Mega-Tech Services, LLC

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

Revision 1

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South Texas Project Nuclear Operating Company
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Prepared by:

Mega-Tech Services, LLC
11118 Manor View Drive
Mechanicsville, Virginia 23116

1.0 BACKGROUND

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

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

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

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

Guidance and strategies required by the Order would be available if a loss of power, motive force and normal access to the ultimate heat sink needed to prevent fuel damage in the reactor and SFP affected all units at a site simultaneously. The Order requires a three-phase approach for mitigating BDBEEs. The initial phase requires the use of installed equipment and resources

to maintain or restore key safety functions including core cooling, containment, and SFP cooling. The transition phase requires providing sufficient portable onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from offsite. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely.

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

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

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

2.0 EVALUATION PROCESS

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

By letter dated February 28, 2013, (ADAMS Accession No. ML13070A011), and as supplemented by the first six-month status report in letter dated August 26, 2013 (ADAMS Accession No. ML13249A060), South Texas Project Nuclear Operating Company (STPNOC) (the licensee) provided the South Texas Project (STP) Units 1 and 2 Integrated Plan for compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by STPNOC 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 NRC staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the 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 (LUHS). These hazards are broadly grouped into the categories discussed below in Sections 3.1.1 through 3.1.5 of this evaluation. Characterization of the applicable hazards for a specific site includes the identification of realistic timelines for the hazard; characterization of the functional threats due to the hazard; development of a strategy for responding to events with warning; and development of a strategy for responding to events without warning.

3.1.1 Seismic Events.

NEI 12-06, Section 5.2 states:

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

On page 7 in the Integrated Plan, in the section regarding determination of applicable extreme external hazards, the licensee stated that the assessment to determine the applicability of a BDB seismic event was completed in accordance with NEI 12-06, Section 5, "Assess Seismic Impact." The licensee noted that Section 5.2 requires that all sites address BDB seismic considerations in the implementation of FLEX strategies, so a BDB seismic event is considered applicable to the STP site. The licensee also stated, on page 11, 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.

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.

The reviewer noted that the 6-month update provided a discussion of storage plans for the two trailer-mounted, large diesel driven FLEX pumps. In the 6-month update, plans are described for storing the FLEX pump in two buildings *not* protected from the external hazards but located a sufficient distance apart to ensure the survivability of at least one pump. During the audit process, the licensee further stated that the equipment and storage structures will be evaluated/protected as necessary to ensure damage does not occur from a seismic hazard. The licensee summarized the plans to address consideration 1 above for FLEX equipment protection as follows: A steel enclosure will house the FLEX diesel generators and will be built to the plant's design basis for SSE. Equipment inside the structure will be protected from seismic interactions so that the equipment survives the event. The licensee further stated that NEI 12-06 Section 5.3.1 guidance is being followed for all three storage locations, the steel enclosure on the mechanical auxiliary building (MAB) roof and the two additional storage buildings to be constructed to house the trailer mounted diesel driven FLEX pumps.

The Integrated Plan did not provide information regarding securing FLEX equipment for protection during a seismic event nor did the Integrated Plan address protection from seismic interactions, considerations 2 and 3 above, respectively. The licensee addressed these considerations during the audit process by stating that equipment inside the structures will be protected from a seismic event to assure survival.

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

3.1.1.2 Deployment of FLEX Equipment - Seismic Hazard

NEI 12-06, Section 5.3.2 states:

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

considerations are implicitly addressed.

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

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

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

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

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

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

With regard to consideration 1 above, the Integrated Plan did not address soil liquefaction in the section for evaluating an extreme seismic hazard (page 7) or in subsequent sections regarding deployment. The licensee addressed this consideration during the audit process by stating that the STP UFSAR section 2.5.4.8.1.5 states "...it is concluded that liquefaction will not occur in the plant area during the SSE."

With regard to consideration 2 above, the Integrated Plan did not provide sufficient information to demonstrate that at least one access path to connections for strategies was only through protected structures. However, during the audit process, the licensee provided information to address this issue. The licensee explained that the electrical auxiliary building (EAB), the mechanical auxiliary building (MAB), the diesel generator building (DGB), the turbine generator building (TGB) and the isolation valve cubicle (IVC) are all interconnected with roof walkways. The licensee further stated that an operator can traverse between these buildings and therefore, can access all required FLEX equipment no matter what event caused the ELAP. The reviewer was able to determine from information on page 32 of the Integrated Plan, from the drawings provided in the attachments to the Integrated Plan, and from the building diagrams in the flood analysis provided as reference materials, that the buildings noted above are all protected structures with the exception of the TGB. From information contained in the Integrated Plan, the reviewer determined that all primary FLEX strategy connections are accessed through protected structures, and only defense-in-depth FLEX connection strategies need to be accessed inside the TGB.

Although the licensee discussed potential *upstream* dam failures in the Integrated Plan, there was no discussion of a downstream dam failure and the postulated impact on mitigation strategy water supplies as noted in consideration 3 above. The licensee addressed this concern during the audit process and stated that there is no downstream dam affecting the STP site.

The reviewer was unable to find any information in the Integrated Plan regarding the use or need for auxiliary power to facilitate moving or deploying equipment as noted in consideration 4 above. An example would be the use of power to open a storage building door. The need to address consideration 4 is identified as Open Item 3.1.1.2.A in Section 4.1.

With regard to consideration 5, the Integrated Plan did not contain information on the availability or storage of equipment that would be needed to clear debris from deployment paths to facilitate use of the FLEX equipment or to clear site access of arriving site personnel. The licensee addressed this concern during the audit process and stated that two tractors with front-end loaders will be available to clear debris and will be stored in the same locations as the FLEX diesel driven pumps.

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 deployment if these requirements are implemented as described.

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

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

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

On page 14 of the Integrated Plan, in the section discussing time constraints item 6, the licensee stated that in the event that all direct current (dc) power is lost such that instrumentation is lost, procedures would direct operators to use a multimeter to get readings from the qualified display parameter system (QDPS) until dc power could be restored. Although the plan briefly discusses the use of portable instruments to obtain necessary instrument readings at the QDPS, the plan does not fully address the guidance of NEI 12-06, Section 5.3.3, consideration 1 because:

1 Reference source for the operators for obtaining necessary instrument readings to support implementation of the coping strategy is needed for both control room and non-control room readouts and how and where to measure key readings at containment penetrations (where applicable) using a portable instrument;
2 Guidance should include critical actions to perform until alternate indications can be connected (measured) [an example would be – guidance on what the operator should do if SG pressure indication was lost during the time you are connecting a portable instrument to read SG pressure]; and
3 Guidance should include instructions on how to control critical equipment without control power. [an example would be controlling the TDAFW pump without control power]

During the audit process, the licensee discussed this concern and stated that the considerations above would be addressed during the development and incorporation of the guidance provided in the Westinghouse Owners Group FLEX emergency response guidelines. This is identified as Confirmatory Item 3.1.1.3.A, in Section 4.2.

The licensee's Integrated Plan did not address the development of mitigating strategies with respect to the procedural interface for seismic hazards as per considerations 2 and 3 above. These considerations include addressing large internal flooding sources that are not seismically robust and do not require ac power; and the use of ac power to mitigate ground water in critical locations. The licensee addressed these items during the audit process. The licensee stated that internal flooding was evaluated during the licensing process and the conclusion was that no essential components required for safe shutdown would be impacted. With regard to ground water, the licensee stated that a corrective action has been generated to address the issue. This is identified as Confirmatory Item 3.1.1.3.B in Section 4.2.

Consideration 4 was previously addressed by the licensee's statement noted in Section 3.1.1.2 above that there are no downstream dams impacting the STP site.

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

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

On page 17 of the Integrated Plan, in the section regarding the regional response center plan, the licensee stated that the industry will establish two (2) regional response centers (RRCs) to support utilities during BDBEEs. First arriving equipment, as established during development of STP's agreed upon contractual plan of action (SAFER Response Plan), will be delivered to the site staging area within 24 hours from the initial request. The staging area has yet to be determined and is a self identified open item. A contract has been executed and will be maintained in accordance with Section 12 of NEI 12-06.

The licensee's Integrated Plan did not address seismic consideration with respect to the arrival area and the transport to the onsite pre staging areas for offsite resources. The licensee addressed this during the audit process by describing that if site access is not permitted, an alternate staging area has been designated. Furthermore, as a last resort, the equipment and supplies could be transported to the site by helicopter.

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 offsite support if these requirements are implemented as described.

3.1.2 Flooding.

NEI 12-06, Section 6.2 states:

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

NEI 12-06, Section 6.2.1 states in part:

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

On page 7 and 8 of the Integrated Plan, in the section regarding extreme external hazards, the licensee stated that the assessment to determine the applicability of BDB external flooding hazards on the site was completed in accordance with NEI 12-06, Section 6, "Assess External Flooding Impact", and addressed the following types of flooding:

- Flooding from nearby rivers, lakes and reservoirs
- Local intense precipitation
- High tides
- Seiche
- Hurricane and storm surge
- Tsunami events

In addition, the licensee stated that the UFSAR Section 2.4, "Hydrologic Engineering," provides an assessment of the types of flooding applicable to the site. The licensee concluded that BDBEE flooding of all of the types identified above could potentially occur at the site and must be considered in assessing the flooding impact. On page 6 of the Integrated Plan, the licensee stated that as a result of the assessment for the flood hazard, STP screens in this external hazard. On page 2 of the Integrated Plan, the licensee further clarified the characterization of flooding hazards and stated that STP has a unique challenge associated with one of the external hazards. The licensee discussed the fact that the STP site could be subject to rapid flooding from the breach of the main cooling reservoir. The licensee implemented a detailed flood analysis in March 2012 as part of the Fukushima response. The objective of the study was to provide information to better understand the many dimensions of a postulated levee breach. On page 8 of the Integrated Plan, the licensee continues with a discussion regarding characterization of the flood hazard. The licensee stated that per the UFSAR, Section 2.4, the potential effects of tsunamis, seiches, ice flooding, landslides, channel diversions, and low water are not critical.

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 flood hazard screening to if these requirements are implemented as described.

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

> These considerations apply to the protection of FLEX equipment from external flood hazards:
>
> 1. The equipment should be stored in one or more of the following configurations:
>
>   a. Stored above the flood elevation from the most recent site flood analysis. The evaluation to determine the elevation for storage should be informed by flood analysis applicable to the site from early site permits, combined license applications, and/or contiguous licensed sites.
>
>   b. Stored in a structure designed to protect the equipment from the flood.
>
>   c. FLEX equipment can be stored below flood level if time is available and

plant procedures/guidance address the needed actions to relocate the equipment. Based on the timing of the limiting flood scenario(s), the FLEX equipment can be relocated [footnote 2 omitted] to a position that is protected from the flood, either by barriers or by elevation, prior to the arrival of the potentially damaging flood levels. This should also consider the conditions on-site during the increasing flood levels and whether movement of the FLEX equipment will be possible before potential inundation occurs, not just the ultimate flood height.

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

The licensee addressed the considerations above during the audit process. The licensee stated all FLEX equipment will either be stored in flood protected Category 1 structures or in diverse, disparate locations providing for one “N+1” FLEX pump to survive depending on the nature of the berm breach of the MCR.

Since the response time from a MCR breach is so short, the licensee’s strategy is to prestage essential “N” sets of FLEX equipment. The licensee will prestage two 480 VAC diesel generators per unit on the mechanical auxiliary building roof in an enclosure that will protect the DGs from external hazards. The licensee will prestage a 300 gpm motor-driven AFW pump in the isolation valve cubicle next to the current motor driven AFW pumps. The licensee will prestage a 40 gpm (700 psig) RCS injection pump on the 21’ elevation in the fuel handling building in the current SI injection pump bay. The licensee will prestage a 250 gpm (150psig) pump for spent fuel pool makeup on the 21’ elevation in the fuel handling building. The licensee will not prestage the “N+1” portable equipment. Staff evaluation of this condition is addressed in section 3.1.2.2 Deployment of FLEX Equipment.

The licensee’s approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protection of equipment 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 reactor coolant pump (RCP) seal leak off, obtaining dewatering pumps, creating temporary flood barriers, etc. These factors can be credited in considering how the baseline capability is deployed.

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

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

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

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

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

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

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

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

Considerations 2 and 9 above have been previously addressed by the licensee's statement that two tractors with front-end loaders will be available to clear debris and move equipment, and as discussed in Section 3.1.2.1 of this report, all FLEX equipment will either be stored in flood protected Category 1 structures or in diverse, disparate locations providing for one “N+1” FLEX pump to survive depending on the nature of the berm breach of the MCR..

The licensee stated that a break in the MCR would flood the protected area and hinder deployment of FLEX equipment; therefore, the licensee has a strategy to prestage primary strategy FLEX equipment in its deployment location for core cooling, RCS inventory control, and spent fuel pool cooling. FLEX equipment to support spent fuel pool spray is not required until after 72 hours. The licensee expects the flood water to recede to 1.5’ at 72 hours, which will allow deployment of the FLEX equipment to establish makeup spray to the SFP from their trailer mounted FLEX pump.

In the course of the audit, the licensee discussed the ability to move the portable equipment, indicating that during a design basis flood, deployment of the trailer mounted diesel driven pump, which is the spare portable pump for SG makeup, will not be immediately available because, water level does not recede to below 4' above ground level at the pump connections until approximately 40 hours into the event in the worst case and to 1.5' at 72 hours, which will allow deployment of the FLEX equipment. No further information was provided on the time necessary for the water level to recede to ground level at the pump connections and to clear the pathways between the trailer mounted diesel driven pump storage location and the pump connections sufficiently to enable use of the pump. The licensee explained during the audit discussions that storage of the trailer mounted diesel driven pump in a protected location where it could be used for this strategy had been considered, but not selected as the permanent storage location due to competing needs for the space. From the staff's current understanding of the licensee's plan for the design basis flood, the remaining "N+1" trailer-mounted, diesel driven FLEX pump would remain unavailable for deployment for up to 72 hours awaiting flood recession. While this could be considered a non-conformance with the guidance of NEI 12-06, Section 6.2.3.2, Consideration 9, NEI 12-06, it has been proposed that the provision of NEI 12-06, Section 11.3.3, that "FLEX mitigation equipment should be stored in a location or locations informed by evaluations performed per Sections 5 through 9 such that no one external event can reasonably fail the site FLEX capability (N)," (Footnote omitted) would render this in conformance with NEI 12-06 as a whole. (The design basis flood would be considered to be an external event that could reasonably fail the spare (+1) capability, but not the site FLEX capability (N).) There is a further interaction with the unavailability controls discussed in Section 3.3.1, below. The licensee has recognized this situation as a vulnerability to the deployment of the pump, but has not identified it as an alternate approach to the guidance of NEI 12-06, as endorsed by JLD-ISG-2012-01 or provided a rationale for how this situation would meet the requirements of Order EA-12-049. This is identified as Open Item 3.1.2.2.A in Section 4.1.

The licensee addressed consideration 3 above during the audit process. The licensee stated that floodwaters could be expected to impact the replenishment of the auxiliary feedwater storage tank (AFWST). In that scenario, the licensee has developed an additional strategy to fill the AFWST by draining water from the feedwater deaerator storage tanks into the AFWST through FLEX strategy piping modifications.

Although the fuel oil supplies are addressed in the Integrated Plan, the reviewer was not able to determine whether access is available to the emergency diesel generator fuel oil storage tanks in the event of flooding (consideration 4 above). The licensee addressed this concern during the audit process by stating that the operators will have access to the diesel generator fuel using a catwalk that is at least 10 feet above maximum postulated flood levels.

The licensee addressed access to mitigating strategy connection points (consideration 5 above) in the Integrated Plan by describing how modification connection points were being protected from the external hazards. The connection points are either protected, or there are alternate access points if a connection point is not protected.

The licensee addressed consideration 6 above, flooding conditions generated by storm driven flooding, during the audit process. The licensee explained that the EAB, the MAB, the DGB the TGB and the IVC are all interconnected with roof walkways. Also, without going below flood level elevation, an operator can traverse between these buildings (no lower than the 55' when not inside the category 1 structures) and therefore, can access all required FLEX equipment no matter what event caused the ELAP. The licensee further stated that the only FLEX equipment

that may be difficult to access would be the diesel driven pumps, stored in two places in the yard area. These pumps will not be required to support a strategy for 3 days, which is considered sufficient time for flood waters to recede and debris removal to commence.

Considerations 7 and 8, power for water extraction pumps, and the potential need for flood barriers were not addressed in the Integrated Plan. The need to address these considerations is identified as Open Item 3.1.2.2.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 deployment 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 73 of the Integrated Plan and as referenced in numerous instances in the plan, the licensee has listed a self-identified open item regarding procedures as follows:

> Open Item #9 - FLEX Support Guideline (FSG) procedure work associated with:
>
> Use of the RRC
> Fuel oil strategy
> Filling SFP
> 125VDC plan (deep load shedding)
> Connecting power to the electrical FLEX equipment (e.g. hookup to breakers)
> FLEX implementing strategies
> Filling AFWST

The future development of procedure guidance for FLEX strategies to address flooding is identified as Confirmatory Item 3.1.2.3.A in Section 4.2.

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

requirements of Order EA-12-049 will be met with respect to procedural interfaces if these requirements are implemented as described.

3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

On page 17 of the Integrated Plan, in the section regarding programmatic controls, the licensee stated that the industry will establish two (2) RRCs to support utilities during beyond design basis events. Each RRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the Strategic Alliance for Flex Emergency Response (SAFER) team and the utility. The licensee has addressed the topic of transporting equipment under adverse conditions during the audit process by stating that alternate routes are available and that air transport will be available if necessary.

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 offsite resources if these requirements are implemented as described.

3.1.3 High Winds

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

The screening for high wind hazards associated with hurricanes should be accomplished by comparing the site location to NEI 12-06, Figure 7-1 (Figure 3-1 of U.S. NRC, "Technical Basis for Regulatory Guidance on Design Basis Hurricane Wind Speeds for Nuclear Power Plants," NUREG/CR-7005, December, 2009); if the resulting frequency of recurrence of hurricanes with wind speeds in excess of 130 mph exceeds 10^{-6} per year, the site should address hazards due to extreme high winds associated with hurricanes.

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

On pages 8 and 9 of the Integrated Plan, in the section regarding the determination of applicable extreme external hazards, the licensee concludes that high wind hazards are applicable to the STP site for hurricanes and tornadoes.

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

3.1.3.1 Protection of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.1 states:

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

all locations.

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

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

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

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

On page 21 of the Integrated Plan, in the section on storage protection related to maintaining core cooling, and similarly in the sections for other safety functions, the licensee stated that the structures housing the two FLEX generator will be designed to provide protection from high winds and wind generated missiles. The 6-month update provided information regarding the storage facilities for trailer mounted diesel driven FLEX pumps. The licensee stated that one pump would be stored within the protected area and the building would not be protected from external events. The second pump would be stored in a similar building and would be located two miles distance from the first pump such that a single external event should not render both storage facilities unavailable. The licensee further stated that the plan would meet the guidelines of consideration 1.b above.

During the audit process, the licensee further stated that storage facilities for the trailer mounted diesel driven FLEX pumps would be protected for consideration 1.a. above and provided adequate separation for consideration 1.b. 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 protection if these requirements are implemented as described.

3.1.3.2 Deployment of FLEX Equipment - High Winds 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 licensee stated during the audit process that water would initially be taken from the refueling water storage tank (RWST) and then recycled from the containment. The water sources described are not susceptible to storm generated debris (consideration 2 above). Considerations 3, 4, and 5 are addressed by the licensee's plan to have two tractors with front-end loaders available to transport equipment and to clear debris.

The licensee's strategy is to store one trailer mounted diesel driven pump in the protected area, but not in a protected structure. The licensee's strategy includes storing a second trailer mounted diesel driven pump at a location 2 miles from the protection area. The licensee believes having two diverse locations will ensure at least one pump will survive. The licensee stated that debris removing equipment will be stored with the FLEX equipment.

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

3.1.3.3 Procedural Interfaces - High Winds Hazard

NEI 12-06, Section 7.3.3, states:

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

Although the Integrated Plan made reference to developing procedures to implement strategies as indicated by a licensee identified open item (OI#9), it is not clear from the information provided that the intent is to address considerations for high winds such as

personnel protection or removing debris. This is identified as Confirmatory Item 3.1.3.3.A in Section 4.2. This procedural issue is common to the high temperature hazard as well and the considerations of high temperature should be part of this Confirmatory Item.

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

3.1.3.4 Considerations in Using Offsite Resources – High Winds 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.

The issue of transporting offsite equipment to the site has been previously discussed and is addressed by the licensee's plan to have alternate routes to the site available and to have air transport capability available.

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

3.1.4 Snow, Ice and Extreme Cold

As discussed in part in NEI 12-06, Section 8.2.1:

All sites should consider the temperature ranges and weather conditions for their site in storing and deploying their FLEX equipment consistent with normal design practices. All sites outside of Southern California, Arizona, the Gulf Coast and Florida are expected to address deployment for conditions of snow, ice, and extreme cold. All sites located North of the 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 9 of the Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that because of the location of the STP site, which is at an approximate latitude of 28° 48' North per the UFSAR, Section 1.2, the hazards of extreme snow, and extreme cold are not applicable. The licensee stated that although *extreme* ice is not applicable to the STP site, the site is located in the zone of Level 3 Severity Level where "Low

to medium damage to power lines and/or existence of considerable amount of ice" should be considered.

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 if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.1 states:

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

As discussed above, extreme snow, and cold are not applicable to the STP site. Based on the storage facilities described by the licensee in the Integrated Plan and during audit process, the reviewer concluded that reasonable protection is afforded for moderate ice hazards. In addition, during the audit process, the licensee stated that ice storms are likely to be predicted and STP would be able to prepare for the event.

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

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

NEI 12-06, Section 8.3.2 states:

There are a number of considerations that apply to the deployment of FLEX equipment for snow, ice, and extreme cold hazards:

1. The FLEX equipment should be procured to function in the extreme conditions applicable to the site. Normal safety-related design limits for outside conditions may be used, but consideration should also be made for any manual operations required by plant personnel in such conditions.

2. For sites exposed to extreme snowfall and ice storms, provisions should be made for snow/ice removal, as needed to obtain and transport FLEX equipment from storage to its location for deployment.

3. For some sites, the ultimate heat sink and flow path may be affected by extreme low temperatures due to ice blockage or formation of frazil ice. Consequently, the evaluation should address the effects of such a loss of ultimate heat sink (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.

As discussed above, extreme snow, and cold are not applicable to the STP site. As noted above, ice storms are likely to be predicted and STP would be able to prepare for the event. In addition, during the audit process, the licensee stated that if ice conditions were to occur, each safety function is protected by a unique strategy that would be unaffected by the ice. Strategies requiring transport of equipment would be slowed considerably by icy conditions but STP has reasonable assurance that primary capability would survive the ice event. Three days into the event, the AFWST would need to be filled using one of the trailer mounted diesel driven pumps. By this time, STP has reasonable assurance that offsite resources would provide dirt or salt to drop on the roads to make them passable. Also well before this time, the RRC will provide similar pumps to the site to perform the same function.

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

As discussed above, extreme snow, and cold are not applicable to the STP site. Because extreme ice is not a concern at STP, the reviewer concluded that development of procedures specific to the ice hazard would not be necessary at STP.

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

NEI 12-06, Section 8.3.4, states:

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

As discussed above, extreme snow, and cold are not applicable to the STP site. As noted previously in this section of the report, STP has provided information related to plans and precautions related to ice conditions, and because severe icing is not an issue at STP, it is reasonable to assume that site access and staging areas would not be a significant impact to access 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 offsite resources if these requirements are implemented as described.

3.1.5 High Temperatures

NEI 12-06, Section 9.2 states:

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

On page 10 of the Integrated Plan in the section regarding the determination of applicable extreme external hazards, the licensee stated that the assessment to determine the applicability of BDB extreme heat hazard was completed in accordance with NEI 12-06, Section 9, "Assess Impact of High Temperatures," which, in Section 9.2, states that "all sites must consider the impact of high temperatures." The licensee concluded that extreme heat is applicable for STP 1 and 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 screening if these requirements are implemented as described.

3.1.5.1 Protection of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

On page 21 and of the Integrated Plan regarding the strategies for maintaining core cooling in the transition phase (Phase 2), and similarly in other sections related to other safety functions, the licensee addressed the storage/protection of equipment from high temperature hazard by stating that all of the storage locations will be evaluated for high temperature effects during the

design phase.

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

Specific information was not provided in the Integrated Plan to demonstrate that high temperature was addressed for deployment of equipment per the guidance of NEI 12-06, Section 9.3.2 considerations noted above. However, the licensee has generated two self identified open items (OI#4 and #9) to track the resolution of storage location, protection, and transportation, and the administrative requirements associated with those elements. Further review, to assure that considerations for high heat are part of the resolution, is identified as Confirmatory Item 3.1.5.2.A in Section 4.2.

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

The Integrated Plan did not discuss procedural enhancements to address the effects of high temperatures on FLEX equipment. However, as noted above, the licensee has generated two self-identified open items to track the resolution of storage location, protection, and transportation, and the administrative requirements associated with those elements. Further evaluation of is required to confirm procedures enhancements address high temperatures. This is combined with previously identified Confirmatory Item 3.1.5.2.A in Section 4.2.

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

requirements of Order EA-12-049 will be met with respect to procedural interfaces if these requirements are implemented as described.

3.2 PHASED APPROACH

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

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

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

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

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

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

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

During the audit, the licensee was asked to discuss its position regarding the ten recommendations identified in the analysis/evaluations performed for the Westinghouse NSSS design and listed in WCAP-17601, Section 3.1. The topics of the recommendations of Section 3.1, and the responses provided by the licensee during the audit process are as follows (numbering from WCAP-17601):

(1) Initiation of cooldown,

> Response - STP plans to initiate an RCS cooldown within one hour of the event. This is sooner than the 2 hours assumed in WCAP 17601-P.

(2) Development of inventory copying time,

> Response - STP does not currently intend to replace the existing RCP seal package with low leakage seals. The current RCP seal package is adequate because the leakage location for the Model 100 pumps at STP is approximately the same elevation as the cold leg centerline, which is approximately 3.15 feet higher than the 93A and 93A-1 pumps assumed in the WCAP 17601-P analysis. A higher elevation results in a transition from liquid to vapor flow at the leakage location occurring sooner, which reduces the water mass loss from the RCS. The site specific analyses will confirm that the current seal package will not result in additional operator burdens. These analyses are expected to be completed by the end of the year.

Regarding the elevation of leakage from the seals of a Model 100 RCP, the NRC staff noted that two-phase leakage would not be expected to occur at the mid-loop elevation on the cold-leg side prior to entry into the reflux condensation cooling mode. Nonetheless, in its review of mitigating strategies for PWRs, the staff has used the transition to reflux condensation cooling as the juncture by which primary makeup should be provided to turn around the ELAP transient with respect to RCS inventory. Therefore, it would appear reasonable to expect that the Model 100 RCP may provide additional margin between the time of entry into reflux cooling and the time of core uncovery when compared to other RCP designs.

(3) Instrumentation required for confirming/maintaining core cooling,

> Response - STP has incorporated the instruments identified in Section 3.4 of WCAP-17601-P that are needed for STP's strategies, and the instrumentation is aligned with the guidance provided in the Pressurized Water Reactor Owners Group's (PWROG's) ELAP instrumentation recommendation from the generic FLEX support guideline and interfaces white paper (Revision 0, December 2012).

(4) Sub-criticality study,

> Response - For maintaining a subcritical condition in the reactor core, it is recommended that a set of curves be developed on a plant specific basis based on the realistic conditions cited in WCAP-17601-P. STP will incorporate the recommended curves into plant procedures for the ELAP event.

5) Maintaining adequate core cooling and shutdown margin,

Response - The FLEX RCS make up pump will either be the in-place positive displacement pump with a rating of 35 gallons per minute (gpm) at 3200 pounds per square inch gage (psig) or a FLEX pump with a rating of 40 gpm at 700 psig. Since STP has a safety grade letdown system using the reactor vessel head vent system, a lower pressure RCS makeup pump is justified. The ability of these pumps to provide sufficient makeup flow will be demonstrated by plant specific analyses, scheduled to be completed by the end of the year 2013.

(6) The use of Shield® Passive Thermal Shutdown Seal (SDS)/low leakage seal,

Response - STP does not plan to use SDS or low leakage seals at this time.

(7) Feedwater interruption times,

Response - The ELAP strategies that were developed for the industry by the PWROG will be utilized during the development of STP site-specific ELAP procedures. The generic guidance recognizes the importance of feedwater strategies and maintaining an adequate heat sink. Diagnostic steps per the PWROG guidance will be included in the STP emergency operating procedure (EOP) for a loss of all ac power to maintain the proper priority to minimize any interruption in feed flow to the SGs. The PWROG also provides guidance for staging FLEX equipment to minimize interruption when the TDAFWP steam pressure is no longer sufficient to provide a motive force for the pump. Section 5.4.1.1 of WCAP-17601-P provides generic steam generator dry out times at various times in an ELAP Event. The reference case has a steam generator liquid mass to thermal power ratio of approximately 106 lbm/MW. This same ratio at STP is approximately 148 lbm/MW. Therefore, the steam generator dry out times presented in the WCAP bound STP.

(8) Feeding a single SG,

Response - STP is sizing the portable FLEX RCS core cooling pump to deliver 300 gpm at 500 psig. EOPs will provide guidance to the operator during an ELAP event to perform a symmetric cooldown and deploy any needed FLEX equipment.

The reviewer noted that the Integrated Plan is in conflict with this information as it states these pumps are expected to deliver 300 gpm at 400 psig. Nonetheless, as discussed further below, the future demonstration of the adequacy of this pump's capability is addressed by Confirmatory Item 3.2.1.9.C in Section 4.2 of this report.

(9) Prevention of nitrogen injection from accumulators,

Response - STP will only utilize the emergency core cooling system (ECCS) accumulator volume that would inject, based on the current EOP setpoint for not allowing nitrogen injection. STP does not plan to ensure all ECCS accumulator water is injected since STP does not have wide range ECCS accumulator water level instrumentation. STP will commence a cooldown within one hour of the initiation of the ELAP event to a setpoint that ensures nitrogen injection will not occur. Steam generator pressure will be maintained until power to the ECCS accumulator isolation valves becomes available. At this time the ECCS

accumulator isolation valves will be closed. The FLEX RCS makeup pump will be used, when available, to restore RCS water inventory and borate the RCS. The RCS cooldown will recommence and RCS pressure will be reduced until the RCP seal water return header relief valve (PSV3200) reseats (i.e., at an expected RCS pressure of 135 psig), terminating the seal leakage. This condition will be maintained until residual heat removal (RHR) or other means of core cooling can be placed in service.

The licensee's response did not fully address the methodology that would be used to ensure that nitrogen injection from the accumulators would not occur. In Attachment 1 to the PWROG's interim core cooling position paper, a methodology accounting for containment heatup, instrument uncertainties, and other factors, was specified to ensure the selection of a final steam generator pressure that would prevent nitrogen injection. It was not made clear during the audit whether the licensee plans to follow this approach or is planning to use an alternate approach. Therefore, the NRC will need to confirm that the licensee will (1) use the methodology in Attachment 1 to the PWROG's interim core cooling position paper or (2) specify an alternate method for preventing nitrogen injection and demonstrate its acceptability. This is identified as Confirmatory Item 3.2.1.A in Section 4.2 below.

(10) Cooldown limits on SGs.

Response - STP's FLEX support guidelines will address ECCS accumulator isolation in the event RCS pressure cannot be maintained. This guidance will be consistent with the PWROG FLEX guidance.

During the audit, the licensee was requested to discuss the means of operation for the steam generator PORVs. The licensee stated that

> STP's SG PORVs use class 1E DC for control power and 480V class 1E power for the hydraulic pump. There is enough hydraulic pressure in the accumulator for 1 1/2 full strokes of the valve. On loss of hydraulic pressure the valve fails as is & hydraulic pressure can be manually increased locally at the PORV for more remote operations from the control room.

The licensee further noted that

> Local manual operation of the SG PORV will not be necessary unless class 1E DC is lost.

The above discussion did not affirm whether remote operation of the PORV would be implemented such that the available hydraulic pressure in the PORV accumulators would be sufficient without local operator actions to increase the available pressure. Therefore, the licensee should confirm (1) that remote operation of the steam generator PORVs will be implemented in a manner that will conserve the available hydraulic pressure such that the PORVs can be remotely operated to the extent necessary to perform the cooldown called for in the integrated plan without local actions, (2) that local manual actions can be taken to increase the hydraulic pressure to permit further remote operation of the PORVs consistent with the integrated plan or (3) that direct local operation of the PORVs can be accomplished consistent with the integrated plan. This is identified as Confirmatory Item 3.2.1.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 successful resolution of the Confirmatory Items identified above, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to implementing the WCAP-17601, Section 3.1 recommendations for Westinghouse plants if these requirements are implemented as described.

3.2.1.1 Computer Code Used for the ELAP Analysis

NEI 12-06, Section 1.3 states:

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

During the audit, the licensee was requested to specify which analysis performed in WCAP-17601, or alternate analysis, is being applied to STP. The licensee responded by stating that STP will be performing plant-specific analyses to evaluate the reactor coolant system and containment thermal-hydraulics and core reactivity during an ELAP event. The licensee further stated that the analyses were being performed using RETRAN-3D computer code and that the analyses are expected to be complete by the end of 2013.

RETRAN-3D is a general-purpose, industry-developed thermal-hydraulic code that is based on the one-dimensional homogenous equilibrium model (the "-3D" appellation refers to the code's capability for three-dimensional neutron kinetics). As documented in its safety evaluation of the Electric Power Research Institute's topical report NP-7450(P), Revision 4, the NRC staff has reviewed the RETRAN-3D code and deemed its use acceptable, under specified limitations and conditions, for performing licensing-basis analysis of transients other than loss-of-coolant accidents.

Because the licensee's proposed application of the RETRAN-3D code for ELAP analysis would be beyond the scope of the staff's prior review, the NRC staff discussed the application of this code for ELAP analysis with the licensee during the audit. The licensee also recognized the necessity of providing additional justification for the application of the RETRAN-3D code to support its use for ELAP analysis. In particular, the licensee agreed to provide a white paper documenting the applicability of RETRAN-3D for ELAP analysis which would contain the following information:

(1) A comparison of predicted results for the ELAP transient using the RETRAN-3D code to predictions generated by the RELAP5-MOD3.3 code following the conversion of the RETRAN-3D input deck to a format compatible with RELAP5-MOD3.3. The white paper would include a comparison of the timing of key events in the transient and plots of key parameters.
(2) References to validate RETRAN-3D models for key phenomena associated with the prediction of the ELAP transient, including heat transfer in two-phase flow regimes, the drift flux model, evaporation and condensation, two-phase level swell, and natural circulation.

(3) A summary of the limitations and conditions specified in the NRC staff's safety evaluation on RETRAN-3D, and a description of how the ELAP analysis performed for STP complies therewith.
(4) Additional validation work that was not available during the NRC review of topical report NP-7450(P), Revision 4, for newer RETRAN-3D models applicable for the ELAP event.

The licensee further stated that it did not intend to credit the RETRAN-3D analysis past the transition to reflux condensation cooling.

Based upon the information provided by the licensee, summarized above, the NRC staff agreed to consider the licensee's white paper regarding the proposed use of RETRAN-3D for ELAP analysis. During the discussion, the staff provided suggestions regarding specific information to include in the RETRAN-3D white paper and stated the following:

(1) The expected scope of the review effort for RETRAN-3D would likely be comparable to that for the application of the CENTS code for ELAP analysis.
(2) RETRAN-3D code manuals applicable to the code version used to perform the analysis for STP should be made available to the NRC staff.
(3) Given the importance of demonstrating adequate agreement between RETRAN-3D and RELAP5-MOD3.3 (or comparable thermal-hydraulic codes), the staff may request input decks for the RETRAN-3D and/or RELAP5-MOD3.3 models used to perform confirmatory simulations of the ELAP transient for STP.

In light of the discussion above, the licensee should address the following thermal-hydraulic code and analysis issues to support the demonstration of the effectiveness of its mitigating strategy:

(1) Demonstrate the applicability of the RETRAN-3D code for analysis of the ELAP transient. This is identified as Open Item 3.2.1.1.A in Section 4.1, below.

(2) Provide analysis of the ELAP transient that is applicable to STP and which demonstrates the adequacy of the mitigating strategy proposed for STP. This includes specification of an acceptable definition for the transition to reflux condensation cooling to ensure that the analysis is not credited beyond this juncture. A sufficient number of cases should be included in the analysis to demonstrate the acceptability of different strategies that may be necessary to mitigate an ELAP (e.g., as discussed further below in Section 3.2.1.6, in some cases "N" and "N+1" pumps have different capabilities, which could substantially affect the sequence of events in the integrated plan). This is identified as Open 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 Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the computer code 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 ELAP, cooling to the RCP seal packages will be lost and water at high temperatures may degrade seal materials leading to excess seal leakage from the RCS. Without ac power available to the ECCS, 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.

On page 3 of the integrated plan, the licensee made reference to an assumed 21 gpm leak from each seal package, consistent with the assumptions of WCAP-17601-P, Section 4.2.2. Based on its review of the licensee's integrated plan, the NRC staff identified a number of issues for the licensee to address during the audit process. A summary of the issues and the responses provided by the licensee is presented below:

a. WCAP-17601, Table 5.3.1.7-1, "Calculated Core Uncovery Time for Westinghouse NSSS Plants," lists six Westinghouse plant design categories for which the core uncovery times were calculated. All of these calculations were based upon an RCP seal leakage rate of 21 gpm. Each of these plant designs utilize either a Model 93 or Model 93A RCP design, except for the South Texas plant design, which is equipped with Model 100 pumps. Justify the 21 gpm RCP seal leak rate assumption for the Model 100 RCPs.

Response: This issue is currently being addressed generically by the PWROG group. STP anticipates that a RCP seal leakage of 21 gpm will be justified.

b. Discuss how the pressure-dependent RCP seal leakage rates are calculated. If the analysis uses the equivalent size of the break area based on the initial total RCP leakage rate and a specific flow model to calculate the pressure-dependent RCP seal leakage rates during the ELAP, discuss and justify the flow rate model used. Discuss whether the size of the break area is changed or not in the analysis for the ELAP event. If the size is changed, discuss the changed sizes of the break area and address the adequacy of the sizes. If the break size remains unchanged, address the adequacy of the unchanged break size throughout the ELAP event in conditions with various pressure, temperature (considering that the seal material may fail due to an increased stress induced by cooldown) and flow conditions that may involve two-phase flow which is different from the single phase flow modeled for the RCP seal tests that are used to determine the initial total RCP seal leakage rate assumed in the ELAP analysis.

Response: The RCP seal leakage rates are calculated using the Henry-Fauske critical flow model. The RCP seal leakage area assumed in the calculation is based on a 21 gpm flow rate for each pump at the RCS cold leg conditions at normal full power conditions (560 degrees F and 2235 psig). The calculation does not take credit for pressure drops across the RCP seal leakage line. While the RCP seal leakage rate decreases as the RCS pressure decreases, the RCP

seal leakage area remains constant throughout the event. In the event, the collapsed water level decreases below the elevation where the RCP seal leak is occurring (centerline of the cold leg), the Moody critical flow model is used to calculate the vapor flow rate. The adequacy of the unchanged break size is being addressed generically by the PWROG.

Discussion with the licensee during the audit confirmed that the Henry-Fauske critical flow model is used in RETRAN-3D for single-phase liquid leakage. As noted earlier, the staff does not expect that two-phase leakage from the reactor coolant pump seals will occur prior to the transition to reflux cooling. This expectation will need to be confirmed through a future review of the results of the licensee's RETRAN-3D simulation results. This is identified as Confirmatory Item 3.2.1.2.A in Section 4.2 below.

As noted by the licensee, the assumption of a constant seal leakage area is being addressed generically by the PWROG. Confirmation of the acceptability of this assumption in light of the potential for increased stresses on seal materials during cooldown is identified as Confirmatory Item 3.2.1.2.B in Section 4.2 below.

c. Section 4.4.1 of WCAP-17601 states, in part, that, "The NRC Information Notice (IN) 2005-14 has accepted the use of a 21 gpm assumption in deterministic analyses to develop coping analyses to show compliance with Appendix R. Given that the 50.63 station blackout (SBO) transient is similar with regard to seal performance, the 21 gpm should also be acceptable for developing ELAP strategies; this has not been called into question by the NRC in inspections (e.g., Component Design Basis Inspections)." Address the applicability of the following statements from IN 2005-14 to the ELAP analysis:

(i) It is stated in IN 2005-14 that, "For the Westinghouse RCP seals, as discussed in a recently submitted document on RCP seal performance, a leakage rate of 21 gpm per RCP may be assumed in the licensee's safe shutdown assessment following the loss of all RCP seal cooling. Assumed leakage rates greater than 21 gpm are only warranted if the increase seal leakage is postulated as a result of deviations from seal vendor recommendations."

(ii) It is also stated in IN 2005-14 that, "Even if seal cooling is not reestablished, degradation of the seals for leakage rate to significantly increase is not expected for an indefinite period of time if the RCPs are secured before the seal temperature exceeds 235 degrees F. Restoration of seal cooling may result in cold thermal shock of the seal and possibly cause increased seal leakage."

Response: STP procedures conform to the vendor seal recommendations.

d. Section 4.4.1.1 of WCAP-17601 states that "… In some plant designs, such as those with 1200 to 1300 psia SG design pressures and no accumulator backing of the main steam system PORV actuators, the cold legs could experience temperatures as high as 580 degrees F before cooldown commences." It further states that "this is beyond the qualification temperature [550 degrees F] of the O-rings but it is judged that the O-rings will remain intact for at least several hours at this temperature and normal operating pressure." Address the applicability of the above statements to the ELAP analysis, and justify that the integrity of the associated O-rings will remain for a specified time period.

Response: During an ELAP event, the SG PORVs will fail closed, resulting in the steam generator pressure increasing to the first safety relief setpoint of 1285 psig. This could result in the RCS cold legs experiencing temperatures as high 582 degrees F, which is above the currently documented test results of 550 degrees F. Currently the operators are directed to control steam generator pressure between 1180 and 1190 psig. This action could take as long as 20 minutes to implement. This would reduce the RCS cold leg temperatures to approximately 567 degrees F. STP anticipates that additional testing by Westinghouse will demonstrate that the O-rings will be able to withstand temperatures as high as 582 degrees F for an eight hour period. STP anticipates the Westinghouse testing will be completed by the end of year.

e. The NRC staff questioned if STP would be using the RCP safe shutdown/low leakage seals, and if so, posed questions related to their use.

Response: STP does not have the SHIELD shutdown seal modification.

f. This NRC issue was related to Combustion Engineering plant designs and is not applicable to the STP site.

Response: No response required.

g. Provide the manufacturer's name and model number for the reactor coolant pumps and the reactor coolant pump seals. Discuss whether or not the reactor coolant pump and seal combination complies with a seal leakage model described in WCAP-17601.

Response: The two units at STP are four loop plants. Each loop was a Westinghouse Model-11013-A (M100A) Reactor coolant pump. These pumps and seals comply with the description provided in section 4.4.1 of WCAP-17601.

h. Confirm that the primary ELAP strategy is to perform a "symmetric" cooldown using all RCS loops.

Response: The STP strategy is to perform a "symmetric" cooldown using all RCS loops.

i. Confirm that load shed activities will not interfere with required valve positioning or operator action capability that may be credited in establishing ELAP response strategies, including specifically those actions related to isolating RCS leakage paths, including the CBO.

Response: STP loss of all AC power procedure currently has a load shedding requirement which will extend battery life at least four hours. The current procedure dispatches an operator to any valves that need to be repositioned. Any additional load shedding due to an ELAP should occur within two hours from the loss of all AC. Any current procedural requirements for valve manipulation should be completed prior to the additional load shedding. When the procedure for dc management during an ELAP is written, then the impact on the loads that will be stripped will be evaluated and appropriate compensatory guidance will be provided in the procedure if needed.

Additional information provided by the licensee during the audit further clarified that the means for isolating RCP seal leakage does not directly involve operator actions to reposition valves, but rather involves depressurizing the reactor coolant system to a pressure of approximately 135 psig, whereupon a relief valve on the seal leak-off line is designed to reseat.

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

- WCAP-17601-P, Revision 1, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs" dated January 2013 (ADAMS Accession No. ML13042A011 and ML13042A013 (Non-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 reviewing these submittals, the NRC staff placed certain limitations on Westinghouse-designed plants with respect to RCP seal leakage rates. Those limitations and their applicability are discussed below in light of design-specific information pertaining to the reactors at STP:

(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.

    Based upon the information provided during the audit, the licensee intends to comply with this limitation by assuming a seal leakage rate at normal pressure and temperature conditions of 21 gpm per RCP.

(2) In some plant designs, such as those with 1200 to 1300 psia SG design pressures and no accumulator backing of the main steam system power-operated relief valve (PORV) actuators, the cold legs could experience temperatures as high as 580 ^{0}F before cooldown commences. This is beyond the qualification temperature (550 ^{0}F) of the O-rings used in the RCP seals. For those Westinghouse designs, a discussion of the information (including the applicable analysis and relevant seal leakage testing data) should be provided to justify that (1) the integrity of the associated O-rings will be maintained at the temperature conditions experienced during the ELAP event, and (2) the seal leakage rate of 21 gpm/seal used in the ELAP is adequate and acceptable.

Based upon the information provided during the audit, the licensee is aware of the need to address the performance of RCP seal O-rings at increased temperatures that bound conditions expected for STP during an ELAP. However, industry testing to determine O-ring performance at increased temperatures has not been completed. Pending demonstration of adequate O-ring performance under conditions that bound STP, this issue is designated as Open Item 3.2.1.2.C.

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

Based upon the information provided during the audit, the licensee is not planning to install low-leakage seals at STP as part of its ELAP mitigating strategy.

(4) If the seals are changed to the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals, the acceptability of the use of the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals should be addressed, and the RCP seal leakages rates for use in the ELAP analysis should be provided with acceptable justification.

Based upon the information provided during the audit, the licensee is not planning to install low-leakage seals at STP as part of its ELAP mitigating strategy.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01 and subject to the successful closure of issues related to the Open and Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to RCP 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 pages 18 and 19 of the integrated plan describing Phase 1 core cooling and heat removal, and on page 20 of the plan describing Phase 2 core cooling and heat removal, the licensee describes the sequence of actions to be taken to provide cooling water to the core following an ELAP event. These actions and their sequence and timing are dependent on the decay heat rate that is modeled in the thermal hydraulic analysis.

During the audit, the NRC staff requested that the licensee address the applicability of Assumption 4, on page 4-13 of WCAP-17601, which indicates that decay heat is per ANS 5.1-1979 + 2 sigma, or equivalent. Also, if the ANS 5.1-1979 + 2 sigma model is used in the ELAP analysis, the licensee was requested to provide the range within which the decay heat model is applicable for the following key parameters: (1) initial power level, (2) fuel enrichment, (3) fuel burnup, (4) effective full power operating days per fuel cycle, (5) number of fuel cycles, if hybrid fuels are used in the core, and (6) fuel characteristics (addressing whether they are based on the beginning of the cycle, middle of the cycle, or end of the cycle). The licensee responded that the STP plant specific analysis applies a multiplier to the ANS 5.1-1979 decay heat curves used for the design basis events where maximum decay heat is limiting. The site specific analyses assume the event is initiated from the nominal full power of 3853 MWth. The reload safety evaluation process ensures that the multiplier bounds; (1) fuel enrichment, (2) fuel burnup, (3) effective full power operating days per fuel cycle, (4) number of fuel cycles, if hybrid fuels are used in the core, and (5) fuel characteristics for each fuel cycle.

The staff did not consider the licensee's response to be completely adequate in that the value of the multiplier applied to the ANS 5.1-1979 decay heat standard for the ELAP event and its basis were not specified. As such it was not clear whether the multiplier would be capable of accounting for the residual heat contribution from actinides (e.g., plutonium, neptunium) and neutron absorption in fission products, or whether these residual heat sources were accounted for explicitly. Furthermore, the response did not clarify whether the discussion applies to the RETRAN-3D thermal-hydraulic analysis or whether it applies to auxiliary calculations (e.g., the determination of steam generator makeup required during various phases of the ELAP coping analysis). The resolution of the above issues is designated Confirmatory Item 3.2.1.3.A 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 Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to decay heat removal 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 sequence of events (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.

As noted previously in Section 3.2.1.1 of this report, the site-specific analyses for STP will be performed using the RETRAN-3D computer code. Because this analysis has not been completed, the initial values for key plant parameters and analytical assumptions cannot be evaluated in full at the present time. However, the licensee's integrated plan submittal does reference a number of assumptions that are consistent with Section 3.2 of NEI 12-06, including the statement that analytical assumptions are consistent with those detailed in NEI 12-06, Section 3.2.1. Based on the discussion above, the licensee should confirm that the key initial plant parameters and assumptions used in the forthcoming RETRAN-3D analysis

are consistent with the appropriate values from NEI 12-06, Section 3.2, or justify deviations therefrom. This is identified as Confirmatory Item 3.2.1.4.A 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 referenced Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to initial values and assumptions if these requirements are implemented as described.

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states in part:

> The parameters selected must be able to demonstrate the success of the strategies at maintaining the key safety functions as well as indicate imminent or actual core damage to facilitate a decision to manage the response to the event within the Emergency Operating Procedures and FLEX Support Guidelines or within the severe accident management guidelines (SAMGs). Typically, these parameters would include the following:
>
> - SG Level
> - SG Pressure
> - RCS Pressure
> - RCS Temperature
> - Containment Pressure
> - SFP Level
>
> The plant-specific evaluation may identify additional parameters that are needed in order to support key actions identified in the plant procedures/guidance or to indicate imminent or actual core damage.

On page 19 of the Integrated Plan, in the section regarding Phase 1 core cooling strategy, the licensee provides the following list of instrumentation required for coping strategies:

- SG Wide Range (WR) levels
- SG pressures
- AFW flow
- RCS pressure
- RCS T_{colds} [cold leg temperature]
- AFWST level
- Extended Range Nuclear Instrumentation System
- RCS T_{hots} [hot leg temperature]
- Core exit thermocouples

On page 27 and 36 of the Integrated Plan, in the sections regarding Phase 1 RCS inventory control and maintaining containment, respectively, the licensee added the following instruments to those already listed above:

- Pressurizer level
- Reactor vessel water level

- Reactor water storage tank level
- RCS wide range pressure
- Reactor containment building wide range sump level
- Reactor containment building pressure

The instrument lists provided are consistent with guidance provided in NEI 12-06.

During the audit process, the NRC staff requested additional information from the licensee regarding containment instrumentation. The NRC staff requested that the licensee justify that the instrumentation listed, and the associated setpoints credited in the ELAP analysis for automatic actuations and indications required for the operator to take appropriate actions, are reliable and accurate in the containment harsh conditions with high moisture level, temperature and pressure during ELAP. In responding to this concern, the licensee provided details of the analysis being used at STP to provide confidence the instrumentation would be functional throughout the ELAP event. Section 3.2.3 of this report will provide greater detail of the containment analysis information. Resolution of the concern regarding survivability and proper function of containment instrumentation is dependent on results of the containment analysis and is identified as Confirmatory Item 3.2.1.5.A in Section 4.2 below.

The licensee also described its plan for investigating use of RCS pressure wide range indication for ensuring that nitrogen injection from the cold leg accumulators will not occur. Although noting that the associated pressure transmitter was located outside containment, the licensee did not provide sufficient information during the audit to justify that the RCS wide range pressure indication would not be influenced by containment conditions to an extent that would affect a reliable determination of nitrogen injection from the cold leg accumulators. This is identified as Confirmatory Item 3.2.1.5.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 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.

The licensee presented a sequence of events on pages 54 through 58 of the integrated plan in Attachment 1A. This timeline reflected information available at the time the integrated plan was submitted. However, as discussed in Section 3.2.1.1 and 3.2.1.2 of this report, there are unresolved issues regarding the thermal-hydraulic analyses, RCP seal leakage rates, and other areas that can affect the development of this timeline. The licensee also stated during the audit that the timeline would be modified if necessary, based on the results of RETRAN-3D analyses.

The staff further observed that, regardless of the thermal-hydraulic code relied upon by the licensee, the sequence of events on pages 54 through 58 of the integrated plan submittal would apparently require modification. The original sequence of events appears to be based on the

generic industry strategy for PWRs, whereas the strategy outlined during the audit reflects a modified version of the generic approach that includes plant-specific considerations applicable to STP.

In particular, the licensee discussed during the audit a two-stage process for depressurizing the reactor. The initial depressurization would apparently be similar to that specified in the generic industry strategy; however, a subsequent depressurization would be carried out, when supportable, in an effort to arrest the leakage from the reactor coolant pump seals. This additional depressurization may affect (and be affected by) the timeline for actions to borate the reactor coolant system, vent the reactor coolant system, isolate accumulators to prevent nitrogen injection, and other actions in the existing sequence of events timeline.

The NRC staff further observed during the audit that the licensee may in fact require more than one sequence of events for ELAP mitigation. A unique aspect of the mitigation strategy for STP is that redundant equipment intended to fulfill a given function in the ELAP mitigation strategy may have different capabilities (e.g., different pumps with different capabilities fulfilling the “N” and “N+1” redundancy guidelines). Thus, depending on the specific pieces of equipment that survive the ELAP initiating event, different sequences of events may be called for in the mitigating strategy.

For example:

- Depending upon the availability of the chemical and volume control system positive displacement pump, the licensee recognized during the audit the need to explicitly consider the need for RCS venting capability to facilitate boration via the FLEX RCS makeup pump to achieve adequate shutdown margin for the reactor. However, an action for establishing an RCS vent had not been presented in the sequence of events in the integrated plan submittal.

- With regard to steam generator makeup, if the “N+1” FLEX RCS core cooling pump is not available to mitigate a given event, steam generator depressurization would eventually be required to a pressure below that discussed in the integrated plan submittal, to permit injection of the trailer-mounted diesel-driven pumps. Clearly, RCS inventory and shutdown margin calculations could be substantially affected by the unavailability of the “N+1” RCS core cooling pump.

Therefore, based upon our review during the audit, the staff concluded that further development of the sequence of events for mitigating an ELAP event would be necessary for STP. This further development should include significant contingencies (as applicable) to account for variants in strategy that depend on the availability of certain pieces of mitigating equipment; alternately, multiple sequences of events may be provided that explicitly reflect significant strategy variants whose selection depends on the availability/unavailability of certain pieces of mitigating equipment. Further development of the final timeline(s) and sequence(s) of events for STP will be required and is identified as Open Item 3.2.1.6.A in Section 4.2. Also, as previously captured under Open Item 3.2.1.1.B, above, a sufficient number of analysis cases is needed to demonstrate the successfulness of the different mitigation strategy variants for scenarios where variations in mitigating equipment availability substantially affects the sequence of events in the mitigation strategy.

The licensee’s approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful

closure of issues related to the Open Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the sequence of events if these requirements are implemented as described.

3.2.1.7 Cold Shutdown and Refueling

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

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

The generic concern related to shutdown and refueling requirements is applicable to STP. This generic concern has been resolved via the submittal of an NEI position paper entitled "Shutdown/Refueling Modes" (ADAMS Accession No. ML13273A514), which has been endorsed by the NRC in a letter dated September 30, 2013 (ADAMS Accession No. ML13267A382).

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

During the audit process, the licensee informed the NRC of their plans to abide by this generic resolution.

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

3.2.1.8 Core Sub-Criticality

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

> All plants provide means to provide borated RCS makeup.

In the sequence of events timeline on page 56 of the integrated plan, the licensee indicated that plant operators will complete the cooldown of the RCS at an elapsed time of four hours and proceed to maintain a constant SG pressure. Based on additional information provided by the licensee during the audit, it appears that a further depressurization of the RCS to approximately 135 psig is planned to support reseating of the relief valve on the reactor coolant pump seal leak-off line. As noted by the licensee, the capability to cool down the RCS depends on injecting an adequate quantity of boric acid to maintain the core in a subcritical state.

The NRC staff reviewed the licensee's integrated plan and determined that a generic concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the reactor coolant system (RCS) under natural circulation conditions potentially involving two-phase flow was applicable to STP.

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. The NRC staff concluded that the August 15, 2013, position paper was not adequately justified and has not endorsed this position paper.

STP has informed the NRC of its intent to use the RETRAN-3D analysis and stated that the RETRAN-3D model assumes perfect mixing of boric acid. During the audit, the licensee stated the following restriction that would be placed on modeling boric acid mixing, which appeared to have been derived in part from previous discussion between the NRC staff and PWROG:

> While in single phase flow, credit for boron is not taken until one hour after the target boron concentration has been reached. While in two phase flow, credit is not taken for boron unless the liquid velocity is greater than the single phase liquid velocity, after which boron credit is not applied for one hour after the target boron concentration has been reached.

The NRC staff considers the licensee's proposed treatment of boric acid mixing during single-phase natural circulation flow to be reasonable based upon comparison to data from past tests of boric acid mixing under single-phase natural circulation flow conditions that is referenced in the August 15, 2013, position paper. However, the wording of the licensee's proposed treatment of boric acid mixing under two-phase flow conditions is not sufficiently clear to the staff. Resolution of issues concerning boric acid mixing under two-phase natural circulation flow conditions in the reactor coolant system remains a topic of discussion between the NRC staff and industry. Considering the information and analysis presented on behalf of the industry at the present time (e.g., the August 15, 2013, position paper referenced above), the staff would find the following position on boric acid mixing under two-phase natural circulation flow conditions to be acceptable:

> (1) Adequate borated makeup is provided such that the natural circulation flow in each loop under two-phase conditions does not decrease below the loop flow rate corresponding to single-phase natural circulation. In this case, it is permissible to credit uniform mixing of the boric acid one hour after the targeted quantity of boric acid has been added to the reactor coolant system.
>
> (2) If loop flow during two-phase natural circulation has decreased below the single-phase natural circulation flow rate, then the mixing of any borated primary makeup added to the reactor coolant system is not to be credited until one hour after both of the following conditions have been satisfied:
>
> (a) the flow in all loops has been restored to a flow rate that is greater than or equal to the single-phase natural circulation flow rate, and
>
> (b) the targeted quantity of boric acid has been added to the reactor coolant system.

The licensee's proposed treatment of boric acid mixing appears to be similar to the position recommended by the NRC staff, but the intent of the licensee's wording cannot be conclusively interpreted by the staff. Therefore, to avoid ambiguity, the staff has designated Confirmatory

Item 3.2.1.8.A for the licensee to either (1) confirm that it will abide by the position expressed by the NRC staff above, or (2) identify another acceptable method for ensuring that the boric acid necessary to achieve adequate shutdown margin to mitigate an ELAP event will be adequately mixed with the reactor coolant system volume under two-phase natural circulation flow conditions.

The licensee stated that site-specific analyses showing that the core will remain subcritical during an ELAP event will be completed by the end of the year. Completion of this analysis and demonstration of adequate shutdown margin is identified as Confirmatory Item 3.2.1.8.B in Section 4.2.

During the audit, the licensee noted that no credit for xenon in excess of its equilibrium concentration would be credited for the first 23 hours following reactor trip. Although this value may be reasonable, its basis was not adequately documented during the audit. Therefore, the staff designated Confirmatory Item 3.2.1.8.C for the licensee to provide adequate basis that the core xenon concentration would remain above its equilibrium value for at least 23 hours post-trip.

During the audit, the licensee also noted that the current upper head design moved the control rod shutdown banks inboard, resulting in significantly increased shutdown margin. However, the magnitude of this value, relative to the typical cycle-to-cycle variation in shutdown margin requirements, was not clear to the NRC staff. As such, the staff considers it prudent that the licensee commit to verifying during the reload process that shutdown margin requirements for future operating cycles remain bounded by the calculation for Unit 1, Cycle 14. This is identified as Confirmatory Item 3.2.1.8.D.

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 core sub-criticality if these requirements are implemented as described.

3.2.1.9 Use of Portable Pumps

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

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

plant specific analysis to ensure sufficient quantities are available as well as to address delivery capabilities.

NEI 12-06 Section 11.2 states in part:

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

NEI 12-06, Section 3.2.2, includes the following paragraph on page 23 following Guideline (15) with regard to the quantity of equipment necessary:

> 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.

The information presented in the Integrated Plan regarding the FLEX pumps has been updated with information provided during the audit process. The use of FLEX pumps was explained during the audit process as follows:

> For core cooling, the N pump is the new FLEX RCS Core Cooling pump (300 gpm @ 500 psig). This pump will be located in the IVC on the 10 foot elevation in a room that is protected from flooding as well as all other design basis external events. The +1 pump for is the trailer mounted diesel driven pumps.
>
> For RCS makeup, the licensee credits the installed plant chemical volume control system positive displacement pump (CVCS PDP) as the N pump and the +1 pump is the FLEX RCS Makeup pump prestaged in the fuel handling building (FHB).
>
> For SFP makeup, the licensee credits the installed plant reactor makeup water pump as the N pump and the +1 pump is the FLEX SFP Makeup pump prestaged in the FHB.

The licensee has identified the STP on-site permanent CVCS PDP and the reactor makeup water pumps as "N" pumps for mitigating strategies. The Integrated Plan does not identify whether the CVCS and its necessary supporting systems are robust and reasonably protected.

This issue is identified as Confirmatory Item 3.2.1.9.A in Section 4.2.

The licensee further stated during the audit response "all these N pumps will be pre-staged in Category 1 structures, protected from all external events." However, the licensee has previously stated that the storage of the trailer-mounted diesel driven pumps was in non-Category 1 buildings physically separated to assure survivability of at least one pump. Resolution of this apparent conflict is identified as Confirmatory Item 3.2.1.9.B in Section 4.2.

There are a number of pumps identified for use in the mitigation strategies and these uses involve various configurations of pumps, hoses, pipe runs and connection hardware to facilitate the implementation of coping strategies. However, insufficient information has been provided to demonstrate reasonable assurance of conformance to the guidelines of NEI 12-06, Section 11.2, regarding calculations and analyses to verify adequate flow would be delivered to meet strategy objectives. During the audit process, the NRC staff requested that the licensee provide the following information regarding the FLEX pumps:

> (a) Provide information to show that deployment of the portable pumps can be completed within the associated time constraint. The deployment will require portable pump installation which should be started prior to the time constraint with enough margins to ensure strategy success.
>
> (b) Discuss how the required capacity (i.e., flow rate and corresponding pump head) of each of the listed pumps is determined. The requested information should include a discussion and justification of methods and assumptions used for determining the required pump capacity.
>
> (c) Provide information to show that the required capacity of each of the above portable pumps is sufficient for use in maintaining core cooling and sub-criticality during an ELAP event.

The licensee responded to these requests for information by stating the following: STP plans to make the FLEX RCS makeup and core cooling pumps available within 10 hours of the initiation of the ELAP event. The FLEX RCS makeup pump will either be the in-place positive displacement pump with a rating of 35 gpm at 3200 psig or a pump with a rating of 40 gpm at 700 psig. The FLEX RCS core cooling makeup pump will be capable of delivering 300 gpm at 500 psig. The licensee further stated that these pumps have been sized and deployment time determined to ensure that (1) reflux cooling will not occur, (2) the RCS makeup flow will exceed the RCP seal leak off and be able to restore pressurizer water level, (3) sufficient boron is provided to prevent a return to power and (4) decay heat removal is assured. The ability of these pumps to provide sufficient makeup flow in the required time frame will be demonstrated by plant specific analyses, scheduled to be completed by the end of the year. The evaluation of the results of the analyses is identified as Confirmatory Item 3.2.1.9.C in Section 4.2.

The guidance provided in NEI 12-06 specifies using installed plant equipment during phase 1 until deployment of portable equipment in phase 2. Licensees should have “N” sets of portable FLEX equipment to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities. In addition, the guidance specifies having “N+1” sets of equipment to ensure at available of “N” sets.

- NEI 12-06 provides guidance in Appendix ”D” on repowering charging pumps. The licensee is deviating from this guidance by specifying the “N” set as installed plant equipment, instead of specifying portable equipment.

- NEI 12-06 does not specifically delineate use of installed pump to provide spent fuel pool cooling. The licensee's strategy for SFP cooling uses a new FLEX SFP makeup pump (250 gpm @ 150 psi) prestaged in the power block, protected from external hazards. The N+1 pump is the trailer mounted diesel driven pump used for pool spray.

The licensee also stated that the EOP changes that will be made to support the ELAP strategies and the analyses will be validated to ensure any time constraints will be met and that operation can properly implement the guidance. Once the FLEX modifications have been installed, additional in-plant walkdowns or validation will be performed to integrate the times for deployment of FLEX equipment with the times associated with the controlling EOP procedure's kick-outs to FLEX guidance. These activities will be accomplished as part of the normal EOP revision process. Completion of these validations is identified as Confirmatory Item 3.2.1.9.D in Section 4.2.

During the audit the licensee stated that, during a design basis flood, deployment of a trailer-mounted diesel-driven pump will not be immediately available because the onsite water level does not recede to below four feet above ground level at the pump connections until approximately 40 hours into the event in the worst case and to 1.5' at 72 hours, which will allow deployment of the FLEX equipment. It was not clear whether the TDAFW would be capable of providing adequate makeup inventory to the steam generators for 40 hours following the initiation of the ELAP event, potentially at reduced RCS pressures, as decay heat decreases. During the audit, the licensee noted that simulations with RETRAN-3D will be performed to assist in this determination. The staff observed that engineering evaluations would also be of use in determining minimum steam requirements necessary for TDAFW pump operation. In particular, understanding the minimum steam pressure for the TDAFW pump could be necessary from a procedural standpoint to allow for the case that operators are unable to reseat the RCP seal leak-off line relief valve at the expected pressure. Therefore, identifying the minimum steam requirements to support TDAFW operation and justifying that the TDAFW pump can perform its function until FLEX pumps can be placed into operation for all relevant scenarios is Confirmatory Item 3.2.1.9.E.

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 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.

As discussed previously in Section 3.2.1.9 of this report, for SFP makeup, the licensee designated the reactor makeup water pump as the N pump and the +1 pump is the FLEX SFP makeup pump located in the FHB. However, NEI 12-06 does not specifically delineate use of installed pump to provide spent fuel pool cooling. The licensee's strategy for SFP cooling uses a new FLEX SFP makeup pump (250 gpm @ 150 psi) prestaged in the power block, protected from external hazards. The N+1 pump is the trailer mounted diesel driven pump used for pool spray.

On page 39 of the Integrated Plan, in the section discussing Phase 2 SFP cooling strategy, the licensee stated that the fuel would become uncovered due to boiling at 144 hours into the event. This was an apparent conflict with reference documents that stated the time for fuel to uncover was 131 hours. The licensee resolved this conflict during the audit process by stating that time to reach the boiling point, 13 hours, was included in the first value but not included in the latter.

On page 41 of the Integrated Plan, in the section discussing the SFP cooling for Phase 3 using the portable SFP pump, the licensee stated that a pre-staged FLEX SFP fill pump will be attached to the ECCS in a manner still to be determined. The licensee discussed this during the audit process and stated that the FLEX modification design packages are scheduled for completion in May of 2014. Review of the SFP fill pump configuration is identified as Confirmatory Item 3.2.2.A in Section 4.2.

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

3.2.3 Containment Functions Strategies

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

In support of the original Integrated Plan, the licensee performed preliminary GOTHIC calculations to demonstrate that no Phase 1 or 2 actions would be required to remove heat and protect the containment functions following an ELAP event. However, the analysis was still

being completed and tracked as a licensee-identified open item (OI#6). When reviewing the Integrated Plan, the NRC staff had questions regarding how the licensee would assure that the containment conditions would not adversely impact the containment instrumentation relied upon during the event. During the audit process, the licensee was requested to provide additional information, and that information should: (a) include a discussion of the analysis that is used to determine the containment moisture, temperature and pressure profiles during ELAP and address the adequacy of the computer codes/methods, and assumptions used in the analysis; and (b) show that the listed instrumentation will function as designed.

The licensee responded by stating that a site specific containment analysis is being performed to ensure that containment integrity is not challenged by the energy release resulting from the ELAP event and, that environmental effects on equipment located inside containment relied upon to mitigate the ELAP event, will not result in this equipment failing to perform its intended function. The licensee also stated that the purpose of the containment analysis is to ensure that containment integrity is not challenged by the energy release resulting from the ELAP event. The licensee stated that the containment analysis is being performed using the GOTHIC 8 computer code. The analysis will evaluate the first 30 days of the event. The analysis will use the RCS temperatures from the RETRAN3D in the modeling of the ambient heat gain from the RCS into containment. The mass and energy release for the RCP seal leakage, pressurizer pressure operated relief valves (PORVs) and reactor vessel head vents that were utilized in RETRAN3D, will also be used to determine the pressure, local temperatures and local humidity throughout containment to ensure equipment relied upon to mitigate the effects of the ELAP event will perform their intended function and that the maximum pressure limit for the current containment pressure temperature analysis is not exceeded. The analysis is scheduled for completion by the end of the year 2013.

Because the analysis described above is pending, the licensee's plans to maintain containment is identified as Confirmatory Item 3.2.3.A in Section 4.2.

On page 36 of the Integrated Plan, in the section regarding Phase 3 strategies for maintaining containment, the licensee stated that, based on the preliminary GOTHIC analysis, if the ELAP event duration is prolonged greater than 90 days, some means of containment cooling may be required. These strategies would be part of the restoration phase and are not strategized in this Integrated Plan. However, the specific needs of a long-term strategy for maintaining containment functions will be based on the finalized results of the analysis identified above in Confirmatory Item 3.2.3.A. Because of the clear connection between these two analyses, the licensee’s need to provide a Phase 3 strategy in the Integrated Plan for maintaining containment for an indefinite period of time is combined with Confirmatory Item 3.2.3.A 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 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 maintaining containment if these requirements are implemented as described.

3.2.4 Support Functions

3.2.4.2 Equipment Cooling – Cooling Water

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

Plant procedures/guidance should specify actions necessary to assure that equipment functionality can be maintained (including support systems or alternate method) in an ELAP/LUHS or can perform without ac power or normal access to the UHS.

Cooling functions provided by such systems as auxiliary building cooling water, service water, or component cooling water may normally be used in order for equipment to perform their function. It may be necessary to provide an alternate means for support systems that require ac power or normal access to the UHS, or provide a technical justification for continued functionality without the support system.

The licensee made no reference in the Integrated Plan regarding the need for, or use of, additional cooling systems necessary to assure that coping strategy equipment functionality could be maintained. Nonetheless, the only portable 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 would not be expected to require an external cooling system nor would they require ac power or normal access to the UHS for cooling.

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 45 of the Integrated Plan, in the section regarding safety support functions, the licensee stated that 120 VAC high volume fans are already strategically located in the EAB for use during loss of HVAC events. These fans would be used to move air for personnel and equipment. They would be powered from the 120 VAC FLEX diesel generators. The licensee further stated that current procedural direction exists to ventilate the FHB in the event of elevated temperatures in the building. On-site personnel will block open various doors for the MAB and FHB, thus encouraging ventilation through natural circulation.

Although the licensee provided information regarding ventilation for the spent fuel area, for the QDPS room, and for the TDAFW pump room, there was no discussion regarding the main control room, or other areas such as access paths to steam dump valves. In addition, there was no discussion of monitoring temperatures in rooms or areas with the risk of elevated temperatures. The licensee addressed this concern during the audit process by stating that a GOTHIC analysis was prepared for rooms with critical monitoring equipment. That analysis showed that the room temperatures rose slowly even with a fairly significant heat load in the rooms. As an example, the QDPS cabinet rooms were analyzed and the results indicated that with a starting temperature of about 75°F, the room heats up to a temperature of 115 degrees F in about 36 hours. That scenario assumes the doors are kept closed. The licensee concludes that this example shows that a relatively small room surrounded by thick concrete walls with a fairly significant heat load will heat up slowly.

STP's ventilation strategy consists of using FSGs to manage ventilation of specific areas of concern early in the event. The areas in the plant with critical FLEX equipment will have doors propped open within the first few hours of the event. Forced ventilation was deemed unnecessary in the above mentioned GOTHIC analysis for most equipment rooms. The GOTHIC analyses led the licensee to conclude that sufficient time is provided such that off-site resources would be available to support adding ventilation to these critical rooms. The licensee also stated in the audit process that, based on the GOTHIC analyses, 12 hours into the event, the FSGs will have site personnel begin monitoring critical equipment/room temperatures periodically to evaluate when it may be necessary to establish this forced air ventilation.

With regard to the battery room, the licensee was requested to discuss the potential affects of elevated or lowered temperatures in the battery room, especially if the ELAP is due to a high or low temperature hazard. The licensee addressed these issues during the audit process. The licensee stated that STP is not in the extreme cold area of the US per NEI 12-06, and it would follow that lowered temperature in the battery room is not at issue for STP. The licensee also stated that the primary strategy for ventilating the battery room will be repowering and starting

one of the three existing battery exhaust fans from Flex supplied power. This fan provides exhaust ventilation to all four class 1E battery rooms. Power will be provided to the fan from FLEX power about the same time as placing the battery chargers in equalize charge mode. This is expected to occur in approximately 4-6 hours following the event. It should be noted that this strategy will also maintain hydrogen concentrations in the room per design. The licensee also reemphasized the importance of their analyses using GOTHIC on other room heating scenarios and the resulting slow heatup rates even with high heat loads in the rooms. The licensee pointed out that batteries would add very little heat to the room during this event (both while discharging and re-charging) especially with the room being ventilated. Nonetheless, FLEX support guideline (FSG) procedures will have personnel evaluate opening doors to the battery rooms to further encourage exchange of air between EAB rooms if it is warranted (depending on outside air conditions).

During the review of the Integrated Plan, the NRC staff identified a concern regarding the potential for high temperature in the TDAFWP room and postulated consequences. The licensee addressed this concern during the audit process and stated that STP has changed their strategy and now plans to implement FLEX strategies to provide power to the TDAFWP room vent fans to preclude excess temperatures. The timing of this action will be as directed by the FSG procedures.

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

3.2.4.3 Heat Tracing

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

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

On page 10 of the Integrated Plan, the licensee screened out the extreme cold hazard for the STP site. Therefore, consideration of heat tracing needs for STP is not applicable with regard to water in piping and instrument lines. However, there was no discussion in the Integrated Plan regarding the need for heat tracing in lines with borated coolant, and if necessary, how the heat tracing would be powered. Although the boron concentration in the RWST appears to be sufficiently low that freezing would occur prior to precipitation, the concentration associated with the boric acid storage tank may result in precipitation if the temperature of this tank could not be adequately maintained. Therefore, clarification of the need for heating to prevent boric acid precipitation for a duration sufficient to support the actions in the integrated plan, and required

power sources for the heaters, 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 45 of the Integrated Plan, in the section regarding safety support functions, the licensee stated that each operator has portable lighting on his person and additional headlamps will be stored in protected locations throughout the plant. Appendix R lighting is expected to last at least 8 hours. Additional lighting (e.g. Battle-lanterns) is located inside the power block. In the event that areas are discovered where additional lighting is desired, lighting strings will be purchased and will be located in areas inside the power block. 120 VAC FLEX diesel generators will provide power to these light strings.

The NRC staff has reviewed the licensee communications assessment (ML12318A096 and ML13092A259) in response to the March 12, 2012 50.54(f) request for information letter for DNPS and, as documented in the staff analysis (ML13142A160) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2, Guideline (8) regarding communications capabilities during an ELAP.

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

It was not apparent from the review of the Integrated Plan that access to the protected area and internal locked areas was being addressed. The licensee addressed this concern during the audit process and stated that operations personnel currently have keys to doors within the protected area. In addition, each control room has access to secured area keys.

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

3.2.4.6 Personnel Habitability – Elevated Temperature

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

Plant procedures/guidance should consider accessibility requirements at locations where operators will be required to perform local manual operations.

Due to elevated temperatures and humidity in some locations where local operator actions are required (e.g., manual valve manipulations, equipment connections, etc.), procedures/guidance should identify the protective clothing or other equipment or actions necessary to protect the operator, as appropriate.

FLEX strategies must be capable of execution under the adverse conditions (unavailability of installed plant lighting, ventilation, etc.) expected following a BDBE resulting in an ELAP/LUHS. Accessibility of equipment, tooling, connection points, and plant components shall be accounted for in the development of the FLEX strategies. The use of appropriate human performance aids (e.g., component marking, connection schematics, installation sketches, photographs, etc.) shall be included in the FLEX guidance implementing the FLEX strategies.

Section 9.2 of NEI 12-06 states, in part:

All sites will address high temperatures. Virtually every state in the lower 48 contiguous United States has experienced temperatures in excess of 110˚F. Many states have experienced temperatures in excess of 120° F.

Although there was some discussion in the Integrated Plan regarding ventilation, it was not apparent from the review that habitability evaluations had been completed to determine if compensatory actions would be required to permit personnel to access and work in areas such as the control room, the TDAFW pump room, and other areas that may be subject to adverse conditions. The licensee addressed this concern during the audit process and stated that habitability in the control room will be assured by monitoring conditions, by applying heat stress

countermeasures, and by rotation of personnel to the extent feasible. The STP FSGs will provide guidance for the control room staff to evaluate the control room temperature and take actions as necessary. With regard to other areas, the licensee stated that STP plant procedures provide guidance for heat stress and stay times for performing work in thermally hot environments (greater than 100 degrees F). The FSGs will direct operators to block open doors and establish ventilation to improve habitability and equipment functionality during an ELAP event. Operator aids will be used in the FSGs as called out in NEI 12-06 section 3.2.2 (11) to help prevent errors in this error prone event.

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

3.2.4.7 Water Sources.

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

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

On page 18 of the Integrated Plan, in the section regarding Phase 1 core cooling and heat removal, and then on page 20 in the section regarding Phase 2 core cooling and heat removal, the licensee discusses the use of the turbine driven auxiliary feed pump and a FLEX SG feed pump to supply water to the steam generators. Both of these pumps will draw suction from the

auxiliary feedwater storage tank. On page 24 in the Integrated Plan in the section regarding Phase 3 core cooling and heat removal, the licensee stated that depending on the type of external event that took place, different tanks, basins and reservoirs will or will not be available as a supply to fill the AFWST. The FSG will list each potential source of water in order of priority and equipment needed will be staged and protected. The licensee stated that this is a licensee self identified open item (Open Item #9).

On page 41 of the Integrated Plan, in the section regarding Phase 3 spent fuel pool cooling, the licensee stated that large capacity diesel driven pumps are available to provide a high volume of water to the SFP. These pumps can take suction on a variety of water sources in the plant area including the main cooling reservoir and the ultimate heat sink.

Although the Integrated Plan briefly discusses long term sources for cooling, it is not apparent that the use of the main cooling reservoir and ultimate heat sink is being addressed for the complications posed by the breach and loss of the main cooling reservoir discussed on page 8 of the Integrated Plan. In addition, there was no discussion addressing a consideration of hurricane or tornado debris in the long term water source.

The licensee provided additional information regarding water sources during the audit process. The licensee stated that the first tanks that will be used in the SFP makeup strategy are the RWST (520,000 gallons) and the reactor makeup water storage tank (RMWST) (150,000 gallons). These tanks are protected inside Category I buildings. Even considering that the RCS makeup strategy may take as much as 100,000 gallons of RWST water to bring the level to 50%, that leaves 570,000 gallons for SFP makeup. Design basis boil-off is 130.6 gpm so the 570,000 gallons of water will last over 90 days.

The licensee further stated that STP has current procedural direction for taking suction on various tanks and basins throughout the plant. The procedure lists the following sources:

1. Demineralized Water Storage Tank - not protected
2. Organics Basin - below grade so it would be protected somewhat
3. Circulating Water below ground piping (access under manholes) - below grade so it would be protected somewhat
4. ECW Pond - protected
5. Main Reservoir - not protected

Other sources available for use are:

6. Neutralization basin - below grade, somewhat protected
7. Secondary Makeup tank - not protected

Actions regarding how to use each source of water to supply the trailer-mounted diesel driven pumps will be spelled out in an FSG procedure.

The licensee stated that in the event that debris from a hurricane or tornado corrupts one/all of the water sources, offsite support from the RRC will provide tanker trucks of water to use.

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 20 of the Integrated Plan, in the section on Phase 2 core cooling, the licensee stated that a 480 VAC diesel generator (DG) will be staged and protected on the roof of the MAB. This DG will power a pre-staged SG feed pump located at the bottom level of the IVC to feed the SGs. In addition, actions include pre-staging the fuel tank, and, cabling and conduits. Cabling will be pre-installed to areas near the buckets on selected MCCs to enable powering of battery chargers on A and C ESF DC buses for instrumentation considerations. Also, on page 28, the licensee stated that cable and conduit will be installed to power the CVCS PDP.

As described above, the licensee has identified the use of temporary 480 VAC FLEX power but there was no information regarding the technical analyses performed as the basis for the size and configuration of the generator and distribution system for Phase 2 or for Phase 3. The licensee addressed this concern during the audit process and stated that the FLEX diesel generator sizing calculation is currently being performed and is expected to be complete by end of 2013. STP is evaluating both 850 kW and 1 MW generators. The review of these final sizing calculation results is identified as Confirmatory Item 3.2.4.8.A in Section 4.2.

As previously stated in this report, the licensee's strategy for mitigating an ELAP is to use a 480 VAC air cooled diesel generator on top of roof of the mechanical auxiliary building (MAB) to provide power to an electric driven SG FLEX pump, a RCS FLEX pump and a spent fuel pool FLEX pump. A conceptual sketch was provided on page 65 of the Integrated Plan, but it was not clear whether an additional DG would be available on the roof. The text of the Integrated Plan does not describe one. The NRC staff noted that NEI 12-06 states "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." It is not apparent that the licensee meets the guidance in NEI 12-06 for this diesel generator. The NRC staff requested the licensee to provide clarification with regard to meeting the guidance in NEI 12-06. The licensee responded to this request during the audit process by stating that each unit has two FLEX diesel generators, an N and +1, pre-staged on the roof of the MAB, and inside a structure that protects them from all external events. This use of pre-staged diesel generators appears to be an alternative approach for satisfying the Mitigating Strategies Order. Guidance for accepting this approach of using pre-staged generators has not been developed to date. This is identified as Open Item 3.2.4.8.B.

Although the licensee plans to use backup diesel generators to supply power for Phase 2 strategies and Phase 3 strategies, it was not clear how the licensee would meet the guideline of NEI 12-06, Section 3.2.2, guideline (13) regarding isolation and interactions. Specifically, the licensee was requested to describe how electrical isolation will be maintained such that (a) Class 1E equipment is protected from faults in portable/FLEX equipment and (b) multiple sources do not attempt to power electrical buses. The licensee addressed this request during the audit process by providing the following information: Procedurally, personnel will be

prevented from energizing FLEX equipment from the FLEX diesel generator until all power on the respective buses is lost. The Flex support guideline, when written, will ensure loads are connected in the correct sequence and to only one power supply. The licensee further stated that when normal power is being restored, the procedures will direct operators to disconnect FLEX power to a bus or component before energizing it from normal power. The breaker design will provide protection based on the FLEX component that it would be supporting. Development of these procedures and breaker design is identified as Confirmatory item 3.2.4.8.C. in section 4.2.

The licensee was requested to discuss whether the FLEX generator instrumentation was to be utilized in monitoring equipment operation, and if so, to discuss the associated instrument tolerances/accuracies and the ability to assure proper operation of the equipment to support the strategies. The licensee responded to this request during the audit process and stated that once a vendor has been selected to provide the diesels, the instrumentation information would be available. The licensee also stated that procedures developed for operations will provide strict guidance for safe operation and for proper operational interfaces with FLEX equipment. Development of these procedures is identified as Confirmatory item 3.2.4.8.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 power sources and isolations if these requirements are implemented as described.

3.2.4.9 Portable Equipment Fuel.

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

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

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

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

On pages 45 and 46 of the Integrated Plan, in the section regarding safety support functions, the licensee provided a description of the provisions for fuel oil to support the FLEX strategies. The licensee stated that fuel oil will be available from the ESF DG fuel oil storage and can be pumped to the FLEX generator fuel oil tank on top of the MAB roof. STP has approximately 180,000 gallons of diesel fuel that is protected from external events. The licensee stated that exact fuel consumption rates have not yet been determined and has a self identified open item to track the resolution of fuel usage and how long on-site supplies will last (open item #15). The concern regarding having an "indefinite" fuel supply was addressed by the licensee during the audit process. The licensee stated that the RRC would provide fuel if the onsite sources became depleted.

The reviewer was unable to determine from information in the Integrated Plan how the licensee would monitor and assure the quality of fuel oil for FLEX strategy usage. This concern is

identified as Confirmatory Item 3.2.4.9.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to fuel oil 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 14 of the Integrated Plan, in the section regarding time constraints, Item 5, the licensee stated that operators would perform deep DC load shedding per new FLEX support guidelines within 2 hours of event. The deep stripping allows the required instrumentation and control capabilities to be extend beyond the initial 4 hours capacity if completed within 2 hours. The licensee further stated, "This will allow time to obtain flex equipment to restore battery charger and instrument bus." However, it is not clear to the reviewer when battery charging will start. On page 14 of the Integrated Plan, time constraint Item 6, the licensee stated battery charging should start within 12 hours. On the sequence of events timeline, on page 56, the licensee stated that charging would begin at 8 hours. In discussion provided during the audit response on the subject of battery room ventilation, the licensee indicated that battery charging would be initiated at "4-6 hours". If STP mitigation strategies are dependent on batteries for greater than 8 hours before charging is initiated, then the generic concern related to extended battery duty cycles will become applicable to the STP site.

It was not clear from the information provided how long the batteries will be relied upon during the mitigation strategies before charging is initiated. If the duration is greater than 8 hours, the licensee is requested to provide documentation that shows STP will abide by the generic resolution provided in Nuclear Energy Institute (NEI) position paper entitled "Battery Life Issue" and the NRC endorsement (Agencywide Documents Access and Management System

(ADAMS) Accession No. ML13241A186 and ML13241A188, respectively).

The purpose of the Generic Concern and associated endorsement of the position paper was to resolve concerns associated with Integrated Plan submittals in a timely manner and on a generic basis, to the extent possible, and provide a consistent review by the NRC staff. Position papers provided to the NRC by industry further develop and clarify the guidance provided in NEI 12-06 related to industry's ability to meet the requirements of Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for beyond Design Basis External Events."

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

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

The licensee is requested to clarify whether the generic concern is applicable to STP, and if so, whether or not STP will abide by this generic resolution. This request is identified as Confirmatory Item 3.2.4.10.A in Section 4.2.

The NRC staff identified several questions/requests regarding the battery load shedding evolution. The licensee addressed these items during the audit process. The questions/requests are presented below along with the licensee's responses:

1. Provide a detailed discussion on the loads that will be shed from the dc bus, the equipment location (or location where the required action needs to be taken), and the operator actions required and the time to complete each action. In your response, explain which functions are lost as a result of shedding each load and discuss any impact on defense in depth and redundancy.

    Response: In STP's loss of all ac power, loads are de-energized to extend the battery life for four hours. The following loads are de-energized to extend battery - ESF Load Sequencer Train A, B and C. This process is expected to be complete within 30 minutes. There is no impact on defense and depth or redundancy since ESF Diesels are not available.

    The ESF loads sequencers are located on the 10 foot elevation of the electrical auxiliary building (EAB) which is a CAT I building protected from external events in three separate rooms. The ac and dc electrical power trains are divided by elevation in the EAB. The train A and D power distribution equipment is located on the 10 foot elevation of the

EAB; Train B power distribution equipment is located on the 35 foot elevation of the EAB; Train C power distribution equipment is located on the 60 foot elevation of the EAB.

STP has procedures that de-energize electrical panels and distribution centers for online maintenance and outages. These procedures provide a list of loads that identifies the impact when a breaker is de-energized. We also have abnormal operating procedures for a loss of vital 120 VAC panels and Class 1E dc power. The dc management FLEX support guideline will identify the additional load shedding that is needed to further extend the Class 1E battery life until a FLEX diesel is capable of powering a battery charger. The FLEX support guideline will use existing procedures to determine if any remedial measures are required for de-energizing the additional loads. Note: The dc seal oil pump at STP will not be de-energized as part of the load shedding.

2. Provide the basis for the minimum dc bus voltage that is required to ensure proper operation of all required electrical equipment.

   Response: The minimum voltage, 105.5 volts is stated in STP's Loss of All AC Power procedure (0POP05-EO-EC00). It states, "Train A, B, and C bus voltages should be monitored for the duration of the event, and their respective battery output breakers opened if bus voltages lowers to LESS THAN OR EQUAL TO 105.5vdc in order to conserve the battery should a standby DG become available." This ensures there is field flash capability should the ESF DG become available.

3. Provide the dc load profile with the required loads for the mitigating strategies to maintain core cooling, containment, and spent fuel pool cooling.

   Battery Calculation 2011-11676-EAD has been provided as part of the Integrated Plan reference documentation.

The reviewer requests follow-up information related to the responses provided above. With regard to item 1 above, the licensee is requested to discuss how the dc seal oil pumps are provided with power and what, if any, precautions are needed to control hydrogen levels when the dc supplies are exhausted. With regard to item 2 above, please confirm that the 105.5 minimum voltage is sufficient to ensure voltage at device terminals is adequate to support proper functioning of critical components. With regard to item 3, a technical review of the battery calculation is beyond the scope of this report and may be the subject of further review or inspection activities. These items are identified as Confirmatory Item 3.2.4.10.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 load reduction if these requirements are implemented as described.

3.3 PROGRAMMATIC CONTROLS

3.3.1 Equipment Maintenance and Testing.

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

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

NEI 12-06, Section 11.5 states:

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

2. Portable equipment that directly performs a FLEX mitigation strategy for the core, containment, or SFP should be subject to maintenance and testing[1] guidance provided in INPO AP 913, Equipment Reliability Process, to verify proper function. The maintenance program should ensure that the FLEX equipment reliability is being achieved. Standard industry templates (e.g., Electric Power Research Institute (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.

   d. 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.

[1] Testing includes surveillances, inspections, etc.

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

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

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

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

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

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

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

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

As discussed in Section 3.1.2.2, above, the staff's understanding of the licensee's plan for the design basis flood includes that the remaining "N+1" trailer-mounted, diesel driven FLEX pump would remain unavailable for deployment for up to 72 hours awaiting flood recession. Should the design basis flood occur, the inability to move the pump would render it unavailable as a

spare capability, but leave the site primary capability available, which would be in conformance with NEI 12-06, Section 11.5.3.b for periods of up to 90 days. Furthermore, should the RCS Core Cooling FLEX pump, become unavailable, then the site capability would not be maintained. This would result in a need to initiate actions within 24 hours to restore the capability and implement compensatory measures within 72 hours, as described in NEI 12-06, Section 11.5.3.f. Of particular note, the provision of NEI 12-06, Section 11.5.3.e is not applicable to this situation because the flooding hazard is not amenable to protection by use of diverse storage locations.

While blind conformance with NEI 12-06, Section 11.5.3.b could be achieved by repositioning the pump every 90 days, it is not clear that this would provide an equivalent level of protection to the availability scheme contemplated by NEI 12-06. The reviewer also notes that the hazard of concern is the design basis flood hazard, which results from the instantaneous removal of a large section of the embankment of the Cooling Reservoir and that this hazard is under review pursuant to the 10 CFR 50.54(f) letter of March 12, 2012.

Recognition of the impact of unavailability of the spare capability on the unavailability controls for the RCS Core Cooling FLEX pump is identified as Confirmatory Item 3.3.1.A in Section 4.2.

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

3.3.2 Configuration Control.

NEI 12-06, Section 11.8 states:

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

On page 12 and 13 of the Integrated Plan discussing key site assumptions to implement NEI 12-06 strategies (Item 19), the licensee stated that the plant Technical Specifications contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. The result of the BDB event may place the plant in a condition where it cannot comply with certain Technical Specifications and/or with its Security

Plan, and, as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p). On page 16 of the Integrated Plan regarding programmatic controls, the licensee stated that the unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy will be managed using plant equipment control guidelines developed in accordance with NEI 12-06, Section 11.5. The licensee further stated that 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 in accordance with NEI 12-06, Section 11.8.

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

3.3.3 Training.

NEI 12-06, Section 11.6 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

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

connect to or operate permanently installed equipment during these drills and demonstrations.

On page 17 of the Integrated Plan regarding training, the licensee stated that the Systematic Approach to Training (SAT) will be used to evaluate what training is required for station personnel based upon changes to plant equipment and procedures that result from implementation of the strategies described in this Integrated Plan. This training will be completed prior to final implementation of the requirements of the NRC Order.

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

3.4 OFFSITE RESOURCES

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

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

On pages 17 of the Integrated Plan in the section discussing the RRC the licensee provided a discussion of plans for offsite assistance. The licensee stated the industry will establish two (2) RRCs to support utilities during beyond design basis events. Each RRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be

established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of STP's agreed upon contractual plan of action (playbook), will be delivered to the site staging area within 24 hours from the initial request. A contract has been executed and will be maintained in accordance with section 12 of NEI 12-06. Although the licensee had not yet selected the staging area, a self-identified open item was generated to track this item to closure.

Review of the licensee's use of off-site resources, as described above, provides reasonable assurance that the proposed arrangement will conform 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, insufficient information was provided to demonstrate conformance to the guidance of NEI 12-06, Section 12.2, considerations 2 through 10 above. The licensee addressed this issue during the audit process and stated that STPNOC is actively involved in industry initiatives to establish the RRC. The industry has contracted with the SAFER organization through Pooled Equipment Inventory Company (PEICo) to establish and operate the RRCs as part of PEICo's existing Pooled Inventory Management (PIM) Program. The SAFER proposal, as well as its subsequent acceptance by the industry and implementation, is based on the Phase 3 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 offsite resources if these requirements are implemented as described.

4.0 OPEN AND CONFIRMATORY ITEMS

4.2 OPEN ITEMS

Item Number	Description	Notes
3.1.1.2.A	Provide information regarding the need for, or use of auxiliary power to facilitate moving or deploying FLEX equipment.	
3.1.2.2.A	The licensee does not provide for transportation/deployment of the remaining "N+1" diesel driven trailer mounted pump relied upon as a spare SG makeup pump in the event of a design basis flood.	
3.1.2.2.B	The Integrated Plan did not address flood considerations regarding the need to power water extraction sump pumps, or the potential need for flood barriers.	
3.2.1.1.A	Demonstrate the applicability of the RETRAN-3D code for analysis of the ELAP transient.	
3.2.1.1.B	Provide analysis of the ELAP transient that is applicable to STP and which demonstrates the adequacy of the mitigating strategy proposed for STP. This includes specification of an acceptable definition for the transition to reflux condensation cooling to ensure that the analysis is not credited beyond this juncture. A sufficient number of cases should be included in the analysis to demonstrate the acceptability of different strategies that may be necessary to mitigate an ELAP (e.g., as discussed in Section	

	3.2.1.6, in some cases "N" and "N+1" pumps have different capabilities, which may substantially affect the sequence of events in the integrated plan).	
3.2.1.2.C	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 exceeding 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 such 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.	
3.2.1.6.A	Development of the final timeline(s) and sequence(s) of events for STP is required.	
3.2.4.8.B	Electric Power Sources – On page 20 of the Integrated Plan, the licensee stated the strategy for mitigating an ELAP is to use a 480 VAC air cooled diesel generator on top of roof of the mechanical auxiliary building (MAB) to provide power to an electric driven SG FLEX pump, a RCS FLEX pump and a spent fuel pool FLEX pump. The use of pre-staged generators appears to be an alternative to NEI 12-06. The licensee has not provided sufficient information to demonstrate that the approach meets the NEI 12-06 provisions for pre-staged portable equipment. Additional information is needed from the licensee to determine whether the proposed approach provides an equivalent level of flexibility for responding to an undefined event as would be provided through conformance with NEI 12-06.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.3.A	Although the Integrated Plan briefly discusses the use of portable instruments to obtain necessary instrument readings at the QDPS, the plan does not fully address the guidance of NEI 12-06, Section 5.3.3, consideration 1 regarding providing operators with adequate information to obtain these readings. During the audit process, the licensee stated that this concern would be addressed by the development and incorporation of the guidance provided in the Westinghouse Owners Group FLEX emergency response guidelines.	
3.1.1.3.B	The licensee's Integrated Plan did not address the development of mitigating strategies with respect to the procedural interface for the use of ac power to mitigate	

	ground water in critical locations. The licensee stated that a corrective action has been generated to address the issue. The resulting actions to resolve the concern will need to be evaluated.	
3.1.2.3.A	On page 73 of the Integrated Plan and as referenced in numerous instances in the plan, the licensee listed a self-identified open item regarding support guideline procedure development (OI#9). Completion of the procedures identified in OI#9 will need to be confirmed.	
3.1.3.3.A	Although the Integrated Plan made reference to developing procedures to implement strategies as indicated by a licensee identified open item (OI#9), it is not clear from the information provided that the intent is to address considerations for high winds such as personnel protection or removing debris. This procedural issue is common to the high temperature hazard and should be addressed as well.	
3.1.5.2.A	With regard to a concern regarding addressing the high heat hazard for deployment, the reviewer noted that the licensee has generated two self identified open items (OI#4 and #9) to track the resolution of storage location, protection, and transportation, and the administrative requirements associated with those elements. Further review is required to assure that considerations for high heat of FLEX equipment deployment and procedural interfaces are part of the resolution.	
3.2.1.A	Confirm that the analysis for preventing nitrogen injection from the accumulators will use the methodology in Attachment 1 to the PWROG's interim core cooling position paper or specify an alternate method for preventing nitrogen injection and demonstrate its acceptability.	
3.2.1.B	Confirm (1) that remote operation of the steam generator PORVs will be implemented in a manner that will conserve the available hydraulic pressure such that the PORVs can be remotely operated to the extent necessary to perform the cooldown called for in the integrated plan without local actions, (2) that local manual actions can be taken to increase the hydraulic pressure to permit further remote operation of the PORVs consistent with the integrated plan or (3) that direct local operation of the PORVs can be accomplished consistent with the integrated plan.	
3.2.1.2.A	Confirm that two-phase leakage from the reactor coolant pump seals will not occur prior to the transition to reflux cooling	
3.2.1.2.B	Provide confirmation of the acceptability of assuming a constant seal leakage area in light of the potential for increased stresses on seal materials during cooldown.	
3.2.1.3.A	The licensee should address the following issues associated with decay heat modeling: (1) specify the value of the multiplier applied to the ANS 5.1-1979 decay heat standard	

	for the ELAP event and its basis. (2) Clarify whether the multiplier would be capable of accounting for the residual heat contribution from actinides (e.g., plutonium, neptunium) and neutron absorption in fission products, or whether these residual heat sources were accounted for explicitly. (3) Clarify whether the discussion applies to the RETRAN-3D thermal-hydraulic analysis or whether it applies to auxiliary calculations (e.g., the determination of steam generator makeup required during various phases of the ELAP coping analysis).	
3.2.1.4.A	Confirm that the key initial plant parameters and assumptions used in the forthcoming RETRAN-3D analysis are consistent with the appropriate values from NEI 12-06, Section 3.2, or justify deviations therefrom.	
3.2.1.5.A	In response to a concern regarding the survivability of critical instrumentation in an adverse containment atmosphere, the licensee provided details of the containment analysis being used at STP. Resolution of the concern regarding survivability and proper function of containment instrumentation is dependent on results of the containment analysis.	
3.2.1.5.B	Provide adequate justification that the RCS wide range pressure indication would not be influenced by containment conditions to an extent that would affect a reliable determination of nitrogen injection from the cold leg accumulators.	
3.2.1.8.A	The licensee should either (1) confirm that it will abide by the position expressed by the NRC staff in Section 3.2.1.8 of this report, or (2) identify another acceptable method for ensuring that the boric acid necessary to achieve adequate shutdown margin to mitigate an ELAP event will be adequately mixed with the reactor coolant system volume under two-phase natural circulation flow conditions.	
3.2.1.8.B	Completion of shutdown margin analysis for STP and demonstration of adequate shutdown margin during an ELAP event.	
3.2.1.8.C	Provide adequate basis that the core xenon concentration would remain above its equilibrium value for at least 23 hours post-trip	
3.2.1.8.D	Commit to verifying during the reload process that shutdown margin requirements for future operating cycles remain bounded by the calculation for Unit 1, Cycle 14.	
3.2.1.9.A	The licensee has identified the STP on-site permanent CVCS PDP and the reactor makeup water pumps as "N" pumps for mitigating strategies. The licensee is requested to provide a basis for the assuming that these pumps will be available and functional given the possibility of the postulated external hazard events, and to provide a discussion regarding ability to provide electrical power. This discussion should consider any non-safety related MCCs and controls that are necessary	

	for operation of these pumps.	
3.2.1.9.B	The licensee stated during the audit response "all these N pumps will be pre-staged in Category 1 structures, protected from all external events." However, the licensee has previously stated that the storage of the trailer mounted diesel driven pumps was in non-Category 1 building physically separated to assure survivability of at least one pump. Resolution of this apparent conflict is identified as a Confirmatory Item.	
3.2.1.9.C	The licensee stated that the FLEX pumps have been sized and deployment time determined to ensure that (1) reflux cooling will not occur, (2) the RCS makeup flow will exceed the RCP seal leak off and be able to restore pressurizer water level, (3) provide sufficient boron to prevent a return to power and (4) to remove decay heat. The ability of these pumps to provide sufficient makeup flow in the required time frame will be demonstrated by plant specific analyses, scheduled to be completed by the end of the year.	
3.2.1.9.D	Once the FLEX modifications have been installed, additional in-plant walkdowns or validation will be performed to integrate the times for deployment of FLEX equipment with the times associated with the controlling EOP procedure's kick-outs to FLEX guidance. These activities will be accomplished as part of the normal EOP revision process.	
3.2.1.9.E	Identify the minimum steam requirements to support TDAFW operation and justify that the TDAFW pump can perform its function until FLEX pumps can be placed into operation for all relevant scenarios.	
3.2.2.A	On page 41 of the Integrated Plan, in the section discussing the spent fuel pool cooling for Phase 3 using the portable SFP pump, the licensee stated that a pre-staged FLEX SFP fill pump will be attached to the ECCS system in a manner still to be determined. The licensee later stated that the FLEX modification design packages are scheduled for completion in May of 2014. Review of the SFP fill pump configuration is identified as a Confirmatory Item.	
3.2.3.A	The licensee stated that a site specific containment analysis is being performed to ensure that containment integrity is not challenged by the energy release resulting from the ELAP event and, that environmental effects on equipment located inside containment relied upon to mitigate the ELAP event, will not result in this equipment failing to perform its intended function. The licensee also stated that the purpose of the containment analysis is to ensure that containment integrity is not challenged by the energy release resulting from the ELAP event. The analysis is scheduled for completion by the end of the year 2013. This analysis should address strategies for all Phases of an ELAP.	
3.2.4.3.A	There was no discussion in the Integrated Plan regarding the	

	need for heat tracing in lines with borated coolant, and if necessary, how the heat tracing would be powered. Although the boron concentration in the RWST appears to be sufficiently low that freezing would occur prior to precipitation, the concentration associated with the boric acid storage tank may result in precipitation if the temperature of this tank could not be adequately maintained. Therefore, clarification of the need for heating to prevent boric acid precipitation for a duration sufficient to support the actions in the integrated plan, and required power sources for the heaters, is necessary.	
3.2.4.8.A	The licensee has identified the use of temporary 480 VAC FLEX power but there was no information regarding the technical analyses performed as the basis for the size and configuration of the generator and distribution system for Phase 2 or for Phase 3. The licensee addressed this concern during the audit process and stated that the FLEX diesel generator sizing calculation is currently being performed and is expected to be complete by end of 2013.	
3.2.4.8.C	Based on the licensee's plans to use backup diesel generators to supply power for Phase 2 strategies and Phase 3 strategies, it was not clear how the licensee would meet the guideline of NEI 12-06, Section 3.2.2, guideline (13) regarding isolation and interactions. The licensee addressed this request during the audit process by providing the following information: Procedurally, personnel will be prevented from energizing FLEX equipment from the FLEX diesel generator until all power on the respective buses is lost. The Flex support guideline, when written, will ensure loads are connected in the correct sequence and to only one power supply. The licensee further stated that when normal power is being restored, the procedures will direct operators to disconnect FLEX power to a bus or component before energizing it from normal power. The breaker design will provide protection based on the FLEX component that it would be supporting. Confirmation of the procedures and design is necessary.	
3.2.4.8.D	The licensee was requested to discuss whether the FLEX generator instrumentation was to be utilized in monitoring equipment operation, and if so, to discuss the associated instrument tolerances/accuracies and the ability to assure proper operation of the equipment to support the strategies. The licensee responded to this request during the audit process and stated that once a vendor has been selected to provide the diesels, the instrumentation information would be available. The licensee also stated that procedures developed for operations will provide strict guidance for safe operation and for proper operational interfaces with FLEX equipment.	

3.2.4.9.A	The reviewer was unable to determine from information in the Integrated Plan how the licensee would monitor and assure the quality of fuel oil for FLEX strategy usage. This concern is identified as a Confirmatory Item.	
3.2.4.10.A	The licensee is requested to clarify how long the batteries will be relied upon during the mitigation strategies before charging is initiated. If the duration is greater than 8 hours, the licensee is requested to provide documentation that shows STP will abide by the generic resolution provided in Nuclear Energy Institute (NEI) position paper entitled “Battery Life Issue” and the NRC endorsement (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13241A186 and ML13241A188, respectively).	
3.2.4.10.B	The reviewer requests follow-up information related to the dc load shedding. 1) The licensee is requested to discuss how the dc seal oil pumps are provided with power and what, if any, precautions are needed to control hydrogen levels when the dc supplies are exhausted. 2) Confirm that the 105.5 minimum voltage is sufficient to ensure voltage at device terminals is adequate to support proper functioning of critical components. 3) Because a technical review of the battery calculation is beyond the scope of this report, final review may be required.	
3.3.1.A	The lack of a means to deploy the diesel driven trailer mounted pump relied upon as a backup SG makeup pump during a design basis flood during the first 72 hours renders it unavailable to combat that hazard. The licensee should confirm that appropriate equipment unavailability controls will be used for the RCS Core Cooling FLEX Pump will be implemented.	