monitoring of SG pressure using a local gage near the ADVs.
- ANO-1 operating procedure OP-1203.002, “Alternate Shutdown,” Exhibit A, “Local Operation of ADVs at Mode 3, >525 degrees F,” provides instruction for local manual (handjack) operation of the ADVs, and local monitoring of SG outlet pressure. Section 2.0 of the procedure provides direction for operations personnel to maintain SG pressure initially at ~1000 psig (using the ADVs), and SG level at 300” to 340” using manual control of EFW valves, as required. Section 3.0 of the procedure provides instructions for alternate shutdown cooldown using manual operation of the ADVs.
- Manual operation of the ADVs will not alter the coping times for an ELAP at ANO. The coping timelines reflect initiation of required actions for an SBO condition at zero (0) hours into the event. Cooldown for ANO-1 is deferred until the RCS inventory control is assured. ANO-1 and ANO-2 cooldown is deferred until the Phase 2 turbine-driven EFW backup feedwater supply is staged and available. The sequence of events timelines for both ANO-1

and ANO-2 indicate cooldown is currently scheduled to begin at approximately 8 hours from event initiation. The ANO-2 cooldown requires confirmation of existing analysis or additional analysis during the ANO-2 detailed design to support the delay in the cooldown to 8 hours following and ELAP.

The need to confirm these analyses support the delay in the cooldown is identified as Confirmatory Item 3.2.1.B in Section 4.2.

On page 18 of the Integrated Plan the licensee stated that the issue of primary makeup arises days into the event. Considering that analyses in WCAP-17601-P suggest that loss of natural circulation could occur within 24 hours for both B&W and Combustion Engineering (CE) reactors, the statement on page 18 does not appear consistent with the generic recommendation of the Pressurized Water Reactor Owners Group (PWROG) in the core cooling interim position paper provided by letter dated January 30, 2013, ADAMS Accession No. ML130420011, that natural circulation be maintained. The licensee was requested to identify the time when primary makeup is needed to ensure that single-phase natural circulation is not interrupted and to confirm whether the integrated plan will ensure an adequate supply of primary makeup prior to this time.

During the audit the licensee provided the following information regarding RCS makeup:

a) The time by when RCS makeup is required to maintain single-phase natural circulation was determined in the site-specific ELAP analysis performed for each unit.

b) ANO-1 will begin RCS makeup at 6 hours. The RCS volume is maintained sufficient to maintain natural circulation confirmed by the ELAP analysis. As discussed previously, the ELAP analysis is based on RELAP5 cases from WCAP-17601.

c) ANO-2 will begin RCS makeup at 17.5 hours. The transition to two-phase natural circulation conditions occurs at approximately 18.5 hours into the ELAP event. The ELAP analysis is based on CENTS. RCS makeup is not required until 18.5 hours due to the large size and volume of the safety injection tanks (SITs). This analysis requires confirmation or additional analysis during the ANO-2 detailed design to support the delay in the ANO-2 cooldown to 8 hours following an ELAP.

d) Both units have an adequate supply of primary makeup prior to these times. For ANO-1 the initial suction source will be the ANO-2 BAMT followed by the ANO-2 RWT. The ANO-1 BWST will be used if available and the preferred ANO-1 sources for RCS makeup are unavailable. For ANO-2 the suction source will be either the ANO-1 BWST or ANO-2 RWT. An additional borated water source is being identified should either the BWST or RWT not be available due to a tornado.

The licensee was requested to clarify why it is not necessary to provide level indication for the ANO-1 core flood tanks (CFTs) and to provide the basis for concluding that the core flood tanks will be isolated or vented prior to discharging noncondensible gas into the reactor coolant system, thereby potentially inducing adverse effects such as termination of natural circulation and degraded heat transfer.

During the audit the licensee provided the following information regarding the CFT's

a) The ANO-1 FLEX strategy defers cooldown and depressurization until RCS Inventory is assured (i.e., aligning a RCS makeup pump with a source of borated water). The cooldown is initiated 8 hours following the ELAP and continues until a RCS temperature of 350 degrees F is reached.
b) According to plant specific analysis performed by Westinghouse this corresponds to a RCS pressure of ~500 psia. The CFTs will be isolated before RCS pressure reaches the nitrogen pressure of 140 psig during cooldown. The availability of RCS pressure indication precludes the need for CFT level indication. The isolation will be accomplished by closing the CFT isolation valves using power from a portable FLEX generator connected to their normal power sources.

The licensee was requested to identify the non-safety related installed systems or equipment that are credited in establishing ELAP mitigation strategies, and for all the identified systems or equipment, discuss the intended mitigation functions, and provide information to show that the identified systems or equipment are available and reliable to provide the intended mitigation functions on demand during an ELAP event.

During the audit process the licensee in part, provided the following information regarding credited non-safety systems:

a) In general, any non-safety related installed systems or equipment that are credited for ELAP mitigation strategies are, or will be shown to be, sufficiently robust for the conditions in which they are credited to function in the strategies. Specific non-safety related equipment and systems that are currently known to be credited are discussed below. Additionally, the FLEX equipment platforms are qualified for anticipated loads, including loads from the probable maximum flood for the site.

<u>Common</u>
<u>Diesel-driven fire pump</u>
a) The Phase 1 water source [core cooling and heat removal] for seismic and flood events is the QCST. The Phase 1 water source for wind/missile events is initially the QCST supplemented by the emergency cooling pond (ECP) supplied by the (shared) diesel-driven fire pump. The diesel-driven fire pump starts automatically on loss of AC power and will require valve operation to align the pump's discharge to the service water header. The diesel driven fire pump is housed in the seismic Category I intake structure, and is protected from tornado winds and missiles. The diesel driven fire pump has a day tank containing enough diesel oil for eight hours of operation. The day tank has provisions for refilling from the 185,000 gallon diesel oil bulk storage tank (T25). (ANO-2 FSAR Section 9.5.1.2.2)
b) The ANO-2 TRM Section 3.7.1 provides testing and inspection requirements for the diesel-driven fire pump and its fuel supply to ensure functional reliability.

<u>ANO EFW Turbine Exhaust Piping</u>
a) The EFW turbine-driven pump is required for Phase 1 core cooling. With the exception of the condensate storage tank (CST), no portion of the EFW System is exposed to potential tornado generated missiles which could affect both trains. The EFW turbine exhaust piping performs no active function, and is classified as non-safety related. (Upper Level Document (ULD) ULD-2-SYS-12, ANO-2 Emergency Feedwater System, Section 4.7) The EFW pump turbine exhaust piping is ANSI B31.1.0 class and has been analyzed to withstand DBE seismic loads. (ANO-2 FSAR Section 10.4.9.1)
b) Since some failure modes (e.g., crimping) of this non-safety related exhaust piping could impair functioning of the safety-related portions of the EFW system, this piping has been designed for protection against SSEs, tornadoes, and HELBs. The EFW turbine exhaust

provides dual paths for protection against crimping caused by HELB from the MFW or MS lines which pass in close proximity to the exhaust piping. One path has been analyzed and designed to survive a DBE (SSE) event. The other path has been analyzed and designed to survive both tornado wind loads and tornado missile strikes. A rupture disk has been installed in the EFW Pump turbine exhaust line to provide an alternate vent path in the unlikely event the exhaust line is pinched by a main feedwater line break and pipe whip. (ULD-2-SYS-12, ANO-2 Emergency Feedwater System, Section 4.7)

ADVs and ADV exhaust piping

ANO-2 ULD-2-SYS-21, Main Steam, Section 4.7 states that the main steam containment penetrations, headers, and safety related components outside containment, including the MSSVs, ADVs, ADV isolation valves, main steam piping to the EFW pump turbine, MSIVs, the air accumulator tank for the MSIVs and the instrument air supplies, are not protected from tornadoes of missiles. A missile impact analysis has been performed and concludes that missile impacts on these penetrations, headers and safety related components would not cause a MSLB or prevent a safe plant shutdown. The analysis has been reviewed and accepted by the NRC. (2CNA097612, Safety Evaluation Report Revision No. 1, dated September 3, 1976) FSAR Table 3.2-2 indicates that the ADVs are seismic Category 1.

ANO-1

SFP piping

A portion of the SFP cooling system piping will be used to provide an alternative for makeup to the SFP with water supplied using a temporary FLEX pump and hose connected to a threaded connection on the SFP pipeline. The SFP cooling system piping has been demonstrated by calculation to be seismically rugged with regard to pressure boundary integrity. Additional means for makeup and spray for SFP cooling are available as discussed in the OIP; these other means are qualified for all BDBEE events.

Charging system

a) For ANO-1, one of the ANO-2 charging pumps will be repowered from their normal power sources using the portable FLEX diesel generator (PDG). The charging pumps' discharge will be cross-tied to either a primary or an alternate location in the ANO-1 HPI system. This allows injection of RCS inventory for ANO-1 prior to plant cool down and depressurization. The initial suction source for the charging pumps will be the ANO-2 BAMT and subsequently inventory will be provided by the ANO-2 RWT. The charging pump and the BAMT and RWT are seismic category I according to ANO-2 FSAR Table 3.2-2. Several alternatives are being evaluated to address RCS inventory needs during a wind/missile event.

b) Conduit for cabling necessary to provide power to the charging pump from the portable FLEX generator is being installed as seismic Category 1 conduit.

Review of the licensee evaluation of RCS makeup supplies is addressed in TER Section 3.2.4.7 "Water Supplies."

EFW turbine exhaust piping

Evaluation of the AN0-1 EFW turbine exhaust piping for robustness is anticipated to be completed in 2014.

This has been identified as Confirmatory Item 3.2.1.C in Section 4.2

ADVs and ADV exhaust piping

a) The Reactor Building main steam penetrations, headers, and safety related components outside of the Reactor Building are not protected from tornadoes or missiles. This includes the MSSVs, ADVs, ADV isolation valves, main steam piping to the EFW pump turbine, MSIVs, air accumulator tanks for the ADVs/MSIVs and the instrument air supplies. A missile impact analysis has been performed and concludes that missile impacts on these penetrations, headers, and safety related components would not cause a MSLB or prevent a safe plant shutdown. The analysis has been reviewed and accepted by the NRC. (ANO-1 SER, Section 3.5 Missile Protection)

b) The ADVs are provided to allow plant cooldown when normal cooldown components are not available, such as when the MSIVs are closed or when the main condenser is not available. Safety grade controls provided through the Emergency Feedwater Initiation and Control (EFIC) System allow for control of the valve in the event of a loss of all AC power. The ADVs receive "A" and "B" control signs from the EFIC System. Handjacks are provided on the ADVs to allow manual operation even with a loss of all electrical power. (ULD-1-SYS-21, Section 4.3)

c) The ADVs were replaced with valves of an improve design, and manual local control capabilities were enhanced.

d) Evaluation of the ADVs and their exhaust piping for seismic robustness is anticipated to be complete in August 2014. See Confirmatory Item 3.2.1.A above.

The licensee was requested to discuss if any safety related equipment is not protected from external hazards (tornado missile), e.g. EFW pump exhaust, ADVs, etc.

During the audit process the licensee provided the following information regarding external hazards for non-safety equipment:

a) The QCST will supply initial inventory for both units for core cooling and heat removal; however an additional water supply is required for tornado missile events as the QCST would require modification to assure missile protection. The QCST will not be credited for extended use in mitigation of the consequences of a tornado missile strike event.
b) In the event of a high wind missile event that damages the QCST, a minimum of 30 minutes of inventory is available (ANO-2 FSAR Section 9.2.6.3). In this case, Fire Water Pump P-6B will be used to deliver adequate suction from the intake structure on Lake Dardanelle to the turbine-driven EFW pumps for both units via a new permanently installed cross-tie between fire water and service water.

The licensee was requested to provide a description of the FLEX equipment flood platform and if it is robust to survive external events.

During the audit process the licensee provided the following information regarding the flood platform:

a) New staging platforms outside the ANO-1 post accident sampling system (PASS) Building and ECP Intake Structure for use during flooding events will be structurally qualified for the loading associated with dead weight, seismic loads, flood loads, wind loads and equipment loads. The top of the platforms is anticipated to be at 362 feet mean sea level (MSL) which is above the maximum flood elevation for ANO of 361 feet MSL. The staging platforms will be non-safety, non-seismic structures. Since the platforms will only be used in response to flooding events, no seismic event is considered with the loaded structure.

b) Conservatively, the OBE seismic loads will be considered on the unloaded structure in order to ensure that the permanent structure will not be damaged prior to a beyond design basis external flooding event. The flood loads are determined in accordance with Section 5.4.4 of ASCE 7. The wind loads are determined in accordance with Section 6.5 of ASCE 7. (Reference calculation CALC-13-E-0005-08, Design of FLEX Staging Platform and Concrete Pad.)

The licensee was requested to describe where equipment will be prepositioned to assure protection (include N+1 equipment).

During the audit process the licensee provided the following information regarding the design of the permanent staging platform structures.

One staging platform is installed west of the PASS building and above the maximum flood elevation to pre-stage the following portable FLEX equipment in anticipation of a flooding event:

- 2 steam generator makeup pumps
- 1 RCS makeup pump (Unless it is decided to use Charging Pump for ANO-2 RCS Makeup)
- 1 SFP makeup pump
- 1 portable FLEX generator (for repowering electrical equipment including both unit's battery chargers and ANO-2 charging pumps)

An additional, permanent staging platform will be installed near the ECP and above the maximum flood elevation for pre-staging a FLEX inventory transfer pump for QCST makeup in anticipation of a flooding event.

Because one of the FLEX Equipment Storage locations is above the maximum flood elevation, there is no need to pre-stage the +1 set of equipment.

The licensee was requested to discuss the long term reliability of the steam driven EFW pump during an ELAP event by addressing the following items:
a) Excessive moisture in the steam supply can disrupt turbine operation. Discuss whether the ELAP event will impact steam supply line moisture removal such that turbine operation is potentially impacted. If the condensate discharges to a local sump, please address long term area temperature and humidity along with the removal of the condensate before local room flooding can occur.

b) The steam driven EFW pump has mini flow recirculation line that provides relief from dead heading the pump. This recirc may not be protected from external events associated with an ELAP event. Staff requests the licensee assess operation of the mini flow recirc line and any action required if the line become crimped, or severed resulting in loss of inventory.

During the audit process the licensee provided the following information regarding the EFW pumps:

a) For both ANO-1 and ANO-2, the steam turbine driver is a single stage, solid wheel, non-condensing, horizontal, split case unit. It will operate with steam generator pressures ranging from 1,100 psia to 60 psia. Given the solid wheel design of the turbine, moisture in the steam, if affected by an ELAP, is not expected to affect EFW turbine performance.

b) Self-identified licensee open items have been noted for ANO-1 and ANO-2 as to whether ventilation for the EFW turbine/pump rooms will be required to ensure the rooms are habitable

for local manual operator actions required for core cooling scenarios.

c) EFW turbine steam lines and the EFW turbine valves and casing are provided with drains which typically include steam traps to remove moisture from the steam lines and equipment during standby conditions. During EFW turbine operation these drains are not required as moisture will not collect in the (flowing) steam lines or components.

ANO-1
The EFW steam line from the SG includes an orificed normally open drain line which drains to the main condenser. An additional orificed normally open drain from the steam inlet line, and similar drains from the trip and throttle valve, governor valve and turbine casing drain exist to remove condensed moisture. These drains are combined and flow through parallel steam traps to a sump in the EFW pump room. Because of no or very low flow through the orificed drains during EFW turbine operation, significant amounts of condensate are not expected to collect in the room sump. The EFW turbine/pump is not in an enclosed room. Thus increases in room humidity from steam drains and flooding of the room from this source should not be a concern.

ANO-2
The steam line from the SGs to the EFW turbine includes steam trap drains which are continuously in service (valves maintained open) drain to the main condenser. Additional steam line drains inside the EFW room also drain to the main condenser via steam traps. EFW turbine trip and throttle valve and governor valve leakoffs and turbine gland drains drain to the turbine building. Therefore increases in room humidity from steam drains and flooding from steam drains in the EFW pump room is not a concern.

For ANO-1 and ANO-2 it was concluded in these evaluations that it is not credible for the EFW minimum flow recirculation piping to become crimped such that it prohibits flow in excess of the installed flow orifices. For ANO-1 it was concluded that should the non-seismically supported piping be compromised, compensatory actions could be taken to route the flow to the Flume through seismically qualified piping to alleviate internal flooding concerns. For ANO-2 it was concluded that the existing flood evaluation reports envelope EFW recirculation piping Moderate Energy Line Break flooding concerns. A severed minimum flow line could reduce the amount of time from the 30 minutes credited in the current licensing basis for which suction from the QCST is available and thus switch over to a source from the ECP or Dardanelle Lake may be required sooner.

The current ANO-1 strategy for RCS inventory control strategy for Phase 2 is provided by cross-connecting ANO-2 charging pumps to the ANO-1 high pressure injection system and re-energizing one of ANO-2's charging pumps from the portable diesel generator. The initial suction source for the ANO-2 charging pumps will be the ANO-2 boric acid makeup tank (BAMT) followed by the ANO-2 refueling water tank (RWT). The licensee further stated that this new strategy allows injection of RCS inventory for ANO-1 prior to plant cool down and depressurization. However, this conflicts with the guidance provided in NEI 12-06 Section 3.2.2 Guideline (13) which specifies that regardless of installed coping capability, all plants will include the ability to use portable pumps to provide makeup as a means to provide a diverse capability beyond installed equipment; therefore, a deviation from NEI 12-06 Section 3.2.2 guideline (13) is being taken.

During the audit, the licensee stated that:

> The use of the installed ANO-2 charging pumps to provide RPV makeup is an

acceptable alternative to a portable FLEX pump for the transitional phase of FLEX. The guidance states the ELAP response is to be addressed with a combination of three categories of equipment: installed plant capability, portable on-site equipment, and off-site equipment resources (1st bullet below.) Only one phase of the response is limited to utilizing equipment from just one of the equipment categories. To ensure that there is enough time to deploy and implement portable equipment, Phase 1 can only use installed plant equipment. Even though Phase 2 and Phase 3 will utilize portable equipment (onsite for Phase 2 and offsite from RRC for Phase 3) there is no prohibition against the use of permanently installed plant equipment in those two phases as long as it is robust with respect to design basis external events (2nd and 3rd bullets below). NEI 12-06 recognizes the need for this and provides guidance (i.e., "…robust with respect to design basis external events…") for which installed equipment can be utilized the guidance dies provide some examples of types of installed equipment (i.e., robust piping, 4th and 5th bullet below) which can be used, but it does not exclude any equipment types other than installed, emergency on-site AC power sources which are excluded by the ELAP initial conditions.

- 3 STEP 1: ESTABLISH BASELINE COPING CAPABILITY – "The primary FLEX objective is to develop a plant-specific capability for coping with a simultaneous ELAP and LUHS event for an indefinite period through a combination of installed plant capability, portable on-site equipment, and off-site resources. Each plant will establish the ability to cope for these baseline conditions based on the appropriate engineering analyses and procedural framework.

- 3.2 PERFORMANCE ATTRIBUTES – "…The baseline assumptions have been established on the presumption that other than the loss of the ac power sources and normal access to the UHS, installed equipment that is designed to be robust with respect to design basis external events is assumed to be fully available. Installed equipment that is not robust is assumed to be unavailable."

- 3.2.1.3 Initial Conditions (6) – "Permanent plant equipment that is contained in structures with designs that are robust with respect to seismic events, floods, and high winds, and associated missiles, are available."

- 3.2.1.3 Initial Conditions (8) – "Installed electrical distribution system, including inverters and battery chargers, remain available provided they are protected consistent with current station design."

- 2.1 ESTABLISH BASELINE COPING CAPABILITY – "While initial approaches to FLEX strategies will take no credit for installed ac power supplies, longer term strategies may be developed to prolong Phase 1 coping that will allow greater reliance on permanently installed. Bunkered or hardened ac power supplies that are adequately protected from external events."

The ANO-2 charging pump and related piping and components meet the NEI 12-

> 06 requirements for use of installed plant equipment. The components are contained in Seismic Category I structures that provide protection from BDBEEs. The components are seismically robust or are being evaluated to demonstrate that they are seismically robust. The ANO-2 charging pump and related components' FLEX functions are similar to that of the ANO-2 charging pump's original design functions. Any of the three, redundant ANO-2 charging pumps can be used in the FLEX strategy. Power to any of the pump motors is provided from a portable FLEX diesel generator. The cable routing from generator is through Seismic Category 1 structures. The use of installed ANO-2 charging pumps minimizes the deployment resources for implementing Phase 2 RPV FLEX strategies. Additionally, the basis for use of the installed ANO-2 charging pumps in lieu of portable FLEX pumps is consistent with the justification provided in NEI 12-06 FAQ 2013-06. Based on the above attributes, it is concluded that use of the installed ANO-1 meets the intent of the NEI 12-06 guidance providing Phase 2 FLEX strategies and there is no need for a portable FLEX pump for RPV makeup.

The NRC staff identified sixteen concerns that need to be addressed regarding ANO-1's new RCS inventory control strategy. During the audit the licensee responded to these concerns, however the response was received too late to be analyzed and incorporated into this TER. In addition to the alternate approach regarding the use of installed charging pumps, the licensee requested a second alternative to the provisions of NEI 12-06 regarding the ANO-2 electrical configuration for an interim eight month period of ANO-1 required compliance when all of the planned electrical modifications will not be completed. The specific issue is described more completely in Section 3.2.4.7 of this TER. Review of the proposed charging pump power supply during this interim period are therefore included in the sixteen concerns described above. The NRC staff will review the information presented in the licensee's supplemental responses to determine whether it sufficiently justifies the use of alternative approach for compliance with Order EA-12-049. Additional information may be needed to confirm compliance with Order EA-12-049. This has been identified as Open Item 3.2.1.D in Section 4.1.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that the Integrated Plan provides an alternate approach to the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to RCS cooling, heat removal, and inventory control strategies. These concerns are identified as Open Item in Section 4.1, and as Confirmatory Items in Section 4.2.

3.2.1.1 Computer Code Used for the ELAP Analysis

NEI 12-06, Section 1.3 states:

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

The licensee was requested to identify the thermal-hydraulic codes that are being used for the plant-specific analysis of core cooling for both ANO-1 and ANO-2 and provide justification that they are capable of providing an accurate estimate of the coping time under ELAP conditions.

Additionally, the licensee was requested to clarify whether the codes are being used in a manner consistent with the generic recommendations in PWROG position Paper PA-PSC-0965, justifying any deviations, and, if 2-phase cooling (including reflux condensation) is relied upon during the critical portion of the ELAP analysis (such that an error in those models may impact when certain equipment needs to be setup at the plant), justify the capabilities of the computer code to model that phenomena.

During the audit the licensee provided the following information:

ANO-1 and ANO-2 action times are based on WCAP-17601 analysis supplemented with site specific ELAP analyses performed by Westinghouse.
The ANO-1 site specific analysis is based on the FLEX acceptance criteria as documented in WCAP-17601. WCAP-17601 utilized RELAP5/MOD2-B&W for evaluating ELAP cases. As indicated in WCAP-17601 in Section 4.1.3, ANO-1 was the reference plant design and model for the analysis cases (Cases A through C). The ANO-1 RCS leakage rate for the site specific analysis was consistent with that described in WCAP-17601. The margin to loss of natural circulation was estimated by comparing the aggregate decrease in RCS liquid inventory with the post-trip pressurizer liquid inventory. No new thermal hydraulic computer code cases were utilized for the site specific analysis at ANO-1.

The ANO-2 site specific analysis utilized site specific CENTS cases based upon reference Cases 6 and 8 from WCAP-17601. The principle change from the WCAP-17601 cases for the site specific cases was to use a modified cooldown termination temperature. The site specific analysis additionally evaluated the inputs and assumptions from WCAP-17601 for applicability to the FLEX requirements established in NEI 12-06. Two-phase natural circulation conditions were found to occur at approximately 18.5 hours into the ELAP event, and therefore RCS makeup will be initiated prior to this time at a rate to ensure single-phase natural circulation is maintained. The current ANO-2 cooldown strategy, as detailed in the 6-month update, delays the ANO-2 cooldown until 8 hours following an ELAP. Confirmation of existing analyses or additional analysis during the ANO-2 detailed design is required to determine the timing impact on the assurance of single-phase natural circulation for ANO-2.

During the audit the licensee affirmed the use of the RELAP5 analysis for ANO-1 and provided the following additional information:

- The site specific analysis for ANO-1 consists of a mass balance model for inventory conditions to ensure a minimum volume of coolant is maintained in the pressurizer corresponding to the maintenance of natural circulation. The acceptance criteria are based on the RELAP cases performed for WCAP-17601 and documented therein.
- The ANO-1 strategy calls for establishing RCS makeup flow at a rate of 35 gpm at six hours following the event. A cooldown of 20 degrees F/hr is assumed to be initiated two hours following initiation of RCS makeup. While the makeup pump is initially unable to match the rate of inventory contraction due to the cooldown, the coolant never drops below the acceptance criteria and therefore the results are acceptable. Natural circulation will therefore be maintained for the duration of the ELAP event.
- As the analysis discussed indicates RCS coolant will maintain necessary inventory in the pressurizer to ensure natural circulation, the core will remain covered for the duration of the ELAP event.

Section 3.2 of WCAP-17601-P discusses the PWR Owners Group's recommendations for CE plants and Section 3.3 discusses the recommendations for Babcock and Wilcox plants. The

licensee was requested to provide the following information relative to Section 3.2:

- Discuss the licensee's position on each of the recommendations for ANO-2 and ANO-1, respectively.
- List the recommendations that are applicable to each plant, provide rationale for the applicability, address how the applicable recommendations are considered in the ELAP coping analysis, the applicable code used in the coping analysis, and discuss the plan to implement the recommendations.
- Provide rationale for each of the recommendations that are determined to be not applicable to the plant.

During the audit process the licensee provided the following response regarding Section 3.2 of WCAP-17601-P:

CE Recommendations

Recommendation-1- The ANO-2 SBO (station blackout) procedure directs isolation of the controlled bleedoff valve very early in the response (sixth step).

Recommendation-2- The ANO-2 strategy incorporates cooldown starting at 8 hours following the ELAP event and reaching the target temperature of 350°F approximately 2.67 hours later.

Recommendation-2- This requirement will be incorporated into FLEX procedures.

Recommendation-3- Procedural guidance is being developed as recommended by WCAP- 17601, promoting an early and extensive cooldown and depressurization. Entergy is a participant in the PWROG project PA□PSC□0965 and will implement the FSGs at ANO in a timeline to support the implementation of FLEX.

Recommendation-4- Cooldown and depressurization will proceed as stated in the Integrated Plan. Opening of the head vent will be used as a letdown path to allow for additional boration and RCS make up to address solid plant condition concerns.

Recommendation-5- The portable FLEX SG Feed Pumps address this WCAP□17601 recommendation
.
Recommendation-6- An analysis has been performed on SITs injection in Westinghouse Calculation CN□SEE□II-13□2 Rev. 1. The results indicate that the entire volume of the SITs will not inject into the RCS during cooldown, allowing for the SITs to be isolated to prevent nitrogen injection. This analysis requires confirmation or additional analysis during the ANO-2 detailed design to support the delay in the ANO-2 cooldown to 8 hours following an ELAP.

Recommendation-7- ANO-2 will conduct a symmetric cooldown. An asymmetric cooldown would only be required if additional failure beyond the NEI 12-06 guidance are assumed; therefore, no additional procedures or analyses are required.

B&W Recommendations

Recommendation-1- The ANO FLEX strategy utilizes a turbine driven EFW pump to provide feedwater to the SGs. The available steam pressure is expected to be sufficient to operate the turbine driven emergence feedwater (TDEFW) pump through at least 72 hours. The EFW flow will be controlled by local manual action following loss of remote control. A backup FLEX SG Feed pump is also available should the need for an alternate source arise.

Recommendation-2- This recommendation is not applicable to the ANO-1 FLEX strategy. The ANO-1 strategy delays cooldown until a source of RPV makeup is available (starting at 6 hours following the ELAP). This ensures that there is sufficient RCS inventory to ensure natural circulation is maintained during the cooldown. The ANO-1 ADVs will be operated manually as required to achieve a RCS cooldown rate of approximately 20 degrees F/hour. For Unit 2, Action Item 8 from Attachment 1A, page 43 of the integrated plan notes that a plant cooldown will commence 8 hours into the ELAP event.

Although the RELAP5/MOD2-B&W code has been reviewed and approved for performing loss of coolant accident (LOCA) and non-LOCA transient analysis, the NRC staff had not previously examined the technical adequacy of this code for simulating an ELAP event. In particular, the ELAP scenario is differentiated from typical design-basis small-break LOCA scenarios in several key respects, including the absence of normal emergency core cooling system injection and the substantially reduced leakage rate, which places significantly greater emphasis on the accurate prediction of primary-to-secondary heat transfer, natural circulation, and two-phase flow within the RCS. As a result of these differences, concern associated with the use of the RELAP5/MOD2-B&W code for ELAP analysis arose regarding the modeling of two-phase flow within the RCS and heat transfer across the steam generator tubes as single-phase natural circulation transitions to two-phase flow and boiler condenser cooling. This concern resulted in the following Confirmatory Item:

(1) Reliance on the RELAP5/MOD2-B&W code in the ELAP analysis for B&W plants is limited to the flow conditions prior to boiler-condenser cooling initiation. This has been identified as Confirmatory Item 3.2.1.1.A in Section 4.2.

During the audit the licensee affirmed the use of the CENTS analysis for ANO-2 and provided the following additional information:

- ANO-2 will maintain single phase natural circulation. The ANO-2 CENTS cases are based upon WCAP-17601 cases. The site specific case run as part of the ELAP analysis indicates two-phase natural circulation starts at approximately 18.5 hours.
- A sensitivity case was run with a 20 gpm RCS makeup beginning at 17.5 hours to demonstrate single phase conditions would be maintained. The definitions associated with single phase and two phase natural circulation, along with reflux boiling, are presented in the industry whitepaper on the use of CENTS.
- The CENTS cases indicate that even with no additional RCS makeup beyond the inventory of the SITS, the core remains covered for over 100 hours. ANO-2 intends to begin RCS makeup via an RCS FLEX Makeup Pump or a Charging Pump prior to 17.5 hours to maintain single phase natural circulation. This makeup will provide additional margin to ensure the core remains covered throughout the ELAP event.

Although the NRC staff does acknowledge that CENTS has been reviewed and approved for performing non-LOCA transient analysis, the NRC staff has not examined its technical

adequacy for simulating the ELAP transient. A generic concern associated with the use of CENTS for ELAP analysis arose because NRC staff reviews for previous applications of the CENTS code had imposed a condition limiting the code's heat transfer modeling in natural circulation to the single-phase liquid flow regime. This condition was imposed due to the lack of benchmarking for the two-phase flow models that would be LOCA scenarios. Because the postulated ELAP scenario generally includes leakage from reactor coolant pump seals and other sources, two-phase natural circulation flows may be reached in the reactor coolant system (RCS) prior to reestablishing primary makeup. Therefore, the NRC staff requested that the industry provide adequate basis for reliance on simulations with the CENTS code as justification for licensees' mitigation strategies.

To address the NRC staff's concern associated with the use of CENTS to simulate two-phase natural circulation flows that may occur during an ELAP for the licensee and other CE-designed PWRs, the PWROG submitted a position paper dated September 24, 2013, entitled "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on CENTS Code in Support of the PWROG" (ADAMS Accession No. ML13297A174 (Non-Publicly Available)). This position paper provided a comparison of several small-break LOCA simulations using the CENTS code to the CEFLASH-4AS code that was previously approved for analysis of design-basis small-break LOCAs. The analyses in the position paper show that the predictions of CENTS were similar or conservative relative to CEFLASH-4AS for key figures of merit for natural circulation conditions, including the predictions of loop flow rates and the timing of the transition to reflux boiling. The NRC staff further observed the fraction of the initial RCS mass remaining at the transition to reflux boiling predicted by the CENTS code for the ELAP simulations in WCAP-17601-P to be (1) in reasonable agreement with confirmatory analysis performed by the staff with the TRACE code and (2) within the range of results observed in scaled thermal-hydraulic tests that involved natural circulation (e.g., Semiscale Mod-2A, ROSA-IV large-scale test facility). After review of this position paper, the NRC staff endorsed a resolution through letter dated October 7, 2013 (ADAMS Accession No. ML13276A555 (Non-Publicly Available)). This endorsement contained one limitation on the CENTS computer code's use for simulating the ELAP event. That limitation and its corresponding Confirmatory Item number for this TER are provided as follows:

(1) The use of CENTS in the ELAP analysis for CE plants is limited to the flow conditions prior to reflux boiling initiation. The licensee is requested to address its compliance with the above limitation on the use of CENTS in the ELAP analysis. This has been identified as Confirmatory Item 3.2.1.1.B in Section 4.2.

This includes providing a justification for how the initiation of reflux boiling is defined.

During the audit the licensee provided the following updated information regarding CENTS analysis:

a) CENTS is an NRC-approved code (WCAP-15996-A, ADAMS Accession No. ML053290344) with an applicable range limited to the single phase liquid natural circulation cooling (NCC) for referencing in a licensing application of the PWRs designed by CE and Westinghouse Electric Company.
b) The use of CENTS in the ANO-2 ELAP analysis was limited to single-phase liquid flow conditions prior to reflux boiling initiation. Therefore, ANO-2 will abide by the generic resolution as endorsed by the NRC in their letter dated October 7, 2013 (ADAMS Accession No. ML13276A555).

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 codes used to perform ELAP analysis, if these requirements are implemented as described.

3.2.1.2 Reactor Coolant Pump Seal Leakage Rates

NEI 12-06, Section 1.3 states:

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

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

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

- WCAP-17601-P, Revision 1, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, CE and B&W NSSS [Nuclear Steam Supply Systems] Designs" dated January 2013 (ADAMS Accession Nos. ML13042A011 and ML13042A013 (Non-Publicly Available)).

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

After review of the above noted submittals, the NRC staff placed certain limitations for B&W designed plants (such as ANO-1). Those applicable limitations and their corresponding Confirmatory Item numbers for this TER are provided as follows:

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

the RCS temperatures within the limits of the seal design temperatures, and address the adequacy of the seal leakage rate (2 gpm/seal) used in the ELAP analysis. This has been identified as Confirmatory Item 3.2.1.2.A in Section 4.2.

2. Some plants have low leakage seals to maintain the initial maximum leakage rate of 2 gpm/seal for the ELAP analyses of the RCS response. For those plants, a discussion of the information (including seal leakage testing data) should be provided to justify the use of 2 gpm/seal in the ELAP analysis. This has been identified as Confirmatory Item 3.2.1.2.B in Section 4.2.

3. Address the acceptability of using of the FlowServe N-9000 RCP seals with the Abeyance seal in the Westinghouse RCPs. The RCP seal leakages rates for use in the ELAP analysis should be provided with acceptable justification. This has been identified as Confirmatory Item 3.2.1.2.C in Section 4.2.

After review of the NEI submittals mentioned above, the NRC staff has placed certain limitations for CE designed plants (such as ANO-2, but with the exception of Palo Verde Nuclear Generating Station). Those limitations and the corresponding Confirmatory Item number for this TER are provided as follows:

1. The RCP seal initial maximum leakage rate should be greater than or equal to the upper bound expectation for the seal leakage rate for the ELAP event (15 gpm/seal) discussed in the PWROG position paper addressing the RCP seal leakage for CE plants (Reference 2). If the RCP seal leakage rate used in the plant-specific ELAP analysis is less than upper bound expectation for the seal leakage rate discussed in the position paper, justification should be provided. This is not applicable to ANO-2, as the licensee during the audit has stated that the initial maximum leak-off for each RCP seal assumed in the ANO-2 ELAP analysis is 15 gpm.

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 RCP seal leakage, if these requirements are implemented as described.

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.

The licensee was requested to address the applicability of assumption 4 from WCAP Section 4.2.1 Input Assumptions - Common to All Plant Types on page 4-13 of WCAP-17601, which states that "Decay heat is per ANS 5.1-1979 + 2 sigma, or equivalent." A discussion regarding the decay heat model used in the ELAP is needed which specifies the values of the following key parameters used to determine the decay heat: (1) initial power level, (2) fuel enrichment, (3) fuel burnup, (4) effective full power operating days per fuel cycle, (5) number of fuel cycles, if

hybrid fuels are used in the core, and (6) fuel characteristics are based on the beginning of the cycle, middle of the cycle, or end of the cycle. The discussion should also address the adequacy of the values used. If the different decay heat model is used, describe the specific model and address the acceptability of the model and the analytical results.

During the audit process the licensee stated that the information requested is not available at this time. This has been identified as Open Item 3.2.1.3.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 decay heat analysis, if these requirements are implemented as described.

3.2.1.4 Initial Values for Key Plant Parameters and Assumptions

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

On page 4 of the Integrated Plan the licensee states that the assumptions are consistent with those detailed in NEI 12-06 and the Executive summary of the PWROG core cooling position paper. In addition, Entergy stated that there are currently no identified deviations in the ANO-1 FLEX conceptual design with respect to the PWROG guidance pending completion of PWROG-sponsored revision to WCAP-17601-P that is in progress for the updated NSSS strategy for B&W NSSS designs. Furthermore, Entergy has evaluated WCAP-17601-P considering ANO-2 site-specific parameters and determined that the conclusions of that document are generally applicable to ANO-2 and there are currently no identified deviations in the ANO-2 FLEX conceptual design with respect to the PWROG. This is identified as Confirmatory Item 3.2.1.4.A in Section 4.2.

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

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states in part:

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

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

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

Entergy provided the following regarding instrumentation credited for ELAP analysis and to support strategy implementation, in the Integrated Plan:

- SG Level
- SG Pressure
- QCST Level
- RCS Pressure
- Core Exit Thermocouples (CETs)
- RCS Temperature
- RCS Pressure
- ANO-2 SIT Level
- Pressurizer Level (Modes 1 - 4)
- Reactor Vessel Level (Modes 5 and 6)
- Containment Pressure
- SFP Level

Because no containment temperature instrumentation was identified, the licensee was requested to provide the basis for concluding that monitoring the temperature of the containment atmosphere is not required for purposes such as validating the qualification range of measurement instruments located in the containment or establishing the survivability of penetration seals or other equipment. During the audit, the licensee stated that NEI 12□06 does not identify containment temperature as a key containment parameter; therefore, containment temperature indication is not required. Preliminary MAAP calculations (CALC-13-E-0005-02) for ANO-1 provide assurance that following an ELAP event the Mode 1□4 (SGs available) containment temperatures remain well within the containment design temperature (approximately 216 degrees F at 120 hours versus design of 286 degrees F). The ANO FLEX strategy only uses containment pressure and does not take any action on containment temperature. However, once AC power is restored by portable generators, many additional indications will become available, including containment temperature. Similar results are expected for ANO-2; however, the design activities for ANO-2 have not started.

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.

On pages 45 through 48 of the integrated plan in Attachment 1A, Entergy provided sequence of events and applicability statements for each event.

The integrated plan references WCAP-17601-P for supporting analysis; however, no analysis in this WCAP specifically matches or directly supports the SOE presented in the Integrated Plan. The licensee was requested to provide a SOE for the plant-specific ELAP analysis used to support the FLEX mitigation strategies that includes the following information:

a) A reference for each event.
b) A description of why the time is reasonably achievable.
c) A justification or reference demonstrating why performing this action by this time will be acceptable. If this answer is associated with an analysis, provide that analysis.
d) A reference for each event in the SOE table and the applicable sections of the WCAP-17601.
e) Identify and justify deviations from the WCAP report.

During the audit the licensee provided revised SOE's for both units. The references, descriptions, time constraints, justifications, references and deviations were provided as part of 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 the SOE, 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:

> Licensees 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 the plant. This 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 processes.

During the audit process, the licensee stated that ANO will incorporate the supplemental guidance provided in the NEI position paper entitled "Shutdown / Refueling Modes" to enhance the shutdown risk process and procedures.

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

3.2.1.8 Core Sub-Criticality

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

> All plants provide means to provide borated RCS makeup.

The licensee was requested to provide a discussion that explains if the acceptance criteria presented in WCAP-17601-P, Section 4.3 is the same as those used in ANO-1 and ANO-2's ELAP analyses. During the audit the licensee provided the following information regarding Section 4.3 of WCAP-17601:

a) The site specific ELAP analyses performed for ANO-1 and ANO-2 by Westinghouse use the same acceptance criteria as those presented in WCAP-17601.
b) The acceptance criteria from WCAP-17601 Section 4.3 are that no core damage will occur and there shall be no return to criticality once the loss of all AC power has occurred.
c) The ELAP analyses for ANO-1 and ANO-2 determine RCS inventory makeup flow rates required to maintain natural circulation cooling, thus precluding core damage.
d) For ANO-1, the analysis for lowered loop B&W plants in WCAP-17601 indicates the shutdown margin acceptance criteria is met. The ANO-1 analysis provides boron concentrations based on RCS inventory makeup, to be used on a cycle-by-cycle basis to confirm shutdown margin is maintained within the acceptance criteria.
e) For ANO-2, the site specific ELAP analysis indicates shutdown margin will be maintained greater than the 1.0 %Δρ acceptance criteria of WCAP-17601. From CENTS results, shutdown margin will be 3.43 %Δρ following SIT injection. This analysis requires confirmation or additional analysis during the ANO-2 detailed design to support the delay in the ANO-2 cooldown to 8 hours following an ELAP.

This has been identified as Confirmatory Item 3.2.1.8.A in Section 4.2.

The licensee was requested to discuss the boron mixing model used for the re-criticality analysis in support of the plant FLEX mitigation strategies and address the adequacy of the

boron mixing model for the intended purpose with support of an analysis and/or boron mixing test data applicable to the ELAP conditions, and also, address whether and how the delay time of the borated water delivered to the core is considered.

During the audit the licensee stated that a uniform boron mixing model is assumed for both ANO-1 and ANO-2. This model is further discussed in OG-13-284, the August 15, 2013 PWROG boron mixing white paper. To meet the white paper conditions, single phase natural circulation will be maintained for the duration of both ANO-1 and ANO-2 ELAP events. Additionally, at least 60 minutes margin exists from the time RCS makeup is started to when the completion is required, allowing ample time for complete mixing. RCS makeup will be initiated from the cold legs, and limiting RCP seal leakage is considered.

The NRC staff reviewed the licensee's Integrated Plan and determined that a generic concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the RCS under natural circulation conditions potentially involving two-phase flow is applicable to ANO-1 and ANO-2.

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

(1) The required timing for providing borated makeup to the primary system should consider conditions with no reactor coolant system leakage and with the highest applicable leakage rate for the reactor coolant pump seals and unidentified reactor coolant system leakage.
(2) For the condition associated with the highest applicable reactor coolant system leakage rate, two approaches have been identified, either of which is acceptable to the staff:
   a. Adequate borated makeup should be provided such that the loop flow rate in two-phase natural circulation does not decrease below the loop flow rate corresponding to single-phase natural circulation.
   b. If loop flow during two-phase natural circulation has decreased below the single-phase natural circulation flow rate, then the mixing of any borated primary makeup added to the reactor coolant system is not to be credited until one hour after the flow in all loops has been restored to a flow rate that is greater than or equal to the single-phase natural circulation flow rate.
(3) In all cases, credit for increases in the reactor coolant system boron concentration should be delayed to account for the mixing of the borated primary makeup with the reactor coolant system inventory. Provided that the flow in all loops is greater than or equal to the corresponding single-phase natural circulation flow rate, the staff considers a mixing delay period of one hour following the addition of the targeted quantity of boric acid to the reactor coolant system to be appropriate.

At the time the audit was conducted, the licensee had not committed to abide by the generic approach discussed above, including the additional conditions specified in the NRC's endorsement letter. As such, the generic concern associated with modeling the timing and

uniformity of boric acid mixing within the RCS under natural circulation conditions potentially involving two-phase flow needs to be adequately addressed for ANO-1 and ANO-2. Verification that the licensee's plan will conform to the NRC-endorsed generic resolution and that the additional conditions discussed above will be satisfied is identified as Open Item 3.2.1.8.B in Section 4.1

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

3.2.1.9 Use of Portable Pumps

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

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

NEI 12-06 Section 11.2 states in part:

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

On page 12 of the Integrated Plan, the licensee stated that:

> The transition into Phase 2 for core heat removal will occur as portable resources are utilized to support the Phase I strategies. The turbine-driven EFW pump will remain available as long as steam is available for powering the pump and a source of supply water is maintained. In preparation of turbine-driven EFW unavailability, the diesel-driven SG FLEX pump will be staged to deliver feedwater to both SGs if the turbine-driven EFW pump becomes unavailable.

> As the QCST depletes, portable diesel-driven pumps will be staged to transfer inventory to the QCST or directly to the SG feedwater (turbine-driven EFW or SG FLEX) pump suction. The qualified backup in the event the QCST is depleted is provided from the ECP via a portable FLEX inventory transfer pump.

On page 20 of the Integrated Plan the licensee stated that:

> Following RCS cool down and depressurization, RCS inventory will be added as needed by utilizing a portable FLEX RCS makeup pump. The FLEX RCS makeup pump will be provided by either the ANO-1 BWST or ANO-2 Refueling Water Tank (RWT). If the BWST or RWT are not available due to a tornado, an additional borated water source will be identified and utilized. Maintaining RCS inventory is required to maintain NCC long term.

On pages 39 and 40 of the Integrated Plan, the licensee provided a list of portable pumps to be used for both Phase 2 and 3 strategies, however the licensee did not provide supporting details regarding any analyses that were used to determine the required pump flow rates and corresponding pressures and implementation timing required of the portable pumps for SG cooling or RCS makeup strategies for Phase 2 or 3 strategies.

The licensee was requested to provide supporting details regarding any analyses that were used to determine the required flow rates and corresponding pressures of the portable pumps for SG or RCS fill strategies for Phase 2 or 3 strategies. The licensee was also requested to specify the required times for the operator to realign each of the above discussed pumps and confirm that the required times are consistent with the results of the ELAP analysis, and additionally discuss how the operator actions are modeled in the ELAP to determine the required flow rates of the portable pumps, and justify that the capacities of each of the above discussed pumps are adequate to maintain core cooling during phases 2 and 3 of ELAP.

During the audit the licensee provided the following information regarding portable pump operations:

a) The time for connecting the pumps for Modes 1□4 are discussed in the sequence of events timeline and the relevant sections of the Integrated Plan. Procedures have not been developed at this time, but validation of the procedures will validate the timing for deploying and starting pumps. Per the white paper on shutdown modes, specific time lines are not required to be addressed for Modes 5 and 6. The flow rates for pumps supporting core cooling and sub□criticality are consistent with the WCAP□17601 and the plant specific analyses performed by Westinghouse (CN-SEE-II-13-4 for ANO-1 and CN-SEE-II-13-2 for ANO-2). b) Note that strategy items (e.g., Portable ANO-2 RCS Injection Pump) related to the analysis in CN-SEE-11-13-2 requires confirmation or additional analysis during the ANO-2 detailed design to support the delay in the ANO-2 cooldown to 8 hours following an ELAP. This has been identified as Confirmatory Item 3.2.1.9.A in Section 4.2.

c) Specific times for Phase 3 actions have not been finalized but are expected to occur following delivery of RRC equipment. No specific time requirement is since it is expected that the Phase 2 equipment will be able to continue to function well beyond 72 hours. This has been identified as Confirmatory Item 3.2.1.9.B in Section 4.2.

The required TDH in the table below is determined by hand calculations using standard

methods (e.g. Crane 410). In addition, the licensee provided the required flows and required pump head for the Phase 2 and Phase 3 pumps.

For ANO-2, the licensee was requested to provide discussion regarding the analysis used to determine the RCS makeup flow rate of 20 gpm at 17.5 hours in Action Item 10, Align FLEX RCS makeup pump from suction source, and to also, specify the required pressure corresponding to the RCS makeup flow of 20 gpm and discuss the analysis used to determine the required pressure.

During the audit the licensee provided the following information regarding RCS make-up for ANO-2:

a) Plant specific calculations, in addition to those in WCAP-17601-P, were performed for ANO-2 to determine required RCS makeup flow based on the existing strategy provided in the ANO Integrated Plan. ANO-2 has a large accessible volume in the SITs and is implementing a cooldown and depressurization strategy consistent with the PWROG Core Cooling recommendations for the ELAP scenario (WCAP-17601-P).
b) A new RCS thermal hydraulic case using the same methodology as that documented in WCAP-17601-P and with a cooldown termination temperature of 350 degrees F was performed. Based on the results of the CENTS case the transition to two-phase conditions occurs at approximately 18.5 hours into the ELAP event. Note that the core does not uncover within 100 hours of event initiation; therefore, a FLEX pump is not necessary to prevent core uncovery.
c) A sensitivity case showed that implementing a make-up rate of 20 gpm at 17.5 hours following the event ensures that single-phase conditions are maintained. A pressure of 200 psia pump was also confirmed by the sensitivity case. An alternate strategy is under consideration to use the charging pumps to make up to the ANO-2 RCS after the ANO-1 cooldown is complete.
d) In addition, the analysis performed in CN-SEE-ll-13-2 requires confirmation or additional analysis during the ANO-2 detailed design to support the delay in the ANO-2 cooldown to 8 hours following an ELAP.

This has been previously identified as Confirmatory Item 3.2.1.A in Section 4.2.

In the Integrated Plan, the licensee revised the methodology to supply the turbine driven emergency feedwater (TDEFW) pump from the emergency cooling pond for high wind/missile events because the normal source of water (QCST) is not protected from missiles. The licensee was requested to provide discussion on how this will be accomplished using reliable and qualified equipment, using either a portable FLEX inventory pump or use of diesel driven fire pump, and include a discussion of equipment and supporting components and if they are robust.

The licensee provided the following information regarding the above strategy change:

a) The strategy actually provides water from the ANO-1 intake structure on Lake Dardanelle to the EFW pump for the high wind missile events. The intake structure can draw suction from the lake or the ECP. The ECP is gravity feed into the Unit 1 intake bays. b) The portions of the intake structure housing the service water pumps have been designed to Seismic Class1 standards to ensure safe operation of service water pumps which are Seismic Class 1 equipment. The structure has also been designed to withstand tornado, flood, live and dead loads (ANO-1 SAR Section 5.3.4). The service water piping from the intake structures to the plant is underground and is, therefore, protected from tornado missiles.

The licensee was requested to provide a discussion regarding the time required for the portable diesel-driven pumps to be staged during Phase 2. During the audit the licensee stated in part that:

a) For ANO-1 and ANO-2 at 8 hours, the Inventory Transfer pumps are staged and aligned to provide makeup from the emergency cooling pond via hoses to the QCST prior to exhausting its normal operating volume.
b) At 24 hours, the SFP Feed Pump is aligned to the SFP. Assuming 15 feet of water is needed above the fuel racks for shielding, makeup to the ANO-1 SFP is not required until 47.65 hours after the event and for ANO-2 until 24.74 hours after the event. The SFP Feed Pump is shared between units and is adequately sized to provide necessary makeup flow for both ANO-1 and ANO-2.
c) As time permits, the portable the diesel driven SG FLEX pumps will be staged to deliver feedwater to both SGs if the TDEFW pump becomes unavailable.

The licensee was requested to: a) address the location of portable diesel-driven inventory transfer pumps, such as discussed on page 12 of the Integrated Plan that will be staged to transfer inventory to the QCST, and b) for any pumps, hoses, etc., that will be located outside flooding-protected buildings, clarify plans and timing for their deployment, giving consideration to the potential for this equipment to be swept away or damaged by floodwater currents.

The licensee provided the following information regarding portable pump locations:

a) The portable FLEX diesel-driven inventory transfer pump for QCST fill will be staged on a platform in close proximity to the ECP. This platform will be permanently installed and capable of supporting the staged equipment. The approximate location of this staging platform is shown in Attachment 1 of CALC-ANOC-ME-13-00001, ANO FLEX Strategy Development.
b) The maximum flood elevation for ANO is 361 feet mean sea level (MSL). A flood of this magnitude will be forecast five days prior to its arrival at the plant site according to the ANO FLEX OIP. Therefore, in a flood BDBEE, pre-staging of equipment is acceptable. This report also contains the ANO-1 and ANO-2 recommended sequence of events timeline, including staging of the inventory transfer pump. The strategy to prevent connected hoses from being swept away by floodwater currents will be evaluated and guidance provided in the FLEX Support Guidelines.

The subject of fuel for portable equipment in accordance with NEI 12-06, Section 3.2.2, Guideline (13) noted above, is addressed later in this technical evaluation report in Section 3.2.4.7 Portable Equipment Fuel.

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

3.2.2 Spent Fuel Pool Cooling Strategies

NEI 12-06, Table 3-2 and Appendix D summarize one acceptable approach for the 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 28 of 51 of the integrated plan under SFP cooling Phase 1 Entergy stated, in part:

> SFP cooling is not challenged early in the event for either unit. During phase 1, SFP cooling will be by boil-off of inventory in the pool. SFP makeup will be addressed in phase 2, but during phase 1 a makeup hose will be staged to ensure that makeup capability is available for phase 2.

For ANO-1, for the maximum credible heat load, the time to boil is 3.87 hours. The boil-off rates of 28.10 gpm and 66.50 gpm were determined for normal and maximum decay heat in the SFP, respectively. These values correspond to a required volumetric flow rate of 27.32 gpm and 64.66 gpm, respectively, to replace any boil-off losses in the SFP using water with coolant properties at 130 degrees F.

For ANO-2, for the maximum credible heat load, the time to boil is 2.19 hours. The ANO-2 SFP has a smaller volume and a higher decay heat load than the ANO-1 SFP. The boil-off rates of 42.92 gpm and 81.73 gpm were determined for normal and maximum decay heat in the SFP, respectively. These values correspond to a required volumetric flow rate of 41.73 gpm and 79.46 gpm, respectively, to replace any boil-off losses in the SFP using water with coolant properties at 130 degrees F.

On page 29 of the Integrated Plan, the licensee stated that:

> SFP cooling in the ELAP condition is accomplished by local pool boiling and evaporation supported by coolant makeup. SFP cooling is not challenged early in the event (Phase 1) for either unit due to the limited inventory loss due to boiling. However, access to the SFP area as a part of Phase 2 response could be challenged due to environmental conditions local to the pool. Thus, actions

> that require access to the SFP deck will be completed prior to Phase 2. Makeup will be provided using the FLEX SG feed pump that is in use (either from the primary or secondary staging location) or separate FLEX SFP makeup pump. The strategies for the discharge connection to the SFP are to:
>
> - install branch connection to the SFP deck to accommodate a hose connection or oscillating spray fire nozzle
> - provide makeup via connection into existing SFP Cooling system (ANO-1) piping or service water (ANO-2) piping.

On page 32 of the Integrated Plan, the licensee stated that:

> For Phase 3, Entergy intends to continue with the Phase 2 strategies (boil-off) with additional support and equipment provided by off-site resources. RRC equipment can be installed into the existing SWS piping to provide makeup indefinitely. This strategy credits that back-ups to the Phase 2 equipment will be delivered from the RRC to be on-site during Phase 3 should any Phase 2 equipment fail during the indefinite coping period.

The licensee was requested to provide the analysis and a description of the methodology used to compute SFP boil-off rates, boiling onset timing, and the justification for determining the timing at which makeup to the SFP's is required for both ANO-1 and -2. During the audit the licensee stated that Calculation CN-SEE-II-12-43, "Determination of the Time to Boil" in the Arkansas Nuclear One (ANO) 1 & 2 Spent Fuel Pools after an Earthquake", provides the basis for the SFP makeup time constraints in the Sequence of Events Timeline. Calculation CN-SEE-II-12-43 identifies the time to boil and the boil off rate by determining the amount of SFP water that is sloshed out of the pool during an earthquake and computing the time to boil for the remaining water.

On page 29 of the integrated plan, the licensee stated that, both SFPs are located in a structure that does not require additional ventilation. The licensee was requested to clarify whether adequate ventilation would exist for an ELAP with no action taken, or to justify that accumulated steam in the vicinity of the spent fuel pool will not create a hazard for personnel access to mitigation equipment or adversely affect the functionality of any mitigation equipment.

During the audit the licensee provided the following information regarding SFP area access:

- Ventilation for the SFP area enables steam to escape so that it does not cause access or equipment problems in other parts of the plant. Based on site walkdown, the SFP ventilation strategy can be accomplished through a variety of means. Door 317 could be opened to the steam pipe area or Door 316 could be opened to the ventilation area, which would provide a pathway for steam to exit the SFP area. In addition, there is a passive vent with a manual louver that is open between the SFP area and the Turbine Building in addition to various other doors that could be opened.
- There is no time constraint on when a SFP area door has to be opened. The door that is most accessible following a BDBEE should be propped open when the SFP makeup strategy is implemented.
- There are no modifications required to vent the SFP area. During development of the FSGs, the door(s) that should be propped open when the SFP makeup strategy is

> implemented will be determined. This action should be taken before the pools start boiling as determined by existing plant procedures for the pool inventories at the time.

The site has two separate spent fuel pools. The licensee intends to use only one FLEX pump for both pools. The licensee was requested to provide makeup requirements and justify that one pump is sufficient for both pools.

During the audit the licensee stated that long term makeup is provided by a FLEX inventory transfer pump that takes suction from the ECP to provide water to the QCST for SG feed as well as SFP makeup. Additional details regarding makeup to the SFPs are discussed in TER Section 3.2.4.7, “Water Sources.”

During the audit the licensee provided the following information regarding SFP makeup strategies: The hydraulic analysis for SFP makeup is analyzed in Calculation CALC-13-E-0005-10, “ANO FLEX Phase 2 Spent Fuel Pool Makeup and Spray Pump Sizing”. The required flow rate for SG makeup and SFP hose/hardened makeup is 400 gpm. The calculation is in draft status, but will be uploaded to the e-Portal when completed.

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

3.2.3 Containment Functions Strategies

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

On page 25 of the Integrated Plan, the licensee stated that:

> Containment function is not challenged early in the event; therefore, no actions are required in Phase 1 in support of containment function.
>
> For Modes 5 and 6, containment function will be addressed using current procedural actions of References 8a, 8b, and 8c.

On page 26 of the Integrated Plan, the licensee stated that containment function is not challenged early in the event; therefore, no actions are required in Phase 2 in support of containment function. Also per the analysis supporting Reference 5, containment is not expected to be challenged for the duration of Phase 2.

On page 27 of the integrated Plan, the licensee stated that using RRC equipment for restoration of SW to containment cooling, containment function will not be challenged even later in the event; therefore, no further actions are required in Phase 3 in support of containment function.

References 5 and 8 noted above were specified as the following documents:

> Reference 5 - Entergy Document, "Arkansas Nuclear One Station Response to INPO IER 11-4, 'Near-Term Actions to Address the Effects of an Extended Loss

of All AC Power in Response to the Fukushima Daiichi Event'"

Reference 8 - ANO Procedures
a. ANO-1 Procedure 1203.028, "Loss of Decay Heat Removal"
b. ANO-2 Procedure 2203.029, "Loss of Shutdown Cooling"
c. ANO-2 Procedure 2202.011, "Lower Mode Functional Recovery"

The licensee was requested to provide a table listing the peak containment pressure and temperature against the corresponding design limits and also to provide a discussion of the containment analysis which addresses the adequacy of the analysis including the computer code/method and assumptions, and also, a discussion of the analysis used to determine the strategies and time requirements for actions beyond 7 days to reduce containment pressure and temperature.

During the audit the licensee provided the following information regarding containment analysis:

- According to Calculation CALC-13-E-0005-02, ANO-1 MAAP Containment Analysis for BDBEE, the peak containment pressure for Modes 1-4 is 9 psig, while the peak containment temperature for Modes 1-4 is 216 degrees F. The ANO-1 design maximum containment pressure is 59 psig, and the maximum design containment temperature is 286 degrees F.
- The MAAP code is used for the containment analysis. Time constraints related to core cooling are not based on the MAAP analysis. The ANO containment analysis is performed in accordance with NEI position paper dated June 2013, entitled "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications" (Accession Number ML13190A201). According to the October 3, 2013 letter from the NRC to NEI (Accession Number ML13275A318), NRC staff has reviewed this position paper and has not identified any concerns regarding the use of MAAP4 in performing containment analyses in satisfying the intent of the NRC Order EA-12-049.
- With respect to the QA program, the ANO containment analysis conforms to the limitations contained in the NRC's endorsement letter of the NEI position paper discussed above.
- The containment response is not analyzed past 120 hours (5 days). Containment pressure and temperature may be reduced by repowering the existing containment coolers. The service water system is being modified to add flanged connections that allow the RRC equipment to provide cooling water flow to the containment coolers in Phase 3.
- Calculation CALC-13-E-0005-02, ANO-1 MAAP Containment Analysis for BDBEE has been performed; however, the ANO-2 version has not been performed at this time.

Review of the results of the ANO-2 containment ELAP analysis has been identified as Confirmatory Item 3.2.3.A in Section 4.2.

During the audit the licensee provided the following updated information regarding the MAAP code:

The ANO containment analysis is performed in accordance with NEI position paper dated June 2013, entitled "Use of Modular Accident Analysis Program (MAAP) in Support of Post-Fukushima Applications" (Accession Number ML13190A201). According to the October 3, 2013 letter from the NRC to NEI (Accession Number ML13275A318), NRC staff has reviewed this

position paper and has not identified any concerns regarding the use of MAAP4 in performing containment analyses in satisfying the intent of the NRC Order EA-12-049.

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

3.2.4 Support Functions

3.2.4.1 Equipment Cooling – Cooling Water

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

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

The licensee was requested to provide additional information regarding their plans to provide supplemental ventilation and cooling to the subject areas and equipment when normal cooling will not be available during the ELAP. For example, the potential need for cooling water for the turbine-driven EFW pumps bearings was not discussed. During the audit, the licensee responded by stating that the turbine-driven EFW pump bearings are self-cooled and do not require any additional cooling water. The licensee also stated that each charging pump has its own seal lubrication provided by a separate pump with its own subsystem; however, the charging pumps are capable of operating without seal lubricating (cooling). The mentioned water systems are not required during Phase 1 and 2 of an ELAP. Additionally supplemental ventilation is evaluated in Calculation CALC-13-E-0005-01, Heat-Up Calculation for AB Electrical Equipment Rooms and MCR following BDBEE. Portable ventilation must be deployed by 10 hours to maintain the Main Control Room (MCR) at acceptable temperature.

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

3.2.4.2 Ventilation – Equipment Cooling

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

> Plant procedures/guidance should consider loss of ventilation effects on specific energized equipment necessary for shutdown (e.g., those containing internal

electrical power supplies or other local heat sources that may be energized or present in an ELAP.

ELAP procedures/guidance should identify specific actions to be taken to ensure that equipment failure does not occur as a result of a loss of forced ventilation/cooling. Actions should be tied to either the ELAP/LUHS or upon reaching certain temperatures in the plant. Plant areas requiring additional air flow are likely to be locations containing shutdown instrumentation and power supplies, turbine-driven decay heat removal equipment, and in the vicinity of the inverters. These areas include: steam driven AFW pump room, … the control room, and logic cabinets. Air flow may be accomplished by opening doors to rooms and electronic and relay cabinets, and/or providing supplemental air flow.

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

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

Actuation setpoints for fire protection systems are typically at 165-180°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.

The licensee was requested to provide an analysis of the need for ventilation requirements in areas of the plant where plant equipment will be required to function in all Phases of an ELAP.

During the audit the licensee provided the following information regarding ventilation for equipment cooling:

a) ANO-1 and 2 Main Control Rooms - Preliminary Calculation "CALC-13-E-0005-01 - Heat-Up Calculation for AB Electrical Equipment Rooms and MCR following BDBEE" has been completed and concludes that temperatures in the ANO-1 Main Control Room briefly peak above 110 degrees F early in the transient, then drop to temperatures below 110 degrees F and remain there for the duration of 72 hours. This brief peak is not expected to have a long term impact on MCR habitability. Maintaining MCR habitability is accomplished by first opening

doors 64, 65, 66, 67, and 198 on elevation 386 ft. 0 in. to the MCR by 6 hours into the transient to allow air flow from the Turbine Building. Then a 10,000 CFM portable FLEX fan powered by a portable FLEX diesel generator is placed in the doorway of door #64 no later than 10 hours into the transient blowing air to the ANO-1 Main Control Room. The portable FLEX fan and FLEX generator will be stored in the FLEX storage buildings.

b) The calculation for ANO-2 Main Control Room has not been performed at this time; however, the results are expected to be similar. This has been identified as Confirmatory Item 3.2.4.2.A in Section 4.2.

c) ANO-1 and 2 Battery Rooms – A Battery Room hydrogen accumulation evaluation has not been completed at this time. The ANO FLEX strategy to prevent hydrogen accumulation while recharging the batteries in phase 2 or 3 is to repower the normal Battery Room Exhaust Fans when the bus that supplies power to the battery charger and exhaust fans is re-energized by the Phase 2 FLEX generator. This will maintain the hydrogen concentrations below the lower explosive limit (LEL) which is 4% of the volume of the room for ANO. The exhaust path for the Battery Room Exhaust Fans is through the existing exhaust path (i.e., current design). The only dampers in the exhaust flowpath are fire dampers and backdraft dampers. There are no dampers in the flow path that require air supply or electric power to open or close.

d) For ANO-1 during battery charging operations in Phases 2 and 3 in support of maintaining power to instrumentation and controls for core cooling, containment, and SFP cooling functions, ventilation may be required in the battery rooms for cooling. The battery room doors will be manually propped open. Preliminary calculation “CALC-13-E-0005-01 - Heat-Up Calculation for AB Electrical Equipment Rooms and MCR following BDBEE” has been completed. This calculation indicates no additional actions are needed for cooling other than to open the room doors. Opening the battery room doors by 10 hours following the event initiation results in a maximum temperature of approximately 108 degrees F achieved in either room after 72 hours. Per Nuclear Utility Management and Resources Council (NUMARC) 87-00, the equipment in the rooms can be exposed to thermal environments of 150 to 300 degrees F for up to 8 hours. The temperature in the battery rooms is not expected to exceed approximately 130 degrees F. Therefore, the equipment in these rooms is expected to remain operable.

a) During cold weather, the battery rooms would be at their normal operating temperature at the onset of the event and the temperature of the electrolyte in the cells would build up due to the heat generated by the batteries discharging and during re-charging. The battery rooms are located internal to the plant leading to a long time frame required for outside temperatures to cause the electrolyte in the cells to drop to a limiting temperature. Therefore, it is reasonable to assume that the room will remain near its pre-event temperature during the relatively short period of time until the FLEX generators are deployed and have energized the battery chargers. Once the battery charger is re- energized and is charging the battery, the charger is carrying the DC loads during Phase 2 and 3.

b) For ANO-2, a calculation will be prepared to evaluate the temperature profile of the battery rooms and determine whether additional forced air flow for cooling is required. Results are expected to be similar to ANO-1. Additional details on adequacy of ANO-2 battery room ventilation for extreme temperature protection will be available later in the design / procedure development process.

This has been identified as Confirmatory Item 3.2.4.2.B in Section 4.2.

c) ANO-1 TDEFW Pump Room - Ventilation requirements for operation of the TDEFW post BDBEE Calculation “Calculation No: 10-E-0010-03 - ANO-1 EFW Room GOTHIC Heat-Up Calculations” indicates no additional actions are needed. The room temperature transient response was calculated for the event lasting 30 days. Results indicate the temperature at 36 hours is 115 degrees F and at the end of 30 days is 122 degrees F. No additional ventilation is needed.

d) ANO-1 Electrical Equipment Rooms – Preliminary calculation “CALC-13-E-0005-01 - Heat-Up Calculation for AB Electrical Equipment Rooms and MCR following BDBEE” has been completed. This calculation indicates no additional actions are needed for cooling other than to open the room doors. Opening the equipment room doors by 10 hours following the event initiation results in a maximum temperature of approximately 119 degrees F achieved in any room after 72 hours except the North Switchgear Room. The temperature in North Switchgear Room exceeds the 120 degrees F (temperature reaches 121 degrees F) acceptance criteria towards the end of the 72 hour period. Per NUMARC 87-00 the equipment in the rooms can be exposed to thermal environments of 150°F to 300 degrees F for up to 8 hours. The temperature in the electrical equipment rooms is not expected to exceed approximately 130 degrees F. Therefore, the equipment in electrical equipment rooms is expected to remain operable.

e) ANO-2 TDEFW Pump Room and Electrical Equipment Rooms – Calculations have not been completed but are expected to yield similar results. Additional details on heatup and required ventilation of ANO-2 TDEFW Pump Room and Electrical Equipment Rooms will be available later in the design / procedure development process.

This has been identified as Confirmatory Item 3.2.4.2.C in Section 4.2.

f) ANO-2 Charging Pump Rooms – An existing calculation (94-E-0095-35 Rev O) has determined that the maximum temperate in the ANO-2 charging pump room without room coolers is 114.5 degrees F after 5 days. The limiting component temperature rating is 140 degrees F. Based on this calculation, no portable ventilation is required for the ANO-2 charging pump rooms.

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 ventilation for equipment cooling, if these requirements are implemented as described.

3.2.4.3 Heat Tracing

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

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

> where heat tracing is needed to ensure control systems are available. If any such systems are identified, additional backup sources of water not dependent on heat tracing should be identified.

The licensee was requested to provide a discussion of any heat tracing issues such as for the boric acid tanks and piping. During the audit, the licensee stated that there were no tanks or piping that required heat tracing to implement the mitigating strategies. Additionally, the licensee stated that the need for heat tracing of other components will be addressed later in the design/procedure development phase. Walkdowns will be conducted to identify areas heat tracing for freeze protection may be required. Results of the walkdown evaluation will be addressed in the FLEX design process and, if needed, included in procedures.

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

3.2.4.4 Accessibility – Lighting and Communications

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

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

On page 34 of the Integrated Plan, the licensee stated in part that:

> Additional installed equipment may be required to be powered by the FLEX generators. …. Additional equipment that may be required to be powered include portable fans/lighting, … and other essential equipment.

During the audit the licensee was requested to provide additional information regarding lighting requirements, i.e., re-powering existing lighting or using temporary lighting for all Phases for areas of the plant affected by the ELAP where personnel will be required to perform operations.

The licensee provided the following information regarding lighting:

- Part of the standard gear/equipment of operators with duties in the plant (outside the main control room) includes flashlights; flashlights would be available to operations personnel immediately following the start of the event. This requirement is currently in procedure EN-OP-115-01, Operator Rounds. Procedures will be revised if necessary to reflect additional lighting requirements for ELAP events.

- The emergency lighting system receives power from the non-class 1E 125-volt DC power bus and may be available following the event, however, for conservatism in the FLEX strategy, these light are assumed to be however, for conservatism in the FLEX strategy these lights are assumed to be lost during an ELAP. Since the lighting is supplied via the non-class 1E 125-volt DC power bus, replacement of existing lights with LEDs was not considered. Portable lighting powered by a FLEX generator will be used to illuminate the control room to supplement the flashlights as required; this is assumed to be available approximately six hours following the beginning of the event.
- Although not credited, in addition, self-contained emergency lighting units with an 8-hour power supply are located in many areas. These lights were installed per 10CFR50 Appendix R to provide adequate lighting for operators to access, operate and then egress from safe shutdown equipment.

The NRC staff has reviewed the licensee communications assessment (ADAMS Accession No. ML12305A534 and ML13053A193) in response to the March 12, 2012, 50.54(f) request for information letter, and as documented in the staff analysis (ADAMS Accession No. ML13127A198) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2 (8) regarding communications capabilities during an ELAP. Confirmation will be required that upgrades to the site's communications systems have been completed. This has been identified as Confirmatory Item 3.2.4.4.A in Section 4.2.

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

3.2.4.5 Protected and Internal Locked Area Access

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

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

The licensee was requested to provide a discussion regarding access to the Protected Area and internal locked areas without ac power available. During the audit the licensee stated that, procedures exist and FSGs will be developed to ensure that operators can access the required areas in the event of a loss of power. Additional details on controls for access to security controlled or internal locked areas where extended loss of all power (ELAP) would disable normal controlled access will be contained in the FSGs or associated procedures. This information may be in general terms due to Safeguards/SUNSI (sensitive unclassified non-safeguards information) concerns.

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 locked area access, if these requirements are implemented as described.

3.2.4.6 Personnel Habitability – Elevated Temperature

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

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

Section 9.2 of NEI 12-06 states,

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

Ventilation and habitability issues regarding the MCR, battery rooms, the ANO-1 TDEFW pump room, the ANO-2 TDAFW pump room, and electrical equipment rooms were discussed in this TER, Section 3.2.4.2 above. Confirmatory Items 3.2.4.2.A, (ANO-2 MCR) 3.2.4.2.B, (ANO-2 battery room), and 3.2.4.2.C, (ANO-2 TDAFW pump rooms and electrical equipment rooms) were previously identified because additional analysis is required to determine habitability acceptability for these areas.

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 personnel habitability at elevated temperatures, if these requirements are implemented as described.

3.2.4.7 Water Sources

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

> *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 net positive suction head (NPSH) can be demonstrated and, for example, that the water does not gravity drain back to the UHS. Alternate water delivery systems can be considered available on a case-by-case basis. In general, all CSTs should be used first if available. If the normal source of makeup water (e.g., CST) fails or becomes exhausted as a result of the hazard, then robust demineralized, raw, or borated water tanks may be used as appropriate.

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

On page 12 of the Integrated Plan, the licensee stated that as the QCST depletes, portable diesel-driven pumps will be staged to transfer inventory to the QCST or directly to the SG feedwater (turbine-driven EFW or SG FLEX) pump suction. The qualified backup in the event the QCST is depleted is provided from the ECP via a portable FLEX inventory transfer pump.

On page 16 of the Integrated Plan, the licensee stated that alternate water sources were evaluated for their capability to extend SG feed time after plant trip. The primary water source is the QCST. The site alternate water source is the ECP.

On page 20 of the Integrated Plan, the licensee stated that:

RCS inventory control and boration in Modes 1 through 4 will be provided by injecting borated water using charging pumps. The initial suction source for the charging pumps will be the ANO-2 BAMT and the subsequently inventory will be provided by the ANO-2 RWT.

For ANO-2, initial makeup inventory is provided by the safety injection tanks (SITs) during RCS cool down and depressurization. Following RCS cool down and depressurization, RCS inventory will be added as needed by utilizing a portable FLEX RCS makeup pump. The FLEX RCS makeup pump will be provided by either the ANO-1 BWST or ANO-2 RWT. If the BWST or RWT are not available due to a tornado, an additional borated water source will be identified and utilized. Maintaining RCS inventory is required to maintain NCC long term.

During the audit, the licensee was requested to:

- Clarify how borated water would be supplied for ANO-1 and ANO-2 once the borated water storage tank and refueling water storage tank are depleted.
- Provide a technical basis that the necessary boric acid is either available onsite or can be supplied in a timely manner and confirm that the strategy for preparing additional borated water would be feasible under cold weather conditions applicable to the ANO site.
- Provide the specifications for the mobile boration unit If it is determined that a mobile boration unit is necessary.

In response the licensee provided the following information regarding borated water sources:

- To cope for 72 hours following a FLEX event in modes with SGs available for heat removal, ANO-1 and ANO-2 have the following borated water requirements based on the site-specific analyses performed by Westinghouse (Refs. CN-SEE-11-13-4 and CN-SEE-11-3-2).
  - ANO-1 – 55,920 gallons
  - ANO-2 – 65,400 gallons
- Therefore, ANO-1 and ANO-2 together require 121,320 gallons of borated water for coping following a BDBEE with both units in modes with steam generators available for heat removal.
- As the BAMTs will be available for all external events and have a procedurally controlled minimum volume of 10,179 each or 20,358 total (Ref. OP-2104.003), they will be utilized first following any BDBEE. The additional required volume of borated water beyond the BAMTs is 100,962 gallons.
- For BDBEEs that do not involve high wind events, the BWST and RWT have a Technical Specification (TS) min volume of 271,180 and 350,350 gallons, respectively.
- For high wind BDBEEs, a new borated water storage tank, which is sized for 72 hours of coping (i.e. about 100,000 gallons), will be available.
- The long term strategy for providing borated makeup is to utilize a mobile boration unit supplied from the RRC. Raw water for the makeup can be supplied from the emergency cooling pond or Lake Dardanelle; water from either of these two sources will be processed through a mobile water treatment system supplied from the RRC. Details for implementation of the post 72 hour borated water makeup strategy will be included in procedures developed for implementation of the FLEX strategies (i.e., FSGs). Specifications for the RRC supplied mobile boration unit and mobile water treatment system will be reflected in RRC Engineering Information Record, Document 51-9199717-001, "Regional Response Center Generic and Site-Specific Equipment," when the strategy is finalized.

Review of this strategy has been identified as Confirmatory Item 3.2.4.7.A in Section 4.2.

During the audit, the licensee was requested to provide the capacity of all the tanks and water supplies that will be used for FLEX makeup strategies, the timing for switchover to alternate supplies and discuss the consequences of using potentially impure raw water source to supply the SGs.

The licensee provided the following information regarding water supplies:

- The credited water capacity for the QCST is 267,000 gallons. The credited capacity of the ANO-1 BWST is 271,180 gallons. The credited capacity of the ANO-2 RWT is 350,350 gallons. The Emergency Cooling Pond (ECP) credited capacity is 22,809,600 gallons. The QCST volume is conservatively estimated to deplete 7 hours following the event. This time will be increased pending completion of calculations evaluating gravity draining water from the BWST to the QCST via a 5-inch hose connection. Long term makeup is provided by a FLEX inventory transfer pump that takes suction from the ECP to provide water to the QCST for SG feed as well as SFP makeup. In Phase 2 a portable FLEX SG makeup pump is utilized to take suction from the QCST to the SGs via hose to new installed hose connections in EFW discharge piping.
- The FLEX inventory transfer pump would have to be staged at 5 hours after the event and begin providing makeup by 7 hours. As noted above, this can be delayed several hours if water is gravity drained from the BWST.
- In the event of a high wind missile event that damages the QCST, A minimum of 30 minutes of inventory is available protected by a tornado missile shield wall (reference ANO-1 SAR Sections 1.4.30, 10.4.8 and ANO-2 SAR 9.2.6.3). In this case, Fire Water Pump P-6B will be used to deliver adequate suction from the intake structure on Lake Dardanelle to the turbine-driven EFW pumps for both units via a new permanently installed cross-tie between fire water and service water. This action is similar to the current design basis action described in the ANO-1 SAR (Table 10-1) and the ANO-2 SAR (Section 9.2.6.3) except that the FW pump is used instead of the SW pump. Four valves in the intake structure will be manually opened to establish the crosstie. The ability to perform the action will be confirmed during the development and validation of FSGs and associated procedures. The FW to SW cross-tie consists of a 12 in. cross-tie between the systems to provide suction to the EFW pumps from Fire Pump P-6B. The cross-tie is located in the ANO-1 intake structure and is designed to match the pipe class of the FW system, pipe class KB, at the FW tie-in, and match the pipe class of the SW system, pipe class HBD, at the SW tie-in. The FW tie-in will have an augmented quality globe valve for system isolation during normal operation and for throttling flow after a BDBEE. The SW cross-tie isolation valve will provide a class break from safety related HBD class piping to pipe class KB. Pipe class KB is standard non-nuclear piping for the Fire Water system and therefore matches the pipe class of the line that the FW modification ties into.
- The augmented quality FW isolation globe valve is required to provide system isolation between the Fire Protection system and the cross-tie during normal plant operations, provide a flow path and flow throttling from Fire Pump P-6B to SW for a Phase 1 FLEX response in the event of QCST missile damage, and to isolate the FW system from the SW system in Phase 3 so long term cooling water can be delivered to the plant via SW. Seismic robustness or protection from external floods for the cross-tie piping is not required as this source is only necessary for a high wind missile event. The fire water pump automatically starts on loss of offsite power. The cross-tie will have to be implemented within 30 minutes to ensure a continued source of water for the TDEFW pump. This 30-minute action to manually align valves in the Intake Structure will be validated during the procedure development phase and staffing assessment.
- Calculation CALC-13-E-0005-03 determines the effects on the heat transfer capabilities using lake or ECP water as a long-term source of coolant for the once through steam generators. The analysis conservatively assumes that makeup to the steam generators is initiated 30 minutes following the BDBEE and continues for 120 hours. The analysis shows that after approximately 120 hours, the heat transfer capabilities of each steam generator will be reduced by 0.3% and 0.4% using ECP and Lake Dardanelle water,

respectively. The OTSGs are designed to remove heat from the RCS at full power conditions. This decrease in heat transfer capability of less than one percent is deemed acceptable as the heat transfer requirements decrease exponentially after shutdown. The quality of the ECP water has been previously addressed during the review associated with Licensee Amendment 214 for ANO-1 and Licensee Amendment 232 for ANO-2.

In the six month update, the licensee indicates that they may be changing methodology to providing borated water to the RCS. The licensee was requested to provide a discussion on the proposed change.

The licensee provided the following information regarding providing borated water to the RCS:

- RCS makeup for ANO-1 will be provided by the ANO-2 charging pumps taking suction initially from the ANO-2 BAMT followed by the RWT and then the BWST. The ANO-2 charging pumps are capable of providing 44 gpm of makeup to the ANO-1 RCS via the Makeup and Purification (MUP) System. A combination of new installed cross-tie piping and hose is used to make the alignment. The charging pumps are each capable of delivering 44 gpm at 3010 psi (the required TDH is 2482.7 psi). The new cross-tie pipe will be routed from the ANO-2 Chemical and Volume Control System (CVCS) tie-in (downstream of the charging pumps), penetrate the wall dividing stairwells 1 and 2001, and terminate within twenty feet of the tie-in downstream of the MUP Primary Makeup pumps. High pressure hoses are used to connect the cross-tie piping to the MUP piping. A tie-in will be installed on DHR system piping downstream of the BWST for the suction source. Hoses will be run from this tie-in to a similar tie-in on the ANO-2 charging pump suction line. A portable FLEX generator will be used to repower the charging pumps connected to their normal power sources. Relevant operating experience from plant events will be considered during the design of this modification.
- RCS makeup for ANO-2 is initially provided by the safety injection tanks (SITs) during RCS cool down and depressurization. Following RCS cool down and depressurization, RCS inventory will be added as needed by utilizing a portable FLEX RCS makeup pump. The FLEX RCS makeup pump will utilize water from either the ANO-1 BWST or ANO-2 RWT. An alternate strategy is under consideration to use the charging pumps to make up to the ANO-2 RCS after the ANO-1 cooldown is complete.
- A new borated water tank will be installed for coping with FLEX following high wind BDBEEs. This tank provides a new 100,000 gallon borated water storage tank for use following a high-wind BDBEE that disables the existing borated water tanks on site. The new tank will contain enough borated water to provide makeup to the RCS for both Units during Phase 2 to facilitate core cooling.

In the six month update, the licensee has changed methodology to supply both units RCS makeup using a Unit 2 charging pump. The licensee was requested to provide details on this approach including what is the protected water source, piping routes, backup or alternate approach, and how this method meets N+1 for FLEX equipment.

During the audit the licensee provided the following information regarding use of the Unit 2 charging pump for Unit 1:

- ANO-1 is utilizing the ANO-2 charging pumps for RCS makeup. The current ANO-2 strategy is to use a portable FLEX RCS makeup pump for RCS makeup. An alternate

strategy is under consideration to use the charging pumps to make up to the ANO-2 RCS after the ANO-1 cooldown is complete.

- N+1 portable FLEX RCS makeup pumps will be provided for ANO-2.
- Similar to the strategy described in FAQ 2013-06, the ANO-1 FLEX strategy utilizes three installed charging pumps as the primary and alternate means of RPV makeup in Phase 2. These permanently installed pumps are repurposed for use in the FLEX strategy. These pumps provide diverse capability beyond the installed Phase 1 equipment used for RPV makeup. The installed charging pumps are located in a structure which is robust with respect to seismic events, floods, and high winds and associated missiles. The pumps are re-powered from their normal power sources by a portable FLEX diesel generator.
- NEI 12-06 Section 3.2.2, consideration 13 states that 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 a diverse capability beyond installed equipment. The ANO-1 FLEX strategy does not include this capability and thus crediting of installed ANO-2 charging pumps for the ANO-1 FLEX Phase 2 strategy is a deviation from the NEI 12-06 guidance. However, the use of the installed ANO-2 charging pumps to provide RPV makeup may be an acceptable alternative to a portable FLEX pump for the transitional phase of FLEX. The guidance states that the ELAP response is to be addressed with a combination of three categories of equipment: installed plant capability, portable on-site equipment, and off-site equipment resources (1st bullet below). Only one phase of the response is limited to utilizing equipment from just one of the equipment categories.
- To ensure that there is enough time to deploy and implement portable equipment, Phase 1 can only use installed plant equipment. Even though Phase 2 and Phase 3 will utilize portable equipment (onsite for Phase 2 and offsite from RRC for Phase 3) there is no prohibition against the use of permanently installed equipment in those two phases as long as it is robust with respect to design basis external events (2nd and 3rd bullets below). NEI 12-06 recognizes the need for this and provides guidance (i.e., "…robust with respect to design basis external events…") for which installed equipment can be utilized. The guidance does provide some examples of types of installed equipment (i.e., robust piping, 4th and 5th bullet below) which can be used, but it does not exclude any equipment types other than installed, emergency on-site AC power sources which are excluded by the ELAP initial conditions. References from NEI 12-06 are as follows:
    - 3 STEP 1: ESTABLISH BASELINE COPING CAPABILITY - "The primary FLEX objective is to develop a plant-specific capability for coping with a simultaneous ELAP and LUHS event for an indefinite period through a combination of installed plant capability, portable on-site equipment, and off-site resources. Each plant will establish the ability to cope for these baseline conditions based on the appropriate engineering analyses and procedural framework."
    - 3.2 PERFORMANCE ATTRIBUTES - "…The baseline assumptions have been established on the presumption that other than the loss of the ac power sources and normal access to the UHS, installed equipment that is designed to be robust with respect to design basis external events is assumed to be fully available. Installed equipment that is not robust is assumed to be unavailable."
    - 3.2.1.3 Initial Conditions (6) - "Permanent plant equipment that is contained in structures with designs that are robust with respect to seismic events, floods, and high winds, and associated missiles, are available."

- 3.2.1.3 Initial Conditions (8) - “Installed electrical distribution system, including inverters and battery chargers, remain available provided they are protected consistent with current station design.”
- 2.1 ESTABLISH BASELINE COPING CAPABILITY - “While initial approaches to FLEX strategies will take no credit for installed ac power supplies, longer term strategies may be developed to prolong Phase 1 coping that will allow greater reliance on permanently installed, bunkered or hardened ac power supplies that are adequately protected from external events.”

- The ANO-2 charging pump and related piping and components meet the NEI 12-06 requirements for use of installed plant equipment. The components are contained in Seismic Category I structures that provide protection from BDBEEs. The components are seismically robust or are being evaluated to demonstrate that they are seismically robust. The ANO-2 charging pump and related components’ FLEX functions are similar to that of the ANO-2 charging pump’s original design functions. Any of the three, redundant ANO-2 charging pumps can be used in the FLEX strategy. Power to any of the pump motors is provided from a portable FLEX diesel generator. The cable routing from generator is through Seismic Category I structures. The use of installed ANO-2 charging pumps minimizes the deployment resources for implementing Phase 2 RPV FLEX strategies. Additionally, the basis for use of the installed ANO-2 charging pumps in lieu of portable FLEX pumps is consistent with the justification provided in NEI 12-06 FAQ 2013-06. Based on the above attributes, it is concluded that use of the installed ANO-2 charging pump and components for RPV makeup in the FLEX transition phase for ANO-1 meets the intent of the NEI 12-06 guidance for providing Phase 2 FLEX strategies and there is no need for a portable FLEX pump for RPV makeup.

The licensee also provided the updated information regarding the use of the ANO-2 charging pump for ANO-1:

- The ANO-1 FLEX strategy relies on re-powering one of the ANO-2 charging pumps (2P-36A, 2P-36B, or 2P-36C) for borated water makeup in order to cooldown and depressurize the ANO-1 reactor coolant system following a Beyond-Design-Basis External Event (BDBEE). The ANO-2 electrical modifications that are required to support the ANO-1 FLEX strategy are connections for a portable diesel generator through the ANO-2 2B5 and 2B6 load centers (separate safety-related trains). Full implementation of FLEX strategy is currently required by the 1R25 refueling outage for ANO-1 (February 2015) and the 2R24 refueling outage for ANO-2 (October 2015). Because 1R25 occurs approximately eight months prior to 2R24 any ANO-2 modifications needed to support the ANO-1 FLEX strategy requiring an ANO-2 outage must be installed in the upcoming 2R23 ANO-2 refueling outage (March 2013).
- The ANO-2 2B5 and 2B6 load centers require modification to support the ANO-1 FLEX strategy in order to provide diverse electrical connections. Modification to the 2B6 load center is planned during the upcoming 2R23 refueling outage. The 2B6 load center provides power to the 2P-36B and 2P-36C (swing) charging pumps. The 2B6 load center can also power the 2B5 load center through existing cross-tie breakers. The 2B5 load center provides power to the 2P-36A charging pump. Any of the three ANO-2 charging pumps are capable of being powered via the 2B6 load center to support the ANO-1 FLEX strategy.
- The modification to the 2B5 load center is planned during the ANO-2 2R24 refueling outage (October 2015). As an alternative to NEI 12-06 additional diverse power would

be provided once the 2B5 load center modification is completed during the 2R24 refueling outage (October 2015). For the eight-month period between 1R25 and 2R24, the ANO-2 charging pumps (supporting the ANO-1 FLEX strategy) would rely on power from energizing the 2B6 load center from the portable diesel generator.

The basis for this alternative is provided below:

- To modify both of the 2B5 and 2B6 load centers in 2R23 would incur risk to both of the safety-related load centers in a single outage. From an integrated risk perspective, this would not normally be performed. While minor maintenance is performed on both trains of safety-related equipment in a refueling outage, for risk mitigation each outage has a specific train emphasis for major maintenance and modifications. Refueling outage 2R23 is focused on green train equipment (2B6) maintenance, and 2R24 is focused on red train equipment (2B5) maintenance. There is currently a planned bus outage scheduled on the 2B5 load center in the 2R24 outage. To mitigate the risk of inducing equipment malfunctions in both safety-related load centers in a single outage it is prudent to separate these modifications and perform the 2B5 modifications in 2R24.
- As a result of the outage train focus described above, extensive schedule changes would be required to insert the 2B5 modifications into 2R23. The insertion of 2B5 into 2R23 affects the scheduling of red train testing as well as numerous motor operated valve tests. At this stage in the 2R23 scheduling process, this amount of rescheduling flux introduces the risk of improperly mitigating the comprehensive risk of multiple equipment schedule interactions. With a 2B5 bus outage already scheduled in 2R24, it is prudent to avoid this 2R23 schedule flux risk by performing the 2B5 modifications in 2R24.
- Other options to provide a diverse electrical connection to a red train ANO-2 charging pump have been considered. These options induce their own set of risks. Because the ANO-2 FLEX strategies also rely on the 2B5 and 2B6 load centers for both charging pumps, modification to the 2B5 load center is required for ANO-2, and therefore, any alternate options to provide a diverse electrical connection to the red train ANO-2 charging pump for the ANO-1 FLEX strategy would be temporary and very short-term. An alternate option would only be in place for the eight-month period between 1R25 (February 2015) and 2R24 (October 2015).
- In summary, the 2B5 load center modification during the 2R24 refueling outage to provide additional diverse electrical connections for the ANO-1 FLEX strategy that relies on re-powering one of the ANO-2 charging pumps is an acceptable alternative to NEI 12-06.
- Power will be provided to the charging pumps by use of a portable FLEX generator. Connection points for the portable FLEX generator will be provided on electrical ESF Buses 2B5 and 2B6. See response to Audit Question 117 for additional discussion of these changes. Since these buses can be cross-tied, repowering either one of the buses results in the capability to repower any one of three charging pumps (2P-36A, B, or C) through motor control centers (MCCs) 2B52, 2B62, or 2B64. The charging pumps are capable of operating without seal lubrication cooling. Therefore, the seal lubrication pumps are not required for the strategy. Each charging pump has a corresponding lube oil pump that is required for charging pump operation. The lube oil pumps are powered from the same source as their corresponding charging pump and thus will be repowered at the same time as the charging pump is repowered. In addition, new manual valves are being installed to provide the means to provide flow from the charging pumps to the

ANO-1 RCS. Existing valves required for alignment of the charging pumps to the ANO-1 RCS are operated manually or from 1E dc power sources.

- An existing calculation (94-E-0095-35 Rev 0) has determined that the maximum temperature in the room without room coolers is 114.5 degrees F after 5 days. The limiting component temperature rating is 140 degrees F. Based on this calculation, no portable ventilation is required for the charging pump rooms.

The Staff has reviewed the ANO approach that uses the Unit 2 charging pump to supply makeup to the Unit 1 RCS for inventory control but has not concluded that this approach is acceptable. This has been previously identified as Open Item 3.2.1.D in Section 4.1.

Review of the licensees approach, as described above, has raised concerns which must be addressed before confirmation can be provided that the Integrated Plan is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, or that an acceptable alternative was provided, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to makeup water sources. These questions are identified as an Open Item in Section 4.1, and as a Confirmatory Item in Section 4.2.

3.2.4.8 Electrical Power Sources/Isolations and Interactions

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

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

The licensee was requested to describe how electrical isolation will be maintained such that (a) Class 1E equipment is protected from faults in portable/FLEX equipment and (b) multiple sources do not attempt to power electrical buses.

During the audit the licensee provided the following information regarding electrical isolation:

a) Appropriate controls for the equipment will be implemented in procedures to ensure compliance with NEI 12-06 section 3.2.2.13. Connection points and other permanent modifications will be designed in accordance with approved design practices to ensure no adverse effects during normal operation.
b) At the onset of the ELAP, Class 1E emergency diesel generators (EDGs) are assumed to be unavailable to supply the Class 1E busses. Portable generators are used in response to an ELAP in FLEX strategies for Phases 2 and 3. At the point when ELAP mitigation activities require tie-in of FLEX generators, in addition to existing electrical interlocks, procedural controls such as inhibiting EDG start circuits and breaker rack-outs (e.g., EDG breakers, offsite feeder breakers, etc.), will be employed to prevent simultaneous connection of both the FLEX generators and Class 1E EDGs to the same AC distribution system or component. Additionally, repowering the Class 1E electrical buses from either FLEX generators or subsequently the Class 1E EDGs (should they become available) will be accomplished manually and controlled by procedure; no automatic sequencing or automatic repowering of the buses will be utilized. FLEX strategies, including the transition from installed sources to portables sources (and vice versa), will be addressed in the FLEX procedures and guidance which are in the development stage.

The licensee was requested to provide single line diagrams showing the proposed connections of Phase 2 and 3 electrical equipment on the e-Portal, and to show protection information (breaker, relay, etc.) and rating of the equipment on the Single Line Diagrams. During the audit the licensee stated that a preliminary single line diagram showing the proposed connections of Phase 2 and Phase 3 electrical equipment is provided in CALC-13-E-0005-06, ANO Flex Diesel Sizing Calculation, Attachment 5. This calculation is posted in e-portal. Phase 2 FLEX Schematic Drawing E-2941 Sheet 16 is also provided in the Integrated Plan for additional detail.

The licensee was requested to provide a summary of the sizing calculation for the FLEX generators to show that they can supply the loads assumed in phases 2 and 3.

During the audit the licensee provided the following information regarding portable generator load sizing:

- The portable FLEX generator will be adequately sized to provide Phase 2 power to both ANO-1 and ANO-2 simultaneously.
- The loading calculation for the FLEX generators is documented in Calculation Number 13-E-0005-06. This calculation generates critical performance characteristics (kW, KVAR, and kVA demands for starting, stopping, and maintaining loads with margin) that must be met by the portable generators.
- For the Phase 2 portable FLEX 480V generators, the calculation tabulates the critical plant equipment loads needed during Phase 2 of the BDBEE mitigation strategy. It also tabulates the loads that could be re-powered during Phase 3 of the BDBEE mitigation strategy and verifies that the equipment that could be furnished from the RRC is capable of repowering these electrical loads. A draft of this calculation is available on the e-Portal.
- These calculations are being developed in accordance with approved design processes that utilize appropriate design inputs for calculating electrical loads and the necessary considerations for use in sizing generators and their drivers (e.g., load starting requirements, voltage and frequency recovery requirements between applied loads, etc.). Loading and unloading of the generators will be controlled by procedure, based on vendor recommendations, to prevent overloading or tripping of the generators.

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.

During the audit, the licensee was requested to provide the following information regarding portable equipment fuel:

- A discussion regarding how long FLEX equipment can be sourced from onsite diesel fuel storage tanks, the methods to be used to retrieve oil form the site tanks and deliver to FLEX equipment, what actions are to be taken if the tanks are unavailable, and how on-site makeup will be provided for indefinite coping.
- An evaluation justifying that these tanks will be available or diesel fuel will be available from an assured source, with sufficient access and discuss how the quality of the fuel stored in in FLEX equipment over the long term will be maintained.

During the audit, the licensee provided the following additional information regarding portable equipment fuel:

- The main source of fuel oil for FLEX equipment is the onsite, underground, T-57 and 2T-57 diesel fuel oil storage tanks. For ANO-1, the minimum volume of fuel available in the underground fuel oil storage tank is 20,000 gallons (reference ANO-1 Technical Specifications LCO 3.8.3 Condition A). For ANO-2, the minimum volume of fuel available in the underground fuel oil storage tank is 22,500 gallons (reference ANO-2 Technical Specifications LCO 3.8.1.3).
- Per ANO-1 FSAR Section 8.3.1.1.7.2: Two emergency diesel storage fuel tanks and two transfer pumps are contained in a flood proof, Seismic Class 1, excavated vault. The emergency storage tank vaults are of Seismic Class 1 design and, in addition, have been specifically designed to resist the loadings imposed by the design flood. This includes anchoring the vault to rock and providing ventilation openings above flood elevation. The outside door is of watertight construction. Fuel oil is provided to the portable FLEX equipment by repowering the diesel fuel oil transfer pumps with a portable FLEX generator to pump fuel oil via hose to the portable FLEX equipment. During the pre-flood deployment, hose(s) would be connected and routed from the connection point through the roof to FLEX equipment. This allows the hose(s) to exit the Fuel Oil Storage Building without opening the flood doors.
- Similarly ANO-2 FSAR 9.5.4.2 states: The emergency storage tank vaults are of Seismic Category 1 design and, in addition, have been specifically designed to resist the loadings imposed by the probable maximum flood. This includes anchoring the vault to rock and providing ventilation openings above flood elevation. The outside door is of watertight construction.
- Fuel oil is provided to the portable FLEX equipment by repowering the existing diesel fuel oil transfer pumps with a portable FLEX generator. Fuel oil is routed through a hose from the diesel fuel oil transfer pumps out of an opening in the fuel oil storage building above the flood elevation to the portable diesel-driven FLEX equipment or a portable fuel oil truck mounted tank. The NEI 12-06 guidance does not require the failure of the onsite diesel fuel storage tanks to be considered, since the tanks are protected from all external events.
- ANO-1 FSAR Section 9.5.4.1 states: When a flood is imminent, the inlet to the fuel storage tanks, which is inside the vault, can be closed. There is then an assured inventory of fuel available for at least seven days at full load for one diesel engine.
- ANO-2 FSAR Section 9.5.4.1 states: A fuel capacity of at least 22,500 gallons for one underground Emergency Storage Tank plus a fuel capacity of at least 520 gallons for

one diesel day tank will be sufficient for not less than three and one half days of operation of one Emergency Diesel Generator loaded to its maximum continuous rating. Thus, in accordance with ANSI 59.51 and the NRC Regulatory Guide1.137, at least a seven day total diesel fuel inventory will be available onsite in the emergency storage tanks for operation of one Emergency Diesel Generator loaded to its maximum continuous rating during loss of electric power conditions.

- For ANO-1, the emergency diesel generators are rated at 2600 kW and the ANO-2 emergency diesel generators are rated at 3250 kW. Per the above FSAR sections, there is enough diesel fuel in the onsite emergency diesel generator storage tanks to power a combined ANO-1 and ANO-2 load of 5850 kW for seven days of continuous operation.
- Detailed fuel consumption rates for the diesel driven FLEX equipment have not been performed at this time since the final requirements for Phase 2 diesel driven FLEX equipment has not been finalized. However, based on the projected size of the FLEX generator (one 800 kW FLEX generator to supply both units) and the diesel driven FLEX pumps for both units (two approximately 250 hp diesel driven pumps and two approximately 100 hp diesel driven FLEX pumps) there is sufficient diesel fuel onsite to power the diesel driven FLEX equipment well beyond 72 hours since the combined FLEX equipment load would be well below the rating of a single emergency diesel generator which can be powered for 168 hours (see response to Audit Question 113 for the description of the diesel driven FLEX pumps). After existing plant sources of fuel are exhausted, there will be ample time to have additional fuel provided from offsite resources as necessary.
- The quality of fuel oil in Emergency Diesel Generator Fuel Oil Storage Tanks is maintained in accordance with the Diesel Fuel Oil Testing Program (reference ANO Technical Specifications Administrative Program 5.5.13). Fuel oil in the fuel tanks of portable diesel engine driven FLEX equipment will be maintained in the Preventative Maintenance program in accordance with the EPRI maintenance templates being developed for FLEX equipment by the industry. Gasoline is not used to fuel any 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) states:

> *Plant procedures/guidance should identify loads that need to be stripped from the plant dc buses (both Class 1E and non-Class 1E) for the purpose of conserving dc power.*
>
> DC power is needed in an ELAP for such loads as shutdown system instrumentation, control systems, and dc backed AOVs and MOVs. Emergency lighting may also be powered by safety-related batteries. However, for many plants, this lighting may have been supplemented by Appendix R and security lights, thereby allowing the emergency lighting load to be eliminated. ELAP procedures/guidance should direct operators to conserve dc power during the event by stripping nonessential loads as soon as practical. Early load stripping

can significantly extend the availability of the unit's Class 1E batteries. In certain circumstances, AFW/HPCI /RCIC operation may be extended by throttling flow to a constant rate, rather than by stroking valves in open-shut cycles.

Given the beyond-design-basis nature of these conditions, it is acceptable to strip loads down to the minimum equipment necessary and one set of instrument channels for required indications. Credit for load-shedding actions should consider the other concurrent actions that may be required in such a condition.

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

During the audit the licensee stated that the loads that will be shed from the dc bus are identified in CALC-13-E-0005-14, "ANO-1 FLEX Battery Load Shed Calculation", which is available on e-portal. The licensee also stated that equipment locations will be identified as part of the FLEX procedure development phase and addressed during walkthroughs, and walkthroughs will also address the time frame to complete the proposed load shed and results will be utilized in the battery coping calculation methodology. In addition, the licensee stated that for ANO-1, the allotted time to shed loads is reasonable and will be validated during procedure development and the FLEX strategy walkthroughs and demonstrations. The procedure development process may identify the need for operator aides such as checklists or special marking of breakers. For ANO-2, the licensee stated that the design for ANO-2 FLEX implementation has not started at this time. It is expected that the allotted time to shed loads is reasonable. The time will be validated during procedure development and the FLEX strategy walkthroughs and demonstrations. The procedure development process may identify the need for operator aides such as checklists or special marking of breakers. This has been identified as Confirmatory Item 3.2.4.10.A in Section 4.2.

The licensee was requested to provide the direct current (dc) load profile with the required loads for the mitigating strategies to maintain core cooling, containment, and spent fuel pool cooling. During the audit the licensee stated that the direct current (dc) load profile with the required loads for the mitigating strategies to maintain core cooling, containment, and spent fuel pool cooling are described in CALC-13-E-0005-14, "ANO-1 FLEX Battery Load Shed Calculation" which is available on e-portal. No information was provided for ANO-2. This has been identified as Confirmatory Item 3.2.4.10.B in Section 4.2.

The licensee was requested to provide the basis for the minimum dc bus voltage that is required to ensure proper operation of all required electrical equipment. During the audit the licensee stated that a minimum battery voltage of 105Vdc for batteries D06 and D07 is identified in CALC- 13-E-0005-14, ANO-1 FLEX Battery Load Shed Calculation and is available on e-portal. This value was taken from the SBO 2-hour emergency duty cycle calculation, which identified 1.81 Vdc as the minimum cell voltage (58 cells total). No information was provided for ANO-2. This has been identified as Confirmatory Item 3.2.4.10.C in Section 4.2.

The licensee was requested to confirm (for ANO-1 and ANO-2) that load shed activities will not interfere with required valve positioning or operator action capability that may be credited in establishing ELAP response strategies, including specifically those actions related to isolating RCS leakage paths, including the CBO. During the audit, the licensee stated that the load

shedding activities will not interfere with the capability of isolating RCS leakage paths. The ANO blackout procedures include steps to isolate the RCS early in the response to the event. The extended load shedding activities may be performed concurrently if resources allow. ANO-1 will isolate the CBO within the first 10-20 minutes from the Control Room. For ANO-2, load shedding activities will be completed before a containment entry is made for the final isolation of CBO relief to Quench Tank.

The licensee was requested to discuss the safety consequences of performing a load shed on the dc buses, to include the strategy to prevent an uncontrolled hydrogen release from the main generator if the backup seal oil pump is shed. The licensee responded by stating that hydrogen release from the main generator during a load shed is addressed in SBO procedures ANO-1 1202.008 which contains instructions on purging the main generator of hydrogen and ANO-2 2201.008 provides directions to shutdown the lube oil and seal oil systems.

On page 45 (ANO-1) and 47 (ANO-2) of the Integrated Plan, Attachment 1A - Sequence of Events Timeline, the licensee stated that the elapsed time to deploy and connect the FLEX 480V generator to power the RCS makeup pump is 6 hours and 18 hours, respectively. Subsequently, the licensee provided an update status in the first six-month update stating the elapsed time to deploy and connect the FLEX 480V generator is 6 hours for ANO-1 and ANO-2 to provide power to ANO-2 charging pumps and battery chargers for each unit. The FLEX 480V diesel generator is shared between units and is adequately sized to provide power to ANO-1 and ANO-2.

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

3.3 PROGRAMMATIC CONTROLS

3.3.1 Equipment Maintenance and Testing

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

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

functions). Other FLEX support equipment only requires an N capability.

NEI 12-06, Section 11.5 states:

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

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

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

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

    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.

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

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

During the audit the licensee provided the following update regarding maintenance programs: ANO will utilize the Electric Power Research Institute (EPRI) Report 3002000623, dated September 2013, entitled "Nuclear Maintenance Applications Center: Preventive Maintenance Basis for FLEX Equipment," which describes the EPRI Preventive Maintenance Basis Database, and will utilize the EPRI developed FLEX Equipment and Testing Templates for developing programs for maintenance and testing 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 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 8 of the Integrated Plan the licensee stated that they plan to maintain the FLEX strategies and modify existing plant configuration control procedures to ensure changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.

The licensee did not provide any discussion regarding how strategies and their bases will be maintained in an overall program document that includes a historical record of previous strategies and the bases for changes and that 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 as described in NEI 12-06, Section 11.8, items 1 and 3. This has been identified as Confirmatory Item 3.3.2.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 8 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, mechanical maintenance, and electrical maintenance. The training plan development will be done in accordance with ANO site procedures using the Systematic Approach to Training and will be implemented to ensure that the required Entergy ANO site 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 <u>OFF SITE RESOURCES</u>

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

1) A capability to obtain equipment and commodities to sustain and backup the site’s coping strategies.
2) Off-site equipment procurement, maintenance, testing, calibration, storage, and control.
3) A provision to inspect and audit the contractual agreements to reasonably assure the capabilities to deploy the FLEX strategies including unannounced random inspections by the Nuclear Regulatory Commission.
4) Provisions to ensure that no single external event will preclude the capability to supply the needed resources to the plant site.
5) Provisions to ensure that the off-site capability can be maintained for the life of the plant.
6) Provisions to revise the required supplied equipment due to changes in the FLEX strategies or plant equipment or equipment obsolescence.
7) The appropriate standard mechanical and electrical connections need to be specified.
8) Provisions to ensure that the periodic maintenance, periodic maintenance schedule, testing, and calibration of off-site equipment are

comparable/consistent with that of similar on-site FLEX equipment.

9) Provisions to ensure that equipment determined to be unavailable/non-operational during maintenance or testing is either restored to operational status or replaced with appropriate alternative equipment within 90 days.
10) Provision to ensure that reasonable supplies of spare parts for the off-site equipment are readily available if needed. The intent of this provision is to reduce the likelihood of extended equipment maintenance (requiring in excess of 90 days for returning the equipment to operational status).

The license's plans for the use of off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies (item 1 above), however, insufficient information was provided regarding the remaining items (2 through 10 above). This has been identified as Confirmatory Item 3.4.A in Section 4.2.

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

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.2.1.D	The Staff has reviewed the ANO approach that uses the Unit 2 charging pump to supply makeup to the Unit 1 RCS for inventory control, including the proposed interim electrical configuration that will be in place for approximately eight months after the ANO-1 order compliance date, but has not concluded that this approach is acceptable. The NRC staff will continue the review of the licensee's proposal after issuance of the ISE to ensure that it complies with Order EA-12-049.	Significant
3.2.1.3.A	The licensee should provide information to address the applicability of assumption 4 from WCAP Section 4.2.1 Input Assumptions - Common to All Plant Types on page 4-13 of WCAP-17601, which states that "Decay heat is per ANS 5.1-1979 + 2 sigma, or equivalent."	
3.2.1.8.B	At the time the audit was conducted, the licensee had not committed to abide by the generic approach discussed above, including the additional conditions specified in the NRC's endorsement letter. As such, the generic concern associated with modeling the timing and uniformity of boric acid mixing within the RCS under natural circulation conditions potentially involving two-phase flow needs to be adequately addressed for ANO-1 and ANO-2. Verification that the licensee's plan will conform to the NRC-endorsed generic resolution and that the additional conditions discussed above will be satisfied is needed.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.2.A	The licensee should provide a discussion regarding the potential need for a power source move or deploy the equipment (e.g., to open the door from a storage location),	
3.1.1.4.A	Confirm that the local staging area for RRC equipment has been identified and a description of the methods to be used to deliver the equipment to the site has been provided.	
3.1.3.1.A	Confirm that the axis of separation and distance between the portable equipment storage buildings provides assurance that a single tornado will not impact both buildings.	
3.2.1.A	The ANO-1 ADVs are not safety related, and are not qualified for seismic events. The ANO-2 ADVs upstream of the MSIVs are not safety-related but are classified seismic Category 1. The licensee should perform an analysis to verify that the ADVs and associated piping are sufficiently robust and will remain functional during a seismic event.	
3.2.1.B	The ANO-2 cooldown requires confirmation of existing analysis or additional analysis during the ANO-2 detailed design to support the delay in the cooldown to 8 hours following and ELAP.	
3.2.1.C	Evaluation of the EFW turbine exhaust piping for robustness is ongoing. Review of the analysis regarding the robustness of the EFW turbine exhaust piping is needed.	
3.2.1.1.A	Confirm that reliance on the RELAP5/MOD2-B&W code in the ELAP analysis for B&W plants is limited to the flow conditions prior to boiler-condenser cooling initiation.	
3.2.1.1.B	The use of CENTS in the ELAP analysis for CE plants is limited to the flow conditions prior to reflux boiling initiation. Confirm the licensee's compliance with the above limitation on the use of CENTS in the ELAP analysis.	
3.2.1.2.A	B&W designed plants use a variety of RCPs, seals and motors. Some plants rely on procedures to maintain RCS temperatures below the design temperatures of the limiting components (i.e., elastomers), and thus, keep the RCP seal leakage low. Provide information to justify that the procedures are effective to keep the RCS temperatures within the limits of the seal design temperatures, and address the adequacy of the seal leakage rate (2 gpm/seal) used in the ELAP analysis.	
3.2.1.2.B	Some plants have low leakage seals to maintain the initial maximum leakage rate of 2 gpm/seal for the ELAP analyses of the RCS response. Provide a discussion of the information (including seal leakage testing data) to justify the use of 2 gpm/seal in the ELAP analysis.	
3.2.1.2.C	Address the acceptability of using of the FlowServe N-9000 RCP seals with the Abeyance seal in the Westinghouse RCPs. The RCP seal leakages rates for use in the ELAP analysis should be provided with acceptable justification.	
3.2.1.4.A	The Licensee stated that there are currently no identified deviations in the ANO-1 FLEX conceptual design with respect to	

Item Number	Description	Notes
	the PWROG guidance pending completion of PWROG-sponsored revision to WCAP-17601 that is in progress for the updated NSSS strategy for B&W NSSS designs. The licensee should provide the revision to WCAP-17601 and explain if the assumptions in the revised WCAP are consistent with the assumption in NEI 12-06.	
3.2.1.8.A	For ANO-2, the site specific ELAP analysis indicates shutdown margin will be maintained greater than the 1.0 %Δρ acceptance criteria of WCAP-17601. From CENTS results, shutdown margin will be 3.43 %Δρ following SIT injection. This analysis requires confirmation or additional analysis during the ANO-2 detailed design to support the delay in the ANO-2 cooldown to 8 hours following an ELAP.	
3.2.1.9.A	The times for connecting the portable FLEX pumps for Modes 1□4 is discussed in the sequence of events timeline and the relevant sections of the Integrated Plan. Procedures have not been developed at this time, but validation of the procedures will validate the timing for deploying and starting pumps. The strategy regarding the portable ANO-2 RCS injection pump related to the analysis in licensee calculation CN-SEE-11-13-2 requires confirmation or additional analysis during the ANO-2 detailed design to support the delay in the ANO-2 cooldown to 8 hours following an ELAP. Review of this additional analysis is needed.	
3.2.1.9.B	Specific times for Phase 3 actions regarding us of the portable RRC pumps have not been finalized but are expected to occur following delivery of RRC equipment. No specific time requirement is required since it is expected that the Phase 2 equipment will be able to continue to function well beyond 72 hours. Review of the final specific times for connection and use of the portable RRC pumps is needed.	
3.2.3.A	Calculation CALC-13-E-0005-02, ANO-1 MAAP Containment Analysis for BDBEE has been performed; however, the ANO-2 version has not been performed at this time. The results of the ANO-2 containment ELAP analysis should be provided for review, to confirm that containment functions will be maintained.	
3.2.4.2.A	The heatup calculation for ANO-2 Main Control Room has not been performed at this time; however, the results are expected to be similar to ANO-1. The licensee should provide the results of the ANO-2 MCR ELAP analysis for review and confirm that MCR functions will be maintained.	
3.2.4.2.B	Provide additional details to confirm the adequacy of ANO-2 battery room ventilation for extreme temperature protection when available later in the design / procedure development process.	
3.2.4.2.C	For the ANO-2 TDEFW pump room and electrical equipment rooms, calculations have not been completed but are expected to yield results similar to ANO-1. Additional details on heatup and required ventilation of ANO-2 TDEFW Pump Room and Electrical Equipment Rooms will be available later in the design /	

Item Number	Description	Notes
	procedure development process. The licensee should provide the results of the calculations to confirm that the ANO-2 TDEFW pump and electrical equipment rooms are maintained at temperatures to allow continued equipment operation.	
3.2.4.4.A	Confirmation will be required that upgrades to the site's communications systems have been completed.	
3.2.4.7.A	The long term strategy for providing borated makeup is to utilize a mobile boration unit supplied from the RRC. Raw water for the makeup can be supplied from the emergency cooling pond or Lake Dardanelle. Details for implementation of the post 72 hour borated water makeup strategy will be included in procedures developed for implementation of the FLEX strategies (i.e., FSGs). Specifications for the RRC supplied mobile boration unit and mobile water treatment system will be reflected in RRC Engineering Information Record, Document 51-9199717-001, "Regional Response Center Generic and Site-Specific Equipment," when the strategy is finalized. Review of the final strategy for use of the mobile boration unit is required.	
3.2.4.10.A	For ANO-2, the licensee stated that the design for ANO-2 FLEX implementation regarding load shedding has not started at this time. It is expected that the allotted time to shed loads is reasonable. The time will be validated during procedure development and the FLEX strategy walkthroughs and demonstrations. The procedure development process may identify the need for operator aides such as checklists or special marking of breakers. Review of additional information regarding ANO-2 load shedding is needed.	
3.2.4.10.B	The licensee was requested to provide the dc load profile with the required loads for the mitigating strategies to maintain core cooling, containment, and spent fuel cooling. No information was provided for ANO-2 regarding this issue.	
3.2.4.10.C	The licensee was requested to provide the basis for the minimum dc bus voltage that is required to ensure proper operation of all required electrical equipment. No information was provided for ANO-2 regarding this issue.	
3.3.2.A	The licensee did not provide any discussion regarding how strategies and their bases will be maintained in an overall program document that includes a historical record of previous strategies and the bases for changes and that 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 as described in NEI 12-06, Section 11.8, items 1 and 3. Review of these considerations for configuration control is needed.	
3.4.A	The license's plans for the use of off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies (item 1 above), however, insufficient information was provided	

Item Number	Description	Notes
	regarding the remaining items (2 through 10 above).	