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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PSEG Nuclear, LLC
Salem Nuclear Generating Station, Units 1 and 2
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1.0 BACKGROUND

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

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

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

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

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

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

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

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

2.0 EVALUATION PROCESS

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

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

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

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

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

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

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

3.0 TECHNICAL EVALUATION

By letter dated February 28, 2013, (ADAMS Accession No. ML130590378), and as supplemented by the first six-month status report in letter dated August 25, 2013 (ADAMS Accession No. ML13239A097), PSEG Nuclear LLC (the licensee or PSEG) provided Salem Nuclear Generating Station, Units 1 and 2 (Salem or SGS) Integrated Plan for Compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by the licensee for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the NRC staff in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the Order.

3.1 EVALUATION OF EXTERNAL HAZARDS

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

3.1.1 Seismic Events.

NEI 12-06, Section 5.2 states:

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

The licensee's screening for seismic hazards, as presented in their integrated plan, has screened in this external hazard. The licensee confirmed on page 1 of their integrated plan that they will address BDB seismic consideration in the implementation of FLEX strategies consistent with NEI 12-06. The licensee further indicated that, as discussed in the SGS UFSAR Section 2.5.1.2, the Vincetown Formation soils are not considered liquefiable. This Section of the UFSAR states that the Vincetown Formation had been determined to be the closest stratum to the ground surface suitable for foundation support and is located some 70 feet below grade in the Salem Station area. This section of the UFSAR further states that the bottom of the base mats of major Category I structures at Salem are located 22 to 46 feet below grade with a lean concrete fill placed between the Vincetown and the base of the Category I structures. Finally, the UFSAR states that Vincetown soils were compared with subsurface conditions at Niigata, Japan, where an earthquake greater than the site safe shutdown earthquake had occurred, causing areas of liquefaction; this comparison showed that the Vincetown soils would be a suitable foundation medium. The SGS UFSAR contains no discussion on the potential for liquefaction of the soil between the site grade and the Vincetown Formation. The licensee also states 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.

Based on the above, the licensee is required to consider seismic hazards in the development of FLEX mitigation strategies.

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

3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

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

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

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

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

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

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

In various sections of its integrated plan the licensee stated that FLEX equipment required to mitigate a seismic event will be stored at its point of deployment in a seismically robust structure (e.g., auxiliary building, etc.) or will be stored in the canceled Hope Creek Generating Station (HCGS) Unit 2 reactor building. An evaluation is in progress to verify that construction of the HCGS Unit 2 structures has been sufficiently completed, and will meet NEI 12-06, Section 5.3.1 criteria for protection of FLEX equipment against seismic hazards. Large portable FLEX equipment (other than the pre-positioned equipment) will be secured for a seismic event and located so that it is not damaged by other items in a seismic event. In the NRC audit process the licensee stated that the evaluation for the use the SGS auxiliary building and the use of HCGS Unit 2 reactor building for permanent FLEX equipment storage has not been finalized to date. This is identified as Confirmatory Item 3.1.1.1.A in Section 4.2.

The licensee stated that equipment supporting the transitional phase mitigating strategies will be stored in the HCGS Unit 2 reactor building includes portable 480 VAC FLEX diesel generators (DGs) and necessary connecting power cables. Connections for the Nuclear Service Water system hoses are also stored in the HCGS Unit 2 reactor building.

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

3.1.1.2 Deployment of FLEX Equipment - Seismic Hazard

NEI 12-06, Section 5.3.2 states:

> The baseline capability requirements already address loss of non-seismically robust equipment and tanks as well as loss of all AC. So, these seismic considerations are implicitly addressed
>
> There are five considerations for the deployment of FLEX equipment following a seismic event:
>
> 1. If the equipment needs to be moved from a storage location to a different point for deployment, the route to be traveled should be reviewed for potential soil liquefaction that could impede movement following a severe seismic event.
>
> 2. At least one connection point for the FLEX equipment will only require access through seismically robust structures. This includes both the connection point and any areas that plant operators will have to access to deploy or control the capability.
>
> 3. If the plant FLEX strategy relies on a water source that is not seismically robust, e.g., a downstream dam, the deployment of FLEX coping capabilities should address how water will be accessed. Most sites with this configuration have an underwater berm that retains a needed volume of water. However, accessing this water may require new or different equipment.
>
> 4. If power is required to move or deploy the equipment (e.g., to open the door from a storage location), then power supplies should be provided as part of the FLEX deployment.
>
> 5. A means to move FLEX equipment should be provided that is also reasonably protected from the event.

With regard to FLEX equipment movement from storage locations to deployment points, on page 2 of the Integrated Plan the licensee stated that the deployment pathways of FLEX equipment from the proposed storage location will consider the potential for debris due to failure of non-seismically designed structures. Debris removal equipment onsite will be capable of clearing pathways for deployment. As discussed in Section 3.1.1.1 above, the licensee stated that soil liquefaction was not applicable for the SGS site. The licensee further stated that all critical buildings around the SGS site are surrounded by highly compacted backfill. The licensee did not address the potential for soil liquefaction along the pathways between the critical buildings of the SGS site and the proposed storage locations for the equipment. Review of these routes for potential soil liquefaction is identified as Confirmatory Item 3.1.1.2.A in Section 4.2.

With regards to protection of connections, on pages 17, 19, and 20, the licensee described the proposed connections which will be used to support FLEX strategies in the transition and final phases during the seismic event. The licensee stated that piping connections for the FLEX Auxiliary Feedwater (AFW) pump will be located within the seismic class 1, missile protected auxiliary building and will be afforded protection from the external hazards applicable to SGS.

The licensee states that for supplying an indefinite supply of water for feeding steam generators (SGs) and a motor driven AFW pump (i.e., portable FLEX pump) for use in the event that the turbine-driven auxiliary feedwater (TDAFW) pump is unavailable includes installation of a permanent hose connection on both the 11 and 12 Nuclear Service Water headers external to the auxiliary building. The licensee does not state that the Nuclear Service Water Connections will be protected from seismic events. This is identified as Confirmatory Item 3.1.1.2.B in Section 4.2.

In the NRC audit process, the licensee indicated that SGS will have two trucks or bulldozers of sufficient combined capability to clear debris and snow, perform minor earthwork, and transport equipment and material. This equipment will also service HCGS.

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

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

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

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

The licensee's Integrated Plan did not provide any information on the availability of a reference source for obtaining instrument readings using a portable instrument to support coping strategy implementation. In response to the audit question, the licensee stated that a procedure is being developed to provide guidance on how and where to measure key instruments at containment penetrations using a portable instrument. This is identified as Confirmatory Item 3.1.1.3.A in Section 4.2.

The licensee's Integrated Plan did not provide any information on: 1) non-robust internal flooding sources that do not require ac power; 2) the use of ac power to mitigate ground water in critical locations. This is identified as Confirmatory Item 3.1.1.3.B in Section 4.2.

In response to the audit question concerning potential impact due to the failure of a non-seismically robust downstream dam, the licensee refers to the Hope Creek question on the same subject which concludes that there are no downstream dams. Further, in the Hope Creek response to the NRC audit and review process question concerning downstream dam failures, the licensee stated that Consideration 5.3.3 consideration 4 of NEI 12-06 is not applicable, per PSEG Early Site Permit (ADAMS Ascension Number ML13098A281) section 2.4.1.2.3, "Dams and Reservoirs," which states, in part, that "[t]he Delaware River is the longest undammed river east of the Mississippi River."

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and 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 seismic interfaces considerations, if these requirements are implemented as described.

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

On page 9 of the Integrated Plan, the licensee stated that the Strategic Alliance for FLEX Emergency Response (SAFER) will move equipment from a regional response center (RRC) to a local offsite assembly area, established between the affected nuclear site and the SAFER team. Further, the licensee stated that required equipment will be moved to the site as needed, as stated in the nuclear site's playbook. The initial staging area will be within 25 miles of the site and will receive equipment within 24 hours of the initial request. Additionally, locally held portable equipment exists that could be requested from site to site and utility to utility on an as required basis thus establishing 64 response centers capable of providing specific Phase 2 equipment.

During the NRC audit process, the licensee was asked to provide more detail concerning the staging and deployment of offsite resources because of the absence of identification of the local staging area and a description of the methods to be used to deliver the equipment to the site.

In response to the NRC audit response question, the licensee stated that PSEG met with SAFER and tentatively identified onsite and offsite staging locations. Equipment will be delivered by road if conditions permit or by air if the ground routes are not available. The area at the north east corner of the site is 600' by 800' and is large enough to accommodate the onsite equipment staging area for SGS and HCGS. This area includes plans for a helicopter landing pad. The licensee is evaluating several offsite locations for equipment staging which will be provided in a future six-month update report. This is Confirmatory Item 3.1.1.4.A in Section 4.2.

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

3.1.2 Flooding

NEI 12-06, Section 6.2 states:

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

NEI 12-06, Section 6.2.1 states in part:

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

On page 4 of the Integrated Plan, the licensee indicated that for SGS, external flooding is an applicable hazard. The current licensing basis, described in the SGS UFSAR Section 2.4.2, states the probable maximum hurricane event is the only applicable external flooding event. The hurricane event is assumed to have greater than 48 hours of warning time and flooding is expected to persist on the site for approximately 12 hours. The 48-hour lead-time allows for pre-staging FLEX equipment as described in various places in the Integrated Plan. The licensee also stated that the flood re-evaluation pursuant to the 10 CFR 50.54(f) letter of March

12, 2012 had not been completed and therefore not assumed in their Integrated Plan. Although failures of upstream dams (which are located on tributaries to the Delaware River) are not evaluated in the SGS UFSAR, they are evaluated in the PSEG Early Site Permit Application for this site, which is currently under review by the NRC. This application shows that the water levels at the site as a result of dam failures are considerably lower than the water level from the probable maximum hurricane event.

Based on the above, the licensee is required to consider flooding hazards in the development of FLEX mitigation strategies.

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

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

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

On page 4, the licensee explained that FLEX equipment required to mitigate a flooding event at SGS will be stored at its point of deployment in a flood protected structure (e.g., auxiliary building, etc.) or will be stored in the flood protected HCGS Unit 2 reactor building FLEX staging area.

FLEX equipment not pre-staged prior to the event will be located in the HCGS Unit 2 reactor building and will begin deployment at approximately 12 hours. Debris removal equipment will also be staged in the HCGS Unit 2 reactor building prior to the hurricane to support deployment of FLEX equipment in Phases 2 and 3.

On page 16, the licensee explained that FLEX pumps, necessary hoses and fittings are protected from seismic events and flooding hazards while stored in the HCGS Unit 2 reactor building or pre-staged in protected areas of the plant.

In addition the licensee expects the turbine building lowest elevations to flood and has devised a strategy for using that captured water as an AFW source. This strategy includes the use of submersible pumps with strainers and compatible fittings, which is part of the licensee's FLEX equipment. Electrical power for these pumps is expected to be portable diesel-driven generators (DGs).

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, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to protection of FLEX equipment during flood hazards, if these requirements are implemented as described.

3.1.2.2 Deployment of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.2 states:

> There are a number of considerations 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 [reactor coolant system], isolating accumulators, isolating RCP [reactor coolant pump] seal leak off, obtaining dewatering pumps, creating temporary flood barriers, etc. These factors can be credited in considering how the baseline capability is deployed.
>
> 2. The ability to move equipment and restock supplies may be hampered during a flood, especially a flood with long persistence. Accommodations along these lines may be necessary to support successful long-term FLEX deployment.
>
> 3. Depending on plant layout, the ultimate heat sink may be one of the first functions affected by a flooding condition. Consequently, the deployment of the FLEX equipment should address the effects of LUHS, as well as ELAP.
>
> 4. Portable pumps and power supplies will require fuel that would normally be obtained from fuel oil storage tanks that could be inundated by the flood or above ground tanks that could be damaged by the flood. Steps should be considered to protect or provide alternate sources of fuel oil for flood

conditions. Potential flooding impacts on access and egress should also be considered.

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

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

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

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

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

With respect to deployment of FLEX equipment during flooding conditions, the licensee explained on page 7 of the Integrated Plan that deployment routes will be established for all equipment stored remotely from its deployment area. The identified paths and deployment areas will be assessed for accessibility during all modes of operation. This deployment strategy will be included within administrative programs in order to keep pathways clear or actions to clear the pathways.

On page 20 of the Integrated Plan, the licensee stated that submersible pumps with strainers will be deployed to elevation 84 ft. of the turbine building prior to hurricane events. Permanently installed discharge piping with isolation valves will be routed to the demineralized water line that currently feeds the TDAFW pumps. The licensee further explained that the submersible pumps could take suction from either the strainer or the condenser hotwells. The hoses are equipped with quick disconnect fittings and will be routed from the existing 8” drain valves on the condensate pump suction piping. The valves necessary to align the condensate pump suction to the submersible pump suction will be opened prior to the flood. Reach rods will be installed for other valve manipulations, which will allow operation from above the anticipated water level.

On page 45 of the Integrated Plan, the licensee stated that portable equipment used in Phase 2 will be equipped with fuel storage tanks sufficient for at least 24 hours of operation without refueling to minimize actions required to keep equipment running. A fuel line will be routed from the diesel fuel oil storage tank (DFOST) room in the auxiliary building to elevation 100 ft. and the roof of the auxiliary building for refueling of FLEX equipment. A small motor driven FLEX diesel fuel oil transfer pump will be used to pump diesel fuel oil from either 30,000 gallon DFOST to each elevation. Equipment operators can fill equipment through hose runs or portable containers.

During the NRC audit process the licensee provided more information on its evaluation of changing its originally described equipment as summarized below:

FLEX DG and FLEX Switchgear will be deployed to a location outside the Waste Evaporator Rooms that are watertight, instead of the Auxiliary Building roof.

The originally described 230 VAC FLEX DG units would be replaced with larger 480 VAC units and appropriate transformers such that each SGS Unit's 230 VAC switchgear would be supplied through the single (per unit) DG.

The location of the SW UHS FLEX connections are being evaluated and will be finalized in a future 6-month update.

AFW piping FLEX connection point is being moved from the discharge piping of the TDAFW Pump to the common discharge piping of the two motor driven AFW Pumps to allow greater flexibility to feed SGs via multiple flow paths.

The FLEX Charging Pump suction connection is being moved from the 13 Charging Pump suction to the common charging pump suction piping. The FLEX Charging Pump discharge is being moved from a point upstream of the BIT to a point on the common charging injection line.

An evaluation is in progress for adding connection points on the intermediate head safety injection pump suction and discharge lines.

These changes to the deployment of FLEX equipment are combined in Confirmatory Item 3.1.2.2.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 deployment of FLEX equipment during flooding hazards, if these requirements are implemented as described.

3.1.2.3 Procedural Interfaces – Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

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

On page 4 of the Integrated Plan regarding flooding hazards, the licensee stated that for a hurricane event, which is the credible cause for flooding at SGS, the site will have at least 48 hour notice and therefore the site will be fully staffed prior to the arrival of the event in accordance with procedure, OP-AA-108-111-1001, “Severe Weather and Natural Disaster Guidelines. Among the actions accomplished by this procedure is removal of potential wind-generated missiles, pre-staging of FLEX equipment appropriate to the event, deployment of submersible pumps in the turbine building as described above, and filling of the Auxiliary Feedwater Storage Tank (AFST), Demineralized Water Storage Tank, (DWST), and fire protection/fresh water storage tanks for core cooling during the transition phase.

On page 10 of the Integrated Plan regarding procedural interfaces the licensee stated that operators will respond to the event in accordance with emergency operating procedures (EOPs) to confirm reactor coolant system, secondary system, and containment conditions. A transition to 1-EOP-LOPA-1, “Loss of All AC Power” will be made upon the diagnosis of the total loss of ac power. This procedure directs isolation of reactor coolant system letdown pathways, confirmation of natural circulation cooling, verification of containment isolation, reducing dc loads on the station batteries, and establishment of electrical alignment in preparation for eventual power restoration. The operators confirm AFW flow to the steam generators, establish manual control of the SG PORVs, and initiate a rapid cooldown of the RCS to minimize inventory loss through the RCP seals. 1-EOP-LOPA-1 directs local manual control of AFW flow to the steam generators and local manual control of the SG PORVs to control steam release to control the cooldown rate, as 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 procedural interfaces considering the flooding hazards, if these requirements are implemented as described.

3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

As part of the NRC audit process, the licensee identified its proposed plan for staging and deploying offsite resources. The licensee is evaluating several offsite locations for equipment staging which will be discussed in a future 6 month update. This is combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

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

3.1.3 High Winds

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

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

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

On pages 1 and 2 of the Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that Figures 7-1 and 7-2 from NEI 12-06 were used for this assessment. It was determined that SGS could experience hurricane winds of approximately 160 mph based on Figure 7-1. It was also determined that SGS is in Region 2 and could experience tornado force winds of approximately 166 mph based on figure 7-2. Therefore, the high wind hazard is applicable to SGS.

Based on the above, the licensee is required to consider the hazards of tornados in the development of FLEX mitigation strategies.

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

3.1.3.1 Protection of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.1 states:

> These considerations apply to the protection of FLEX equipment from high wind hazards:
>
> 1. For plants exposed to high wind hazards, FLEX equipment should be stored in one of the following configurations:
>
>   a. In a structure that meets the plant's design basis for high wind hazards (e.g., existing safety-related structure).
>
>   b. In storage locations designed to or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* given the limiting tornado wind speeds from Regulatory Guide 1.76 or design basis

hurricane wind speeds for the site.

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

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

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

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

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

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

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

In various sections of its integrated plan the licensee states that storage structures to provide protection of FLEX equipment required to mitigate a BDBEE at SGS will be stored at its point of deployment in a robust structure (e.g., auxiliary building, etc.) or will be stored in the HCGS Unit 2 reactor building. The FLEX DGs, necessary cables and connectors will be protected from severe storms with high winds while stored in the HCGS Unit 2 reactor building or pre-staged in protected areas of the plant.

In response to an audit question, the licensee stated that evaluation for the use of the SGS Auxiliary Building and HCGS Unit 2 Reactor Building has not been finalized and will be provided in a future 6 month update. This is combined with Confirmatory Item 3.1.1.1.A in Section 4.2.

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

3.1.3.2 Deployment of FLEX Equipment – High Wind Hazard

NEI 12-06, Section 7.3.2 states:

> There are a number of considerations which apply to the deployment of FLEX equipment for high wind hazards:
>
> 1. For hurricane plants, the plant may not be at power prior to the simultaneous ELAP and LUHS condition. In fact, the plant may have been shut down and the plant configuration could be established to optimize FLEX deployment. For example, the portable pumps could be connected, tested, and readied for use prior to the arrival of the hurricane. Further, protective actions can be taken to reduce the potential for wind impacts. These factors can be credited in considering how the baseline capability is deployed.
>
> 2. The ultimate heat sink may be one of the first functions affected by a hurricane due to debris and storm surge considerations. Consequently, the evaluation should address the effects of ELAP/LUHS, along with any other equipment that would be damaged by the postulated storm.
>
> 3. Deployment of FLEX following a hurricane or tornado may involve the need to remove debris. Consequently, the capability to remove debris caused by these extreme wind storms should be included.
>
> 4. A means to move FLEX equipment should be provided that is also reasonably protected from the event.
>
> 5. The ability to move equipment and restock supplies may be hampered during a hurricane and should be considered in plans for deployment of FLEX equipment.

On page 3 of the Integrated Plan regarding assessment of severe storms with high wind hazard impact, the licensee stated that high winds may delay deployment of FLEX equipment. Consequently, the FLEX strategy includes consideration of deployment of equipment prior to the high wind event, since typically, for a high wind event (such as a hurricane); significant warning time would be available. It is noted that for tornados there may not be significant warning time available.

Since tornados are typically short-term event, deployment of equipment during a tornado would not be anticipated. Debris removal equipment will be available to support deployment of FLEX equipment.

During the NRC audit and review process, the licensee was asked about the type of debris removal equipment that would be available for clearing the FLEX pathways in the aftermath of a high wind event.

In response to the NRC audit and review process question, the licensee stated that FLEX debris removal equipment will be protected in accordance with criteria of NEI 12-06. The licensee provided an example of debris removal equipment such as a Komatsu 320 front-end loader with a bucket.

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

3.1.3.3 Procedural Interfaces – High Wind Hazard

NEI 12-06, Section 7.3.3, states:

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

With regards to procedural interfaces, the licensee's Integrated Plan states that for a hurricane event the site will have at least 48 hour notice and therefore the site will be fully staffed prior to the arrival of the event in accordance with OP-AA-108-111-1001, "Severe Weather and Natural Disaster Guidelines."

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

On page 9 of the Integrated Plan regarding the RRC plan, the licensee stated that the industry will establish two RRCs to support utilities during beyond-design-basis events. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, and the fifth set will have equipment in a maintenance cycle. Equipment will be moved from a RRC to a local offsite assembly area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and the required equipment will be moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 25 miles of the site within 24 hours of the initial request. Also available will be locally held portable equipment that could be requested from site to site and utility to utility on an as required basis thus establishing 64 response centers capable of providing specific Phase 2 equipment.

During the NRC audit and review process, the licensee stated that PSEG met with SAFER on September 17, 2013 and tentatively identified onsite and offsite staging locations. Equipment will be delivered by road if conditions permit or by air if the ground routes are not available. The area at the northeast corner of the site is 600' by 800' and is large enough to accommodate the onsite equipment staging area for SGS and HCGS. This area includes plans for a helicopter landing pad. The licensee is evaluating several offsite locations for equipment staging which will be discussed in a future six-month update. This is combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

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

3.1.4 Snow, Ice and Extreme Cold

As discussed in NEI 12-06, Section 8.2.1:

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

On page 3 of the Integrated Plan, the licensee states that based on NEI 12-06, Section 8.2, SGS must address impact of snow, ice and extreme cold on protection and 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 screening for snow, ice and extreme cold hazard if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.1 states:

These considerations apply to the protection of FLEX equipment from snow, ice, and extreme cold hazards:

1. For sites subject to significant snowfall and ice storms, portable FLEX equipment should be stored in one of the two configurations.

    a. In a structure that meets the plant's design basis for the snow, ice and cold conditions (e.g., existing safety-related structure).

    b. In a structure designed to or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* for the snow, ice, and cold conditions from the site's design basis.

    c. Provided the N sets of equipment are located as described in a. or b. above, the 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.).

In various sections of the Integrated Plan the licensee states that storage/protection of equipment from snow, ice, and extreme cold events would be provided. The FLEX pumps, necessary hoses and fittings will be protected from snow, ice, and extreme cold events while stored in the Hope Creek Unit 2 reactor building.

During the NRC audit and review process, the licensee stated that snow removal equipment will be stored in accordance with the criteria of NEI 12-06. Further, if the snow removal equipment is unable to clear FLEX pathways, then FLEX debris removal equipment will be utilized. FLEX debris removal equipment will be protected in accordance with criteria of NEI 12-06. The licensee provided an example of debris removal equipment such as a Komatsu 320 front-end loader with a bucket.

The FLEX DGs, necessary cables and connectors will be protected from snow, ice, and extreme cold events while stored in the HCGS Unit 2 reactor building or pre-staged in protected areas of the plant.

In the NRC audit process the licensee stated that the evaluation for the use of the SGS auxiliary building and the use of the HCGS Unit 2 reactor building for permanent FLEX equipment storage has not been finalized. This is combined with Confirmatory Item 3.1.1.1.A in Section 4.2.

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

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

NEI 12-06, Section 8.3.2 states:

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

On page 49 of the Integrated Plan, the licensee states that portable equipment for Phase 2 includes 2 trucks or bulldozers. This equipment would be used for snow and ice removal. Sufficient combined capability to clear debris and snow, perform minor earthwork, and transport equipment and material.

During the NRC audit and review process, concerning protection of snow removal equipment from extreme cold hazards, the licensee stated that FLEX debris removal equipment will be utilized to remove snow, ice and debris. FLEX debris removal equipment will be protected in accordance with criteria of NEI 12-06. The licensee provided an example of debris removal equipment such as a Komatsu 320 front-end loader with a bucket.

The licensee did not address the formation of frazil ice and means to cope with it. This is identified as Confirmatory Item 3.1.4.2.A in Section 4.2.

The licensee did not address manual operations required by plant personnel during periods of snow, ice, and extreme cold hazards. This is identified as Confirmatory Item 3.1.4.2.B in Section 4.2.

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

3.1.4.3 Procedural Interfaces - Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.3 states:

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

During the NRC audit process, the licensee states that snow removal is a normal activity for SGS. Moderate to normal snow removal could be accomplished by FLEX debris removal equipment if required. The licensee did not state that FLEX debris removal equipment could remove extreme snow and ice. This is identified as Open Item 3.1.4.3.A in Section 4.1.

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

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

NEI 12-06, Section 8.3.4, states:

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

On page 9 of the Integrated Plan, the licensee stated that the industry will establish two RRCs to support utilities during beyond design basis events. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, and the fifth set will have equipment in a maintenance cycle. Equipment will be moved from a RRC to a local offsite assembly area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and the required equipment will be moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 25 miles of the site within 24 hours of the initial request. Also available will be locally held portable equipment that could be requested from site to site and utility to utility on an as required basis thus establishing 64 response centers capable of providing specific Phase 2 equipment.

During the NRC audit and review process, the licensee stated that PSEG met with SAFER on September 17, 2013 and tentatively identified onsite and offsite staging locations. Equipment will be delivered by road if conditions permit or by air if the ground routes are not available. The area at the northeast corner of the site is 600' by 800' and is large enough to accommodate the onsite equipment staging area for SGS and HCGS. This area includes plans for a helicopter landing pad. The licensee is evaluating several offsite locations for equipment staging which will be discussed in a future six-month update. This is combined with Confirmatory Item 3.1.1.4.A in Section 4.2.

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

3.1.5 High Temperatures

NEI 12-06, Section 9 states:

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

In various sections of the Integrated Plan the licensee stated that consistent with NEI 12-06, Section 9.2, it will address high temperatures.

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

3.1.5.1 Protection of 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.

The licensee stated that the FLEX pumps, necessary hoses and fittings are protected from high temperature events while stored in the HCGS Unit 2 reactor building or pre-staged in protected areas of the plant. The FLEX DGs, necessary cables and connectors will be protected from high temperatures while stored in the HCGS Unit 2 reactor building or pre-staged in protected areas of the plant. Two 4.16 kV RRC generators, one for each unit, will be stationed near the auxiliary building truck bay. A 4.16 kV extension cable is run from each generator to the vital 4.16 kV switchgear in each unit at the 64 ft. elevation. A power connection truck is racked into a spare cubicle in one of the 4.16 kV vital buses in each unit. After connection the cables, one 4.16 kV vital bus can be powered up in each unit. The FLEX support equipment is protected from high temperature events while stored in the HCGS Unit 2 reactor building or pre-staged in protected areas on the plant.

During the NRC audit process the licensee stated that the evaluation for the use the SGS auxiliary building and the use of HCGS Unit 2 reactor building for permanent FLEX equipment storage has not been finalized. This has been combined with Confirmatory Item 3.1.1.1.A in Section 4.2.

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

3.1.5.2 Deployment of FLEX Equipment – High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

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

The SGS plan for storage locations includes storage at the point of deployment and use of the HCGS Unit 2 reactor building. These locations will have adequate ventilation to maintain reasonable storage temperatures. Backup ventilation cooling is not required when power is lost because the equipment is expected to be deployed shortly after the initiation of ELAP.

The licensee stated that high temperature does not impact the deployment of FLEX equipment. All FLEX equipment will be procured to be suitable for use in peak temperature for the region.

The licensee did not state the basis for lack of backup ventilation with respect to protection of FLEX equipment during high temperature hazards and what the impacts of high temperature hazards would be on the deployment of the FLEX equipment in such conditions. This 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 of FLEX equipment in a high temperature hazard, if these requirements are implemented as described.

3.1.5.3 Procedural Interfaces – High Temperature Hazard

NEI 12-06, Section 9.3.3 states:

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

On page 7 of the Integrated Plan the licensee states that equipment associated with these strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control as outlined in JLD-ISG-2012-01 Section 6 and NEI 12-06 section 11.

During the NRC audit and review process, the licensee states that FLEX equipment will be procured to operate in peak temperature for the region.

The licensee did not specify the peak temperature for which FLEX equipment would be expected to operate. This is Confirmatory Item 3.1.5.3.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 the procedural interfaces for the high temperature hazard, if these requirements are implemented as described.

3.2 PHASED APPROACH

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

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

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

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

NEI 12-06, Table 3-2 and Appendix D summarize one acceptable approach for the reactor core cooling strategies. This approach uses the installed auxiliary feedwater (AFW)/emergency feedwater (EFW) system to provide steam generator (SG) makeup sufficient to maintain or restore SG level in order to continue to provide core cooling for the initial phase. This approach relies on depressurization of the SGs for makeup with a portable injection source in order to provide core cooling for the transition and final phases. This approach accomplishes 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. In mode 5 (cold shutdown) and mode 6 (refueling) with SGs not available, this approach relies on an on-site pump for RCS makeup and diverse makeup connections to the RCS for long-term RCS makeup with borated water and residual heat removal from the vented RCS.

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.

Section 3.2 of WCAP-17601 discusses the PWROG's recommendations that cover the following subjects for consideration in developing FLEX mitigation strategies: (1) minimizing reactor coolant pump (RCP) seal leakage rates; (2) adequate shutdown margin; (3) time initiating cooldown and depressurization; (4) prevention of the RCS overfill; (5) blind feeding an SG with a portable pump; (6) nitrogen injection from accumulators, and (7) asymmetric natural circulation cooldown (NCC).

During the NRC audit process, the licensee was requested to specify which analysis performed in WCAP-17601, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs," Westinghouse Electric Company dated, August 2012, is being applied to SGS. Additionally, justify the use of that analysis by identifying and evaluating the important parameters and assumptions demonstrating that they are representative of SGS and appropriate for simulating the ELAP transient.

During the NRC audit and response process, the licensee provided the following information concerning the use of the WCAP-17601 analysis:

The licensee stated that WCAP-17601 is being used for the ELAP transient at Salem and the licensee justifies its use because Salem Units 1 and 2 are Westinghouse NSSS plants and WCAP-17601 is therefore applicable. Section 5.3 of WCAP-17601 provides coping time relative to RCS Inventory Control and is an extension of the analysis performed in Section 5.2. The licensee has used this in the development of the SGS mitigating strategies. The parameters and assumptions utilized in the WCAP are representative in the values and actions taken in the current SGS station blackout (SBO) procedures. The licensee states that the WCAP SG depressurization target of 300 psia relates to the 250 psia S/G pressure contained in EOP LOPA-001 with the same basis for balancing RCS Pressure, Cooldown, ECCS Accumulator Pressure, liquid injection and recriticality. The RCP design evaluated in the WCAP reference case (93-A) aligned with Salem RCPs. The RCP Seal leakage rates and assumptions are the same described in the WCAP-10541. The values correspond to the replacement SGs described in 5.2.2 where the licensee substituted the Salem rated core power of 3459 MWt. However, this information is still under review because the licensee did not describe how WCAP-17601 is applicable to Salem, therefore this has been identified as Confirmatory Item 3.2.1.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 Section 3.2 of WCAP-17601 Recommendations, if these requirements are implemented as described.

3.2.1.1. Computer Code Used for 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.

On page 4 of the Integrated Plan regarding the assumptions used to base sequence of events and time constraints the licensee stated that WCAP-17601, RCS Response to the ELAP Event, and PA-PSC-0965, Pressurized Water Reactor Owners Group (PWROG) Core Cooling Position Paper, are used for decay heat, and will establish operator times and actions.

On page 6 of the Integrated Plan, in the section regarding the Sequence of Events (SOE) and time constraints the licensee stated that WCAP-17601 concludes SG dryout can occur within 55 minutes of loss of AFW flow. Should the initiating event damage the AFST, another source of water must be aligned to the TDAFW pump as discussed in Section 2.2 of the Integrated Plan.

During the NRC audit and review process, the licensee stated that it is estimated that suction from the DWST header (fed from either the tank or submersible FLEX pump in the turbine building) can be established within 40 minutes. If the initiating event is a hurricane flood, the FLEX DGs would have been pre-staged in a flood proof structure within the Waste Evaporator watertight room and could be started to support operation of the submersible FLEX pump in the turbine building. If the DWST is not available then the submersible sump pump can take suction either from the turbine building or the condenser hotwell and supply the DWST header (during a flooding or hurricane event). The RCS cooldown is assumed to follow the analysis contained in WCAP-17601 for response to ELAP.

On behalf of the PWROG, Westinghouse developed documents, WCAP-17601-P, Revision 0, and PA-PSC-0965, Revision 0, to supplement the guidance in NEI 12-06 by providing additional pressurized water reactor (PWR)-specific information regarding the individual plant response to the ELAP and loss of ultimate heat sink (LUHS) events. The document includes identification of the generic event scenario and expected plant response, the associated analytical bases and recommended actions for performance of a site-specific gap analysis. As part of this document, a generic PWR Westinghouse 4 loop NSSS evaluation was performed. The PWR Westinghouse 4 loop analysis is applicable to the SGS coping strategy in that it supplements the NEI 12-06 guidance by providing PWR specific information regarding plant response for secondary cooling and RCS inventory control. The guidance provided in NEI 12-06 was utilized as appropriate to develop coping strategies and for prediction of plant's response. Validation of assumed response times will be required once all associated analyses are completed and FLEX Support Guidelines (FSGs) have been developed.

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

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

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

The licensee utilized the existing analyses in WCAP-17601-P, Revision 0, and PA-PSC-0965, Revision 0 to develop its sequence of events and time constraints. The response times will be validated at a future time.

The licensee did not perform a site-specific thermal-hydraulic analysis of an ELAP event. This is identified as Open Item 3.2.1.1.A in Section 4.1.

The licensee utilized the existing analyses in WCAP-17601-P, Revision 0, and PA-PSC-0965, Revision 0 to develop its sequence of events and time constraints. The response times will be validated at a future time. This is identified as Confirmatory Item 3.2.1.1.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/Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the computer codes used to perform ELAP analysis, if these requirements are implemented as described.

3.2.1.2 Reactor Coolant Pump Seal Leakage Rates

NEI 12-06, Section 1.3 states:

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

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

On page 22 of the integrated plan the licensee stated that with an ELAP/LUHS the plant staff will implement a strategy for maintaining RCS inventory during plant stabilization and subsequent RCS cooldown and associated depressurization activities. In general, the Phase 1 FLEX strategy for RCS inventory control / reactivity management relies on RCP seal leakage being sufficiently low for initial control of RCS inventory for the first 16 hours of an ELAP / LUHS event. The RCS responses were evaluated using a generic Westinghouse unit assuming RCP seal leakage of 21 gpm per pump, which indicated that natural circulation flow could be sustained for approximately 16 hours.

During the review it was noted that the above analysis used 84 gpm (21 gpm per pump) seal leakage in the analysis, which conforms to the seal leakage assumed in WCAP-17601-P, Revision 1.

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

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

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

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

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

2. In some plant designs, such as those with 1200 to 1300 psia SG design pressures and no accumulator backing of the main steam system power-operated relief valve (PORV) actuators, the cold legs could experience temperatures as high as 580 ^{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 used in the ELAP analysis is adequate and acceptable. This is identified as Confirmatory Item 3.2.1.2.B in Section 4.2.

During the NRC audit and review process, the licensee stated that Salem does not have accumulator backed SG PORVs. The lowest main steam relief valve setting is 1070 psig which equates to an RCS cold leg temperature of 546.6 degrees F. The RCS cooldown is expected to begin at no later than 2 hours into the event. The cooldown would lower the temperature of the fluid contacting the O-Rings and therefore would be expected to perform as analyzed.

The NRC staff also requested that the licensee provide additional information regarding the calculation of seal leakage flow models, as follows:

a. Provide the value of the maximum leak-off for each RCP seal in gpm assumed in the ELAP analysis.

b. Discuss how the pressure-dependent RCP seal leakage rates are calculated. 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.

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 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)." 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." 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." Address the applicability of the above statements from IN 2005-14 to the ELAP analysis.

d. 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.

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

In response to the audit and review process questions the licensee stated the following:

a. RCP seal leakage rates go from the initial value of 3 gpm to 21 gpm per pump at RCS pressure of 2250 psia after 13 minutes.

b. The pressure-dependent RCP seal leakage rates are based on WCAP-17601 leakage rates assumed for Westinghouse NSSS RCP seal designs. These leakage rates are further discussed in the Westinghouse generic response NRCs RAI (Westinghouse Letter LTR-FSE-13-45).

c. The statements made in IN 2005-14 are applied in the initiation of the event when the RCPs are in service under normal operating conditions, i.e., seal temperatures significantly less than 235 degrees. At t = 0 the RCPs are secured when the ELAP occurs. The RCP seal cooling is located in EOP-LOPA-1, "Emergency Operating Procedure Loss of All AC Power," step 27 when RCP seal injection, seal return, and component cooling isolation valves are closed thereby preventing thermal shocking of the RCP seals when these systems are placed back in service. The SGS ELAP strategies do not impact the actions taken in the EOPs with regard to the RCP seals.

d. SGS has a seal package for RCPs (model 93A) with high temperature O-Rings. As stated in 5.3.1.1 of WCAP-17601, plants with RCP seal designs of this type such as Salem, are represented by the reference in WCAP-17601, section 5.2.3.

e. SGS ELAP strategy is to perform a symmetrical cooldown of the RCS using all four main steam PORVs controlled from the Control Room.

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

Westinghouse completed generic analyses for Westinghouse plants as documented in WCAP-17601-P. During the NRC audit process, the licensee was requested to provide the following information: Address the applicability of assumption 4 on page 4-13 of WCAP-17601, which states that "Decay heat is per ANS 5.1-1979 + 2 sigma, or equivalent." If the ANS 5.1-1979 + 2 sigma model is used in the ELAP analysis, specify the values of the following key parameters used to determine the decay heat: (1) initial power level, (2) fuel enrichment, (3) fuel burnup, (4) effective full power operating days per fuel cycle, (5) number of fuel cycles, if hybrid fuels are used in the core, and (6) fuel characteristics based on the beginning of the cycle, middle of the cycle, or end of the cycle. Address the adequacy of the values used. If the different decay heat model is used, describe the specific model and address the acceptability of the model and the analytical results.

In response to the audit question, the licensee states that the WCAP-17601 states that ANS

5.1-1979 +2 sigma model is applicable to SGS.

In the Integrated Plan, the licensee did not state the initial conditions prior to ELAP events. This information is required in order to conclude that the initial conditions in regards to core decay heat were consistent with the initial conditions specified in NEI 12-06, Section 3.2.1.2 (1). During the NRC audit and review process the licensee was asked to state which initial conditions apply to the Integrated Plan and provide justification for assumptions that are not included in the Salem integrated plan.

During the audit process, the licensee indicated that all PWR-related initial conditions listed in NEI 12-06 Sections 3.2.1.2 through 3.2.1.5 are applicable to Salem.

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

3.2.1.4 Initial Values for Key Plant Parameters and Assumptions

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

On page 4 of the Integrated Plan the licensee stated that the following conditions exist for the baseline case:

- Direct Current (DC) power supplies are available.
- Alternating Current (AC) and DC distribution is available.
- Plant initial response is the same as Station Blackout (SBO).
- The ELAP condition will be identified and entry into the FLEX Support Guidelines (FSGs) will be at approximately 1 hour into the event.
- WCAP-17601, RCS Response to the ELAP Event, and PA-PSC-0965, PWROG Core Cooling Position Paper, are used for decay heat, and will establish operator times and actions.
- No additional events or failures are assumed and the turbine driven auxiliary feedwater (TDAFW) pump remains functional.

The licensee's baseline assumptions included in the Integrated Plan did not include all of the relevant baseline assumptions assumed in NEI 12-06, Section 3.2.1.2, Section 3.2.1.3, 3.2.1.4, and 3.2.1.5, nor include a listing of the initial plant parameters and assumptions used within the baseline analyses used to determine required times for the SOE.

During the NRC audit and review process, the licensee stated that all the initial conditions identified in NEI 12-06 sections 3.2.1.2 through 3.2.1.5 are applicable to SGS.

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

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states in part:

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

On pages 12 and 13 of the Integrated Plan the licensee listed the installed instrumentation credited for maintaining core cooling and heat removal during phase 1 of an ELAP. They included the following parameters:

AFST Level (2 instruments)
AFW Pump Suction Pressure
AFW Pump Discharge Pressure
SG Pressure (12 instruments)
SG Level (12 narrow range and 2 wide range)
RCS Temperature (2 Core Exit Thermocouples)
RCS Level (RVLIS 2 instruments)
Pressurizer Level (4 instruments)
Pressurizer Pressure (4 narrow range and 2 wide range)
RCS Temperature (4 Thot and 4 Tcold)
RCS Pressure (one wide range)
Accumulator Level (4 instruments)
Accumulator Pressure (4 instruments)
RWST Level Unit 1 (2 instruments)
RWST Level Unit 2 (4 instruments)
Containment Pressure (4 instruments)
28 VDC Bus Voltage (2 instruments)
28 VDC Bus Amperage (2 instruments)
125 VDC Bus Voltage (3 instruments)
125 VDC Bus Amperage (3 instruments)

The instruments identified in the Integrated Plan for core cooling, RCS inventory control, SFP cooling and monitoring of containment functions meet the basic needs for monitoring and directing coping strategies. However, the review identified a concern with the level of accuracy of the FLEX instrumentation to ensure that electrical equipment remains protected (from an electrical standpoint – e.g., power fluctuations) and with the ability of this instrumentation to provide operators with accurate information ensure the maintenance of core cooling, containment, and spent fuel cooling. The Integrated Plan did not have a discussion on the accuracy of portable equipment instrumentation as it relates to equipment protection and operator information for maintenance of FLEX strategies. This is identified as Confirmatory Item 3.2.1.5.A in Section 4.2.

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

3.2.1.6 Sequence of Events

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

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

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

> Each site should establish the minimum coping capabilities consistent with unit-specific evaluation of the potential impacts and responses to an ELAP and LUHS. In general, this coping can be thought of as occurring in three phases:
>
> - Phase 1: Cope relying on installed plant equipment.
> - Phase 2: Transition from installed plant equipment to on-site FLEX equipment.
> - Phase 3: Obtain additional capability and redundancy from off-site equipment until power, water, and coolant injection systems are restored or commissioned.

In order to support the objective of an indefinite coping capability, each plant should establish capabilities consistent with Table 3-2 (PWRs). Additional explanation of these functions and capabilities are provided in NEI 12-06 Appendix D, "Approach to PWR Functions."

The licensee provides a tabulation of the SOE timeline on Attachment 1A of the Integrated Plan which provides further details and the technical basis of the new time constraints.

During the NRC audit and review process the licensee summarized the changes in its mitigation strategies for Phase 1 and Phase 2. The licensee will perform the evaluation for implementing these changes and will communicate the results in a future six-month update. This is Confirmatory Item 3.2.1.6.A in Section 4.2 below.

The changes include changing the deployment location of the FLEX DGs from the Auxiliary

Building Roof for hurricane flooding events, to a location outside the Waste Evaporator Rooms watertight door. Additionally, the 230 VAC FLEX DGs originally referenced in the Integrated Plan will be replaced by larger 480 VAC DGs and a FLEX transformer.

A new 4” FLEX hose connection is being evaluated as a replacement for SFP make-up from the FLEX powered AFW, SW, and boron mixing tank pump discharges. Additionally, the SFP spray standpipe arrangement is being re-evaluated. The new connection point is located in the Auxiliary Building in the SFP Pump area.

The SW supply connections from the UHS are being re-evaluated.

The AFW connection is being evaluated to move it from the discharge of the TDAFW Pump to the common discharge of the motor driven AFW pumps.

Connection points for the FLEX Charging pump is being evaluated to be moved from the 13 Charging pump suction to the common Charging pump suction header. The discharge of the FLEX charging pump is being relocated from upstream of the Boron Injection Tank outlet valves to the discharge of the high head ECCS Charging pumps.

The licensee stated that it is performing an evaluation for the addition of two new FLEX connections in the Intermediate Head Safety Injection pumps' suction and discharge headers. This would allow capability for injecting to either the hot or cold legs.

During the NRC audit and review process the licensee stated that with respect to core cooling during the initial phase, for seismic events, the Auxiliary Feedwater Storage tanks would be the preferred source for the TDAFW Pumps. However, if these tanks were damaged then the DWST may be used.

The licensee further stated that, since neither the of these tanks are robust against high wind hazards, for hurricanes, SGS would employ the pre-staged Turbine Building FLEX submersible pumps to feed the TDAFW Pumps.

The licensee also stated that for flooding (which is only hurricane induced at SGS), the FLEX UHS pumps would be deployed which would transfer water from the Delaware River to the suction of the TDAFW Pumps, after the flood waters have receded from the site. Further, prior to the hurricane, the condenser hotwells would be filled and fitted with connections to allow suction to be transferred to the TDAFW Pumps via the pre-staged Turbine Building FLEX submersible pump. The licensee will provide its finalized SOE in a future six-month update. SGS has not completed final analysis regarding validation of the action times reported in the Sequence of Events.

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

3.2.1.7 Cold Shutdown and Refueling

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

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

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

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

During the audit process, the licensee stated that it will incorporate the supplemental guidance provided in the NEI position paper "Shutdown/Refueling Modes," dated September 18, 2013 (ADAMS ML13273A514).

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.

On page 10 of the Integrated Plan the licensee indicates that operators will initiate a rapid cooldown of the plant to minimize adverse effects of high temperature coolant on RCP shaft seal performance and to allow feedwater injection from a portable pump. Minimum SG pressure will be approximately 300 psia at the conclusion of the rapid cooldown. SG pressure of 300 psia corresponds to RCS pressure necessary to inject SI accumulators, but will ensure RCS pressure is above the minimum pressure to preclude injection of accumulator nitrogen into the RCS.

Depressurization of the RCS will result in a decrease in loss of the RCS inventory from RCP seal leakages, and, in turn, an increase in available time for the operator to take action and maintain the core covered with water. In the presence of a negative moderator temperature coefficient, the cooldown by steaming through the SG PORVs increases positive reactivity in the core. If the control rod worth from the inserted control rods following a reactor trip and the boron concentration from the SI accumulators is not sufficient to overcome the positive reactivity addition from the cooldown, the reactor will return back to power. As a result of the power increase and RCS pressure decrease, the calculated departure from nucleate boiling ratios (DNBRs) may decrease, possibly causing fuel damage.

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

During the NRC audit and review process, the licensee was asked the following:

1. Discuss whether the uniform boron mixing model was used in the ELAP analysis. If the perfect boron mixing model was used, address the compliance with the recommendations discussed in a PWROG whitepaper related to the boron mixing model. Also, discuss how the boron concentration in the borated water added to the RCS is considered in the cooldown phase of the ELAP analysis, considering that it needs time for the added borated water to mix with water in the RCS.

2. Discuss the results of the plant specific boration analysis and show that the core will remain sub-critical throughout the ELAP event for the limiting condition with respect to shutdown margin.

In the NRC audit process response, the licensee stated that the uniform boron mixing model was used in the SGS ELAP analysis. The licensee also stated they would comply with the recommendations in the PWROG boron mixing whitepaper (OG-13-184).

The licensee discussed the Salem specific analysis and how they demonstrated that subcriticality would be maintained for both units during an ELAP event. The licensee stated the analysis was performed consistent with the guidance in NEI 12-06 and the RCS cooldown scenario employed in the Salem OIP. No credit was taken for accumulator injection of borated water. Bounding analysis was performed to determine limiting condition was End of Cycle (EOC). 75 ppm of boron was added to the boron concentration requirements to maintain Keff <0.99. This results in maintaining subcriticality for greater than 16 hours without boron addition. Boron injection will begin approximately 8 hours after the reactor trips at 40 gpm using the 13/23 charging pump or a prestaged FLEX Charging Pump. The FLEX Charging Pump can discharge into the Charging pump header using hose connections. Plant specific analysis shows that 430 ppm addition is required to maintain Keff <0.99 at 96 hours. This would require 12606 gallons from the RWST or 4403 gallons from the BASTs. There is adequate Pressurizer volume to accommodate the addition of boric acid.

The PWROG submitted a position paper, dated August 15, 2013 (withheld from public disclosure due to proprietary content), which provides test data regarding boric acid mixing under single-phase natural circulation conditions and outlined applicability conditions intended to ensure that boric acid addition and mixing would occur under conditions similar to those for which boric acid mixing data is available. During the NRC audit and review process, the licensee informed the NRC staff of its intent to abide by the generic approach discussed above. The NRC staff concluded that the August 15, 2013, position paper was not adequately justified and has not endorsed this position paper. As such, resolution of this concern for SGS is identified as Open Item 3.2.1.8.A in Section 4.1.

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

3.2.1.9 Use of Portable Pumps

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

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

NEI 12-06 Section 11.2 states in part:

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

On page 13 of the Integrated Plan, the licensee stated that the Phase 2 strategy for reactor core cooling and heat removal provides an indefinite supply of water for feeding SGs and a motor driven backup AFW pump for use in the event that the TDAFW pump is unavailable. The TDAFW pump is expected to operate for an extended duration before SG steam pressure is reduced to the point where sufficient steam flow cannot be provided to the turbine inlet to support pump operation. The strategy includes repowering the vital 230/460 VAC busses to maintain key parameters monitoring instrumentation and restore equipment. Phase 2 electrical bus repowering strategies are described in Section 6.2. of the Integrated Plan.

Portable DGs would provide motive power to the prestaged FLEX AFW Pump. An indefinite supply of water to the suction of the TDAFW pump or the pre-staged FLEX AFW pump, can be provided from the Delaware River. The Delaware River will remain available for any of the external hazards listed in Section 1. The licensee provided a diagram of the flowpath and equipment used to facilitate this supply of water in Attachment 3, Sketch 1M-6. The diesel engine driven FLEX SW pump will be transported from the HCGS Unit 2 reactor building to a location west of the auxiliary building. A hard suction hose will be routed from the pump suction to the river where water will be drawn through strainer(s) sized to allow the required flowrate while limiting debris to prevent damage to the AFW pump. A discharge hose will be routed from the diesel engine driven FLEX SW pump discharge to two new, diversely located, connections on the SW nuclear headers. The Integrated Plan provides a Table depicting the FLEX equipment to be deployed and states that the quantity does not reflect N+1 requirements; therefore it is not possible to determine how many pieces of equipment will be available for an ELAP/LUHS. This is Confirmatory Item 3.2.1.9.A in Section 4.2 below.

Water from the river can be pumped through the SW system to provide a direct suction source to the TDAFW pump or prestaged FLEX AFW pump. Water from the river can also be pumped to the Spent Fuel Pool as described in Section 5.2.

The diesel engine driven FLEX SW pump is preliminarily sized to provide a minimum of 700 gpm to AFW, 80 gpm for RCS inventory makeup and 200 gpm for Spent Fuel Pool make-up simultaneously to both units. As indicated in the sequence of events discussed in Section 1 and Attachment 1A, the back-up supply of SG injection water will be made available prior to the depletion of Phase 1 water supply to the suction of the TDAFW pump, which would occur no sooner than 12 hours after the ELAP/LUHS initiation. Hydraulic analysis of the flowpath from the river through the SW system and to the various users (TDAFW pump, SFP, etc.) will be performed to confirm that applicable performance requirements are met.

During the NRC audit and review process, the licensee states that if required, the boric acid transfer pumps or a small FLEX boric acid transfer pump can be used to transfer the Boric Acid Tank inventory to the suction of the charging pump or FLEX charging pump using installed piping.

In the event of a hurricane and for long term borated water preparation, a temporary trailer mounted mixing tank with a positive displacement pump and heater will be moved to the flood protected truck bay in the auxiliary building. A portable hose will be used to supply water from the temporary mixing tank's pump to the suction of the charging pump or FLEX charging pump.

Portable equipment used in Phase 2 will be equipped with fuel storage tanks sufficient for at least 24 hours of operation without refueling to minimize actions required to keep equipment running. A fuel line will be routed from the diesel fuel oil storage tank (DFOST) room in the auxiliary building to elevation 100 ft. and the roof of the auxiliary building for refueling of FLEX equipment. A small motor driven FLEX diesel fuel oil transfer pump will be used to pump diesel fuel oil from either 30,000 gallon DFOST to each elevation. Equipment operators can fill equipment through hose runs or portable containers.

On page 46 of the licensee's plan provides for repowering the diesel fuel oil transfer pumps, there is no discussion of how the fuel oil will be assessed in the plant specific analysis to ensure sufficient quantities are available as well as to address delivery capabilities. Additional information is required to demonstrate conformance with NEI 12-06, Section 3.2.2, guideline (13) in regards to fuel for portable equipment. During the NRC audit and review process, the licensee was asked to explain how fuel oil quality will be assured if stored for extended periods of time.

In its response to the audit question, the license stated that fuel used to support FLEX equipment operation during an ELAP will be supplied from the installed fuel oil storage tanks for the emergency diesel generators. The fuel is routinely sampled and analyzed in accordance with the Technical Specification requirements. The fuel supplied to FLEX equipment will be from either the repowered installed fuel oil transfer pumps, or a FLEX fuel oil transfer pump installed near the tank. At approximately 12 hours after the ELAP, the FLEX UHS pumps will be deployed in their location. The fuel necessary for these pumps will be from a portable tanker/skid pump unit. It will be stored in a protected location and will be deployed by FLEX towing or debris removal equipment. A protocol of sampling the fuel stored in FLEX equipment will be developed. The NRC staff noted that the licensee's response addressed the quality of the fuel oil and the delivery capabilities from the fuel oil storage tanks to FLEX equipment;

however, the licensee has not demonstrated the fuel necessary to operate the FLEX equipment has been assessed to ensure sufficient quantities are available in accordance with NEI 12-06, Section 3.2.2, guideline (13). The licensee did not provide fuel consumption rates for each FLEX piece of equipment to calculate total fuel usage and thus demonstrate that sufficient fuel with margin exists on site. This is combined with 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 use of portable pumps, if these requirements are implemented as described.

3.2.2 Spent Fuel Pool Cooling Strategies

NEI 12-06, Table 3-2 and Appendix D summarize one acceptable approach for the SFP cooling strategies. This approach uses a portable injection source to provide 1) makeup via hoses on the refuel deck/floor capable of exceeding the boil-off rate for the design basis heat load; 2) makeup via connection to spent fuel pool cooling piping or other alternate location capable of exceeding the boil-off rate for the design basis heat load; and alternatively 3) spray via portable monitor nozzles from the refueling deck/floor capable of providing a minimum of 200 gallons per minute (gpm) per unit (250 gpm to account for overspray). This approach will also provide a vent pathway for steam and condensate from the SFP.

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

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

On page 33 of the Integrated Plan in regards to maintaining SFP cooling during the initial phase, the licensee stated that the SFP makeup requirements during ELAP events are based on the maximum design basis heat load in the spent fuel pool. The maximum boil off rate for a full core offload is less than 100 gpm. Assuming the technical specification minimum SFP water level, fuel uncovery would not occur for over 44 hours without fuel pool makeup flow.

On page 33 of the Integrated Plan in regards to maintaining SFP cooling during the transition phase, the licensee stated:

> Water Source

The water sources described in Sections 2.2 and 3.2 could also be aligned to provide make-up to the SFP as shown on Attachment 3, Sketches 1M-2 and 1M-6. Ultimately, an adequate supply of water pumped from the Delaware River is available to assure the SFP level is controlled to maintain inventory.

Water Injection

The diesel driven FLEX SW pump deployed to the Delaware River and the motor driven AFW FLEX pump located in the auxiliary building, as described in Section 2.2, could be aligned to provide makeup to the SFP through the piping configurations discussed in Section 2.2. A new stand pipe with appropriate valve configuration, spray nozzle and hose discharge connection will be permanently installed at each SFP with an inlet connection located in the auxiliary building or mechanical penetration area.

Even in under the most conservative full core offload heat load conditions, operators will have sufficient time to arrange for SFP makeup from the various FLEX sources.

During the audit and review process, the licensee provided additional information regarding the SFP makeup during an ELAP event. It stated that a new 4" FLEX hose is being evaluated as replacement for SFP makeup. This connection would be upstream 1(2)SF 9 and would allow water from SW, AFW, and the FLEX boron mixing tank pump discharges to be aligned for SFP makeup. The proposed connection point is in the Auxiliary Building in the SFP pump area. Additionally, the licensee stated that it is re-evaluating the installation and use of a spray pipe system. This is 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. For example: Containment pressure control/heat removal utilizing containment spray or repowering hydrogen igniters for ice condenser containments.

On page 6 of the Integrated Plan regarding discussion of sequence of events and time constraints, the licensee stated that the Phase 3 coping activities to maintain containment and establish indefinite coping capability rely on the use of a 4.16 kV DG, diesel-driven pumps and water treatment equipment (amongst other commodities and equipment) provided by the regional response center (RRC). PSEG intends to notify the RRC of the ELAP at 2 hours after the event, which would deliver equipment to within 25 miles of the site at approximately 26 hours. Sufficient time exists, with continued operation of Phase 2 strategies, to deploy the equipment to the site and establish functionality.

The licensee stated that since the containment temperature and pressure response will be slow, operator actions to reduce containment pressure and temperature will not be required during Phase 1.

On page 29 of the Integrated Plan the licensee stated that since the containment temperature and pressure response will be slow, operator actions to reduce containment pressure and temperature will not be required during Phase 2 following the ELAP event initiation. Assessment of the existing 16 hour SBO analysis reflects that SGS can wait until Phase 3 to establish containment cooling. PSEG will perform further containment analysis to demonstrate that containment integrity can be maintained up until a point in time when containment cooling can be restored during Phase 3.

On page 31 of the Integrated Plan regarding maintaining containment in the final phase, the licensee stated that the Phase 3 coping strategy relies on one large generator per unit providing enough electrical power to the required safeguards equipment. The generator will be used to re-power containment cooling through the use of the installed Containment Fan Coil Units and Delaware River water supplied through the service water system as described in Section 2.2, Phase 2 Maintain core Cooling and Heat Removal. In addition to the Phase 2 FLEX pumps, supplemental pumping capability will be supplied from the RRC to support this function. SGS will implement resources received from the RRC to provide power to the containment ventilation system thereby ensuring pressure control in containment.

Alternative methods to control containment atmosphere are described in SH.OP-AM.TSC-0001, “Supplemental Severe Accident Management Guidelines,” which provides temporary chiller units to enhance Containment Fan Coil Unit capability. The temporary chiller units and associated pumps could be deployed per existing Technical Support Center guidelines and could use the SW piping connections described Section 2.2, Phase 2 Core Cooling.

The licensee committed to perform further containment analysis to demonstrate that containment integrity can be maintained up until a point in time when containment cooling can be restored during Phase 3. This is identified as Confirmatory Item 3.2.3.A in Section 4.2.

On page 13 of the Integrated Plan regarding maintaining containment, the licensee lists containment pressure indicators PI-948A, PI-948C, PI-948C and PI-948D as essential instruments required for monitoring containment integrity.

During the NRC audit and review process, the licensee stated that SGS plans to use MAAP analysis to complete the FLEX strategies and timelines. This is identified as Confirmatory Item 3.2.3.B in Section 4.2.

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

3.2.4 Support Functions

3.2.4.1 Equipment Cooling – Cooling Water

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

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

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

In the Integrated Plan, the licensee made no reference regarding the need for, or use of, additional cooling systems necessary to assure that coping strategy functionality can be maintained. Nonetheless, the only portable 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. SGS Portable equipment has been described in sections 3.1.1.2 of this evaluation.

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

3.2.4.2 Ventilation – Equipment Cooling

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

Plant procedures/guidance should consider loss of ventilation effects on specific energized equipment necessary for shutdown (e.g., those containing internal electrical power supplies or other local heat sources that may be energized or present in an ELAP.

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

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

> provided to the affected cabinet or area, and/or designate alternate means for monitoring system functions.
>
> For the limited cooling requirements of a cabinet containing power supplies for instrumentation, simply opening the back doors is effective. For larger cooling loads, such as … AFW pump rooms, portable engine-driven blowers may be considered during the transient to augment the natural circulation provided by opening doors. The necessary rate of air supply to these rooms may be estimated on the basis of rapidly turning over the room's air volume.
>
> Actuation setpoints for fire protection systems are typically at 165-180°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 regarding safety function support, the licensee stated that Ventilation for the TDAFW Room, battery rooms, inner and outer penetrations, auxiliary building and Main Control Room will be provided as needed from portable fans that are powered from the FLEX diesel generator. Plant doors may be opened as necessary to provide additional ventilation.

During the NRC audit and review process, it was noted that the licensee's Integrated Plan provided insufficient details of the ventilation in the battery room to support a conclusion that there is reasonable assurance that the batteries are protected from the effects of extreme high or low temperatures in the battery room. The licensee was asked to provide information on the adequacy of the ventilation provided in the battery room to protect the batteries from the effects of extreme high and low temperatures.

In its response to the audit question, the licensee stated that the battery rooms are located in areas supplied by ventilation systems and would be expected to have temperatures of between 65 and 76 degrees F prior to the start of the ELAP. GOTHIC modeling of the battery rooms is currently being performed. The results of the modeling is forthcoming. This is identified as a Confirmatory Item 3.2.4.2.A in Section 4.2.

During the NRC audit and review process, the licensee was asked to provide a discussion on how hydrogen concentration in the battery rooms will be maintained below or equal to acceptable limits.

In response to the audit question, the licensee stated that ventilation will be provided to the battery rooms to mitigate the hydrogen accumulated during recharging. Strategies are being developed to accomplish this action. This is identified as a Confirmatory Item 3.2.4.2.B in Section 4.2.

The licensee's Integrated Plan did not provide sufficient details regarding the effects of loss of ventilation in the TDAFW pump room on the electrical equipment, such that the staff is unable to conclude that the electrical equipment in the TDAFW pump room will perform its function and assist in core cooling throughout all Phases of an ELAP. More information regarding the adequacy of the ventilation provided in the TDAFW pump room to support equipment operation throughout all phases of an ELAP is required. Specifically, provide a discussion on the impact of elevated temperatures, as a result of loss of ventilation and/or cooling, on electrical equipment being credited as part of the ELAP strategies (e.g., electrical equipment in the turbine driven emergency feedwater pump room). In your response, specify whether the initial temperature condition assumed the worst-case outside temperature with the plant operating at full power. Provide the list of electrical components that are located in the pump rooms that are necessary to ensure successful operation of required pumps. Also provide the qualification level for temperature and pressure for these electrical components for the duration that the pumps are assumed to perform its mitigating strategies function.

In its response to the audit question, the licensee stated that GOTHIC modeling and room heatup calculations are being developed for plant strategic areas including the TDAFW rooms. The results of the modeling and analyses will be communicated in a future six-month update. This identified as Confirmatory Item 3.2.4.2.C

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

3.2.4.3 Heat Tracing

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

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

The SGS Integrated Plan did not address the loss of heat tracing. The licensee screened in for extreme cold, ice and snow and thus there is a need for the licensee to address loss of heat tracing effects on FLEX strategies in the Integrated Plan.

During the NRC audit and review process, the licensee was asked to describe whether heat tracing circuits would be required in its response to an ELAP, and to discuss which of those heat tracing circuits would be energized via use of its portable equipment. Additionally, the licensee was asked what heat tracing circuits would be necessary in order to complete the ELAP implementation strategies and to address high concentration borated water sources and their flowpaths.

In its response to the audit question, the licensee stated that the AFST and RWST level instrumentation are heat traced and powered from the 230 VAC system. These buses will be energized by FLEX generators during an ELAP. The BASTs have electric heaters powered by the same 230 VAC system.

In its response to the audit question, the licensee stated that the RWST is maintained at or above 35 degrees F during normal operation using a recirculation pump and an electric heater powered by non-vital AC power. During an ELAP, flow through the 20 inch tank discharge line would be expected to prevent freezing.

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, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to heat tracing, boric acid precipitation, and icing concerns, 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 regarding safety function support for portable equipment during the transitional phase, the licensee stated that portable equipment in Phase 2 is required to support continued strategies from Phase 1 and includes ventilation, lighting, air/gas supplies for operation of valves and charging pump control, communication equipment, and fuel.

The licensee described that for lighting, Control Room emergency lighting will be available because the 125 VDC system will have power supplied from the battery chargers from the FLEX diesel generator.

The NRC staff has reviewed the licensee communications assessment (ML13130A387) in response to the March 12, 2012 50.54(f) request for information letter for Salem and, as documented in the staff analysis (ML13127A233) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2 (8) regarding communications capabilities during an ELAP, assuming that the listed upgrades to the site's communications systems are completed. This has been identified as Confirmatory Item 3.2.4.4.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 Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to lighting and communications, if these requirements are implemented as described.

3.2.4.5 Protected and Internal Locked Area Access

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

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

The licensee's Integrated Plan did not provide any discussion on the development of guidance and strategies to access protected and internal locked areas. In response to the audit process question, the licensee states that during the BDBEE with an ELAP the operators have ample security keys within the main control room that will be used to open doors to ensure the overall integrated strategy can be successfully executed. In addition, site security will be available to assist in allowing access to the required vital areas. The turbine building and fuel handling track way doors have electric motors, which can be bypassed locally and operated with a manual pull chain operator.

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 access to protected and internal locked areas, if these requirements are implemented as described.

3.2.4.6 Personnel Habitability – Elevated Temperature

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

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

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

Section 9.2 of NEI 12-06 states,

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

During the NRC audit and review process, it was noted that the licensee indicates maximum environmental room temperatures for habitability or equipment availability are based on NUMARC 87-00. The NUMARC 87-00 room heat-up evaluation methodology is based on a 4-hour coping time. The licensee was requested to provide maximum environmental room temperatures at ELAP coping periods greater than the 4-hours assumed in NUMARC 87-00. This is identified as Confirmatory Item 3.2.4.6.A in Section 4.2.

The licensee's Integrated Plan stated at the onset of a SBO, operators would block open Main Control Room doors to provide cooling until Phase 2 actions could be implemented. They stated additional formal analyses would be performed to support the above assessment. The results would be communicated in a six-month status report. This is identified as Confirmatory Item 3.2.4.6.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 personnel habitability, if these requirements are implemented as described.

3.2.4.7 Water Sources.

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

> *Plant procedures/guidance should ensure that a flow path is promptly established for makeup flow to the steam generator/nuclear boiler and identify backup water sources in order of intended use. Additionally, plant procedures/guidance should specify clear criteria for transferring to the next preferred source of water.*
>
> Under certain beyond-design-basis conditions, the integrity of some water sources may be challenged. Coping with an ELAP/LUHS may require water supplies for multiple days. Guidance should address alternate water sources and water delivery systems to support the extended coping duration. Cooling and makeup water inventories contained in systems or structures with designs that are robust with respect to seismic events, floods, and high winds, and associated missiles are assumed to be available in an ELAP/LUHS at their nominal capacities. Water in robust UHS piping may also be available for use but would need to be evaluated to ensure adequate NPSH can be demonstrated and, for example, that the water does not gravity drain back to the UHS. Alternate water delivery systems can be considered available on a case-by-case basis. In general, all CSTs should be used first if available. If the normal source of makeup water (e.g., CST) fails or becomes exhausted as a result of the

> hazard, then robust demineralized, raw, or borated water tanks may be used as appropriate.
>
> Heated torus water can be relied upon if sufficient [net positive suction head] NPSH can be established. Finally, when all other preferred water sources have been depleted, lower water quality sources may be pumped as makeup flow using available equipment (e.g., a diesel driven fire pump or a portable pump drawing from a raw water source). Procedures/guidance should clearly specify the conditions when the operator is expected to resort to increasingly impure water sources.

The licensee addressed water sources for coping strategies in the Integrated Plan for RCS cooling, RCS inventory control, SFP cooling, and safety function support. Makeup flow is immediately established to the SG during the initial phase of the ELAP strategies.

On page 23 of the Integrated Plan in regards to maintaining RCS inventory control, the licensee stated the borated water is available from the refueling water storage tank (RWST) using installed piping. In addition, sufficient quantities of borated water are available in the Boric Acid Storage Tanks. A FLEX pump can be used to transfer this inventory to the suction of the charging pump or FLEX charging pump using installed piping. During the NRC audit and review process, it was noted that the licensee's primary strategy relies on the RWST, which is not designed to be robust with respect to all design basis external events. The licensee was asked to identify a water source to use for RCS inventory control that is robust with respect to all design basis external events. In its response to the audit question, the licensee stated that the boric acid storage tanks and piping are designed to be robust with respect to all design basis external events and can be aligned to supply the RCS should the RWST be unavailable. Thus, the NRC staff noted that a water source with a robust design is available for maintaining RCS inventory control.

On page 33 of the Integrated Plan in regards to maintaining spent fuel pool cooling the licensee stated that the water sources described in Phase 2 for maintaining core cooling and heat removal and maintaining RCS inventory control could also be aligned to provide make-up to the SFP and ultimately, an adequate supply of water pumped from the Delaware River is available to assure the SFP level is controlled to maintain inventory.

On page 11 of the Integrated Plan in regards to maintaining RCS cooling and heat removal, the licensee stated the primary AFW water supply is provided by the AFST. The tank has a minimum usable capacity of 200,000 gallons and will provide a suction source to the TDAFW pump for a minimum of 12 hours based on AFW consumption requirements delineated in WCAP-17601. In the event of a missile strike to the AFST, the existing piping configuration allows TDAFW pump suction to be aligned to the 500,000 gallon DWST or the 350,000 gallon fire protection/fresh water storage tanks.

On page 16 of the Integrated Plan, the licensee stated that it will also implement other plant modifications (described in the IP), to provide a supply of higher quality water to the AFW system, if available. After declaration of an ELAP/LUHS, operators will assess the condition of available water supply sources across the site and use the highest quality water available for injection to the SGs through the TDAFW pump or the FLEX AFW pump. During the NRC audit and review process, it was noted that Phase 1 of maintaining core cooling and heat removal relies on three sources of water that can be aligned to the TDAFW pump suction, which are the AFST, DWST and fire protection storage tank. It was also noted that these tanks do not have a robust design with respect to hurricane events and associated missiles. The licensee was asked to provide a Phase 1 strategy that relies only on installed equipment that is robust as defined in NEI 12-06.

In its response to the audit question, the licensee stated given the warning time available prior to a hurricane, it has developed a strategy to supply the TDAFW pump from the turbine building basement, which will be filled from flood waters, until the deployment of the UHS diesel-driven pumps taking suction from the Delaware river. In addition, the license clarified that it has also provided a supply connection from the main condenser hotwells in the turbine building to the FLEX submersible pumps, which provide suction to the TDAFW pump, to assure water is available prior to the flood waters filling the turbine building basement floor. Based on this response, it was noted the TDAFW will have water suction source available during Phase 1 of maintaining core cooling during a flooding event.

During the NRC audit and review process, the licensee indicated that during a high wind event, including associated missiles, that its current FLEX strategy relies on the diversity amongst three sets of tanks (i.e., AFST, DWST and fire protection storage tank) distributed about the site to survive the BDBEE. It was also noted that these tanks do not have a robust design with respect to missiles generated from high wind events (i.e., hurricanes and tornados). The licensee appears to use a probability approach to reach a conclusion that at least one of these tanks will survive an ELAP event. This is not in accordance with the guidance in NEI 12-06, Section 3.2.1.3, initial condition (3), which allows the assumption that “[c]ooling water and makeup water inventories contained in systems or structures with designs that are robust with respect to high winds, and associated missiles are available” because the NEI 12-06, Appendix A definition for robust designs relies on consideration of an SSC as a single unit rather than an analysis to demonstrate that redundancy of SSCs in the site design makes protection from missiles unnecessary. The guidance on the acceptability of relying on separation of redundant portable equipment is provided in NEI 12-06, Section 7.3.1, Consideration 1.b. The use of this justification for the availability of the water in the tanks would constitute an alternative approach to NEI 12-06; therefore, the licensee would need to take into account further analysis such as the full scope of the historical data on tornado events in the region surrounding the site rather than the 20 year period examined and a discussion of why a limit on tornado width frequency within the historical data would be appropriate (i.e., bounding only 90% of tornado events for the 50 mile radius, if this approach is taken). This has been identified as Open Item 3.2.4.7.A in Section 4.1.

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

As previously described in section 3.1.1.2 above, the SGS provided detail, including drawings on electrical connections and protection required for implementing the FLEX strategies. Further, procedures are being developed. Actual testing and time validation will occur at a future date.

During the NRC audit and review process, it was noted that, on pages 36, 37, 38, and 39 of the Integrated Plan, the licensee discussed its proposed DC Power, 480 VAC DG Power Distribution, 480 VAC “A” Vital Bus, 230 VAC DG Power Distribution. The licensee did not provide a summary of the sizing calculation for the FLEX DGs to show that they can supply the loads assumed in phase 2 and 3. The licensee was asked to confirm that the electrical equipment will have adequate voltages to ensure intended operation when supplied from FLEX DGs during ELAP event.

In its response to the audit question, the licensee stated that diesel generator sizing calculations are in progress. The results will be communicated in a future six-month update. This is identified as Confirmatory Item 3.2.4.8.A, in Section 4.2.

On page 38 of the Integrated Plan, the licensee discussed use of electrical equipment such as 480 VAC DG Power Distribution, 480 VAC “A” Vital Bus, 230 VAC DG Power Distribution, associated cablings and connectors. The licensee provided insufficient information on how electrical isolation will be maintained such that (a) Class 1E equipment is protected from faults in portable portable/Flex electrical equipment and (b) multiple sources do not attempt to power electrical buses.

In its response to the audit question, the licensee stated that the specific design has not been yet completed. In general the portable FLEX equipment will be connected to a new Switchgear installed under a plant modification package. The specific design will be communicated in a future six-month update. This is identified as Confirmatory Item 3.2.4.8.B in Section 4.2.

The licensee did not provide the minimum voltage that must be maintained and the basis for the minimum voltage on the dc bus. This is identified as Confirmatory Item 3.2.4.8.C. 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 electrical power sources/isolations and Interactions, if these requirements are implemented as described.

3.2.4.9 Portable Equipment Fuel.

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

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

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

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

The licensee did not provide fuel consumption rate for each FLEX piece of equipment to calculate total fuel usage and thus demonstrate that sufficient fuel with margin exists on site. This is identified as a Confirmatory Item 3.2.4.9.A in Section 4.2.

On page 45 of the Integrated Plan describing safety function support regarding portable equipment fuel oil, SGS stated that portable equipment used in Phase 2 will be equipped with fuel storage tanks sufficient for at least 24 hours of operation without refueling to minimize actions required to keep equipment running. A fuel line will be routed from the diesel fuel oil storage tank (DFOST) room in the auxiliary building to elevation 100 ft. and the roof of the auxiliary building for refueling of FLEX equipment. A small motor driven FLEX diesel fuel oil transfer pump will be used to pump diesel fuel oil from either 30,000 gallon DFOST to each elevation. Equipment operators can fill equipment through hose runs or portable containers. The licensee stated that the fuel oil stored in installed fuel tanks for the emergency diesel generators will be sampled and analyzed in accordance with the Technical Specifications Surveillance Requirements. A Protocol to analyze and test fuel oil stored in the portable/FLEX equipment during storage will be developed to ensure fuel oil quality will be maintained. This is identified as a Confirmatory Item 3.2.4.9.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 portable equipment fuel, if these requirements are implemented as described.

3.2.4.10 Load Reduction to Conserve DC Power

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

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

On page 35 of the Integrated Plan describing the safety functions support (electrical), the licensee stated that the following coping strategy is implemented to increase usable battery life to provide power to the vital 125 VDC and 28 VDC busses for instrumentation and other vital loads during Phase 1. Non-essential loads will be removed from the busses in order to extend their availability. These load shedding actions will be completed during the first 30 minutes of the event in accordance with S1.OP-AB.LOOP-0001 and will extend the battery life to a minimum of 4 hours of operation for either unit.

Battery life will be extended through a deep load shedding on each battery. With this deep load shedding strategy, it is expected that the station batteries can be extended through Phase 1 and do not require portable supplemental charging before 4 hours for the most limiting battery. During the NRC audit and review process, the staff requested the licensee to provide (a) the direct current (dc) load profile for the mitigating strategies to maintain core cooling, containment, and spent fuel pool cooling during all modes of operation, (b) provide a detailed discussion on the loads that will be shed from the dc bus, the equipment location (or location where the required action needs to be taken), and the required operator actions needed to be performed and the time to complete each action.

Additional formal analysis will be performed to determine if additional load shedding strategies can extend this duration. If analysis results require a change in strategy, that change will be communicated in a six-month status report.

The licensee did not explain which functions are lost as a result of shedding each load and was asked to discuss any impact on defense in depth and redundancy. The staff also asked the licensee to identify any plant components that will change state if vital ac or dc is lost, de-energized, during this evolution of dc load shed. Additionally, the licensee was asked that when the operators manipulate dc breakers to load shed, identify whether plant components would actuate, de-energize pumps, which breakers will operators open as part of the load shed evolutions, and will the dc breakers to be opened be physically identified by special markings to assist operators in manipulating the correct breakers.

In its response to the audit question, the licensee stated that the deep load shed strategies are under development. The strategy will avoid shedding loads required for ELAP response. Various strategies are being analyzed using the ETAP computer software, with the goal of extending battery life past the 4 hour limit. Load shedding strategies will consider component state changes. Staff will review strategy to ensure equipment necessary to support mitigating strategies is not shed. Considerations include main generator hydrogen gas pressure and actions to vent. This is identified as Confirmatory Item 3.2.4.10.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 load shed to conserve dc power, if these requirements are implemented as described.

3.3 PROGRAMMATIC CONTROLS

3.3.1 Equipment Maintenance and Testing.

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

> In order to assure reliability and availability of the FLEX equipment required to meet these capabilities, the site should have sufficient equipment to address all functions at all units on-site, plus one additional spare, i.e., an N+1 capability,

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

NEI 12-06, Section 11.5 states:

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

2. Portable equipment that directly performs a FLEX mitigation strategy for the core, containment, or SFP should be subject to maintenance and testing[1] guidance provided in INPO AP 913, Equipment Reliability Process, to verify proper function. The maintenance program should ensure that the FLEX equipment reliability is being achieved. Standard industry templates (e.g., EPRI) and associated bases will be developed to define specific maintenance and testing including the following:

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

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

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

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

[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.

On page 8 of the Integrated Plan, the licensee states that they will implement an administrative program from implementation of the FLEX strategies in accordance with NEI 12-06 guidance. FLEX equipment will have unique identification numbers. Installed structures, systems and components pursuant to 10 CFR 50.63(a) will continue to meet the augmented quality guidelines of Regulatory Guide 1.155, Station Blackout. Standard Industry preventative maintenance processes will be used for component maintenance. Testing procedures will be developed and frequencies established based on the type of equipment and considerations made within EPRI guidelines.

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

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

During the NRC audit and review 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 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.

As described above, the licensee stated that it will implement an administrative program for the implementation of the FLEX strategies, however, there is no mention in the plan regarding configuration control. This is identified as Open Item 3.3.2.A in Section 4.1.

In response to the audit process question, the licensee stated that One Line electrical sketches are being updated as designs are finalized. Final connection points may be revised during DCP detailed design which is in progress. This is identified as Confirmatory Item 3.3.2.A in Section 4.2.

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

3.3.3 Training.

NEI 12-06, Section 11.6 provides that:

1. Programs and controls should be established to assure personnel proficiency in the mitigation of beyond-design-basis events is developed and maintained.

These programs and controls should be implemented in accordance with an accepted training process.[2]

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

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

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

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

On page 9 of the Integrated Plan, the licensee states that new training of general station staff and emergency preparedness (EP) will be performed, prior to completion of design installation in 2014 for SGS Unit 1 and 2015 for SGS Unit 2. Training will be implemented in accordance with the existing PSEG training and qualification processes.

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

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[2] The Systematic Approach to Training (SAT) is recommended.

[3] Emergency response leaders are those utility emergency roles, as defined by the Emergency Plan, for managing emergency response to design basis and beyond-design-basis plant emergencies.

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

On page 55 of the Integrated Plan regarding the Milestone Schedule regarding the Regional Response Center plan, the licensee identified that it will contract with the RRC between July and October 2013.

On page 9 in the section of the Integrated Plan regarding the Regional Response Center plan, the licensee stated that the industry will establish two (2) Regional Response Centers (RRC) to support utilities during beyond design basis events. I&M has issued a contract for the RRC. 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. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's response plan, will be delivered to the site within 24 hours from the initial request.

The licensee's Integrated Plan addressed the use of off-site resources to obtain equipment and commodities to sustain and backup the site's coping strategies (Guideline 1). However, the plan did not address implementation guidelines 2 through 10. This has been identified as Confirmatory Item 3.4.A in Section 4.2.

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

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.1.4.3.A	Procedural Interfaces - Snow, Ice and Extreme Cold Hazard - During the NRC audit process, the licensee states that snow removal is a normal activity for SGS. Moderate to normal snow removal could be accomplished by FLEX debris removal equipment if required. The licensee did not state that FLEX debris removal equipment could remove extreme snow and ice.	
3.2.1.1.A	Computer Code Used for ELAP Analysis - The licensee did not perform a site-specific thermal-hydraulic analysis of an ELAP event.	
3.2.1.8.A	Core Sub-Criticality - The Pressurized Water Reactor Owners Group submitted a position paper, dated August 15, 2013 (withheld from public disclosure due to proprietary content), which provides test data regarding boric acid mixing under single-phase natural circulation conditions and outlined applicability conditions intended to ensure that boric acid addition and mixing would occur under conditions similar to those for which boric acid mixing data is available. During the audit process, the licensee informed the NRC staff of its intent to abide by the generic approach discussed above. The NRC staff concluded that the August 15, 2013, position paper was not adequately justified and has not endorsed this position paper.	
3.2.4.7.A	Water Sources - The licensee appears to use a probability approach to reach a conclusion that at least one of the three tanks depended on for SG makeup will survive an ELAP event. NEI 12-06 guidance does not give probability as an option. The licensee should determine if a water supply would be available after a tornado event by analyzing the tornado characteristics for the site compared to the separation characteristics of the tanks. This is an alternate approach from the strategies identified in NEI 12-06.	Significant
3.3.2.A	Configuration Control - The licensee should describe a plan for configuration control of FLEX equipment in its Integrated Plan.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.1.A	Protection of FLEX Equipment including FLEX DGs - The licensee needs to finalize its evaluation of the use of the SGS auxiliary building and the use of the HCGS Unit 2 reactor building for permanent FLEX equipment storage.	
3.1.1.2.A	Deployment of FLEX Equipment – The licensee should provide a	

	review of deployment routes between the proposed equipment storage locations and the areas the equipment will be moved to and evaluate the potential for soil liquefaction.	
3.1.1.2.B	Deployment of FLEX Equipment - The licensee does not state that the Nuclear Service Water Connections will be protected from seismic events. Confirm that this is ensured.	
3.1.1.3.A	Procedural Interfaces – Seismic Hazard - In response to the audit process, the licensee states that a procedure is being developed to provide guidance on how and where to measure key instruments at containment penetrations using a portable instrument.	
3.1.1.3.B	Procedural Interfaces – Seismic Hazard - The licensee's integrated plan did not provide any information on: 1) non-robust internal flooding sources that do not require ac power; 2) the use of ac power to mitigate ground water in critical locations	
3.1.1.4.A	Considerations in Using Offsite Resources – Seismic Hazard - Flooding Hazard - High Winds Hazard - Snow, Ice and Extreme Cold Hazard - Equipment staging areas for deployment of offsite equipment from SAFER will be finalized in a future 6 month update.	
3.1.2.2.A	Deployment of FLEX Equipment – Flooding Hazard - Finalization of proposed changes to the deployment of FLEX equipment during a hurricane induced flooding condition will be provided in a future 6 month update.	
3.1.4.2.A	Deployment of FLEX Equipment – Flooding Hazard - The licensee should address the formation of frazil ice and means to cope with it.	
3.1.4.2.B	The licensee should address manual operations required by plant personnel during periods of snow, ice, and extreme cold hazards.	
3.1.5.2.A	The licensee should state the basis for lack of backup ventilation with respect to protection of FLEX equipment during high temperature hazards and what the impacts of high temperature hazards would be on the deployment of the FLEX equipment in such conditions.	
3.1.5.3.A	The licensee should specify the peak temperature for which FLEX equipment would be expected to operate.	
3.2.1.A	Specify which analysis performed in WCAP-17601 is being applied to your site. Additionally, justify the use of that analysis by identifying and evaluating the important parameters and assumptions demonstrating that they are representative of your site and appropriate for simulating the ELAP transient.	
3.2.1.1.A	Computer Code Used for ELAP Analysis - Reliance on the NOTRUMP code for the ELAP analysis of Westinghouse plants is limited to the flow conditions prior to reflux condensation initiation. This includes specifying an acceptable definition for reflux condensation cooling.	
3.2.1.1.B	The licensee utilized the existing analyses in WCAP-17601-P, Revision 0, and PA-PSC-0965, Revision 0 to develop its sequence of events and time constraints. The licensee will validate the response times at a future time.	

3.2.1.2A	Reactor Coolant Pump Seal Leakage Rates - 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.	
3.2.1.2.B	Reactor Coolant Pump Seal Leakage Rates - 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.	
3.2.1.5.A	Monitoring Instrumentation and Controls - The review identified a concern with the level of accuracy of the FLEX instrumentation to ensure that electrical equipment remains protected (from an electrical standpoint – e.g., power fluctuations) and with the ability of this instrumentation to provide operators with accurate information ensure the maintenance of core cooling, containment, and spent fuel cooling. Please provide a discussion on the accuracy of portable equipment instrumentation as it relates to equipment protection and operator information for maintenance of FLEX strategies.	
3.2.1.6.A	Sequence of Events – During the NRC audit process the licensee summarizes the changes in its mitigation strategies for Phase 1 and Phase 2. The evaluation for implementing these changes will be communicated in a future 6 month update.	
3.2.1.9.A	Use of Portable Pumps – The Integrated Plan provides a Table depicting the FLEX equipment to be deployed and states that the quantity does not reflect N+1 requirements. The licensee should specify how many pieces of equipment will be available for an ELAP/LUHS, and this should meet N+1 requirements.	
3.2.2.A	Spent Fuel Pool Cooling Strategies - In the audit and review, the licensee provided additional information regarding the SFP makeup during an ELAP event. It stated that a new 4” FLEX hose is being evaluated as replacement for SFP makeup. This	

	connection would be upstream 1(2)SF 9 and would allow water from SW, AFW, and the FLEX boron mixing tank pump discharges to be aligned for SFP makeup. The proposed connection point is in the Auxiliary Building in the SFP pump area. Additionally, a spray pipe system is being re-evaluated. The licensee should provide details of the final configuration, including flow rates.	
3.2.3.A	The licensee committed to perform further containment analysis to demonstrate that containment integrity can be maintained up until a point in time when containment cooling can be restored during Phase 3.	
3.2.3.B	Containment Functions Strategies - In the audit and review, the licensee stated that SGS plans to use MAAP analysis to complete the FLEX strategies and timelines. Review these analyses when available.	
3.2.4.2.A	Ventilation – Equipment Cooling - The licensee has provided insufficient details of the ventilation provided in the battery room to support a conclusion that there is reasonable assurance that the effects of elevated or lowered temperatures in the battery room, especially if the ELAP is due to a high or low temperature hazard, have been considered. The licensee was asked to provide information on the adequacy of the ventilation provided in the battery room to protect the batteries from the affects of elevated or lowered temperatures.	
3.2.4.2.B	Ventilation – Equipment Cooling - The licensee provided a discussion on how hydrogen concentration in the battery rooms will be mitigated when the batteries are being recharged during Phases 2 and 3. The licensee will provide strategies to repower installed battery room exhaust fans or portable fans for ventilation.	
3.2.4.2.C	Ventilation – Equipment Cooling - The licensee stated that GOTHIC modeling and room heat-up calculations are being developed for plant strategic areas including the TDAFW rooms. The results of the modeling and analyses will be communicated in a future 6 month update.	
3.2.4.4.A	Communications - Confirm that upgrades to the site's communications systems have been completed.	
3.2.4.6.A	Personnel Habitability – Elevated Temperature -The licensee was requested to provide maximum environmental room temperatures at ELAP coping periods greater than the 4-hours assumed in NUMARC 87-00.	
3.2.4.6.B	Personnel Habitability - The licensee stated that formal analyses would be performed to support the initial actions taken to provide cooling for the MCR until Phase 2 actions can be implemented. The results of the modeling and analyses will be communicated in a future 6 month update.	
3.2.4.8.A	Electrical Power Sources/Isolations and Interactions - licensee stated that diesel generator sizing calculations are in progress. The results will be communicated in a future six-month update.	
3.2.4.8.B	Electrical Power Sources/Isolations and Interactions - The	

	licensee discussed use of electrical equipment such as 480 VAC DG Power Distribution, 480 VAC "A" Vital Bus, 230 VAC DG Power Distribution, associated cablings and connectors. The licensee provided insufficient information on how electrical isolation will be maintained such that (a) Class 1E equipment is protected from faults in portable/Flex electrical equipment and (b) multiple sources do not attempt to power electrical buses.. Specifics will be part of detailed design.	
3.2.4.8.C	Electrical Power Sources/Isolations and Interactions - The licensee should provide the minimum voltage that must be maintained and the basis for the minimum voltage on the dc bus.	
3.2.4.9.A	Portable Equipment Fuel - The licensee should provide fuel consumption rate for each FLEX piece of equipment to calculate total fuel usage and thus demonstrate that sufficient fuel with margin exists on site.	
3.2.4.9.B	Portable Equipment Fuel – The licensee stated that a Protocol to analyze and test fuel oil stored in the portable/FLEX equipment during storage will be developed to ensure fuel oil quality will be maintained.	
3.2.4.10.A	Load Reduction to Conserve DC Power - The licensee did not explain the following: (a) which functions are lost as a result of shedding each load and was asked to discuss any impact on defense in depth and redundancy (b) to identify any plant components that will change state if vital ac or dc is lost, de-energized, during this evolution of dc load shed and (c) when the operators manipulate dc breakers to load shed, identify whether plant components would actuate, de-energize pumps, which breakers will operators open as part of the load shed evolutions, and will the dc breakers to be opened be physically identified by special markings to assist operators in manipulating the correct breakers.	
3.3.2.A	Configuration Control - In response to the audit process question, the licensee stated that One Line electrical sketches are being updated as designs are finalized. Final connection points may be revised during DCP detailed design which is in progress. The licensee should provide the sketches to the NRC for review.	
3.4.A	Offsite Resources - The licensee's Integrated Plan addressed the use of off-site resources to obtain equipment and commodities to sustain and backup the site's coping strategies (Guideline 1). However, the plan needs to address implementation guidelines 2 through 10.	