Mega-Tech Services, LLC

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

Revision 0

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Tennessee Valley Authority
Watts Bar Nuclear Plant, Units 1 & 2
Docket Nos. 50-390 and 391

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## 1.0 BACKGROUND

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

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

After receiving the Commission's direction in SRM-SECY-11-0124 and SRM-SECY-11-0137, the NRC staff conducted public meetings to discuss enhanced mitigation strategies intended to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities following beyond-design-basis external events (BDBEE). 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 Considerations provided in NEI 12-06, Revision 0, subject to the clarifications in Attachment 1 of the ISG are an acceptable means of meeting the requirements of Order EA-12-049.

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

## 2.0 EVALUATION PROCESS

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

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

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

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

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

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

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

## 3.0 TECHNICAL EVALUATION

By letter dated February 27, 2013 (ADAMS Accession No. ML13067A030), and as supplemented by the first six-month status report in letter dated August 28, 2013 (ADAMS Accession No. ML13247A288) Tennessee Valley Authority (the licensee or TVA) provided Watts Bar Nuclear (WBN) Plant's Integrated Plan for compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by TVA 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 Events

NEI 12-06, Section 5.2 states:

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

In the section of its Integrated Plan regarding the determination of applicable extreme external hazards, page E2, the licensee stated that seismic hazards are applicable to the Watts Bar site and that the current licensing basis safe shutdown earthquake (SSE) is 0.18g horizontal and 0.12g vertical rock accelerations as documented in the UFSAR sections 2.5.2.4 and 2.5.2.7. For an operating basis earthquake (OBE), the maximum horizontal and vertical ground accelerations are 0.09g and 0.06 g, respectively. The FLEX strategies developed for Watts Bar will include documentation ensuring that any storage locations and deployment routes meet the FLEX seismic criteria. The licensee has appropriately screened in this external hazard and identified the hazard levels for reasonable protection of the FLEX equipment.

On page E7, in the section of its Integrated Plan regarding key site assumptions (A4), the licensee stated that the seismic re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore was not assumed in their Integrated Plan. As the re-evaluations are completed, appropriate issues will be entered into the corrective action program.

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

In the section of its Integrated Plan regarding key site assumptions (A6), page E7, the licensee stated that Watts Bar will design one new storage location to protect portable FLEX equipment against all five external hazards. This location is referred to as the FLEX equipment storage building (FESB). On page 20 of its Integrated Plan, the licensee stated that the FESB will be designed for seismic loading in excess of the minimum requirements of American Society of Civil Engineers (ASCE) 7-10. The design of the FESB provides a minimum High Confidence of Low Probability Failure (HCLPF) of 2x SSE.

In addition, on page E34 and E43 of its Integrated Plan, the licensee stated that some FLEX equipment will be also be stored in the Auxiliary Building, which is seismically qualified . The 225 kVA 480 VAC DGs will be pre-staged on the roof of the Auxiliary Building. The DGs and the diverse switches will be designed and installed such that each is protected from the five external hazards described in this section. A protective structure will be built around the DGs, which will be designed to the same Seismic Category I requirements as the Auxiliary Building.

The licensee further stated that the FLEX equipment will be stored such that it does not become a target or source of a seismic interaction from other systems, structures or components.

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

3.1.1.2 Deployment of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.2 states:

> 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 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 [mitigation] strategy relies on a water source that is not seismically robust, e.g., a downstream dam, the deployment of 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 deployment.
>
> 5. A means to move the equipment should be provided that is also reasonably protected from the event.

In the section of its Integrated Plan regarding determination of applicable extreme external hazard, page E2, the licensee stated that the FLEX strategies developed for Watts Bar will include documentation ensuring that any storage locations and deployment routes meet the FLEX seismic criteria and that liquefaction potential of all FLEX deployment routes will be addressed in a future assessment. Subsequently, during the audit, the licensee stated that the worst potential liquefaction is nine inches on the FLEX building knoll “loosely” compacted fill. The licensee plans to have vehicles to deploy equipment that can drive over a nine inches of drop/rise. The licensee also stated that no additional liquefaction sampling of the off site staging areas B, C, and D transportation routes are planned. Multiple transportation paths and the ability to airlift equipment provide assurance that a means to transport equipment is always available. These off site staging areas are described in Section 3.1.1.4 below.

In the section of its Integrated Plan regarding key site assumptions (A3), page E7, the licensee stated that the design hardened connections added for the purpose of FLEX are protected against external events or are established at multiple and diverse locations. All FLEX connection points will be designed to meet or exceed Watts Bar design basis SSE protection requirements and that the primary connection points are located inside the Auxiliary Building. The Auxiliary Building is a safety-related structure and is protected from all hazards except flooding.

On page E22, in the section of its Integrated Plan regarding maintaining core cooling and heat removal, the licensee stated that the connections to the Condensate Storage Tanks (CST) and Essential Raw Cooling Water (ERCW) system will be seismically qualified and missile protected. Subsequently, in the six month update, the licensee stated that a new Auxiliary Feedwater Supply Tank (AFWST) designed for all beyond design basis external events will be built for use in the FLEX strategies instead of the CSTs.

During the audit process, the licensee stated that in the assumed event of complete failure of the downstream Chickamauga Dam and with the headwater, before failure, assumed to be at normal summer level, Elevation 682.5 ft., the water surface at the site will begin to drop 3 hours after failure of the dam and will fall at a fairly uniform rate to Elevation 666.0 ft. in approximately 27 hours from failure. This time period is more than ample for initiating the release of water from the upstream Watts Bar Dam, which is also owned and operated by TVA. The estimated minimum flow requirement for the ERCW System is 50 cfs. However, in order to guarantee both ample depth and supply of water, a minimum flow of 3,200 cfs can be released from Watts Bar Dam. This flow will give a river surface elevation of 665.9 ft., which ensures a 5.9-ft. depth of water in the intake channel and approximately 10 ft. in the river. The low pressure FLEX pump will be deployed adjacent to the intake bay of the Intake Pumping station to provide raw water to the ERCW header.

On page E63, the table for Phase 2 portable equipment lists, in addition to pumps and generators as FLEX equipment, the tow vehicle, fuel transportation equipment, crane, and debris clearing equipment. As discussed in section 3.1.1.1, the protection of associated portable equipment from seismic hazards would be provided in a new FLEX equipment storage building.

The Integrated Plan adequately addressed the deployment routes, robustness of connection points, potential failure of a downstream dam, and protection of equipment used for deployment. The specific design features of the FESB have not yet been defined, including the susceptibility to the loss of ac power. Reliance on ac power, if any, to deploy equipment is to be confirmed. This is identified as Confirmatory Item 3.1.1.2.A in section 4.2.

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

3.1.1.3 Procedural Interfaces - Seismic Hazard

NEI 12-06, Section 5.3.3 states:

> There are four procedural interface considerations should be addressed.
>
> 1. Seismic studies have shown that even seismically qualified electrical equipment can be affected by beyond-design-basis seismic events. In order to address these considerations, each plant should compile a reference source for the plant operators that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (see Section 3.2.1.10). This reference source should include control room and non-control room readouts and should also

provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance should include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power.

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

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

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

On pages E16, E30 and E42 of the Integrated Plan, the licensee listed the installed instrumentation credited for monitoring the effectiveness of the FLEX coping strategies. These instruments are discussed in more detail in Section 3.2.1.5. For all instruments credited for implementing the FLEX strategies, the normal power source and the long term power source is the 125 Vdc Vital Battery. In the Integrated Plan it is stated that WBN plans to develop procedures to read instrumentation locally, where applicable, using a portable instrument.

The issue of potential internal flooding sources was not initially addressed in the Integrated Plan. However, during the audit process the licensee stated that it has considered and evaluated the non-safety-related Condenser Circulating Water system as a potential internal flooding source and determined it is seismically robust in accordance with augmented seismic criteria.

The licensee also stated that WBN is designed as a “wet” site and buildings are allowed to flood. Thus a loss of ac power to a sump pump would not challenge the design basis.

The plan adequately addresses use of portable instrumentation, internal flooding sources, loss of ac power to sump pumps and loss of a downstream dam as discussed in section 3.1.1.2 above.

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

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

> Severe seismic events can have far-reaching effects on the infrastructure in and

around a plant. While nuclear power plants are designed for large seismic events, many parts of the Owner Controlled Area and surrounding infrastructure (e.g., roads, bridges, dams, etc.) may be designed to lesser standards. Obtaining off-site resources may require use of alternative transportation (such as air-lift capability) that can overcome or circumvent damage to the existing local infrastructure.

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

In the section of its Integrated Plan regarding offsite support for long term coping, page E13, the licensee stated that TVA will utilize the nuclear industry established Regional Response Centers (RRCs). Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area. Communications will be established between Watts Bar and the Strategic Alliance for FLEX Emergency Response (SAFER) team and required equipment moved from the local staging area to the site as needed. First arriving equipment, as established during development of Watts Bar's playbook, will be delivered to the site within 24 hours from the initial request.

During the audit process the licensee provided additional information on the three local offsite staging areas. Staging area "B" is to be located at the public overlook at the Watts Bar Dam, 1.26 miles from the nuclear plant site. Staging area "C" is currently planned for Kingston Steam Plant, 25.5 miles from the nuclear plant. Staging area "D" is planned for Melton Hill Dam public viewing area, located 33.5 miles from Watts Bar. Diverse travel paths are available from both "C" and "D" by use of interstate 40 to either state road Highway 58 or 27. Highway 58 travels east of the Tennessee River and Highway 27 travels west of the river, providing diversity. All three locations will be accessible by helicopter and large transportation equipment. Each of the three locations is being evaluated for construction of a helicopter landing area.

A TVA procedure (CECC-EPIP-18 Transportation and Staffing Under Abnormal Conditions) is in place to pre-stage people and equipment in anticipation of inclement weather/conditions (flooding, high winds, snow, and ice). Plant access for offsite resources following a seismic event may be accomplished by multiple methods. The primary method will be by road from the west since this direction contains no bridges. Access from an easterly direction may be possible provided the Watts Bar Dam survives the seismic/flooding event. Air lift capabilities from any one of the three staging areas will be the alternate method to obtain offsite resources.

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

3.1.2 Flooding

NEI 12-06, Section 6.2 states:

The evaluation of external flood-induced challenges has three parts. The first part is determining whether the site is susceptible to external flooding. The second part is the characterization of the applicable external flooding threat. The

> third part is the application of the flooding characterization to the protection and deployment of FLEX strategies.

NEI 12-06, Section 6.2.1 states:

> 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.

In the section of its Integrated Plan regarding the determination of applicable extreme external hazards, page E3, the licensee stated that the maximum plant site flood level from any cause is Elevation 739.2 ft (still reservoir). This elevation would result from the probable maximum storm. Coincident wind wave activity results in wind waves of up to 2.2 ft (crest to trough). Run up on the 4:1 slopes approaching the Diesel Generator Building reaches Elevation 741.6 ft. Wind wave run-up on the critical wall of the Intake Pumping Station reaches Elevation 741.7 ft. and wind wave run-up on the walls of the Auxiliary, Control and Shield Buildings reaches Elevation 741.0 ft. Site grade level is Elevation 728 ft.

During the audit process, the licensee stated that WBN is designed as a “wet” site and buildings are allowed to flood. All equipment required to maintain the plant safely during all flooding events including the design basis flood is either designed to operate submerged, is located above the maximum flood level, or is otherwise protected. Accordingly, FLEX strategies will be developed for consideration of external flooding hazards.

During the audit process, the licensee further described the warning times and persistence of the flood. The minimum warning time for any flood event is 27 hours for the failure of Norris and Tellico Dams in an OBE with a 1/2 PMF event. Other flood events have longer warning times ranging from 31 hours to several days for the large storm based events. TVA recognizes the difficulty that implementation of both design basis flood mode and FLEX preparations may present. TVA is evaluating changes in the notification procedures that would provide additional time between the initial notification and the Stage 1 warning to implement FLEX preparations. The flood duration time for the largest duration flood above plant grade is approximately 5 days.

In the section of its Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that the flooding re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore was not assumed in their Integrated Plan. As the re-evaluations are completed, appropriate issues will be entered into the corrective action program

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

3.1.2.1 Protection of FLEX Equipment - Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

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

On page E7, in the section of its Integrated Plan regarding key site assumptions (A6), the licensee stated that Watts Bar will design one new storage location to protect portable FLEX equipment against all five external hazards. This location is referred to as the FESB. Portable equipment required to implement the FLEX strategies will be maintained in the FESB which is sited in a suitable location that is above the PMF level and as such is not susceptible to flooding from any source.

On page E43, in the section of its Integrated Plan regarding the strategies for maintaining containment in the transition phase (Phase 2), the licensee stated that the 225 kVA 480 VAC DGs will be pre-staged on the roof of the Auxiliary Building, and would therefore be sited in a suitable location that is above the PMF and as such is not susceptible to flooding from any source.

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

3.1.2.2 Deployment of FLEX Equipment - Flooding Hazard

NEI 12-06, Section 6.2.3.2 states:

There are a number of considerations which apply to the deployment of FLEX equipment for external flood hazards:

1. For external floods with warning time, the plant may not be at power. In fact, the plant may have been shut down for a considerable time and the plant configuration could be established to optimize FLEX deployment. For example, the portable pump could be connected, tested, and readied for use prior to the arrival of the critical flood level. Further, protective actions can be taken to reduce the potential for flooding impacts, including cooldown, borating the RCS, isolating accumulators, isolating RCP seal leak off, obtaining dewatering pumps, creating temporary flood barriers, etc. These factors can be credited in considering how the baseline capability is deployed.

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

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

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

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

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

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

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

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

During the audit process, TVA stated that WBN has a minimum of 27 hours from the Stage 1 Warning from River Operations, which is procedurally controlled. The FLEX flood strategy equipment will be stored in the FESB, which is above maximum flood grade and deployment will start at or before the Stage 1 Warning. The 5,000 gpm Dominator pumps will be staged above maximum flood elevation just west of the Fifth Diesel Generator Building. As stated on page E7 of the Integrated Plan, in the event of a flood scenario, pumps will also be staged on the Auxiliary Building roof. During flood mode preps Watts Bar will be installing the electrically driven High Pressure (HP) Flex Pump and diesel driven Intermediate Pressure (IP) Flex pump on the Auxiliary Building roof using a mobile crane. This crane will also set a submersible pump into the RWST through the hatch located on top of the tank. A mobile crane operator will be on call 24/7 through a contact with TVA's heavy Equipment division ESS. All deployments potentially affected by rising flood waters will be made before the flood waters hamper mobility at the site.

During the audit process, the licensee stated that it is reevaluating the strategy of staging the electrically driven HP FLEX pump and the IP diesel driven FLEX pumps on the roof of the Auxiliary Building and instead using submersible pumps which would be motor driven and powered by the 3 MW DG. The revised strategy would also eliminate the need to install a submersible pump in the RWST. Since this new approach is still being evaluated, it is identified as Open Item 3.1.2.2.A in Section 4.1.

During the audit process, the licensee addressed the ability to restock supplies considering the flood hazard. The licensee stated that the FLEX equipment includes a sea-van with a 7 day supply of survival kits and Meals Ready to Eat (MRE). This should be adequate considering the longest expected flood persistence is 5 days as stated in section 3.1.2 above.

On page E9, in the section of its Integrated Plan regarding the sequence of events timeline, the licensee stated that an alternate fuel supply will need to be established within 11 hours. This accounts for the 8 hours in which the FLEX equipment fuel supply depletes and the deployment time. During the audit process, TVA provided additional details regarding fuel consumption rates and modes of refueling the FLEX equipment. Fuel oil will be supplied to the 3 MW diesel generators and to the 225 kVA DGs on the Aux Building roof via fuel oil transfer pumps and piping from the safety-related Emergency Diesel Generator (EDG) 7 day tanks. The EDG building floor elevation is above maximum flood grade. This fuel oil supply line will also provide an adequate supply of fuel oil for the IP FLEX pumps staged during the Stage 1 Flood Warning. It has been estimated that the total usage of fuel oil in 7 days is less than 1/2 of combined fuel volume in the four 7 day tanks. PMF will recede below plant grade within 5 days and off-site refueling can be implemented. Fuel oil consumption rates for the FLEX equipment is discussed in more detail in Section 3.2.4.9 below.

On page E7, in the section of its Integrated Plan regarding key site assumptions (A3), the licensee stated that the design hardened connections added for the purpose of FLEX are protected against external events or are established at multiple and diverse locations. On page E22, in the section of its Integrated Plan regarding maintaining core cooling and heat removal, the licensee stated that the primary connection is located inside the Auxiliary Building. The Auxiliary Building is a safety related structure and is protected from all hazards except flooding. For flood conditions, procedures will ensure that hoses are connected before flood levels reach the connection. On page E23, in the section of its Integrated Plan regarding maintaining core cooling and heat removal, the licensee stated that the secondary connection is also located inside the Auxiliary Building. Similar statement are provided on pages E35 and E51 for RCS inventory control and spent fuel pool cooling strategies respectively.

Initially, the Integrated Plan described hose connections to the existing CSTs which are not seismically designed nor protected from tornado borne missiles. In the six month update TVA stated that a new tank, the Auxiliary Feedwater Supply Tank (AFWST), will be constructed that is designed for seismic loads and resistant to tornado borne missiles. Hoses will be deployed and connected to the new AFWST and other potentially vulnerable connection points, before the flood waters submerge those connection points.

The licensee also stated that WBN is designed as a “wet” site and buildings are allowed to flood. Thus a loss of ac power to a sump pump would not challenge WBN’s design basis. No temporary flood barriers are employed.

On page E44, in the section of its Integrated Plan regarding containment, the licensee stated that the protective structure for the 225 kVA 480 VAC DGs pre-staged on the Auxiliary Building roof and the diverse switches will be designed and installed such that each is protected from the five external hazards described in the Integrated Plan.

As stated in section 3.1.1.2 above, the means for deploying the FLEX equipment is stored in the FESB and is thus protected from the flood hazard.

The plan, as clarified through the audit process, provides for the deployment of FLEX equipment utilizing the warning time available for rising flood waters, describes the supplies available on site for the duration of the flood, describes the means for refueling the FLEX equipment considering the flood hazard and, describes the primary and secondary connection points that are protected from the flood 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 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 protection of FLEX equipment considering the snow, ice and extreme cold hazard, if these requirements are implemented as described.

3.1.2.3 Procedural Interfaces - Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

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

On page E7, under key assumptions (A10), the licensee stated that the preplanned strategies developed to protect the public health and safety will be incorporated into the unit emergency operating procedures (EOP) in accordance with established EOP change process, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

On page E12, in the section of its Integrated Plan regarding procedure guidance, the licensee stated that Watts Bar is a participant in the Pressurized Water Reactor Owners Group (PWROG) project PA-PSC-0965 and will implement the FLEX Support Guidelines (FSGs) in a timeline to support the implementation of FLEX by the time of Unit 2 startup. The PWROG has generated these guidelines to assist utilities with the development of site-specific procedures to cope with an ELAP in a manner compliant with the requirements of Reference NEI 12-06.

It is anticipated that the following FSGs will be incorporated into existing plant procedures in order to develop the FSG interface:

- Alternate auxiliary feedwater (AFW) Suction Source
- Alternate Low Pressure Feedwater
- ELAP direct current (dc) Load Shed/Management
- Initial Assessment and FLEX Equipment Staging
- Alternate CST Makeup
- Loss of dc Power
- Alternate RCS Boration
- Long Term RCS Inventory and Temperature Control
- Passive RCS Injection Isolation
- Alternate SFP Makeup and Cooling
- Alternate Containment Cooling
- Transition from FLEX Equipment

During the audit process, the licensee stated that procedure AOI-7.01 directs that the units be shutdown per AOI-39, Rapid Load Reduction during the initial Flood Mode Stage I flood mode preparation. WBN is evaluating changes in the notification process that would provide additional time between the initial notification and the Stage 1 Warning. The River Operations Notification Directory and WBN AOI 7.1 will be revised once these plans have been finalized.

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

3.1.2.4 Considerations in Using Offsite Resources - Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

> Extreme external floods can have regional impacts that could have a significant impact on the transportation of offsite resources.
>
> 1. Sites should review site access routes to determine the best means to obtain resources from off-site following a flood.

2. Sites impacted by persistent floods should consider where equipment delivered from offsite could be staged for use on-site.

On page E3, in the section of its Integrated Plan regarding determination of applicable extreme external event, the licensee stated that Watts Bar is developing procedures and strategies for delivery of offsite FLEX equipment during Phase 3. During the audit process three local staging areas were described as well as diverse access routes. Provision for delivery of equipment by helicopter was also noted.

The interface with the RRC and the offsite local staging areas are described in more detail in section 3.1.1.4 above. Several local offsite staging areas have been identified and a description of the methods to be used to deliver the equipment to the site has been provided

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

3.1.3 High Winds

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

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 E3, in the section of its Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that Watts Bar is susceptible to hurricanes as the plant site is within the contour lines shown in Figure 7-1 of NEI 12-06. It was determined the Watts Bar 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 mph for Region 1 plants, including Watts Bar. Therefore, high-wind hazards are applicable to the Watts Bar site. The licensee has appropriately screened in the high wind hazard and characterized the hazard in terms of wind velocities

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 Wind Hazard

NEI 12-06, Section 7.3.1 states:

> These considerations apply to the protection of FLEX equipment from high wind hazards:
>
> 1. For plants exposed to high wind hazards, FLEX equipment should be stored in one of the following configurations:
>
>    a. In a structure that meets the plant's design basis for high wind hazards (e.g., existing safety-related structure).
>
>    b. In storage locations designed to or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* given the limiting tornado wind speeds from Regulatory Guide 1.76 or design basis hurricane wind speeds for the site.
>
>       - Given the FLEX basis limiting tornado or hurricane wind speeds, building loads would be computed in accordance with requirements of ASCE 7-10. Acceptance criteria would be based on building serviceability requirements not strict compliance with stress or capacity limits. This would allow for some minor plastic deformation, yet assure that the building would remain functional.
>
>       - Tornado missiles and hurricane missiles will be accounted for in that the FLEX equipment will be stored in diverse locations to provide reasonable assurance that N sets of FLEX equipment will remain deployable following the high wind event. This will consider locations adjacent to existing robust structures or in lower sections of buildings that minimizes the probability that missiles will damage all mitigation equipment required from a single event by protection from adjacent buildings and limiting pathways for missiles to damage equipment.
>
>       - The axis of separation should consider the predominant path of tornados in the geographical location. In general, tornadoes travel from the West or West Southwesterly direction, diverse locations should be aligned in the North-South arrangement, where possible. Additionally, in selecting diverse FLEX storage locations, consideration should be given to the location of the diesel generators and switchyard such that the path of a single tornado would not impact all locations.
>
>       - Stored mitigation equipment exposed to the wind should be adequately tied down. Loose equipment should be in protective boxes that are adequately tied down to foundations or slabs to prevent protected equipment from being damaged or becoming airborne.

(During a tornado, high winds may blow away metal siding and metal deck roof, subjecting the equipment to high wind forces.)

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

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

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

On page E7, in the section of its Integrated Plan regarding key site assumptions (A6), the licensee stated that protection of associated portable equipment from high wind hazard hazards would be provided by a new FESB. The building will be designed against all five external hazards. The FESB is sited in a suitable location that is protected from NRC region 1 tornado, missiles, and velocities as defined in NRC Regulatory Guide 1.76 coupled with 360 mph wind speeds.

In addition to equipment being stored in the FESB, equipment will be stored in the Auxiliary Building, which is protected from high winds. On page E43 the licensee stated that the 225 kVA 480 VAC DGs will be pre-staged on the roof of the Auxiliary Building. A protective structure will be built around the DGs, which is sited in a suitable location that is protected from NRC region 1 tornado, missiles, and velocities as defined in Nuclear Regulatory Commission (NRC) Regulatory Guide 1.76 Revision 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 provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protection of FLEX equipment considering the high wind hazard, if these requirements are implemented as described.

3.1.3.2 Deployment of FLEX Equipment - High Wind Hazard

NEI 12-06, Section 7.3.2 states:

There are a number of considerations which apply to the deployment of FLEX equipment for high wind hazards:

1. For hurricane plants, the plant may not be at power prior to the simultaneous ELAP and LUHS condition. In fact, the plant may have been shut down and the plant configuration could be established to optimize FLEX deployment. For example, the portable pumps could be connected, tested, and readied for use prior to the arrival of the hurricane. Further, protective actions can be taken to reduce the potential for wind impacts. These factors can be credited in considering how the baseline capability is deployed.

2. The ultimate heat sink may be one of the first functions affected by a

hurricane due to debris and storm surge considerations. Consequently, the evaluation should address the effects of ELAP/LUHS, along with any other equipment that would be damaged by the postulated storm.

3. Deployment of FLEX following a hurricane or tornado may involve the need to remove debris. Consequently, the capability to remove debris caused by these extreme wind storms should be included.

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

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

The deployment strategies for an event with warning such as a hurricane with high winds are similar to that of the flood hazard. TVA procedure (CECC-EPIP-18 Transportation and Staffing Under Abnormal Conditions) is in place to pre-stage people and equipment in anticipation of inclement weather/conditions (flooding, high winds, snow, and ice). The deployment of FLEX equipment considering the storm warning time, protection of the means to move FLEX equipment and restock supplies is discussed in section 3.1.2.2.

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 provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of FLEX equipment considering the high wind hazard, if these requirements are implemented as described.

3.1.3.3 Procedural Interfaces - High Wind Hazard

NEI 12-06, Section 7.3.3, states:

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

On page E7, under key assumptions (A10), the licensee stated that the preplanned strategies developed to protect the public health and safety will be incorporated into the unit emergency operating procedures (EOP) in accordance with established EOP change process and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

On page E12, in the section of its Integrated Plan regarding procedure guidance, the licensee stated that Watts Bar is a participant in the PWROG project PA-PSC-0965 and will implement the FLEX Support Guidelines (FSGs) in a timeline to support the implementation of FLEX by the time of Unit 2 startup. The PWROG has generated these guidelines to assist utilities with the development of site-specific procedures to cope with an ELAP in a manner compliant with the requirements of Reference 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 procedural interfaces considering the high wind hazard if these requirements are implemented as described.

3.1.3.4 Considerations in Using Offsite Resources - High Wind Hazard

NEI 12-06, Section 7.3.4 states:

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

On page E3, in the section of its Integrated Plan regarding determination of applicable extreme external event, the licensee stated that Watts Bar is developing procedures and strategies for delivery of offsite FLEX equipment during Phase 3. During the audit process three local staging areas were described as well as diverse access routes. Provision for delivery of equipment by helicopter was also noted.

The interface with the RRC and the offsite local staging areas are described in more detail in section 3.1.1.4 above. Several local offsite staging areas have been identified and a description of the methods to be used to deliver the equipment to the site has been provided

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 use of off-site resources considering the high wind hazard if these requirements are implemented as described.
.
3.1.4 Snow, Ice and Extreme Cold

As discussed in NEI 12-06, Section 8.2.1:

> All sites should consider the temperature ranges and weather conditions for their site in storing and deploying their 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 35$^{th}$ Parallel should provide the capability to address extreme snowfall with snow removal equipment. Finally, all sites except for those within Level 1 and 2 of the maximum ice storm severity map contained in Figure 8-2 should address the impact of ice storms.

On page E4, in the section of its Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that from the UFSAR Section 2.3.2.2, the mean temperatures at the Watts bar site, have been in the low 40s degrees F in the winter. Extreme

minima temperatures recorded were -20 degrees F at Decatur and -10 degrees F at Chattanooga in the winter.

The licensee stated that Watts Bar site is above the 35th parallel; therefore, the FLEX strategies must consider the hindrances caused by extreme snowfall with snow removal equipment, as well as the challenges that extreme cold temperature may present.

Regarding applicability of ice storms, the licensee stated that Watts Bar site 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 Watts Bar site does experience significant amounts of snow, ice, and extreme cold temperatures; therefore, the hazard is screened in. The licensee has appropriately screened in the hazard and characterized the hazard in terms of expected temperatures.

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

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

NEI 12-06, Section 8.3.1 states:

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

On pages E7, E21 and E34 of its Integrated Plan, the licensee stated that protection of associated portable equipment from extreme cold hazards would be provided. Watts Bar will

design one new storage location to protect portable FLEX equipment against all five external hazards. This location is referred to in this document as the FESB. The FESB will be evaluated for snow, ice and extreme cold temperature effects and heating will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will have a standalone HVAC system. In addition to equipment being stored in the FESB, equipment will be stored in the Auxiliary Building, which is an environmentally controlled building and provides protection from snow, ice and extreme cold effects.

On page E43 the licensee stated that the 225 kVA 480 VAC DGs will be pre-staged on the roof of the Auxiliary Building. A protection structure will be built around the DGs, and will be evaluated for snow, ice and extreme cold temperature effects and heating will be provided as required to assure no adverse effects on the FLEX. However, the evaluation on the need for providing heat to the protective structure housing the 225 kVA 480 VAC DG is yet to be performed. This is identified as Confirmatory Item 3.1.4.1.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 considering the snow, ice and extreme cold hazard, if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.2 states:

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

In response to an audit question related to the equipment design specification for cold weather operation, the licensee stated that the Outside Normal Condition are Max 95 degrees F and Min 13 degrees F (Abnormal Max 102 degrees F and Min 6 degrees F). The design specifications for the 3 MW and 225 kVA DGs exceed these temperature limitations. FLEX equipment will be stored in the FESB which has HVAC to control the building temperature between 50 - 100 degrees F. All FLEX DGs are air cooled and designed to meet the Normal Design Safety

Limits.

With respect to equipment to be used for snow removal, the licensee stated during the audit process that 1) their current plan is to utilize compact track loaders capable of equipment deployment, debris removal, and snow and ice removal and, 2) this equipment will be maintained in a hardened structure (FESB) to meet NEI 12-06 guidance and temperature controlled between 50 and 100 degrees F.

With respect to ice formation on the ultimate heat sink, the licensee stated during the audit process that since closure of Watts Bar Dam in January 1942 ice formed only at shoreline or in protected inlets. Main channel ice has not been a problem. The lowest water temperature measured at Watts Bar Dam is 39 degrees F. Flooding of the site is the only ice event that could impact safety related structures. An ice jam sufficient to cause plant flooding is inconceivable since no valley restriction exists in the 1.9 mile reach below Watts Bar Dam to initiate a jam. The ice dam would need to reach at least 68 ft above the streambed to endanger the plant.

The licensee adequately addressed the temperature design criteria for the FLEX equipment, the means for snow removal and protection of those means and whether the UHS flow path could be affected ice blockage or formation of frazil ice which would require an evaluation on the effects on deployment of equipment.

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

3.1.4.3 Procedural Interfaces - Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.3 states:

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

On page E7, under key assumptions (A10), the licensee stated that the preplanned strategies developed to protect the public health and safety will be incorporated into the unit emergency operating procedures (EOP) in accordance with established EOP change process and their impact to the design basis capabilities of the unit evaluated under 10CFR50.59.

On page E12, in the section of its Integrated Plan regarding procedure guidance, the licensee stated that Watts Bar is a participant in the PWROG project PA-PSC-0965 and will implement the FLEX Support Guidelines (FSGs) in a timeline to support the implementation of FLEX by the time of Unit 2 startup. The PWROG has generated these guidelines to assist utilities with the development of site-specific procedures to cope with an ELAP in a manner compliant with the requirements of Reference 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 procedural interfaces considering the snow, ice, and extreme cold hazard if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.4, states:

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

On page E3, in the section of its Integrated Plan regarding determination of applicable extreme external event, the licensee stated that Watts Bar is developing procedures and strategies for delivery of offsite FLEX equipment during Phase 3. During the audit process three local staging areas were described as well as diverse access routes. Provision for delivery of equipment by helicopter was also noted.

The interface with the RRC and the offsite local staging areas are described in more detail in section 3.1.1.4 above. Several local offsite staging areas have been identified and a description of the methods to be used to deliver the equipment to the site has been provided.

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 use of off-site resources considering the snow, ice and extreme cold hazard if these requirements are implemented as described.

3.1.5 High Temperatures

NEI 12-06, Section 9 states:

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

On page E4, in the section of its Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that the mean temperatures at the Watts bar site can reach the upper 70s degrees F in the summer. Extreme maxima temperature recorded was 108 degrees F at Decatur, Tennessee and 106 degrees F at Chattanooga, Tennessee in the summer. Therefore, for selection of FLEX equipment the Watts Bar site will consider the site maximum expected temperatures in their specification, storage, and deployment requirements, including ensuring adequate ventilation or supplementary cooling, if required.

The licensee has appropriately screened in the high temperature hazard and characterized the hazard in terms of expected temperatures.

The licensee's approach described above, as currently understood, is consistent with the

guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to screening in the high temperature hazard if these requirements are implemented as described.

3.1.5.1 Protection of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

On pages E7, E21 and E34 the licensee stated that protection of associated portable equipment from high temperature hazards would be provided. Watts Bar will design one new storage location to protect portable FLEX equipment against all five external hazards. This location is referred to in this document as the FESB. The FESB will be evaluated for high temperature effects and ventilation will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will have a standalone HVAC system. In addition to equipment being stored in the FESB, equipment will be stored in the Auxiliary Building, which is an environmentally controlled building and provides protection against high temperature effects.

On page E43, in the Integrated Plan, the licensee stated that the 225 kVA 480 VAC DGs will be pre-staged on the roof of the Auxiliary Building. A protection structure will be built around the DGs, and will be evaluated for high temperature effects and ventilation will be provided as required to assure no adverse effects on the FLEX. The evaluation on the need for providing ventilation to the protective structure housing the 225 kVA 480 VAC DG is yet to be performed. This issue is identified as Confirmatory Item 3.1.5.1.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 considering the high temperature hazard, if these requirements are implemented as described.

3.1.5.2 Deployment of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

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

In response to an audit concern regarding the ability of the FLEX equipment to operate in a high temperature environment, the licensee stated that the Outside Normal Conditions are Max 95 degrees F and Min 13 degrees F (Abnormal Max 102 degrees F and Min 6 degrees F). The design specifications for the 3 MW and 225 kVA DGs exceed these temperature limitations. FLEX equipment will be stored in the FESB which has HVAC to control the building temperature between 50 - 100 degrees F. All FLEX DGs are air cooled and designed to meet the Normal

Design Safety Limits.

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

3.1.5.3 Procedural Interfaces - High Temperature Hazard

NEI 12-06, Section 9.3.3 states:

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

On page E7, under key assumptions (A10), the licensee stated that the preplanned strategies developed to protect the public health and safety will be incorporated into the unit emergency operating procedures (EOP) in accordance with established EOP change process and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

On page E12, in the section of its Integrated Plan regarding procedure guidance, the licensee stated that Watts Bar is a participant in the PWROG project PA-PSC-0965 and will implement the FLEX Support Guidelines (FSGs) in a timeline to support the implementation of FLEX by the time of Unit 2 startup. The PWROG has generated these guidelines to assist utilities with the development of site-specific procedures to cope with an ELAP in a manner compliant with the requirements of NEI 12-06.

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

## 3.2 PHASED APPROACH

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

To meet these EA-12-049 requirements, Licensees will establish a baseline coping capability to prevent fuel damage in the reactor core or spent fuel pool and to maintain containment capabilities in the context of a beyond-design-basis external event that results in the loss of all ac power, with the exception of buses supplied by safety-related batteries through inverters, and loss of normal access to the UHS.

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

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

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

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

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

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.

In the section of the Integrated Plan regarding maintaining RCS inventory control, page E29, the licensee stated that Watts Bar utilized the WCAP-17601-P methodology as the basis for the limiting plant-specific scenarios for RCS inventory control, shutdown margin, and Mode 5/Mode 6 boric acid precipitation control with respect to the guidelines set forth in NEI 12-06. On page EA1-9 Attachment 1B," NSSS Significant Reference Analysis Deviation Table," the licensee stated that "there are no deviations" to the values provided in WCAP-17601-P January 2013 Revision 1.

No detailed comparison of the Watts Bar plant specific parameters with the generic parameters used in WCAP-17601-P has been provided in the Integrated Plan to demonstrate the

applicability of those analyses to the plant specific conditions at Watts Bar. Subsequently, during the audit process the licensee stated that conservative assessments of the results of the generic analysis using Watts Bar specific input has been performed and response times have been developed based on these assessments which bound the values from WCAP-17601-P with respect to core cooling. This is combined with Confirmatory Item 3.2.1.A above.

It is to be noted that additional analyses are being performed to address RCS inventory control and boration requirements as a result of a change in strategy of not using the low leakage RCP seals. This change in strategy will result in a new timeline from that presented in the Integrated Plan regarding reactor cooldown, inventory makeup flow, and boration. This is discussed in Section 3.2.1.6 "Sequence of Events."

The licensee's plan does not address how and to what extent Watts Bar implemented the recommendations specifically applicable to Westinghouse designed plants listed in WCAP-17601-P Section 3.1. During the audit process the licensee stated that the additional analyses will address these issues. This is identified as Confirmatory Item 3.2.1.1.A in Section 4.2.

The licensee's plan did not provide descriptions and justifications for the computer codes and analysis techniques used to analyze the ELAP event to ensure adequate RCS cooling, RCS makeup, and shutdown margin. The description of and justification for the evaluation models (e.g., key code models such as those affecting natural circulation, primary-to-secondary heat transfer, critical flow, and boric acid transport, significant assumptions, boundary and initial conditions) used to ensure adequate core cooling, RCS inventory, and shutdown margin was not provided in the Integrated Plan. During the audit process the licensee stated that Watts Bar utilized the generic results from WCAP-17601-P. WCAP-17601-P analyses have been performed using NOTRUMP. Conservative assessment of these results using Watts Bar specific input has been performed and response times have been developed based on these assessments which bound the values from WCAP-17601-P with respect to core cooling.

The licensee has provided a Sequence of Events (SOE) in their Integrated Plan, which included the time constraints and the technical basis for the site. That SOE is based on an analysis using the industry-developed NOTRUMP computer code. NOTRUMP was written to simulate the response of pressurized water reactors (PWRs) to small break LOCA transients for licensing basis safety analysis.

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

> Reliance on the NOTRUMP code for the ELAP analysis of Westinghouse plants is limited to the flow conditions prior to reflux condensation initiation. This includes specifying an acceptable definition for reflux condensation cooling. This

is identified as Confirmatory Item 3.2.1.1.B in Section 4.2 below.

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

3.2.1.2 RCP Seal Leakage Rates

NEI 12-06, Section 1.3 states:

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

During an Extended Loss of ac Power (ELAP) event, cooling to the RCPs seal packages will be lost and water at high temperatures may degrade seal materials leading to excess seal leakage from the RCS. Without ac power available to the 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 Generic Concern and addressed by the Nuclear Energy Institute (NEI) in the following submittals:

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

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

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

(1) For the plants using Westinghouse RCPs and seals that are not the SHIELD shutdown seals, the RCP seal initial maximum leakage rate should be greater than or equal to the upper bound expectation for the seal leakage rate for the ELAP event (21 gpm/seal) discussed in the PWROG position paper addressing the RCP seal leakage for Westinghouse plants (Reference 2). If the RCP seal leakage rates used in the plant-specific ELAP analyses are less than the upper bound expectation for the seal leakage rate discussed in the position paper, justification should be provided. If the seals are changed to non-Westinghouse seals, the acceptability of the use of non-Westinghouse seals should be addressed, and the RCP seal leakage rates for use in the ELAP analysis should be provided with acceptable justification. This is identified as Confirmatory Item 3.2.1.2.A. in Section 4.2.

(2) In some plant designs, such as those with 1200 to 1300 psia SG design pressures and no accumulator backing of the main steam system power-operated relief valve (PORV) actuators, the cold legs could experience temperatures as high as 580 degrees F before cooldown commences. This is beyond the qualification temperature (550 degrees F) of the O-rings used in the RCP seals. For those Westinghouse designs, a discussion of the information (including the applicable analysis and relevant seal leakage testing data) should be provided to justify that (1) the integrity of the associated O-rings will be maintained at the temperature conditions experienced during the ELAP event, and (2) the seal leakage rate of 21 gpm/seal used in the ELAP is adequate and acceptable. This is identified as Confirmatory Item 3.2.1.2.B in Section 4.2.

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

On page E15, of the Integrated Plan regarding core cooling in Phase 1, the licensee stated that the plant is assumed to be operating at full power at the start of the event. However, no additional information regarding decay heat modeling was provided.

During the audit process TVA stated that the following decay heat models used were:

WBN Unit 1: Westinghouse calculations were performed using the ANS 5.1 1979 + 2 sigma decay heat model. Implementation of this model included fission product decay heat resulting from the fission of U-235, U-238, and Pu-239, actinide decay heat from U-239 and Np-239, and a power history that bounds initial condition 3.2.1.2 (1) of NEI 12-06.

WBN Unit 2 - Use of the decay heat model is yet to be confirmed.

Additional information is required is to address the applicability of assumption 4 on page 4-13 of WCAP-17601-P, which states that "Decay heat is per ANS 5.1-1979 + 2 sigma, or equivalent." If the ANS 5.1-1979 + 2 sigma model is used in the ELAP analysis, values of the following key parameters used to determine the decay heat should be specified and the adequacy of the values used: (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. This issue is identified as Confirmatory Item 3.2.1.3 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 decay heat modeling, 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 E5 the licensee stated that assumptions associated with implementation of FLEX strategies are consistent with those detailed in section 3.2.1 of NEI 12-06. The following discussion expands on and clarifies how Watts Bar addresses some of the site specific considerations.

On page E6 and E7, in the section of the Integrated Plan related to assumptions specific to the Watts Bar site, the licensee stated that the condensate storage tanks (CSTs) and associated piping are not seismically qualified or hardened against missiles and tornados. Watts Bar will either modify the CSTs such that it will be qualified to be robust with respect to high winds and seismic events or construct an alternate seismic and missile protected CST. Throughout the Integrated Plan, several strategies refer to the use of the CSTs as a suction source. However, these strategies will also apply to the use of a new alternate seismic and missile protected CST, as it is intended for this tank to be constructed within close proximity of the current CSTs. Therefore, the Integrated Plan only refers to the current CSTs in the strategy descriptions. In addition, it is assumed that piping analysis will be performed to ensure that either of these tanks will not leak out through the piping and can be credited.

Subsequently in the 6 month update the licensee stated that a new Auxiliary Feedwater Supply Tank (AFWST) will be constructed that is seismically designed and protected against tornado borne missiles. The AFWST will replace the use of the CSTs described in the Integrated Plan. The AFWST will be sized to supply water to both units.

Water from the ultimate heat sink is available in the ERCW header and then from the Tennessee River. Impact of failure of a downstream dam is discussed in section 3.1.1.2.

The water in the ultimate heat sink is accessed using portable diesel driven low pressure high capacity pumps.

During the audit process, the licensee stated that fuel for the FLEX equipment will be drawn from the safety related 7 day tanks. These are underground tanks and are seismically designed and resistant to the flood hazard. The fuel supply is discussed in more detail in section 3.2.4.9.

Permanent plant equipment used for coping is housed in the Auxiliary Building which is seismically designed. The TDAFW pumps are used to supply water to the steam generators during the initial coping phase. Due to the long warning time associated with the flood hazard, existing plant equipment, such as the BAT tanks, are used for boration during the initial coping phase.

The licensee stated, in summary, that the plan defines strategies capable of mitigating a simultaneous loss of all alternating current (ac) power and loss of normal access to the ultimate heat sink resulting from a beyond-design-basis event by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at all units on a 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 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 Considerations or within the SAMGs. Typically, these parameters would include the following:
>
> - [SG Level
> - SG Pressure
> - RCS Pressure
> - RCS Temperature
> - Containment Pressure
> - SFP Level
>
> The plant-specific evaluation may identify additional parameters that are needed in order to support key actions identified in the plant procedures/guidance or to indicate imminent or actual core damage.

On pages E16 and E30 of the Integrated Plan regarding maintaining RCS core cooling, heat removal and inventory control, the licensee listed the installed instrumentation credited for use in coping strategies. They include the following parameters:

1. SG Wide Range Level or Narrow Range Level with AFW Flow indication

2. SG Pressure
3. CST Level.

RCS instrumentation that is assumed to also be available is:

1. Core Exit Thermocouple (CET) Temperature (deleted in the 6 month update)
2. RCS Hot Leg (HL) Temperature ($T_{hot}$) if CETs not available
3. RCS Cold Leg (CL) Temperature ($T_{cold}$)
4. RCS Wide Range Pressure
5. Pressurizer Level
6. Reactor Vessel Level Indicating System (RVLIS) (backup to Pressurizer level) - available for up to 27 hours for limiting flood scenario, at which point pressurizer level is available again.
7. Neutron Flux.

For all instruments listed above, the normal power source and the long term power source is the 125 VDC Vital Battery. Watts Bar also plans to develop procedures to read instrumentation locally, where applicable, using a portable instrument.

Similarly, the plan addressed the necessary instrumentation required for maintaining containment and assuring spent fuel pool cooling. On page E40 of the Integrated Plan regarding maintaining containment, the licensee listed as essential instrumentation the following:

1. Containment Pressure
2. Containment Temperature

On page E48, in the section of its Integrated Plan regarding spent fuel pool cooling, the licensee stated that the implementation of this parameter will align with the requirements of by NRC Order EA 12-051. This instrument will have initial local battery power, with the capability to be powered from the FLEX 480 VAC generators. Watts Bar will develop procedures to read this instrumentation locally, where applicable, using a portable instrument as required by Section 5.3.3 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 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 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.

The sequence of events (SOE) timeline, presented in Attachment 1A in the Integrated Plan, is based on using low leakage rate seals which reduce the potential seal leakage to approximately 1 gpm per RCP. Use of the low leakage seals significantly extends the time when RCS makeup would be required. The sequence of events timeline is strongly influenced by the assumed leakage rate from the RCS. Both Unit 1 and Unit 2 were to have 4 SHIELD®3 seals installed prior to the full implementation of FLEX.

Subsequently, during the audit process, the licensee stated that the use of low leakage seals will not be implemented due to the failure of the low leakage seals to perform during testing. Therefore, Watts Bar will continue to use the existing conventional seals. As a result of this change, the analysis of RCS response to an ELAP will be affected as will portions of the timeline presented in the Integrated Plan.

During the audit process, the licensee stated that two new timelines will be developed-one for the flood mode and the other for the non-flood ELAP event. These timelines are expected to differ from the one presented in the Integrated Plan because of the change in strategy in using the 3 MW diesels for coping in the earlier phases of the ELAP. Previously, these diesels were used to support containment cooling coping strategy whereas in the revised approach they will, in addition, be used to power the safety injection pumps early in the ELAP to restore RCS inventory. They will also be used for repowering the spent fuel pool cooling pumps to remove heat from the pool. Due to the higher RCP seal leakage rates, the reactor will need to be cooled and depressurized earlier than previously planned which may require boration, to preclude recriticality, to be initiated earlier than the eight hours previously envisioned. The licensee indicated during the audit process that the reanalysis in support of developing new SOE timelines will be completed in November 2013 and the revised SOEs will be provided in the next six month update. This is identified as Open Item 3.2.1.6.A in Section 4.1.

Preliminary summary of the results of the reanalysis indicated that based on the RCP seal leakage rate of 21 gpm, RCS inventory will be restored using the Cold Leg Accumulators (CLA)s at 4 hours, the repowered safety injection pump at 5 hours and the HP FLEX pump 8.5 hours after the ELAP.

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

3.2.1.7 Cold Shutdown and Refueling

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

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

The NRC staff reviewed the licensee's Integrated Plan and determined that the Generic Concern related to shutdown and refueling requirements is applicable to the plant. This Generic Concern has been resolved generically through the NRC endorsement of Nuclear Energy Institute (NEI) position paper entitled "Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514); and has been endorsed by the NRC in a letter dated September 30, 2013 (ADAMS Accession No. ML13267A382).

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

Pending the licensee informing the NRC staff of their decision whether to follow the white paper, the licensee's plan for cold shutdown and refueling is identified as Open Item 3.2.1.7.A in Section 4.1.

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.

Section 4.3.2 of WCAP-17601-P indicates that one of the acceptance criteria for the ELAP analysis is to show the core remains subcritical. The control rod shutdown margin, borated water inventory in the RCS and SITs, and borated water injection from the RWST through BDB portable RCS injection pump are used in the re-criticality analysis to show that total reactivity remains negative, assuring the core sub-criticality.

The Integrated Plan presented an approach to RCS boration based on a timeline that was established assuming the installation of low leakage rate seals. Following the declaration of an ELAP, a plant cooldown would be performed at 8 hours after the ELAP. Boration would be achieved using the high pressure FLEX pumps. The BAT tanks are the initial source of boric acid used for assuring core sub criticality. Due to the characteristics of low leakage seals, makeup to maintain RCS inventory is not a concern during the initial phase of the ELAP.

During the audit process, the licensee stated that it will not install the low leakage seals and that it intends to modify the RCS inventory and core boration strategy that is described in the Integrated Plan. The licensee now plans to use the installed safety injection pumps to maintain RCS inventory. The safety injection pump will compensate for leakage from the RCS pump seals and shrinkage due to cooldown. The safety injection pumps will be powered by the 3 MW pre-staged diesel generators located in the new FESB. The safety injection pumps will be turned off once the RCS water inventory is restored. Core cooling by natural circulation is maintained by ensuring adequate RCS inventory.

The strategy for boration of the core will be achieved using a high pressure FLEX pump as originally described in the Integrated Plan. The pumps will be staged near the BATs inside the

Auxiliary Building. The FLEX pump will supply coolant from the BATs or RWST into existing SIP discharge piping. However, the size of the high pressure FLEX pump and timeline for initiating the boration and the duration of such boration, based on using the original conventional seals, has not yet been finalized.

For the flood mode, after the flood waters reach the Auxiliary Building grade level, the high pressure FLEX pumps will be staged on the roof of the Auxiliary Building and will use borated water from the RWST for injecting into the RCS. Submersible pumps will be placed in the RWST to feed the high pressure pumps on the roof.

During the audit process, the licensee stated that the analytical work to support the revised strategy for RCS inventory control and boration to maintain sub criticality during cooldown has not yet been completed. Such analyses are scheduled for completion November 2013. The licensee provided a preliminary summary of results of the reanalysis for RCS inventory control and boration based on using conventional RCP seals. The revised strategy for RCS inventory control will now rely on the water volume in the CLAs and repowering the safety injection (SI) pump. For boration the HP FLEX pump has been resized to 20 gpm from the originally planned 10 gpm capacity. The analysis supporting the revised strategy from that presented in the IP needs to be finalized. This has been identified as Open Item 3.2.1.8.A in Section 4.1.

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

The Pressurized Water Reactor Owners Group submitted a position paper, dated August 15, 2013 (withheld from public disclosure due to proprietary content), which provides test data regarding boric acid mixing under single-phase natural circulation conditions and outlined applicability conditions intended to ensure that boric acid addition and mixing would occur under conditions similar to those for which boric acid mixing data is available. During the audit process, the licensee informed the NRC staff of its intent to abide by the generic approach discussed above. The NRC staff concluded that the August 15, 2013, position paper was not adequately justified and has not endorsed this position paper. As such, resolution of this concern for Watts Bar 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 Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to maintaining 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.

In the section of its Integrated Plan discussing the strategy for maintaining core cooling and heat removal in the transition phase, page E18, the licensee describes the use of portable pumps during the transition phase (Phase 2). For core cooling after the water in the AFWST is depleted, a low pressure FLEX pump will be used to pressurize the ERCW headers which can then be connected to the TDAFWP suction. An intermediate pressure FLEX pump will be provided for supplying water directly to the SGs for core cooling after operating conditions of the TDAFWP cannot be maintained. The intermediate pressure FLEX pump will supply water to the auxiliary feedwater piping downstream of the TDAFWP or motor driven auxiliary feedwater pumps (MDAFWP). The source of water for the intermediate pressure FLEX pump can be either from a refilled AFWST, the pressurized ERCW header or flood waters.

During the audit process, the licensee indicated that a new strategy of using the 3 MW pre-staged diesel generators will be implemented to power the Motor Driven AFW pumps as the preferred backup means for supplying water to the SG's after the TDAFW pumps are secured. The low pressure FLEX pumps will provide for long term core cooling by feeding the ERCW header from the Tennessee River.

In the section of its Integrated Plan discussing the strategy for maintaining RCS inventory control in Phase 2, page E32, the licensee describes the use of portable pumps during the transition phase. If the external event occurs when SGs are available, the RCS will require makeup beginning at 8 hours (based on the original intent of using low leakage seals) to maintain adequate boration and makeup for any minor leakage in the system. This function is provided by using a high pressure FLEX pump to supply coolant from the BATs or RWST into existing Safety Injection Pump (SIP) discharge piping. SIP piping is utilized to supply coolant to the RCS because the system remains at high pressure throughout Phase 2. The electric pump is powered by the 225 kVA 480 VAC DG, which will be aligned prior to when RCS makeup will begin.

During the audit process, the licensee stated that a revised strategy will be to utilize the 3 MW

pre-staged diesels to repower the safety injection pumps for the initial RCS inventory control. RCS inventory makeup will be required earlier after the ELAP due to the higher leakage rate of the conventional RCP seals. High pressure FLEX pumps will be used for boration. As discussed in section 3.2.1.8 above, analyses for defining the timeline for deployment and size of the high pressure pumps have not been finalized. This has been previously identified as an Open Items 3.2.1.6.A and 3.2.1.8.A.

During the audit process the licensee presented additional details on fuel oil consumption and refueling methods for the FLEX equipment. This issue is addressed in sections 3.1.2.2 and 3.2.4.9.

On page E63, in the table listing Phase 2 equipment, the licensee lists the quantities of the various FLEX pumps used in the coping strategies. The table also lists the size of the pumps in terms of flow rates and the total developed head. The number of portable FLEX pumps provided for each service meets the N+1 criterion. There are two 225 kVA DGs provided. These are pre-staged on the Auxiliary Building roof. An alternate approach is used for the +1 consideration. Either of the two 3 MW DGs pre-staged in the FESB can be used as a backup to power the loads assigned to the 225 kVA DGs. One of the two 3 MW DG can power the required loads in both units simultaneously, thus having two generators meets the N+1 criterion.

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 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 spent fuel pool cooling piping or other alternate location capable of exceeding the boil-off rate for the design basis heat load; and alternatively 3) spray via portable monitor nozzles from the refueling deck/floor capable of providing a minimum of 200 gallons per minute (gpm) per unit (250 gpm to account for overspray). This approach will also provide a vent pathway for steam and condensate from the SFP.

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

NEI 12-06, Section 3.2.1.1 provides the acceptance criterion for the analyses serving as the technical basis for establishing the time constraints for the baseline coping capabilities

described in NEI 12-06, which provide an acceptable approach to meeting the requirements of EA-12-049 for maintaining SFP cooling. This criterion is keeping the fuel in the SFP covered.

On page E47, in the section of the Integrated Plan in regards to maintaining SFP cooling during the initial phase, the licensee stated that there will be no volume lost from the SFP due to sloshing. For the operating, pre-fuel transfer, or post-fuel transfer case and considering no reduction in SFP water inventory starting from nominal pool level, the time when boil off decreases the water level to 10 feet above the SFP racks is approximately 37 hours for an SSE seismic event with an initial bulk water temperature in the pool of 100 degrees F. This value was calculated using the normal operating decay heat load. For the fuel in transfer or full core offload case with the maximum credible heat load and an initial water temperature in the pool of 140 degrees F, the time when boil off decreases the water level to 10 feet above the SFP racks is approximately 25 hours. Therefore, no immediate actions are required in Phase1.

In response to an audit question the licensee provided detailed information on the decay heat loads used in the spent fuel pool heat up calculations. All credible decay heat loads were determined based on plant calculated spent fuel pool decay heat values. For the normal credible load, the decay heat was determined at the time in an outage when the core has been fully reloaded in the reactor vessel. The maximum credible decay heat load was determined at the time after shutdown when the last fuel assembly from the core has been loaded into the spent fuel pool. The worst case heat load scenario is the design capability of the spent fuel pool cooling system: 47.4 MBTU/hr [FSAR, page 9.1-6]. For the projected outage, the entire core will be removed from the reactor vessel and placed in the spent fuel pool. This will be done in 186 hours [refueling outage data]. This corresponds to 7.75 days after shutdown. Interpolating the calculated decay heat [from refueling outage data] that includes the entire Unit 1 Cycle 11 core and all discharge batches, the credible maximum decay heat is 11.4733 MW at 7.75 days after shutdown. To calculate the credible normal decay heat, the time in the outage when the portion of the core has been moved from the spent fuel pool back into reactor vessel will be used. From refueling outage data, this occurs 360 hours after shutdown. Interpolating the refueling outage data gives a credible normal decay heat of 4.4478 MW.

Access to the SFP area as part of Phase 2 response could be a challenge due to environmental conditions near the pool. Therefore, the required action is to establish ventilation in this area and deploy any equipment local to the SFP required to accomplish the coping strategies. If the air environment in the SFP area requires the building to be ventilated, doors will be opened to establish air movement and venting the SFP building. For accessibility, establishing the SFP vent and any other actions required inside the fuel handling building should be completed before boil-off occurs.

On page EA1-4, in the Table of the Integrated Plan showing the sequence of events timeline (Action Items 7 and 8), the licensee stated that the SFP area needs to be ventilated and hoses deployed within 6.9 hours of the ELAP event. To provide an unlimited supply of water for SFP makeup during Phase 2, a low pressure FLEX pump will be used to pressurize the ERCW headers which can then be used for makeup to the SFP using hoses. The primary SFP makeup flow method is from the ERCW header valves located on the refueling floor through hoses directly to the open SFP. The secondary SFP makeup flow method is from the ERCW header connections through a hose to a new connection added to the SFP makeup line from the Demineralized Water

System (DWS). This alignment provides makeup control when the refueling floor is not accessible. Both connections can be used during flood and non flood conditions.

On page EA1-6 in the Table of the Integrated Plan showing the sequence of events timeline (Action Item 14), the licensee stated that the ERCW system header is aligned for charging starting at time 10.5 hours after the ELAP with a time constraint of 14.7 hours of the ELAP event. This time is sufficient to initiate water makeup to the pool and maintain the water level in the pool above the spent fuel.

During the audit process, the licensee stated that it now plans to use the 3 MW diesel generators to repower the spent fuel pool cooling pumps to remove the heat from the pool as a coping strategy in Phase 2. The licensee further stated that the SFP cooling pumps and its support equipment will survive an ELAP event. This change delays the need to provide makeup to the pool using hoses from the ERCW system header. The revised SOE timelines discussed in section 3.2.1.6 will reflect this new strategy.

On page E54, in the section of its Integrated Plan in regards to maintaining SFP cooling during Phase 3, the licensee stated that the strategies described for Phase 2 can continue as long as there is sufficient inventory available to feed the strategies. A mobile water purification unit will be received from the RRC that can be used to provide continued purified water to provide makeup to the spent fuel pool.

On page E65 the table listing portable equipment for Phase 2 shows two SFP spray nozzles sized at 250 gpm. This meets the NEI guideline.

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. For example: containment pressure control/heat removal utilizing containment spray or repowering hydrogen igniters for ice condenser containments.

The licensee stated that there are no Phase 1 actions required at this time that need to be addressed.

During Phase 2 the 225 kVA 480 VAC DGs discussed in the safety functions support section will provide power directly to the hydrogen igniter supply transformers. Additionally, the onsite 3 MW DGs are available to provide power to Containment air return fans or Lower Compartment Coolers (LCCs) for containment temperature control. Cooling water would be provided to the LCCs by the onsite low pressure FLEX pump feeding the ERCW header.

During Phase 3, the hydrogen igniters would continue to be repowered by the 225 kVA 480 VAC or 3 MW DGs. A backup or alternate set of Phase 2 equipment will be provided by the RRC as needed.

The licensee stated that the containment evaluations for Phases 1, 2, and 3 based on the boundary conditions described in Section 2 of NEI 12-06 have yet to be done. Based on the results of this evaluation, required actions to ensure maintenance of containment integrity and required instrumentation function will be developed. This includes actions to mitigate pressurization of containment due to steaming when RCS vent paths have been established or actions to mitigate temperature effects associated with equipment survivability. During the audit process, the licensee further acknowledged that the impact on the containment integrity and coping strategy due to the change in the RCP seal strategy will need to be reconsidered. This is identified as Open Item 3.2.3.A.

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 containment functions, 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.

With respect to equipment cooling water, the licensee made no reference regarding the need for, or use of, additional cooling systems necessary to assure that coping strategy functionality can be maintained. Nonetheless, the only portable FLEX equipment used for coping strategies identified in the Integrated Plan that would require some form of cooling are portable diesel powered pumps and generators. These self-contained commercially available units are typically air cooled would not be expected to require an external cooling system nor would they require ac power or normal access to the UHS. In response to an audit question, the licensee stated that all FLEX DG units are air cooled.

During the initial phase of the ELAP, the TDAFW pump is the only installed plant equipment that is used. During the audit process, the licensee stated that the bearings are cooled by water using a side stream from the pump's first stage which passes through the outer jacket that encases each pump bearing and returns to the pump suction. Cooling water is provided to the turbine bearing lube oil cooler as well.

During the audit process, the licensee advised that the 3 MW diesel generators will be used to repower the safety injection pumps and the spent fuel pool cooling pumps for coping in Phase 2. To provide a heat sink for cooling the SI pumps, the component cooling system pumps will be started and the water contained in the component cooling system piping will serve as the heat sink. However, the cooling requirements for the component cooling system pump and the spent fuel pool cooling system pump was not addressed. Additionally, the licensee indicated that the auxiliary air compressors would be placed in service.

The cooling requirements and method of cooling for the additional pumps and air compressor need to be confirmed. This is identified as Confirmatory Item 3.2.4.1.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 FLEX equipment cooling, if these requirements are implemented as described.

3.2.4.2 Ventilation – Equipment Cooling

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

> *Plant procedures/guidance should consider loss of ventilation effects on specific energized equipment necessary for shutdown (e.g., those containing internal electrical power supplies or other local heat sources that may be energized or present in an ELAP.*
>
> ELAP procedures/guidance should identify specific actions to be taken to ensure that equipment failure does not occur as a result of a loss of forced ventilation/cooling. Actions should be tied to either the ELAP/LUHS or upon reaching certain temperatures in the plant. Plant areas requiring additional air flow are likely to be locations containing shutdown instrumentation and power supplies, turbine-driven decay heat removal equipment, and in the vicinity of the inverters. These areas include: steam driven AFW pump room… the control room, and logic cabinets. Air flow may be accomplished by opening doors to rooms and electronic and relay cabinets, and/or providing supplemental air flow.
>
> Air temperatures may be monitored during an ELAP/LUHS event through operator observation, portable instrumentation, or the use of locally mounted thermometers inside cabinets and in plant areas where cooling may be needed. Alternatively, procedures/guidance may direct the operator to take action to provide for alternate air flow in the event normal cooling is lost. Upon loss of these systems, or indication of temperatures outside the maximum normal range of values, the procedures/guidance should direct supplemental air flow be provided to the affected cabinet or area, and/or designate alternate means for monitoring system functions.
>
> For the limited cooling requirements of a cabinet containing power supplies for instrumentation, simply opening the back doors is effective. For larger cooling loads, such as … AFW pump rooms, portable engine-driven blowers may be considered during the transient to augment the natural circulation provided by opening doors. The necessary rate of air supply to these rooms may be

estimated on the basis of rapidly turning over the room's air volume.

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

On page E10, in the section of its Integrated Plan regarding discussion of action items identified in the sequence of events table, the licensee stated that preliminary HVAC analysis determined that ventilation is not required until 24 hours into the ELAP for the Vital Battery and Switchgear room, main control room and the TDAFWP room at which point they can be monitored periodically, if needed.

In the section of the Integrated Plan regarding spent fuel pool cooling, page E47, the licensee stated that access to the SFP area as part of Phase 2 response could be challenged due to environmental conditions near the pool. Therefore, the required action is to establish ventilation in this area and establish any equipment local to the SFP required to accomplish coping strategies (such as the primary SFP cooling strategy discussed below). If the air environment in the SFP area requires the building to be ventilated, doors will be opened to establish air movement and venting the SFP building. For accessibility, establishing the SFP vent and any other actions required inside the fuel handling building should be completed before boil-off occurs

In the section of the Integrated Plan in regards to safety function support during Phase 1 page E56, the licensee stated that preliminary analysis using conservative heat loads in the Auxiliary and Control Buildings has shown that installed equipment credited for mitigation response will remain available. In addition, accessibility of these areas for required actions is acceptable.

However, no information was provided in the Integrated Plan about 1) the expected temperatures in areas where coping equipment such as the TDAFW pumps, electrical panels, vital batteries, boric acid tanks, and the high pressure FLEX pumps are located and 2) proposed method(s) for providing ventilation in the control room, TDAFW pump room and the vital battery and switchgear room should it be determined necessary after 24 hours.

During the audit process, the licensee presented results of HVAC calculations for the above listed areas. Ventilation strategies for areas identified are to open doors to reduce temperatures and if required portable fans and ducting for outside air will be provided. The TDAFW Pump Room el. 692 temperature increases to 126.6 degrees F at 72 hours. Doors to the room will be opened to reduce this temperature. Electrical panels on el. 757 are at 110 degrees F. Inverters on el. 757 are at 110 degrees F. Main Control Room el. 755 will be less than 110 degrees F based on LED emergency light installation. HP FLEX pumps el. 692 are at 104 degrees F. Safety Injection Pump rooms are at 104 degrees F. Component Cooling Pump area is at 104 degrees F. The WBN ELAP Transient Temperature Analysis was performed prior to the change in strategy for starting Safety Injection and Component Cooling water pumps at T-4 hours. This analysis will be revised to add these heat loads. This is identified as Confirmatory Item 3.2.4.2.A in Section 4.2.

The impact of elevated temperatures, as a result of loss of ventilation and/or cooling, on electrical equipment being credited as part of the ELAP strategies (e.g., electrical equipment in the turbine driven emergency feedwater pump room) needs to be addressed. This is identified as Confirmatory Item 3.2.4.2.B in Section 4.2.

During the audit process, the licensee stated that analyses have been performed to demonstrate the vital battery rooms I - IV can tolerate a loss of ventilation for approximately 30 hours. Both hydrogen and high temperatures were examined. The hydrogen was limited to 2% concentration at 29.9 hours and the room temperatures were less than 110 degrees F for that duration. Analysis shows that without heaters, the battery rooms reach around 42 degrees F. The licensee needs to show how the vital batteries can perform at these temperature extremes. This is identified as Confirmatory Item 3.2.4.2.C in Section 4.2.

With respect to providing adequate ventilation to limit the hydrogen concentration in the vital battery room the licensee stated during the audit process that hydrogen generation is predominantly produced during battery float and equalize time periods. During initial discharge in a BDBEE event significant hydrogen will not be produced. Similarly, during periods where the battery is on charge from FLEX DGs, the majority of current from the charger is supporting battery loads and will result in a low charge rate to recover the battery which will produce minimum hydrogen. IEEE-1365-2012 states that peak hydrogen production occurs as the battery nears the fully charged state. Since available current for battery charging is very low, the time to reach float conditions is significantly in excess of 24 hours. Licensee plans to open battery room doors as part of the FLEX strategy. Licensee plans to document an evaluation of potential hydrogen accumulation to support this position.

The evaluation should demonstrate that the hydrogen concentration in the battery rooms is below combustibility limits. This issue is identified as Confirmatory Item 3.2.4.2.D in Section 4.2.

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

3.2.4.3 Heat Tracing

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

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

On page E21, in the section of its Integrated Plan regarding protection of equipment from extreme cold, the licensee stated that the FESB will be evaluated for snow, ice and extreme cold temperature effects and heating will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will have a standalone HVAC system. On page E74 in its Integrated Plan in regards to protection of existing installed plant equipment from extreme cold, the licensee stated that strategies to address extreme cold conditions on the RWST and/or BATs, including potential need to reenergize heaters, have not been finalized.

During the audit process, the licensee stated that WBN has reviewed the need for heat tracing and determined that no heat tracing is required to implement strategies associated with order EA-12-049. Boric Acid Tank heat tracing will be lost at initiation of the ELAP, however, room temperature for the BAT will not decrease significantly and use of boric acid from the BAT will occur at approximately 5 hours so BAT temperatures will be high enough to ensure availability. RWST instrumentation is outside and may freeze after loss of heat tracing, however, staff awareness of inventory in the RWST and strategies to utilize inventory in RWST for RCS makeup do not rely on use of instrumentation because the total makeup to RCS is less than RWST inventory.

Based on preliminary results of the reanalysis based on using conventional RCP seals, the BAT will not be used for boration until 8.5 hours after an ELAP. The BAT temperature needs to be reevaluated after loss of heat tracing during extreme cold conditions to determine if boric acid could precipitate during the expected duration of injecting the boric acid into the RCS and potentially inhibit the flow through the piping system. This is identified as Confirmatory Item 3.2.4.3.A in Section 4.2.

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

3.2.4.4 Accessibility - Lighting and Communications

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

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

On page E9, in the section of its Integrated Plan regards the discussion of the sequence of events (A13) timeline, the licensee stated that acceptable control room lighting will be planned to be established for long term support. This is not a time constraint as control room lighting is

available via batteries, and portable lighting will be available for necessary activities. On page E56 in its Integrated Plan in regards to safety function support during Phase 1 the licensee stated that Watts Bar will rely on existing installed vital batteries to power key instrumentation and emergency lighting. On page E71 in its Integrated Plan in regards to equipment for Phase 3 the licensee lists:

Portable Interior Lighting
- Flashlights
- Headlamps
- Batteries

Portable Exterior Lighting
- Light units with diesel generator

On page E70 in its Integrated Plan in regards to equipment for Phase 3 the licensee lists;

Communications Equipment
- Satellite Phones
- Portable Radios

The licensee's plan however did not address 1) provisions for establishing exterior lighting during the initial and transition phase in the event that the ELAP occurs during the night and 2) the means and capabilities of on-site communication during the initial and transition phases.

During the audit process, the licensee addressed these concerns and stated the following;

1) The lamps in the plant emergency lighting battery packs are being replaced with equivalent lumen LEDs. This will increase the duration of the 8 hr. pack to at least 37 hrs. Lighting stands will be included in the hardened building, protected to the requirements of NEI 12-06 and powered by small portable generators which are to be included in the hardened building. The low pressure pumps once deployed and in service have external lights for personnel use.

2) As part of the NTTF Recommendation 9.3, the NRC issued a letter on March 12, 2012 requiring NRC licensees to perform a Communications Assessment. This assessment was performed in accordance with NEI 12-01. The results of this assessment identified that prior to any planned improvements the communications systems available to the site personnel for internal communications would be sound-powered phones and radios used in line-of-sight mode. TVA is in the process of replacing the current radio system with a more robust design. One radio repeater cabinet is being moved to a Class 1E room above the flood level. This cabinet will be powered from a Class 1E power supply that will be available post-event. This will make the radio system available to all accessible areas of the plant.

The NRC staff has reviewed the licensee communications assessment (ML12311A297 and ML13058A067) in response to the March 12, 2012 50.54(f) request for information letter for MNGP and, as documented in the staff analysis (ML13142A348) 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 accessibility considering the availability of lighting and communications, if these requirements are implemented as described.

3.2.4.5 Protected and Internal Locked Area Access

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

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

The licensee's Integrated Plan did not provide any discussion on the development of guidance and strategies with regard to the access to protected and internal locked areas. The issue of entry access considering the loss of ac power needs to be clarified. This has been identified as Open Item 3.2.4.5.A. in Section 4.2.

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

3.2.4.6 Personnel Habitability– Elevated Temperature

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

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

etc.) shall be included in the FLEX guidance implementing the FLEX strategies.

NEI 12-06 Section 9.2 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.

SFP accessibility was discussed in Section 3.2.2 above under SFP cooling strategies.

On page E56, in the section of its Integrated Plan in regards to safety function support during Phase 1, the licensee stated that preliminary analysis using conservative heat loads in the Auxiliary and Control Buildings has shown that installed equipment credited for mitigation response will remain available. In addition, accessibility of these areas for required actions is acceptable.

The licensee's Integrated Plan, regarding personnel habitability/accessibility, did not contain sufficient information on environmental conditions such as expected temperatures and relative humidity to demonstrate habitable conditions in, 1) the locations where the instruments are to be locally read, 2) other critical areas such as the TWAFW pump room, the auxiliary building, and control building where operators may have to enter for strategy deployment and operation. The plan does not address stay times and the potential need for protective clothing in areas where local coping strategy operations are performed.

During the audit process, the licensee provided the expected temperatures in the Auxiliary Building where the operators perform damage assessment, manipulate breakers, start SI and CCS Pumps, and stage HP FLEX Pumps. The temperatures for these areas are shown section 3.2.4.2 above. The licensee concluded that no provisions for operator protection are warranted based on the temperatures identified in the WBN ELAP Transient Temperature Analysis. The expected temperatures calculated for the areas requiring operator action should not inhibit accessibility or unduly restrict stay times in those areas where coping strategies are carried out.

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

> *Plant procedures/guidance should ensure that a flow path is promptly established for makeup flow to the steam generator/nuclear boiler and identify backup water sources in order of intended use. Additionally, plant procedures/guidance should specify clear criteria for transferring to the next preferred source of water.*
>
> Under certain beyond-design-basis conditions, the integrity of some water sources may be challenged. Coping with an ELAP/LUHS may require water supplies for multiple days. Guidance should address alternate water sources and water delivery systems to support the extended coping duration. Cooling

> and makeup water inventories contained in systems or structures with designs that are robust with respect to seismic events, floods, and high winds, and associated missiles are assumed to be available in an ELAP/LUHS at their nominal capacities. Water in robust UHS piping may also be available for use but would need to be evaluated to ensure adequate NPSH can be demonstrated and, for example, that the water does not gravity drain back to the UHS. Alternate water delivery systems can be considered available on a case-by-case basis. In general, all CSTs should be used first if available. If the normal source of makeup water (e.g., CST) fails or becomes exhausted as a result of the hazard, then robust demineralized, raw, or borated water tanks may be used as appropriate.
>
> Heated torus water can be relied upon if sufficient [net positive suction head] NPSH can be established. Finally, when all other preferred water sources have been depleted, lower water quality sources may be pumped as makeup flow using available equipment (e.g., a diesel driven fire pump or a portable pump drawing from a raw water source). Procedures/guidance should clearly specify the conditions when the operator is expected to resort to increasingly impure water sources.

In the Integrated Plan, the licensee addressed water sources for coping strategies for RCS cooling, RCS inventory control and SFP cooling makeup flow is available from the CSTs to the SGs during the initial phase of the ELAP. Makeup water to the RCS is provided by the BAT tanks and the RWST. The spent fuel pool makeup comes from the ERCW header.

During the audit process, the licensee stated that Watts Bar is constructing a new 500,000 gallon, Auxiliary Feed Water Supply Tank (AFWST) that can withstand the BDBEEs as outlined in NEI 12-06. The AFWST will function in place of the CSTs which are not seismically designed nor are they protected against tornado borne missile. AFWST will supply water to the TDAFW pumps in both units. This volume will provide adequate coping time to deploy and align the Phase 2 coping equipment. The new AFWST will be located on the U2 (east) side of the plant just east of the existing U2 RWST. The new tank location was selected to be close to the existing CSTs to reduce the FLEX equipment deployment time, maintain adequate NPSH to the TDAFW pumps and to utilize the existing CST water volume if it survives the BDBEE. Additional surviving tanks would be used as a source of clean water. These tanks include the Tritiated Water Storage Tank, the two Primary Water Storage Tanks and the Demineralized Water Storage Tank.

On page E9, in the section of its Integrated Plan regarding the sequence of events timeline (Action Item 12), the licensee stated that after the initial supply of water from the AFWST (and CST if available) is depleted, the source of water to the TDAFW pumps will be the ERCW headers. Core cooling will be extended about 4.7 hours using the standing water in the headers. The low pressure FLEX pump will need to be aligned to the ERCW headers before the standing water in the ERCW headers is depleted. Source of charging water to the ERCW headers is the forebay intake pumping station. The ERCW headers or flood waters will be the long term source of water using the intermediate pressure FLEX pump to feed the SGs after the TDAFW pumps are secured.

The ERCW header is the source of water for spent fuel pool makeup.

During the audit process, the licensee advised of a change in strategy for RCS inventory control. In the Integrated Plan the strategy was predicated on using low leakage seals which delayed the need for injecting makeup water into the RCS. The revised strategy is to use the CLAs and the safety injection pumps drawing on the RWST to restore water inventory. Subsequent to the cooldown of the RCS, boration is initiated from the BAT using the high pressure FLEX pumps. Makeup source is then switched to the refueling water storage tank (RWST) for long term inventory control.

The unlimited supply of water is the Tennessee River. The Watts Bar Integrated Plan notes that a clean water source will be used first, and then the strategy transitions to the low pressure pump charging the ERCW headers for core cooling. The low pressure pump will have ½ square inch grid strainer on suction side of pump. In addition, a mobile purification and a mobile boration unit will be utilized for cleaning the raw water source during long term coping in Phase 3. Westinghouse report, DAR-SEE-II-12-18, evaluated the secondary side performance assuming the clean water source is available for 10 hours and then the source is transitioned to the ERCW. This report also takes into account the potential blockage from suspended solids and precipitates from TN River.

For Phase 3 a mobile water purification system will be brought from off site to provide clean water for coping in the long term.

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

3.2.4.8 Electrical Power Sources/Isolations and Interactions

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

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

On page E58, in the section discussing safety function support, the licensee stated that for the 225 kVA 480 VAC DGs, two fused distribution panels will be used to provide power to the supplied loads. Each fuse panel provides connections to two vital battery chargers and one train of hydrogen igniter transfer switches for each unit. Each fuse distribution panel will have a connection to 480 VAC distribution to close Cold Leg Accumulator Isolation valves during cooldown. The 225 kVA 480 VAC DGs are pre-staged equipment. This is an alternative approach for satisfying the Mitigating Strategies Order. Guidance for accepting this approach of using a pre-staged generator has not been developed to date. Therefore, this is identified as Open Item 3.2.4.8.A in Section 4.1.

During the audit process, the licensee stated that the 225kVA DGs are isolated from the Vital Battery Chargers and Hydrogen Igniters by Class 1E transfer switches. 225kVA DG is isolated from the 480 volt distribution by a Class 1E breaker. Procedures will be in place to control operation of the transfer switches and Class 1E breaker. With respect to sizing the 225kVA DGs the licensee stated that there is no set list of loads identified that would address all possible Beyond Design Bases Events. As a result, WBN has elected to permanently pre-stage two 225 kVA FLEX DGs to support the four normal vital battery chargers, two Unit 1 trains

of hydrogen igniters, two Unit 2 trains of hydrogen igniters, and miscellaneous loads from connections to the Class 1E 480V Distribution System. DCN 59675 will provide a calculation evaluating 225 kVA DG's capability of starting the planned individual loads identified in the Flex Strategies, coordination for protective equipment, cable ampacity, and voltage drop. The FSGs will provide procedural guidance for controlling the overall loading within the DG's load rating. This is identified as Confirmatory Item 3.2.4.8.A in Section 4.2.

On pages E57 and E58, in the section discussing the safety functions support, the licensee stated that the 3 MW DGs are pre-staged to provide power to the existing 6.9 kV distribution system. These generators will be staged in the FESB and protected from the external hazards. The 3 MW FLEX DGs are isolated from the safety-related buses by Class 1E qualified manual transfer switches. To connect the existing 6.9 kV system to the 3 MW DGs during FLEX operation, the connection to the existing safety-related DG circuit is opened and the circuits to the 3 MW DGs are closed by operating the existing interlocked transfer switches. This will be done under administrative controls, ensuring that a no load condition exists on the load side of the transfer switches. Procedures will be in place to control operation of the transfer switches.

The permanently installed electrical connection points for the 3 MW DGs are from the DGs' integral output connection panel through conduits within the FESB to underground conduits located on the outside of the FESB south wall. One 3 MW DG will be assigned to Train A on both units and the second 3 MW DG will be assigned to Train B of both units. The 3 MW DGs may also serve as an alternative power source for the loads supplied by the on-site 225 kVA 480 VAC FLEX DGs. Procedures will be in place to control which DG is utilized as a power source for this equipment.

During the audit process, the licensee described a revised coping strategy which now credits the use of the 3 MW diesels for coping in the early phases of the ELAP by repowering a safety injection pump for RCS inventory control. The anticipated time for deployment of these diesels is about 4 hours. The 3 MW DGs are pre-staged equipment. This is an alternative approach for satisfying the Mitigating Strategies Order. Guidance for accepting this approach of using a pre-staged generator has not been developed to date. This is combined with Open Item 3.2.4.8.A above.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that the alternative approach is acceptable, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to electric power sources. These questions are identified as Open Items above and in Section 4.1.

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.

In the section discussing safety function support, page E58, the licensee stated that fuel for the 3 MW DGs and the 225 kVA 480 VAC DGs will be obtained from the installed safety-related DG 7-day fuel tanks. Fuel lines will be installed between the 7-day fuel tanks and the Auxiliary Building roof to provide fuel to the 225 kVA 480 VAC DGs with a fuel transfer pump. Refueling of the 3 MW DGs will be accomplished using a separate fuel transfer pump dedicated for the purpose of transferring fuel from the 7-day fuel tanks to the 3 MW DGs' fuel oil day tanks.

During the audit process, the licensee provided additional information regarding the fuel oil supply and fuel oil consumption rates for the FLEX equipment.

1. Watts Bar FLEX strategy utilizes fuel stored in the four Safety Related Diesel Generator 7 day tanks. These tanks are mounted under the Safety Related DG building which is a seismically qualified building and built to site design criteria for wind generated missile protection.

2. Fuel storage meets 2 X SSE HCLPF, protected for PMF flood, and protected for wind and associated wind generated missiles.

3. Each 7 day tank contains a Technical Specification required volume of 62,000 gallons for a total volume of 248,000 gallons.

4. Portable FLEX pumps will be fueled utilizing a portable transfer pump taking suction from a 7 day tank to fill a portable transfer tank that will be carried to the portable pumps.

5. FLEX DG fuel consumption:
   225kVA DG, 10 gph each
   3 MW DG, 223 gph each

6. FLEX pump fuel consumption:
   Dominator, 30 gph
   Triton, 18 gph each
   Intermediate FLEX pump, 14 gph each
   High press FLEX pump (pump not ordered at this time)
   Haul vehicle approximately 3 gph

7. DGs will have a permanent automatic makeup connection to the 7 day tanks to minimize staffing requirements. The Dominator requires fuel every 10 hours. The Triton booster pump requires fuel every 8 hours. Other pump fuel capacities are not known at this time.

Based on fuel capacities identified above, the largest user is the 3 MW DGs which would utilize about 60 percent of a 7-day fuel tank in 7 days and at this point it is anticipated that makeup to the 7 day tanks would be required. There is sufficient margin in the quantity of fuel that is stored on site to operate the equipment used for coping strategies until replenishment fuel can be brought in from off site.

The licensee did not provide information on how fuel quality will be assured for FLEX equipment. This has been identified as Confirmatory Item 3.2.4.9.A in Section 4.2.

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

3.2.4.10 Load Reduction to Conserve DC Power

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

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

On page E56, in the section of its Integrated Plan in regards to safety function support during Phase 1, the licensee stated that Watts Bar will rely on existing installed vital batteries to power key instrumentation and emergency lighting. To extend run time before recharging is possible, a load-shedding procedure will be implemented with the first phase of load shed complete by 45 minutes and the extended load shed complete by 90 minutes. A battery coping calculation determined that the battery coping time is 8 hours.

During the audit process, the licensee modified the approach to conservation of battery capacity. The 225 kVA DGs will be used to restore power to the battery chargers within 1 hour after loss of all ac. If the charger restoration is successful, load shedding of the batteries is not required. If power is not restored via the 225 kVA DGs, the battery will be load stripped at 90 minutes to establish an 8 hour coping period. Power is expected to be restored at 4 hours via the 3 MW DGs.

During the audit process, the licensee stated that calculations are being prepared to identify which loads will be available for stripping. The minimum acceptable voltage at the battery boards was stated to be 105V dc, which is the minimum acceptable voltage used in all of the vital battery calculations. Adequacy of voltage at the loads will be validated in the load calculation. The load profile calculation and a summary will be provided by November, 2013. This calculation should also address the actions necessary to complete each load shed, the equipment location (or location where the required action needs to be taken), the time to

complete each action and identify which functions are lost as a result of shedding each load and any impact on defense-in-depth strategies and redundancy. This is identified as Confirmatory Item 3.2.4.10.A in Section 4.2.

On page E12, in the section of its Integrated Plan regarding procedure guidance, the licensee stated that Watts Bar will continue participation in PA-PSC-0965 and will update plant procedures upon the completion of the PWROG program. It is anticipated that an FSG, for ELAP dc load shed/management, will be incorporated into existing plant procedures in order to develop the FSG interface.

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

## 3.3 PROGRAMMATIC CONTROLS

### 3.3.1 Equipment Maintenance and Testing.

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

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

NEI 12-06, Section 11.5 states:

> 1. FLEX mitigation equipment should be initially tested or other reasonable means used to verify performance conforms to the limiting FLEX requirements. Validation of source manufacturer quality is not required.
>
> 2. Portable equipment that directly performs a FLEX mitigation strategy for the core, containment, or SFP should be subject to maintenance and testing[1] guidance provided in INPO AP 913, Equipment Reliability Process, to verify

[1] Testing includes surveillances, inspections, etc.

proper function. The maintenance program should ensure that the FLEX equipment reliability is being achieved. Standard industry templates (e.g., EPRI) and associated bases will be developed to define specific maintenance and testing including the following:

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

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

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

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

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

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

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

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

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

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

On page E11 and 12 E, in the section of its Integrated Plan regarding programmatic controls, the licensee stated that equipment associated with the coping strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control in accordance with NEI 12-06 Rev. 0 Section 11.5. The FLEX mitigation equipment will be initially tested (or other reasonable means used) to verify performance conforms to the limiting FLEX requirements. It is expected the testing will include the equipment and the assembled sub-systems to meet the planned FLEX performance. Additionally, Watts Bar will implement the maintenance and testing template upon issuance by the Electric Power Research Institute (EPRI). The template will be developed to meet the FLEX Considerations established in Section 11.5.

During the audit process, the licensee stated that EPRI's guidance on Preventative Maintenance (PM) for FLEX equipment (currently in development), along with the manufacturer recommendations, will provide the basis for Maintenance and Testing Plan for TVA's FLEX equipment. EPRI has issued an Interim (Draft) Report "Preventive Maintenance Basis for FLEX Equipment", dated September, 2013 and has issued the first (Draft) set of Data Reports on "Pumps-Diesel Skid" (1-5).

The licensee further stated that the Preventive Maintenance Basis Database (TVA currently uses PMDB 2.1) is an essential reference for utilities seeking to, 1) validate their current PM program, 2) perform PM tasks less frequently as part of a living maintenance program, 3) improve PM tasks as appropriate corrective action under the maintenance rule, 10CFR50.65, 4) improve equipment reliability, 5) develop more consistent PM programs across a fleet of plants, and 6) for those establishing maintenance recommendations for FLEX equipment, either during long term standby or during intensive use in extreme circumstances. The Nuclear Regulatory Commission in Interim Staff Guidance for the FLEX program has endorsed the use of the PM Basis Database for developing valid technical bases for appropriate PM programs as described in NEI 12-60.

The licensee stated that the Engineering Standard Programs and Processes (SPPs) are used to develop maintenance and testing strategies for all new equipment and described the new equipment maintenance strategy development process and that the EPRI templates will be reviewed, along with other industry guidance, as part of the development of the maintenance strategies.

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 Electric Power Research Institute (EPRI) technical report on preventive maintenance of FLEX equipment, submitted by NEI by letter dated October 3, 2013 (ADAMS Accession No. ML13276A573). The NRC staff's endorsement letter is dated October 7, 2013 (ADAMS Accession No. ML13276A224).

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

processes.

The licensee’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 Consideration.
    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 E7, in the section of its Integrated Plan discussing key site assumptions (A10) to implement NEI 12-06 strategies, the licensee stated that the pre-planned strategies developed to protect the public health and safety will be incorporated into the unit emergency operating procedures in accordance with established EOP change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59.

On page E11, in the section of its Integrated Plan regarding programmatic controls, 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 Rev. 0 Section 11.5. The FLEX strategies and basis will be maintained in an overall program document. Existing plant configuration control procedures will be modified to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.

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

3.3.3 Training.

NEI 12-06, Section 11.6 provides that:

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

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

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

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 E13, in the section of its Integrated Plan in regards to training, the licensee stated that training plans will be developed for plant groups such as the emergency response organization (ERO), Fire, Security, Emergency Preparedness (EP), Operations, Engineering, Mechanical Maintenance and Electrical Maintenance. The training plan development will be done in accordance with Watts Bar procedures using the Systematic Approach to Training, and will be implemented to ensure that the required Watts Bar staff is trained prior to implementation of FLEX.

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

## 3.4 OFFSITE RESOURCES

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

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

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

On page E13, in the section of its Integrated Plan regarding the Regional Response Center plan, the licensee stated that the industry will establish RRCs to support utilities during beyond design basis events. Equipment will be moved from an RRC to a local assemble area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. Equipment arriving first, as established during development of the nuclear site's playbook, will be delivered to the local staging area within 24 hours from the initial request. During the audit process, the licensee identified the local offsite staging areas. These areas are discussed in section 3.1.1.4.

On page E6 of the Integrated Plan the licensee listed the additional FLEX equipment that will be delivered from the RRC for Phase 3.

The licensee's plan conforms to the guidance found 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 (Guideline 1). However, the plan failed to provide any information as to how conformance with NEI 12-06, Section 12.2 Guidelines 2 through 10 will be met. This has been identified as Confirmatory Item 3.4.A in Section 4.2.

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

## 4.0 OPEN AND CONFIRMATORY ITEMS

### 4.1 OPEN ITEMS

| Item Number/ Status | Description | Notes |
|---|---|---|
| 3.1.2.2.A | Deployment Flood Hazard- Review timing and location for staging, connecting and powering up the submersible HP and IP FLEX pumps based on the revised strategy resulting from using conventional RCP seals instead of the low leakage design originally assumed in the IP. | |
| 3.2.1.6.A | SOE- Reanalysis to support the revised timelines, both for the flood and the non flood conditions will be provided in a future 6-month update. The timelines need to be evaluated in light of the revised strategy for using the existing pre-staged 3 MW DGs to power the safety injection pumps to restore RCS inventory. Other aspects of the SOE timeline to be verified are the boration strategy and the spent fuel pool cooling strategy. | |
| 3.2.1.7.A | Cold Shutdown and Refueling-Confirm licensee decision to follow NEI's position paper. | |
| 3.2.1.8.A | Core Sub Criticality- The reanalysis to support the revised core boration coping strategy will be provided in a future 6 month update. The overall approach for providing boration early in the ELAP event including the deployment considerations and the rate of boration as it affects sizing the HP FLEX pump is to be verified. | |
| 3.2.1.8.B | Core Sub Criticality- The generic issue of the boric acid mixing model is not yet resolved. Pending resolution of this issue the impact on the Watts Bar analysis will need to be evaluated. | |
| 3.2.3.A | Containment Functions- Containment evaluations for Phases 1, 2 and 3 have not been done. Results of these evaluations need to be confirmed that containment functions are maintained during the course of the ELAP event. | |
| 3.2.4.8.A | Electric Power Sources – The licensee is relying on pre-staged 225 kVA and 3 MW DGs as part of their mitigating strategies. This is an alternate approach from the strategies identified in NEI 12-06. Guidance for accepting this approach, of using pre-staged DGs, has not been developed to date. | Significant |

### 4.2 CONFIRMATORY ITEMS

| Item Number/ Status | Description | Notes |
|---|---|---|
| 3.1.1.2.A | Deployment of FLEX Equipment - Design features of the FESB have not yet been defined, including the susceptibility to the loss of ac power. Reliance on ac power, if any, to deploy equipment is to be confirmed. | |
| 3.1.4.1.A | Protection of 225 kVA DGs - Extreme cold temperature hazard. | |

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|---|---|---|
| | Confirm the need for heating of the enclosure housing the FLEX diesel generators on the roof of the Auxiliary Bldg. | |
| 3.1.5.1.A | Protection of 225 kVA DGs - High temperature hazard. Confirm the need for ventilating the enclosure housing the FLEX diesel generators on the roof of the Auxiliary Building. | |
| 3.2.1.1.A | Computer Code Modeling - Confirm applicability of recommendations in WCAP 17601 to Watts Bar and to the extent Watts Bar implemented those recommendations. | |
| 3.2.1.1.B | Computer Code Modeling - Confirm that the ELAP analysis using NOTRUMP was limited to flow conditions before reflux condensation initiates. | |
| 3.2.1.2.A. | RCP Seals - Confirm that acceptable justification has been provided for the seal leakage rates used in the ELAP analysis. | |
| 3.2.1.2.B | RCP Seals - Confirm integrity of O-rings if the cold leg temperature exceeds 550 degrees F during the ELAP event. | |
| 3.2.1.3.A | Decay Heat - Confirm the input values used for the decay heat model for Watts Bar Units 1 and 2. | |
| 3.2.4.1.A | Equipment Cooling - Confirm that the spent fuel pool cooling system pumps, component cooling system pumps and the air compressors are sufficiently cooled to function for their expected duration during the ELAP event. | |
| 3.2.4.2.A | Ventilation – Analysis to determine the temperature rise in the SI pump room and CCW pump room has not been completed. Confirmation is required that the equipment in those rooms is capable of operating in the post ELAP environmental temperatures. | |
| 3.2.4.2.B | Ventilation - The impact of elevated temperatures, as a result of loss of ventilation and/or cooling, on electrical equipment being credited as part of the ELAP strategies (e.g., electrical equipment in the turbine driven emergency feedwater pump room) needs to be addressed. | |
| 3.2.4.2.C | Ventilation - The licensee needs to show how the vital batteries can perform at extreme high and low temperature. | |
| 3.2.4.2.D | Ventilation - Calculation of potential hydrogen buildup in the battery rooms needs to be performed and confirmed that the hydrogen concentration in the room would be less than combustibility limits. | |
| 3.2.4.3.A | Heat Tracing - Re-evaluate the BAT temperature for possible precipitation of boric acid after loss of heat tracing during extreme cold conditions. | |
| 3.2.4.4.A | Communication- Confirmation will be required that upgrades to the site's communications systems have been completed in accordance with TVAs Communications Assessment and as evaluated by the NRC staff documented in ML13142A348. | |
| 3.2.4.5.A | Accessibility - The strategy for gaining access to protected and internal locked areas has not yet been developed. This will require evaluation when the licensee submits additional information. | |
| 3.2.4.8.A | Electrical Power Sources- The sizing basis for the 225 kVA DG and their ability to start the planned individual loads identified in | |

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| | the FLEX strategies has yet to be documented. Such analysis will be evaluated when the licensee submits additional information. | |
| 3.2.4.9.A | Portable Equipment Fuel- Confirm the licensee approach on how fuel quality will be assured during long term storage for FLEX equipment. | |
| 3.2.4.10.A | Load Reduction - Calculations are being prepared to identify which loads will be available for stripping. These calculation should address the actions necessary to complete each load shed, the equipment location (or location where the required action needs to be taken), the time to complete each action and identify which functions are lost as a result of shedding each load and any impact on defense-in-depth strategies and redundancy. | |
| 3.4.A | Off-Site Resources - Review how conformance with NEI 12-06, Section 12.2 guidelines 2 through 10 will be met. | |