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
Hope Creek Generating Station
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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 27, 2013, (ADAMS Accession No. ML130590336), and as supplemented by the first six-month status report in letter dated August 22, 2013 (ADAMS Accession No. ML13235A096), PSEG Nuclear LLC (the licensee or PSEG) provided the Hope Creek Generating Station (HCGS) 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.

In the Integrated Plan, the licensee identified that all sites will address seismic hazards. In addition, the licensee stated that the current design basis safe shutdown earthquake (SSE) has a maximum ground acceleration, in both the horizontal and vertical directions, of 0.2g. The associated spectra are included in HCGS UFSAR Figures 2.5-27 and 2.5-28. The licensee stated, on page 5 of their Integrated Plan, that the reevaluation of the seismic hazard as requested by the 10 CFR 50.54(f) letter of March 12, 2012, has not yet been completed and therefore was not assumed in the Integrated Plan. The licensee also stated that as the re-evaluations are completed, appropriate issues would be entered into the corrective action program (CAP) and addressed.

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

3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

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

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

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

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

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

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

On page 2 of the Integrated Plan, the licensee stated that the FLEX equipment required to mitigate a seismic event at HCGS will be stored at its point of deployment in a Seismic Category 1 structure (e.g., reactor building, control diesel building, etc.) or will be stored in the cancelled HCGS Unit 2 reactor building. The licensee stated that large portable FLEX equipment will be secured for a seismic event and located so that it is not damaged by other items during a seismic event. In addition, the licensee stated that an evaluation is in progress to verify that construction of the HCGS Unit 2 structures have been sufficiently completed, and will meet the considerations described in NEI 12-06, Section 5.3.1. This is identified as Confirmatory Item 3.1.1.1.A in Section 4.2 below.

On page 25 of the Integrated Plan, licensee stated the supplemental Phase 2 FLEX equipment normally stored outdoors, such as bulldozers and trucks, will be stored in designated areas that will not be vulnerable to damage from collapsing structures or falling objects.

The Integrated Plan for Salem Generating Station (SGS) Units 1 and 2 was submitted separately. In the SGS Integrated Plan, it describes the storage and deployment of their FLEX equipment utilizing the HCGS Unit 2 reactor building. HCGS's Integrated Plan did not discuss FLEX storage and deployment strategies involving the interaction of SGS's needs and requirements for their FLEX storage and deployment phase of response to an ELAP on Artificial Island. During the audit, the licensee described that the use of the HCGS Unit 2 reactor building for both HCGS and SGS considers the deployment times and strategies of both facilities. In addition, the licensee stated that the storage area is protected from all external events as the HCGS Unit 2 reactor building is a seismically qualified and flood protected structure. Detailed design work is currently in progress associated with a severe storm with high winds (missile protection determination), and extreme cold and heat events (adequate heating, ventilation and air conditioning (HVAC)). The status and results of these design activities will be summarized in future six-month updates.

The HCGS Integrated Plan did not identify if any of the equipment and/or material needed to implement their mitigating strategies are shared or communal with SGS. This identification should extend to the site (N, where N is the number of units on the site) and spare (N + 1) sets of equipment as described in NEI 12-06 as well as any deployment vehicles/trailers. During the audit, the licensee described the shared equipment between SGS and HCGS. The shared equipment consists of but not limited to towing vehicles, debris removal equipment, forklift, trailers for deployment of hoses and cables, portable fuel oil tanks, transfer pumps, and support for the equipment in the storage area (such as battery chargers). Other equipment such as UHS pumps and 480 Vac diesel generators (DGs) will be designed such that they could be utilized on any of the three units and would include a spare (N+1).

On page 11 of the licensee's Integrated Plan, the licensee states that a FLEX header will be pre-installed in the reactor building with connections made to the piping of several systems. Additional information was requested from the licensee regarding seismic qualification, wind-driven missile protection, and other protection from natural phenomena of the FLEX header. During the audit process, the licensee addressed this issue by describing that the FLEX header will be installed within the Unit 1 reactor building. The Unit 1 reactor building is protected from all BDBEEs. The FLEX header will be qualified to function following a seismic event. The design is under development and will be addressed in a future six-month update.

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 equipment protection if these requirements are implemented as described.

3.1.1.2 Deployment of FLEX Equipment - Seismic Hazard

NEI 12-06, Section 5.3.2 states:

> The baseline capability requirements already address loss of non-seismically robust equipment and tanks as well as loss of all AC. So, these seismic considerations are implicitly addressed.
>
> There are five considerations for the deployment of FLEX equipment following a seismic event:
>
> 1. If the equipment needs to be moved from a storage location to a different point for deployment, the route to be traveled should be reviewed for potential soil liquefaction that could impede movement following a severe seismic event.
>
> 2. At least one connection point for the FLEX equipment will only require access through seismically robust structures. This includes both the connection point and any areas that plant operators will have to access to deploy or control the capability.
>
> 3. If the plant FLEX strategy relies on a water source that is not seismically

robust, e.g., a downstream dam, the deployment of FLEX coping capabilities should address how water will be accessed. Most sites with this configuration have an underwater berm that retains a needed volume of water. However, accessing this water may require new or different equipment.

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

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

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.

Also discussed on page 2 of the Integrated Plan, the HCGS UFSAR, Section 2.5.4.8.3 describes that non-liquefiable backfill surrounds the structures (power block and intake structure) up to final grade. This section of the UFSAR also describes that the only soils that may experience SSE induced liquefaction are the sandy portions of the hydraulic fill, which occur generally in the upper 30 feet at the site. The Integrated Plan did not address liquefaction for any deployment routes not in the vicinity of the power block and intake structure. In addition, information regarding liquefaction related to the Artificial Island and site access routes for personnel and transportation of Phase 3 equipment deployment was not discussed in the Integrated Plan. During the audit, the licensee described that liquefaction of the uppermost and recent geologic age site layered sediments, beyond the areas of safety related structures, could possibly occur during a seismic event; but it is expected that the material's behavior as a liquid would cease following the earthquake and would revert to a stiffness and strength needed to accommodate on-site equipment movement. In the event that pathways or roadways are damaged, alternate travel routes around the potentially undermined surfaces would be implemented. In addition, the licensee stated that Phase 3 equipment could be transported to the site by helicopter.

On page 5 of the Integrated Plan, the licensee stated that the hardened connections are protected against external events or are established at multiple and diverse locations. In addition, margin will be added to design FLEX components and hard connection points to address future requirements as re-evaluation warrants. This margin will be determined during the detailed design or evaluation process.

The licensee stated, in several places in the Integrated Plan, that a hose can run from the engine/pump located at the service water intake structure (SWIS) and connect to an existing six inch flanged connection on the service water (SW) pump discharge piping located inside the SWIS. While the SWIS is a seismically robust building (seismic category 1 per UFSAR Table 3.2-1) that contains the connection point, it was not clear in the Integrated Plan that the service water piping is seismic and would survive the event. During the audit, the licensee stated that the service water piping that includes the subject connection point is seismic category I.

HCGS is located on and uses the Delaware River as a source of water. Per the UFSAR Section 2.4.4.1, "Dam Failure Permutations," there are no existing dams on the main stem Delaware River. Therefore, consideration 3 is not applicable.

As described in Section 3.1.1.1, FLEX equipment will be stored at its point of deployment in a Seismic Category 1 structure (e.g., reactor building, control diesel building, etc.) or will be stored in the cancelled HCGS Unit 2 reactor building. The Integrated Plan did not discuss power requirements that may be needed to deploy the equipment as specified in NEI 12-06, Section 5.3.2 consideration 4. During the audit, the licensee described that there are no electrical sources required to open HCGS Unit 2 truck bay door or needed to deploy FLEX equipment.

On page 25 of the Integrated Plan, licensee stated the supplemental Phase 2 FLEX equipment normally stored outdoors, such as bulldozers and trucks, will be stored in designated areas that will not vulnerable to damage from collapsing structures or falling objects.

The HCGS Integrated Plan did not identify if any of the equipment and/or material needed to deploy their mitigating strategies are shared or communal with SGS. During the audit, the licensee described the shared equipment between SGS and HCGS. The shared equipment consists of but not limited to towing vehicles, debris removal equipment, forklift, trailers for deployment of hoses and cables, portable fuel oil tanks, transfer pumps, and support for the equipment in the storage area (such as battery chargers). In addition, during the audit the licensee described that the use of the HCGS Unit 2 reactor building for both HCGS and SGS considers the deployment timelines and strategies of both facilities.

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

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

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

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

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

On page 19 of the Integrated Plan describing Key Reactor Parameters for the Maintaining Core Cooling, BWR [Boiling Water Reactor] Installed Equipment Phase 1 (pages 25, 30, 33, 35, 38 of the Integrated Plan refer to the information contained on page 19), there is no indication of whether the instruments listed are local or control room indications or whether these instruments could be impacted by circumstances described in NEI 12-06, Section 5.3.3, consideration 1 noted above. The Integrated Plan stated that the instruments are powered from 125 Vdc batteries. In addition, the plan did not include consideration of critical actions to perform until alternate indications could be connected nor did it address guidance to include instructions on how to control critical equipment without control power. The licensee addressed this issue during the audit process by describing that the HCGS FLEX strategy is designed to ensure that the power supplies remain energized to critical equipment using the FLEX DG. The FLEX DG will supply the necessary battery chargers with power prior to the batteries reaching minimum voltage to support instrumentation. In addition, the licensee stated that guidance for obtaining necessary instrument readings specified in NEI 12-06, Section 5.3.3 consideration 1 and Section 3.2.1.10 will be developed, if not already in place. Guidance on what actions should be taken until alternate indications can be connected as well as how to control critical equipment will be included in the FLEX support guidelines (FSGs).

With regard to NEI 12-06, Section 5.3.3, considerations 2 and 3 identified above, the Integrated Plan did not adequately address the procedural interface considerations for seismic hazards associated with large internal flooding sources that are not seismically robust and do not require ac power, or the use of ac power to mitigate ground water in critical locations. The licensee addressed this issue during the audit process by describing that there are no large, non-seismic internal flooding sources that do not rely on ac power within the HCGS flood protection boundary. In addition, the licensee stated that HCGS's flood protection design does not rely on ac powered dewatering systems to mitigate ground water.

HCGS is located on and uses the Delaware River as a source of water. Per the UFSAR Section 2.4.4.1, "Dam Failure Permutations," there are no existing dams on the main stem Delaware River. Therefore, consideration 4 is not applicable.

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 if these requirements are implemented as described.

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

> Severe seismic events can have far-reaching effects on the infrastructure in and around a plant. While nuclear power plants are designed for large seismic events, many parts of the Owner Controlled Area and surrounding infrastructure (e.g., roads, bridges, dams, etc.) may be designed to lesser standards.

> Obtaining off-site resources may require use of alternative transportation (such as air-lift capability) that can overcome or circumvent damage to the existing local infrastructure.
>
> 1. The FLEX strategies will need to assess the best means to obtain resources from off-site following a seismic event.

On page 13 of the Integrated Plan, the licensee stated that industry will establish two Regional Response Centers (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; 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 will be delivered to within 25 miles of the site within 24 hours from the initial request.

PSEG's Integrated Plan for the use of offsite resources provided insufficient information regarding if the licensee is going to participate with the industry approach (did not identify that a contract is in place or negotiation is in progress), the identification of the local arrival staging area and a description of the transportation routes or methods to be used to deliver the equipment to the site or if the site will be accessible following a seismic event (accessibility of site access road). The licensee addressed these issues during the audit process by describing that PSEG is a participant in the SAFER. In addition, the licensee stated that they have met with SAFER representatives and tentatively identified onsite and offsite staging areas. Equipment will be delivered to the site by road if conditions permit or by air if the ground routes are not available. Also, the licensee has identified an area at the northeast corner of the site that is large enough to accommodate the onsite staging area for both SGS and HCGS. The licensee stated that they are evaluating several facilities as potential offsite staging areas and will provide the results in a future six-month update.

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

3.1.2 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 pages 2 and 3 of the Integrated Plan, the licensee states that external flooding is applicable to HCGS, where site grade is nominally 101.5 feet PSEG Datum (PSD). As described in UFSAR Section 2.4, HCGS is susceptible to flooding from the probable maximum flood (PMF), dam breach, probable maximum hurricane (PMH) and probable maximum tsunami (PMT). Additionally, the licensee stated that flood re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, are currently being developed based primarily on the analysis prepared for the PSEG Site Early Site Permit Application. Upon completion of the analyses, PSEG will use the results to inform the flooding hazards applicable to HCGS and associated FLEX protection and deployment strategies. Any changes required to HCGS FLEX strategies as a result of the flooding hazard re-evaluation will be communicated in a future six-month update.

The licensee stated that the PMF event is described in HCGS UFSAR Section 2.4.3. The estimated maximum still water level is 97.3 feet PSD (PSEG datum) and the maximum wave run-up height at HCGS is 109.8 feet PSD. The PMF event is estimated to have greater than two hours of warning time and the flooding is expected to persist over site grade for only a few hours (coincident with the high tide cycle and wind direction).

The licensee also stated that the dam breach event is described in HCGS UFSAR Section 2.4.4. Although it is identified as the potentially critical dam failure in HCGS UFSAR Section 2.4.4, the proposed Tocks Island Dam was cancelled. As such, the licensee states that the HCGS current licensing basis is extremely conservative with regard to the flood levels considered for single and multiple dam break scenarios. However, breach of the Francis E. Walter Dam (located on a tributary of the Delaware River) is estimated to develop a maximum still water level of 94 feet PSD and the maximum wave run-up height at HCGS is 105.9 feet PSD. While not stated in the HCGS current licensing basis, the anticipated time for the flood effects of a single/multiple existing dam failure to reach the HCGS site is on the order of 24 hours from the occurrence of the initiating seismic event located in the upper reaches of the Delaware River. The flooding is expected to persist over site grade for only a few hours (coincident with the high tide cycle and wind direction).

In addition, the licensee stated that as described in the HCGS UFSAR Section 2.4.5, the PMH event is the design basis flooding event for HCGS producing the highest water levels across the site. A 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 licensee stated that the maximum water level at plant site resulting from tsunami waves considers the effect of coincident wind-wave activity, as described in HCGS UFSAR Section 2.4.6. The estimated maximum wave height coincident with 10 percent exceedance high tide and two-year extreme wind condition at HCGS is 104.6 feet PSD. The resulting wave run-up height is 107.1 feet PSD. The tsunami event is estimated to have greater than 2.5 hours of warning time and the flooding is expected to persist over site grade for only a few hours (coincident with the high tide cycle).

The licensee stated that flooding events at HCGS have warning times ranging from two hours to greater than 48 hours. The flooding is expected in all cases to persist over site grade for 12 hours or less.

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 flood screening 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 3 of the Integrated Plan, the licensee stated that the FLEX equipment required to mitigate a flooding event at HCGS will be stored at its point of deployment in a flood protected structure (e.g., reactor building, control diesel 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 normally be pre-staged in two diverse outdoor locations, with at least one set located above the flood level associated with a non-hurricane flooding event discussed above. Due to the sufficient amount of warning time associated with a hurricane event, at least one set of debris removal equipment will be pre-staged in the HCGS Unit 2 reactor building prior to the event to support deployment of FLEX equipment in Phases 2 and 3.

In addition, on page 25 of the Integrated Plan, the licensee stated that most Phase 2 FLEX equipment will be stored and deployed within "flood proof" structures such as the Unit 1 and 2 auxiliary buildings, the Unit 1 reactor building and the Unit 1 SWIS and will therefore be protected from the effects of a flood. The engine driven FLEX pump to be deployed near the

SWIS will be normally stored in the flood proof Unit 2 reactor building. Also, the licensee stated that supplemental Phase 2 FLEX equipment normally stored outdoors, such as bulldozers and trucks, will be moved into the Unit 2 reactor building to protect them from flood water.

The licensee stated that equipment pre-staged in the Unit 1 auxiliary or reactor buildings will be available to be placed into service after the BDBEE. However, equipment stored in the Unit 2 reactor building cannot be retrieved until floodwaters fall to the extent that watertight doors can be opened and equipment movement on site will be possible. At this point, earthmoving equipment can be moved out of safe storage and be used to clear pathways to tow/haul FLEX equipment from the Unit 2 reactor building to deployment locations.

On page 35 of the Integrated Plan, the licensee stated that all of the FLEX equipment and piping used to maintain containment will be pre-staged or pre-installed in the reactor building and is protected from design basis floods. Storage locations, such as the turbine building floor, will be used only if flood waters have not filled or do not threaten to fill them with flood water. During the audit, the licensee noted that the turbine building is not part of the flood protected boundary and failure of the circulation water piping in the turbine building will not affect the safety related flood protected boundary.

On page 42 of the Integrated Plan, the licensee stated that all of the FLEX equipment and piping used for SFP cooling will be pre-staged or pre-installed in the reactor building which provides protection from design basis floods.

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

3.1.2.2 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 [loss of ultimate heat sink] LUHS, as well as ELAP.

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

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

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

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

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

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

On page 3 of the Integrated Plan, the licensee stated that FLEX equipment required to mitigate a flooding event at HCGS will be stored at its point of deployment in a flood protected structure (e.g., reactor building, control diesel building, etc.) or will be stored in the flood protected HCGS Unit 2 reactor building FLEX staging area. Due to the sufficient amount of warning time associated with a hurricane event, at least one set of debris removal equipment will be pre-staged in the HCGS Unit 2 reactor building prior to the event to support deployment of FLEX equipment in Phases 2 and 3.

On page 25 of the Integrated Plan, the licensee stated that procedure HC.OP-AB.MISC-0001, "Acts of Nature," requires commencement of unit shutdown when floodwaters are greater than or equal to 99.5 feet, based on PSEG datum. These actions, if performed prior to an ELAP, provide the benefit of removal of significant decay heat from the reactor.

The licensee stated that equipment pre-staged in the Unit 1 auxiliary or reactor buildings will be available to be placed into service after the BDBEE. However, equipment stored in the Unit 2 reactor building cannot be retrieved until floodwaters fall to the extent that watertight doors can be opened and equipment movement on site will be possible. At this point, earthmoving equipment can be moved out of safe storage and be used to clear pathways to tow/haul FLEX equipment from the Unit 2 reactor building to deployment locations.

On pages 5 and 6 of the Integrated Plan, the licensee stated that the designed hardened connections are protected against external events or are established at multiple and diverse locations. In addition, deployment strategies and deployment routes will be assessed for hazard impact.

On page 11 of the Integrated Plan, the licensee stated that critical FLEX equipment, such as the FLEX diesel generator and the FLEX pump to be deployed in the reactor building, will be stored at the point of deployment during all modes of operation. The FLEX pump to be deployed at the SWIS will be stored in the Unit 2 reactor building and will be towed to the point of deployment after the ELAP has been identified and flood waters recede. Significant cable runs will be pre-run and terminated near their planned connection points in quick disconnect receptacles. Final electrical connections will be made with short jumper cables minimizing manpower requirements. A FLEX header will be pre-installed in the reactor building with connections made to the piping of several systems. When required, water for reactor pressure vessel (RPV) injection or SFP replenishment will be selected from the most desirable source by implementing the required valve lineup on the FLEX header. A FLEX pump will be pre-staged near the FLEX header with necessary pipe spools and flexible hose to connect to the header. FLEX piping will be pre-installed and strategically routed to minimize manpower requirements to complete piping runs by installing pipe spools and flexible hose. FLEX equipment will be available during all modes of operation. Procedures will be developed to ensure stored FLEX equipment is not rendered inaccessible by any other hardware or activities during periods such as refueling outages.

On page 50 of the Integrated Plan, the licensee stated that the 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.

As discussed in Section 3.1.2, above, although the licensee has characterized the persistence of the external flooding hazard as being over site grade for twelve hours or less, the licensee's Integrated Plan did not address accommodations along these lines that may be necessary to support successful long-term deployment as specified in NEI 12-06, Section 6.2.3.2, consideration 2. The licensee addressed this issue during the audit process by describing that the HCGS FLEX plan considers the need to function within flood protected areas for the first twelve hours of a flood based ELAP/LUHS. The licensee further described that at approximately 18 hours; the UHS (Delaware River) will be needed to begin replenishing inventory in the suppression pool. This allows approximately six hours to deploy the diesel driven pumps to the SWIS and begin to supply the SW piping and ultimately the suppression pool.

Additionally, during the audit process, licensee stated that supplies are stored within the flood protected boundary of HCGS Unit 1 and Unit 2 and will be accessible during the flood event. Also, the licensee stated that the initial fuel oil supply will be from the onsite safety related emergency diesel generators (EDGs) installed fuel oil storage tanks and day tanks. This will provide a minimum of 180,000 gallons of fuel oil stored in fuel oil tanks. Fuel oil will be routed from the Unit 1 day tanks to the FLEX DGs operating in the Unit 2 area.

The licensee's Integrated Plan did not provide a discussion relative to dewatering efforts for the plant/site due to the loss of installed sump pumps (if any) or the reliance on any temporary flood barriers to protect the plant/site or site access road. During the audit, the licensee addressed these issues by describing that HCGS does not rely on ac power to mitigate ground water in critical locations. In addition, the licensee stated that HCGS does not rely on any temporary flood barriers.

As discussed in Section 3.1.2.1 of this evaluation, the licensee stated in the Integrated Plan that supplemental Phase 2 FLEX equipment normally stored outdoors, such as bulldozers and trucks, will be moved into the Unit 2 reactor building to protect them from flood water.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of FLEX equipment 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 25 of the Integrated Plan, the licensee stated that Procedure HC.OP-AB.MISC-0001, "Acts of Nature," requires commencement of unit shutdown when flood waters are greater than or equal to 99.5 feet, based on PSEG datum. These actions, if performed prior to an ELAP, provide the benefit of removal of significant decay heat from the reactor.

There was insufficient information presented in the Integrated Plan to ascertain that there is reasonable assurance the procedures and programs for deployment of portable equipment in a flooding event conforms to NEI 12-06, Section 6.2.3.3 considerations 1 (incorporation of actions necessary to support flooding deployment considerations into procedures) and 2 (additional guidance may be required to address the deployment of FLEX for flooded conditions). This is identified as Confirmatory Item 3.1.2.3.A. in Section 4.2.

As described in Section 3.1.2.2 of this evaluation, the licensee does not rely on any temporary flood barriers.

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 procedures for flooding if these requirements are implemented as described.

3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

On page 13 of the Integrated Plan, the licensee stated that 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; the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment will be delivered to within 25 miles of the site within 24 hours from the initial request.

PSEG's Integrated Plan for the use of offsite resources provided insufficient information regarding if the licensee is going to participate with the industry approach (did not identify that a contract is in place or negotiation is in progress), the identification of the local arrival staging area and a description of the transportation routes or methods to be used to deliver the equipment to the site or even if the site is accessible (accessibility of site access road). The licensee addressed these issues during the audit process by describing that PSEG is a participant in the SAFER. In addition, the licensee stated that they have met with SAFER representatives and tentatively identified onsite and offsite staging areas. Equipment will be delivered to the site by road if conditions permit or by air if the ground routes are not available. Also, the licensee has identified an area at the northeast corner of the site that is large enough to accommodate the onsite staging area for both SGS and HCGS. The licensee stated that they are evaluating several facilities as potential offsite staging areas and will provide the results in a future six-month update.

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

3.1.3 High Winds

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

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

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

On pages 3 and 4 of the Integrated Plan, the licensee stated that Figures 7-1 and 7-2 from NEI 12-06 were used for their assessment. The licensee determined that HCGS could experience hurricane winds of approximately 160 mph based on Figure 7-1. The licensee also determined that HCGS is in Region 2 and could experience tornado force wind of approximately 166 mph based on Figure 7-2. Therefore, the high wind hazard is applicable to 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 provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to high wind screening if these requirements are implemented as described.

3.1.3.1 Protection of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.1 states:

> These considerations apply to the protection of FLEX equipment from high wind hazards:
>
> 1. For plants exposed to high wind hazards, FLEX equipment should be stored in one of the following configurations:
>
>   a. In a structure that meets the plant's design basis for high wind hazards (e.g., existing safety-related structure).
>
>   b. In storage locations designed to or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* given the limiting tornado wind speeds from Regulatory Guide 1.76 or design basis hurricane wind speeds for the site.
>
>   - Given the FLEX basis limiting tornado or hurricane wind speeds, building loads would be computed in accordance with requirements of ASCE 7-10. Acceptance criteria would be based on building serviceability requirements not strict compliance with stress or capacity limits. This would allow for some minor plastic deformation, yet assure that the building would remain functional.
>
>   - Tornado missiles and hurricane missiles will be accounted for in that the FLEX equipment will be stored in diverse locations to provide reasonable assurance that N sets of FLEX equipment will remain

deployable following the high wind event. This will consider locations adjacent to existing robust structures or in lower sections of buildings that minimizes the probability that missiles will damage all mitigation equipment required from a single event by protection from adjacent buildings and limiting pathways for missiles to damage equipment.

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

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

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

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

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

On page 4 of the Integrated Plan, the licensee stated that the FLEX equipment required to mitigate a BDBEE at HCGS will be stored at its point of deployment in a Seismic Category 1 structure (e.g., reactor building, control diesel building, etc.) or will be stored in the cancelled HCGS Unit 2 reactor building.

On page 6 of the Integrated Plan, the licensee stated that Phase 2 FLEX components stored at the site will be protected against hazards in accordance with NEI 12-06.

On page 26 of the Integrated Plan, the licensee also stated that all safety related structures are designed to withstand the high winds associated with hurricanes and tornadoes. Since hurricanes can be predicted, procedures can be relied on to move equipment stored outdoors to protective structures. However, long term forecasting for tornadoes is not possible making FLEX equipment stored outdoors subject to damage. The licensee also stated that in general, only large equipment will be stored outdoors and will be subject to damage only under the most severe conditions such as tornadoes. All FLEX equipment stored outdoors will be backed up by similar equipment stored at another location that will most likely not be impacted by the same tornado. This is identified as Confirmatory Item 3.1.3.1.A in Section 4.2 below.

On page 42 of the Integrated Plan regarding the strategies for spent fuel pool cooling, the licensee stated that all of the associated FLEX equipment and piping will be pre-staged or pre-installed in the reactor building which is designed to withstand design basis winds and tornado generated missiles.

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 equipment storage 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 4 of the Integrated Plan, the licensee stated that high winds may delay deployment of FLEX equipment. Consequently, the FLEX strategy includes consideration for 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 events, deployment of equipment during a tornado would not be anticipated. Debris removal equipment will be available to support deployment of FLEX equipment.

On pages 5 and 6 of the Integrated Plan, the licensee stated that the designed hardened connections are protected against external events or are established at multiple and diverse locations. In addition, deployment strategies and deployment routes will be assessed for hazard impact.

On page 11 of the Integrated Plan, the licensee stated that the critical FLEX equipment, such as the FLEX diesel generator and the FLEX pump to be deployed in the reactor building, will be stored at the point of deployment during all modes of operation. The FLEX pump to be deployed at the SWIS will be stored in the Unit 2 reactor building and will be towed to the point of deployment after the ELAP has been identified or, in the case of a flood, after flood waters recede. FLEX equipment will be available during all modes of operation. Procedures will be developed to ensure stored FLEX equipment is not rendered inaccessible by any other hardware or activities during periods such as refueling outages.

Deployment routes will be developed as required to transport additional FLEX equipment to the deployment areas. The identified paths and deployment areas will be accessible during all modes of operation. This deployment strategy will include measures to keep pathways clear or actions to clear the pathways.

On page 58 of the Integrated Plan, PSEG listed two trucks/tractors/bulldozers for minor earthwork/repair, transport portable equipment and clear debris and snow.

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

Storage and deployment of portable/FLEX equipment during the high wind hazard were discussed in sections 3.1.3.1 and 3.1.3.2, above. As discussed in those sections, the licensee has not yet completed plans for protection and deployment of portable/FLEX equipment as well as described the interface with SGS during an ELAP event on Artificial Island. There is insufficient information presented in the Integrated Plan, at this time, to ascertain that there is reasonable assurance the procedures and programs for deployment of portable equipment in a high wind event conforms to NEI 12-06, Section 7.3.3. This has been combined with Confirmatory Item 3.1.2.3.A. in Section 4.2.

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

3.1.3.4 Considerations in Using Offsite Resources – High Wind Hazard

NEI 12-06, Section 7.3.4 states:

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

On page 13 of the Integrated Plan, the licensee stated that 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; the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment will be delivered to within 25 miles of the site within 24 hours from the initial request.

PSEG's Integrated Plan for the use of offsite resources provided insufficient information regarding if the licensee is going to participate with the industry approach (did not identify that a contract is in place or negotiation is in progress), the identification of the local arrival staging area and a description of the transportation routes or methods to be used to deliver the equipment to the site or even if the site is accessible (accessibility of site access road). The licensee addressed these issues during the audit process by describing that PSEG is a participant in the SAFER. In addition, the licensee stated that they have met with SAFER representatives and tentatively identified onsite and offsite staging areas. Equipment will be delivered to the site by road if conditions permit or by air if the ground routes are not available. Also, the licensee has identified an area at the northeast corner of the site that is large enough to accommodate the onsite staging area for both SGS and HCGS. The licensee stated that they are evaluating several facilities as potential offsite staging areas and will provide the results in a future six-month update.

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

3.1.4 Snow, Ice and Extreme Cold

As discussed in NEI 12-06, Section 8.2.1:

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

On page 4 of the Integrated Plan, the licensee stated that based on NEI 12-06, Section 8.2, HCGS must address the impact of snow, ice, and extreme cold on protection and deployment of FLEX equipment. Severe weather conditions, such as snow or ice may delay deployment of FLEX equipment. Consequently, the FLEX strategy will include consideration for deployment of equipment (pre-stage equipment) prior to the severe weather event, as necessary, since typically for these severe weather events, significant warning time would be available.

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

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

NEI 12-06, Section 8.3.1 states:

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

On page 4 of the Integrated Plan, the licensee stated that the HCGS plan for storage locations includes either storage at the point of deployment or use of the existing HCGS Unit 2 reactor building. Equipment will be protected consistent with NEI 12-06, Section 8.3. These locations will provide adequate heating to prevent equipment from freezing, and will provide protection against snow and ice loads. Also, snow, ice, and extreme cold are predictable events, and equipment can be pre-staged in the event that weather with potential impacts is predicted.

On page 26 of the Integrated Plan, the licensee also stated that the equipment stored indoors will be safe from the effects of snow, ice and extreme cold. Equipment stored outdoors will be subject to snow or ice cover but will not be damaged. Earth moving type FLEX equipment, whether stored indoors or outdoors, will be available to clear snow and ice obstacles from outdoor pathways to allow movement of FLEX equipment from storage to deployment locations.

In addition, on page 36 the licensee described that all of the FLEX equipment and piping used to maintain the containment will be pre-staged or pre-installed in the reactor building and will not be vulnerable to snow, ice or extreme cold. Even though hot water transferred to the turbine building or CST will be subject to freezing if the extreme cold weather event endures for a long time, freezing will not have an impact on coping activities.

HCGS's Integrated Plan did not address consideration 3 relative to the storage of the N+1 pieces of equipment. The licensee addressed this issue during the audit process by describing that all of the FLEX equipment including deployment vehicles and trailers will be stored in the HCGS Unit 2 reactor building. In addition, the licensee stated that the storage area is protected from all external events as the HCGS Unit 2 reactor building is a seismically qualified and flood protected structure. In addition, the licensee stated that detailed design work is currently in progress associated with a severe storm with high winds (missile protection determination), and extreme cold and heat events (adequate heating, ventilation and air conditioning (HVAC)). The status and results of these design activities will be summarized in future six-month updates.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to storage and protection of portable equipment from 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 4 of the Integrated Plan, the licensee stated that snow removal is a normal activity at the plant site because of the climate. Reasonable access to FLEX equipment will be maintained throughout a snow event. Ice management will be performed as required such that large FLEX equipment can be moved by vehicles. Debris removal equipment will be able to move through moderate snow accumulations and can also be used to move FLEX equipment.

On page 58 of the Integrated Plan, the licensee listed two trucks/tractors/bulldozers for minor earthwork/repair, transport portable equipment and clear debris and snow.

The licensee did not provide information in their Integrated Plan regarding the accessibility of the Delaware River with regard to any potential for freezing near the shoreline during extremely low temperatures. The licensee addressed this issue during the audit process by describing that the Delaware River transitions to the Delaware Bay in the vicinity of HCGS. The Delaware River is tidally influenced up to Trenton, NJ. The tidal range in the vicinity of HCGS is approximately 6 feet with a flow ranging from 400,000 to 472,000 cubic feet per second. Due to these considerations, anchor ice is not considered a viable threat for HCGS FLEX deployment strategies. Surface ice and frazil ice are possible at HCGS. The deployment of the UHS pump at the SWIS will have multiple suction strainers should one clog up from frazil ice. In addition, the licensee stated that the design details for the suction side of the FLEX UHS Pump and its deployment at the intake structure during a potential ice event are being developed as part of the detailed design work and will be made available is a future six month update.

On page 21 of the Integrated Plan, the licensee states that for Phase 2 core cooling, an engine driven FLEX pump, normally stored in the Unit 2 reactor building, will be deployed to a location near the SWIS and a suction hose with strainer will be placed in the river. The licensee was requested to provide additional clarification on how the licensee will place a strainer in the river if the river is iced over as a result of cold weather. During the audit process, the licensee addressed this issue by stating that the Delaware River/Bay is not expected to ice over due to the significant effects of tides at the site. Currently, the approach for the suction side of the UHS pump is to deploy the strainer and suction hose directly into the river, not behind the screens or trash racks to minimize suction hose length and ensure adequate net positive suction head (NPSH)

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

Storage and deployment of portable/FLEX equipment during a snow, ice, and extreme cold hazard was discussed in sections 3.1.4.1 and 3.1.4.2, above. As discussed in those sections, the licensee has not yet completed plans for protection and deployment of portable/FLEX equipment as well as described the interface with SGS during an ELAP event on Artificial

Island. This has been combined with Confirmatory Item 3.1.2.3.A. in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces during a 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 13 of the Integrated Plan, the licensee stated that 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; the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assemble Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment will be delivered to within 25 miles of the site within 24 hours from the initial request.

PSEG's Integrated Plan for the use of offsite resources provided insufficient information regarding if the licensee is going to participate with the industry approach (did not identify that a contract is in place or negotiation is in progress), the identification of the local arrival staging area and a description of the transportation routes or methods to be used to deliver the equipment to the site or even if the site is accessible (accessibility of site access road). The licensee addressed these issues during the audit process by describing that PSEG is a participant in the SAFER. In addition, the licensee stated that they have met with SAFER representatives and tentatively identified onsite and offsite staging areas. Equipment will be delivered to the site by road if conditions permit or by air if the ground routes are not available. Also, the licensee has identified an area at the northeast corner of the site that is large enough to accommodate the onsite staging area for both SGS and HCGS. The licensee stated that they are evaluating several facilities as potential offsite staging areas and will provide the results in a future six-month update.

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 using offsite resources during a snow, ice and extreme cold hazard if these requirements are implemented as described.

3.1.5 High Temperatures

NEI 12-06, Section 9 states:

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

> In this case, sites should consider the impacts of these conditions on deployment of the FLEX equipment.

On page 4 of the Integrated Plan, the licensee stated that consistent with NEI 12-06, Section 9.2, all sites will address high temperatures. In addition, the licensee stated that the HCGS 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 expected to be required if power is lost because the equipment is expected to be deployed shortly after the initiation of the Extended Loss of AC Power (ELAP). Also, 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'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 FLEX Equipment – High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

On page 26 of the Integrated Plan, the licensee stated that the storage and protection of FLEX equipment required for coping with high temperatures is in a climate controlled permanent building. All FLEX equipment will be procured to be suitable for use in peak temperatures for the HCGS region. In addition, on Page 36, the licensee stated all of the FLEX equipment and piping used to maintain the containment will be pre-staged or pre-installed in the reactor building and will not be vulnerable to high temperatures.

On page 42 of the Integrated Plan, the licensee stated all of the FLEX equipment and piping associated with SFP cooling will be pre-staged or pre-installed in the reactor building, which is not vulnerable to 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 storage and protection of portable equipment from 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.

On page 4 of the Integrated Plan, 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. In addition, on Page 11 of the Integrated Plan, the licensee stated that the deployment routes will be developed as required to transport additional FLEX equipment to the deployment areas. The identified paths and deployment areas will be accessible during all modes of operation.

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 equipment during 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.

The licensee addressed this issue during the audit process by describing that the selection of equipment has not been finalized and will be based on expected BDBEE conditions to be determined using GOTHIC analysis. If needed, PSEG will make procedural enhancements in accordance with NEI 12-06 Section 9.3.3, based on equipment requirements and plant environmental conditions.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces from a 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 described in NEI 12-06, Section 1.3, "[p]lant-specific analyses will determine the duration of each phase." This baseline coping capability is supplemented by the ability to use portable pumps to provide reactor pressure vessel (RPV)/reactor makeup in order to restore core or SFP capabilities as described in NEI 12-06, Section 3.2.2, Guideline (13). The NRC endorsed this approach with JLD-ISG-2012-01.

3.2.1 Reactor Core Cooling, Heat Removal, and Inventory Control Strategies

NEI 12-06, Table 3-1 and Appendix C summarize one acceptable approach for the reactor core cooling strategies. This approach uses the installed reactor core isolation cooling (RCIC) system, or the high pressure coolant injection (HPCI) system to provide core cooling with installed equipment for the initial phase. This approach relies on depressurization of the RPV for injection with a portable injection source with diverse injection points established to inject through separate divisions/trains for the transition and final phases. This approach also provides for manual initiation of RCIC/HPCI as a contingency for further degradation of installed structures, systems, and components as a result of the beyond-design-basis initiating event.

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

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

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

3.2.1.1 Computer Code Used for ELAP Analysis.

NEI 12-06, Section 1.3 states:

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

In pages 58 through 66 of the Integrated Plan, the licensee provided a Sequence of Events (SOE) Timeline identifying elapsed time from time zero for each plant response action following the start of the simultaneous ELAP and LUHS event. However, it was not clear what analysis was used to develop or support the timeline for the events related to core cooling. The licensee referenced both analyses from NEDO-33771/NEDC-33771P, "GEH Evaluation of FLEX Implementation Guidelines," Revision 0, (ADAMS Accession No. ML130370742) (hereafter NEDC-33771P) and Modular Accident Analysis Program (MAAP) code results for the development of the events timeline for core cooling and containment heat removal. During the audit process, the licensee stated that the Integrated Plan relied on a MAAP case study and NEDC-33771P was a generic study done to support the Fukushima project.

The licensee has decided to use the MAAP4 computer code for simulating the ELAP event. While the NRC staff acknowledges that MAAP4 has been used many times over the years and in a variety of forums for severe and beyond design basis analysis, MAAP4 is not an NRC-approved code, and the NRC staff has not examined its technical adequacy for performing thermal-hydraulic analyses. Therefore, during the review of licensees' Integrated Plans, the issue of using MAAP4 was raised as a generic concern and was addressed by the NEI in their position paper dated June 2013, entitled "Use of Modular Accident Analysis Program (MAAP4) in Support of Post-Fukushima Applications" (ADAMS Accession No. ML13190A201). After review of this position paper, the NRC staff endorsed a resolution through letter dated October 3, 2013 (ADAMS Accession No. ML13275A318). This endorsement contained five limitations on the MAAP4 computer code's use for simulating the ELAP event for Boiling Water Reactors (BWRs). Those limitations and their corresponding Confirmatory Item numbers for this TER are provided as follows:

(1) From the June 2013 position paper, benchmarks must be identified and discussed which demonstrate that MAAP4 is an appropriate code for the simulation of an ELAP event at your facility. This has been identified as Confirmatory Item 3.2.1.1.A in Section 4.2.

(2) The collapsed level must remain above Top of Active Fuel (TAF) and the cool down rate must be within technical specification limits. This has been identified as Confirmatory Item 3.2.1.1.B in Section 4.2.

(3) MAAP4 must be used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper. This has been identified as Confirmatory Item 3.2.1.1.C in Section 4.2.

(4) In using MAAP4, the licensee must identify and justify the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236). This should include response at a plant-specific level regarding specific modeling options and parameter choices for key models that would be expected to substantially affect the ELAP analysis performed for that licensee's plant. Although some suggested key phenomena are identified below, other parameters considered important in the simulation of the ELAP event by the vendor / licensee should also be included.

    a. Nodalization
    b. General two-phase flow modeling
    c. Modeling of heat transfer and losses
    d. Choked flow
    e. Vent line pressure losses
    f. Decay heat (fission products / actinides / etc.)

This has been identified as Confirmatory Item 3.2.1.1.D in Section 4.2.

(5) The specific MAAP4 analysis case that was used to validate the timing of mitigating strategies in the Integrated Plan must be identified and should be available on the ePortal for NRC staff to view. Alternately, a comparable level of information may be included in the supplemental response. In either case, the analysis should include a plot of the collapsed vessel level to confirm that TAF is not reached (the elevation of the TAF should be provided) and a plot of the temperature cool down to confirm that the cool down is within technical specification limits. This has been identified as Confirmatory Item 3.2.1.1.E in Section 4.2.

Concerning item 4, the Integrated Plan did not provide information relative to the initial condition of the unit being at 100 percent 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 as specified in NEI 12-06, Section 3.2.1.2, consideration 1. During the audit process, the licensee stated that all BWR-related initial conditions listed in NEI 12-06, Sections 3.2.1.2 through 3.2.1.5 are applicable to HCGS.

In addition, the licensee indicated that they are performing an HCGS-specific MAAP4 analysis consistent with the NRC endorsement letter to NEI dated October 3, 2013 (Adams Accession No. ML13275A318) and that the status of the HCGS MAAP4 analysis and a summary of the results, including any resulting changes in the timelines, will be included in future six-month updates.

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

3.2.1.2 Recirculation Pump Seal Leakage Models.

Conformance with the guidance of NEI 12-06, Section 3.2.1.5, Paragraph (4) includes consideration of recirculation pump seal leakage. When determining time constraints and the ability to maintain core cooling, it is important to consider losses to the RCS inventory as this can have a significant impact on the SOE. Special attention is paid to the recirculation pump seals because these can fail in a station blackout (SBO) event and contribute to beyond normal system leakage.

The licensee did not identify or provide justification for the assumptions made regarding primary system leakage from the recirculation pump seals and other sources that addresses the following items:

a. The assumed leakage rate and its predicted pressure dependence relative to test data.
b. Clarification of whether the leakage was determined or assumed to be single-phase liquid, two-phase mixture, or steam at the donor cell.
c. Comparison of design-specific seal leakage testing conditions to code-predicted thermal hydraulic conditions (temperature, void fraction) during an ELAP and justification if predicted conditions are not bounded by testing.
d. Discussion of how mixing of the leakage flow with the drywell atmosphere is modeled.

During the audit process, the licensee was asked to provide details on the assumed pressure-dependence of the leakage rate, and whether the leakage was determined or assumed to be single-phase liquid, two-phase mixture, or steam at the donor cell, and to discuss how mixing the leakage flow with the drywell atmosphere is modeled. The licensee addressed this issue by stating that they are performing a HCGS MAAP4 analysis consistent with the NRC endorsement letter to NEI dated October 3, 2013 (Adams Accession No. ML13275A318). The status of the HCGS MAAP4 analysis and a summary of the results, including any resulting changes in the timelines, will be included in future six-month updates.

A review of the Integrated Plan and audit response provided insufficient information on recirculation pump seal leakage or other sources of leakage used in the ELAP analysis. Additional information is required to evaluate the amount of seal leakage that was used in the HCGS transient analyses and how the seal leakage was determined. This information will need to include the technical basis for the assumptions made regarding the leakage rate through the recirculation pump seals and also other sources. Also, include the assumed pressure-dependence of the leakage rate, and whether the leakage was determined or assumed to be single-phase liquid, two-phase mixture, or steam at the donor cell, and how mixing the leakage flow with the drywell atmosphere is modeled. This has been identified as Confirmatory Item 3.2.1.2.A in Section 4.2.

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

3.2.1.3 Sequence of Events

NEI 12-06 discusses an event timeline and time constraints in several sections of the document, for example Section 1.3, Section 3.2.1.7 principle (4) and (6), Section 3.2.2 Guideline (1) and Section 12.1.

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

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

In order to support the objective of an indefinite coping capability, each plant will be expected to establish capabilities consistent with Table 3-1 (BWRs). Additional explanation of these functions and capabilities are provided in NEI 12-06 Appendix C, "Approach to BWR Functions."

In response to the need to identify expected time constraints, the licensee's Integrated Plan for HCGS included a discussion of time constraints on pages 7 through 10 and a SOE Timeline, Attachment 1A, on pages 58 through 66 for the reactor/containment and Attachment 1A-SFP, on pages 67 through 70 for the spent fuel pool. The licensee also stated on page 10 of the Integrated Plan that NEDC-33771P supplemented the guidance provided in NEI 12-06 by providing additional BWR-specific information regarding the individual plant response to the ELAP and LUHS events. In addition, on page 10 of the Integrated plan, the licensee stated, in part, that:

> 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. In the document, GEH utilized the NRC accepted SUPERHEX (SHEX) computer code methodology for BWR's long term containment analysis for the ELAP analysis. As part of this document, a generic BWR 4/Mark I containment NSSS evaluation was performed. The BWR 4/Mark I containment analysis is applicable to the HCGS (BWR 4/5 Mark I) coping strategy because it supplements the guidance in NEI 12-06 by providing BWR-specific information regarding plant response for core cooling, containment integrity, and spent fuel pool cooling. The guidance provided in NEI 12-06 was utilized as appropriate to develop coping strategies and for prediction of the plant's response.

On page 7 of the Integrated Plan, the licensee stated that the SOE timeline is provided in Attachments 1A and 1A-SFP and that the timeline presents the best estimate elapsed time for baseline coping strategy for each primary safety function. The licensee also stated that validation of assumed response times is required once all associated analyses are completed and FLEX Support Guidelines (FSG) have been developed.

On pages 16 and 17 of the Integrated Plan, the licensee stated that the RPV safety-relief valve (SRV) capability is dependent on availability of compressed gas and drywell pressure and that current SBO procedures direct operators to limit SRV operations as much as possible to limit the use of compressed gas. In addition, the licensee stated that based on engineering judgment and review of the current design basis 125 VDC battery sizing calculation, the battery providing control power to the SRVs will support at least seven hours of service after load shedding and that adequate gas pressure will support the necessary SRV operations. Furthermore, the licensee stated that the SRVs will be available for at least seven hours without any FLEX equipment support and additional analysis of the battery power and nitrogen quantities required for Phase 1 SRV operations will be performed. If changes are required to the Phase 1 strategy as a result of the analysis, they will be provided in a six-month status report.

Based on the foregoing statements, the information in the SOE Timeline is tentative. The licensee addressed this issue during the audit process by describing that the SOE timeline presented in the Integrated Plan will be finalized based on plant-specific analysis, procedure development and time validation. These results will be provided in future six-month updates. This is identified as Confirmatory Item 3.2.1.3.A in Section 4.2.

The Integrated Plan identified NEDC-33771P as one of the Technical Basis Support information documents, and the analyses, time constraints, and output values of the NEDC are referred to numerous times throughout the Integrated Plan. However, the NEDC-33771P document itself states on Page 46, “Therefore, the analyses results presented herein are not deemed to be bounding. Plant-specific justification or detailed analysis is required.” Given this statement, the licensee was requested to provide a detailed discussion of the technical basis for utilizing NEDC-33771P and identify any plant-specific calculations that were performed to verify the results and their direct applicability to HCGS. The licensee addressed this issue during the audit process by describing that the NEDC-33771-P and the MAAP Case Study for HCGS were used for the Integrated Plan. In addition, the licensee stated that they are performing a HCGS-specific MAAP4 analysis consistent with the NRC endorsement letter to NEI dated October 3, 2013 (Adams Accession Letter ML13275A318), to validate the timeline and NEDC-33771P applicability. The results of the evaluation and validation of the SOE timeline need to be provided for review. This is identified as Confirmatory Item 3.2.1.3.B in Section 4.2.

There was no discussion in the Integrated Plan of the margin between when the actions are to begin and the time by which they must be completed in either the Technical Basis section or the SOE timeline in Attachment 1A. The licensee addressed this issue during the audit process by describing that the timeline was developed using the time that the critical action was required to be completed. The action was estimated to take a certain amount of time and some margin was added based on judgment. The FSGs and related procedures need to be time-validated to refine the timeline and provide a better estimate of margin.

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

3.2.1.4 Systems and Components for Consequence Mitigation

NEI 12-06, Section 11 provides details on the equipment quality attributes and design for the implementation of FLEX strategies. It states:

> Equipment associated with these strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control as outlined in this section [Section 11]. If the equipment is credited for other functions (e.g., fire protection), then the quality attributes of the other functions apply.

and,

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

NEI 12-06, Section 3.2.1.12 states:

> Equipment relied upon to support FLEX implementation does not need to be qualified to all extreme environments that may be posed, but some basis should be provided for the capability of the equipment to continue to function.

On page 12 of the Integrated Plan, the licensee states that the FLEX equipment will have unique identification numbers and that 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."

A review was performed of the mitigation strategies discussed in the Integrated Plan. The RCIC pump provides water for core cooling during the initial and transition phases of the ELAP. HPCI is used, as required, at the initiation of the BDBEE to control reactor water level. To minimize torus water heat up, HPCI injection will be terminated as soon as RCIC is capable of controlling reactor pressure vessel (RPV) level alone. To further reduce torus water heat up, HPCI will be manually placed in CST to CST full flow test mode to control RPV pressure. This allows the SRVs to be used only as necessary if HPCI turbine steam usage is not adequate. The RCIC pump can take suction from either the CST or from the torus. If the CST is unavailable due to low water level or because of tank failure, suction will be transferred to the torus. In responding to an audit question, the licensee provided additional information concerning the CST to torus switchover logic, instrumentation and motor operated valves. The licensee stated that in the event that the CST is completely destroyed, both HPCI and RCIC logic power is from the A/B 1E dc backed inverters that will be repowered by the FLEX DG, thereby maintaining power to provide automatic swap functions. In addition, as stated by the licensee, the operator can manually transfer the HPCI and RCIC suctions from the CST to the torus from the main control room (MCR). Also as noted by the licensee, the CST is seismically robust to withstand the design basis seismic event. In addition, the CST is missile protected by the seismic category 1 dike which surrounds it and only the inventory below the top of the dike is credited for high winds.

The transition phase coping strategies include using onsite portable FLEX equipment to maintain core cooling with the RCIC pump. A FLEX electrical generator will supply power to a portion of the dc distribution system through the station battery charger, thus maintaining RCIC system control power and power to critical instruments.

On pages 23 and 24 of the Integrated Plan, the licensee describes the FLEX pumps and piping that will be installed in order to maintain core cooling. At the lowest elevation in the reactor building, a header manifold complete with isolation valves (FLEX header) will be installed. Piping will be installed from the header to existing piping in various systems such as CST, firewater, demineralized water and hotwell water. Where physical separation is required between permanent system piping and FLEX header piping, spool pieces or flexible hoses will be fabricated and stored nearby. An electrically driven pump (powered by the FLEX DG), equipped with a local motor starter (FLEX header pump), will be pre-staged in the "B" core spray room near the header. When required, final piping connections can be made between the FLEX header and pump to provide a diverse source of water for RPV injection, SFP makeup or Torus makeup. The FLEX header and piping will be arranged to make it possible to utilize the FLEX header pump to transfer water from the torus to the SFP.

In addition, the licensee described that a new pipe tap with isolation valve and blind flange will be installed on the RCIC suction piping near the RCIC pump. A hose jumper or spool piece will be fabricated that can be installed between the pipe flange and the FLEX piping.

If required to supply water from the Delaware River, a portable engine driven pump will be towed from its normal storage location in the Unit 2 reactor building and positioned in an outdoor location near the SWIS. A pipe with strainer will be run from the pump suction to the Delaware River. A hose will be run from the pump discharge through a propped open door in the SWIS and connected to the hose connector (modification required) on the service water pipe.

The licensee also described that a new pipe tap and isolation valve will be installed on the service water piping in the reactor building. A pipe manifold complete with valves will be installed near the blind flange to facilitate multiple hose and pipe connections. A spool piece or hose jumper will be fabricated that can be installed between the blind flange and the pipe manifold.

In addition, the licensee stated that a new pipe tap and isolation valve will be installed on the residual heat removal (RHR) flushing line located in the reactor building. A pipe tap and isolation valve will be installed on the abandoned HPCI to RHR steam condensing line near the A division RHR heat exchanger and another one near the B division heat exchanger. Spool pieces or hose jumpers need to be fabricated for all three locations to facilitate connection to FLEX piping.

The licensee also described that pre-installed FLEX piping will be run between:

- The service water pipe tap and the FLEX header pump discharge;
- The service water pipe tap to the area of RHR flushing line in the reactor building;
- The service water pipe tap to the RCIC room; and
- Inside one of the reactor building stairwells, to fuel handling floor complete with a "T" header about mid-way between the two elevations.

Because the Integrated Plan contained insufficient pump and flow technical data to demonstrate adequate flow, the licensee was requested to provide an additional technical basis or a supporting analysis for both FLEX pumping system capabilities (one engine/pump located at the SWIS and one motor/pump located in the reactor building) considering the pressure within the RPV and the loss of pressure along with details regarding the FLEX pump supply line routes, length of runs, connecting fittings, to show that the pumps are capable of injecting water into the RPV with a sufficient rate to maintain and recover core inventory for both the primary and alternate flow paths as well as supplying water to the SFP. The licensee addressed this issue during the audit process and stated that this analysis will be performed as part of the design change process and the results will be provide in future six-month updates. The methodology for the analysis and the results need to be provided for review. This is identified as Confirmatory Item 3.2.1.4.A in Section 4.2.

During the audit process, the licensee was requested to provide a summary of non-safety-related installed equipment that is used in the mitigation strategies and to include a discussion of whether the equipment is qualified to survive all ELAP events. The licensee addressed this issue by describing that the baseline HCGS FLEX strategy relies only on installed safety-related equipment and new FLEX-specific non-safety related (NSR) equipment with protection from external event hazards. Any FLEX-specific installed equipment will be procured as NSR, but protected in accordance with the plant's existing design basis, augmented as appropriate by NEI 12-06 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 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 systems and components for consequence mitigation, if these requirements are implemented as described.

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 provides information regarding instrumentation and controls necessary for the success of the coping strategies. NEI 12-06 provides the following guidance:

> 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:
>
> - RPV Level
> - RPV Pressure
> - Containment Pressure
> - Suppression Pool Level
> - Suppression Pool Temperature
> - 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.

A review of the Integrated Plan was performed of the identified instrumentation necessary for successful completion of mitigation strategies. The licensee listed the installed instrumentation credited for the coping evaluation for maintaining core cooling and containment during ELAP on page 19 of the Integrated Plan. The following instrumentation was included: RPV water level and pressure, drywell pressure and temperature, suppression chamber pressure and temperature, suppression pool water level and temperature. The identified instrumentation is powered from 125 V dc batteries. The FLEX DG will provide 480 Vac power to the chargers for the batteries.

The reactor and containment parameters discussed in the Integrated Plan appear to provide adequate instrumentation to implement the coping strategies for maintaining core and containment cooling.

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

3.2.1.6 Motive Power, Valve Controls and Motive Air System

NEI 12-06, Section 12.1 provides guidance regarding the scope of equipment that will be needed from off-site resources to support coping strategies. NEI 12-06, Section 12.1 states that:

> Arrangements will need to be established by each site addressing the scope of equipment that will be required for the off-site phase, as well as the maintenance and delivery provisions for such equipment.

and,

> Table 12-1 provides a sample list of the equipment expected to be provided to each site from off-site within 24 hours. The actual list will be specified by each site as part of the site-specific analysis.

Table 12-1 includes “Portable air compressor or nitrogen bottles & regulators (if required by plant strategy).”

As described on page 16 of the Integrated Plan, the licensee stated that SRV capability is dependent on availability of compressed gas and drywell pressure. The licensee used engineering judgment and a review of a design calculation to determine availability of SRVs. Depending on primary containment environmental conditions during the event, SRV actuation may require a higher than nominal DC voltage to actuate the SRVs. The SRV pilot solenoid coil electrical resistance will increase due to a higher containment temperature with a longer duration event than an existing SBO coping time. Therefore, to achieve the necessary coil current, a higher voltage is needed to overcome the increase in the coil's resistance. The licensee should evaluate their SRVs' qualification against the predicted containment response with FLEX implementation to ensure there will be sufficient DC bus voltage during the ELAP event. SRVs with shuttle valves may also require additional pneumatic supply pressure to actuate. This may require a higher pneumatic pressure and the ability to implement would be a plant specific action. Determination of site-specific timing requirements is needed for resources and installation of portable pneumatic supplies and potential higher voltage DC power to reliably actuate SRVs. The licensee addressed this issue during the audit process by stating that the SRV pilot solenoids are qualified for 60 years at a service temperature of 240 degrees Fahrenheit. The SRVs were demonstrated to be operable during and following small break loss of coolant accident conditions over a voltage range of 105 to 140 Vdc. The test profile was at, or above, 265 degrees Fahrenheit for 42 hours and at, or above, 215 degrees Fahrenheit for 100 days. These conditions exceed the anticipated environmental conditions for the BDBEE scenario. In addition, the licensee stated that the EQ test voltage range was lower than the minimum voltage they expect to see from the DC coping analysis. Therefore, the SRV pilot solenoids will operate based on their existing design. The final temperature profile and DC coping results will be available in a future 6-month update. Sizing of the pneumatic accumulators for the SRVs will be completed as part of the design change package for mitigating actions. Accumulators for the torus vent air operated valves (AOVs) will be completed as part of the torus vent modifications. Both of these modifications are in process and their status and results will be provided in future six-month updates. Accessibility to the operating station for hydraulic closure of the plant vent isolation valves is being performed as part of the ongoing GOTHIC temperature modeling for the reactor building. The status and summary of the results of the GOTHIC modeling will be provided in future six-month updates. The final sizing calculations for the SRVs accumulators, the final temperature profile of the drywell, DC coping results and the results of the GOTHIC temperature modeling for the reactor building will need to be provided for review. This is identified as Confirmatory Item 3.2.1.6.A in Section 4.2.

In addition, the licensee stated that nitrogen bottles will be changed out with replacement bottles if required and that the current system design allows for replacement of nitrogen bottles without interruption to the gas supply. Furthermore, the licensee stated that it is expected that there are sufficient quantities of nitrogen stored within seismically robust and flood protected structures to supply alternate nitrogen gas system usage for 72 hours.

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 motive power, valve controls and motive air system if these requirements are implemented as described.

3.2.1.7 Cold Shutdown and Refueling

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

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

NEI 12-06, Section 13.1, “Overall Integrated Plan Submittal” states:

> The level of detail generally considered adequate is consistent to the level of detail contained in the Licensee’s Final Safety Analysis Report (FSAR).

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 HCGS will incorporate the supplemental guidance provided in the NEI position paper entitled "Shutdown/Refueling Modes" to enhance the shutdown risk process and procedures.

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

3.2.1.8 Use of Portable Pumps

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

> Regardless of installed coping capability, all plants will include the ability to use portable pumps to provide RPV/RCS/SG makeup as a means to provide diverse capability beyond installed equipment. The use of portable pumps to provide RPV/RCS/SG makeup requires a transition and interaction with installed systems. For example, transitioning from RCIC to a portable FLEX pump as the

source for RPV makeup requires appropriate controls on the depressurization of the RPV and injection rates to avoid extended core uncovery. Similarly, transition to a portable pump for SG makeup may require cooldown and depressurization of the SGs in advance of using the portable pump connections. Guidance should address both the proactive transition from installed equipment to portable and reactive transitions in the event installed equipment degrades or fails. Preparations for reactive use of portable equipment should not distract site resources from establishing the primary coping strategy. In some cases, in order to meet the time-sensitive required actions of the site-specific strategies, the FLEX equipment may need to be stored in its deployed position.

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

NEI 12-06 Section 11.2 states in part:

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

On page 55 of the Integrated Plan, the licensee lists two portable pumps, with different capacities, to be utilized for coping strategies. There are numerous references in the Integrated Plan regarding the use of pumps, hoses, pipe runs and connection hardware to facilitate the implementation of coping strategies. However, because the Integrated Plan contained insufficient pump and flow technical data to demonstrate adequate flow, the licensee was requested to provide an additional technical basis or a supporting analysis for both FLEX pumping system capabilities. The licensee addressed this issue during the audit process and stated that this analysis will be performed as part of the design change process and the results will be provide in future six-month updates. The methodology for the analysis and the results need to be provided for review. This has been combined with Confirmatory Item 3.2.1.4.A in Section 4.2.

During the audit process, the licensee described that the following equipment will be available on-site:

- two FLEX DGs) to provide power for the FLEX pump (N=1 for HCGS);
- two FLEX motor / pumps (N=1 for HCGS);
- two FLEX motor / compressors (N=1 for HCGS)
- four UHS pumps (SWIS engine pumps) that will be shared between both SGS and HCGS, in this instance, (N=3 for SGS [2 units] and HCGS [1 unit] combined).

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 equipment if these requirements are implemented as described.

3.2.2 Spent Fuel Pool Cooling Strategies

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

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 2.1, strategies that require 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 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.

NEI 12-06, Section 3.2.1.6 provides the initial boundary conditions for SFP cooling.

1. All boundaries of the SFP are intact, including the liner, gates, transfer canals, etc.
2. Although sloshing may occur during a seismic event, the initial loss of SFP inventory does not preclude access to the refueling deck around the pool.
3. SFP cooling system is intact, including attached piping.
4. SFP heat load assumes the maximum design basis heat load for the site.

On page 39 of the Integrated Plan, the licensee stated that in the worst case configuration, the time to boil in the SFP is 6.89 hours. The time to start uncovering the fuel is 2.06 days. Using those assumptions, the licensee concluded that initiation of coping strategies can begin at 13 hours or 7 hours depending on whether the initial condition is power operation (Mode 1) or an outage (torus drained and CST not available), respectively.

On page 40 of the Integrated Plan, the licensee stated that prior to boiling, accelerated evaporation will create very humid conditions and elevated air temperatures on the fuel handling floor. After the commencement of boiling, the fuel handling floor will become uninhabitable. The licensee stated that preparations to position FLEX hoses on the fuel handling floor should be completed well in advance of the onset of boiling. However, if the fuel handling floor becomes uninhabitable and the hose jumper at the 201 ft elevation cannot be used, a second option will be to run a hose jumper from the tap at the 162 ft elevation to the existing B.5.b pipe running from the gamma scan room at the 162 ft elevation to the SFP spray nozzles.

Also, the licensee stated that water will be added to the SFP to maintain level utilizing the FLEX header pump in the reactor building or the FLEX pump at the SWIS. The FLEX header pump will be able to take suction from the CST, if inventory is available. The UHS pump at the SWIS will be able to generate adequate pressure to transfer water directly to the SFP utilizing the FLEX piping installed from the tap on the service water piping to the SFP.

In addition, the licensee stated that since the fuel handling floor will become uninhabitable shortly after boiling starts, all preparations to secure a FLEX hose or pipe to the SFP needs to be completed before six hours after loss of cooling.

The evaluation of the SFP timeline is preliminary. During the audit process, the licensee stated that the timeline will be considered final upon completion of procures and time validation of required response actions. This is identified as Confirmatory Item 3.2.2.A in Section 4.2 below.

In several places in the Integrated Plan, HCGS describes connecting to dry FLEX piping and the existing B.5.b pipe running from the gamma scan room at the 162 ft elevation to the SFP spray nozzles. The licensee was requested to clarify whether this piping is, or will be, installed as a seismically qualified component. During the audit process, the licensee addressed this issue by stating that the new FLEX standpipe to be installed will conform to the NEI 12-06 seismic standards. The existing B.5.b piping running from the gamma scan room to the SFP has been designed to seismic II/I standards, and will be evaluated to show that it meets NEI 12-06 seismic standards.

On Page 40 of the licensee's Integrated Plan, the licensee states that after the commencement of boiling, the fuel handling floor will become uninhabitable and that preparations to position FLEX hoses on the fuel handling floor should be completed well in advance of the onset of boiling. The licensee was requested to provide more detailed information on the deployment time frame of FLEX equipment to the SFP area and how the strategy conforms to NEI 12-06. During the audit process, the licensee addressed this issue by stating that the only personnel action required at the refuel floor is to install and secure a single hose from an installed FLEX connection to the edge of the SFP. Continuing, the licensee stated that this action will be performed prior to the onset of boiling and that this action will be added to the timeline and addressed as part of the procedure development and time validation.

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 strategies, if these requirements are implemented as described.

3.2.3 Containment Functions Strategies

NEI 12-06, Table 3-1 and Appendix C provide a description of the safety functions and performance attributes for BWR containments which are to be maintained during an ELAP as defined by Order EA-12-049. The safety function applicable to HCGS (a BWR with a Mark I containment) listed in Table 3-1 is Containment Pressure Control/Heat Removal, and the method cited for accomplishing this safety function is Containment Venting or Alternative Containment Heat Removal. Furthermore, the performance attributes listed in Table C-2 denote the containment’s function is to provide a reliable means to assure containment heat removal. JLD-ISG-2012-01, Section 5.1 is aligned with this position stating, in part, that the goal of this strategy is to relieve pressure from the containment.

The licensee's strategy, as indicated in their Integrated Plan and further discussed during the audit process, is to utilize the guidance of Revision 3 of the Boiling Water Reactor Owner's Group (BWROG) Emergency Procedures Guidelines (EPG) Severe Accident Guidelines (SAG) to open the Hardened Containment Vent System (HCVS) and remove decay heat from the primary containment following an ELAP event.

On page 16 of the Integrated Plan, the licensee stated that torus water temperature rise will be mitigated by venting the torus utilizing the HCVS. During the audit process, the licensee stated that a site-specific analysis (MAAP) will be performed to determine the correct time to open the HCVS vent and the expected drywell and wetwell temperatures during the BDBEE. This information will be included in a future six-month update. The site-specific analysis needs to include a listing of critical drywell components that may be affected by the elevated temperatures (e.g., drywell seals and penetrations). This is identified as Confirmatory Item 3.2.3.A in Section 4.2.

The NRC staff questioned the ability of the RCIC system to operate with suction temperatures up to 230 degrees Fahrenheit. During the audit process, the licensee addressed this issue by stating that a RCIC durability study is in progress. The status of this study and a summary of results will be provided in a future six-month update. The RCIC durability study and results need to be provided for review. This is identified as Confirmatory Item 3.2.3.B in Section 4.2.

On page 32 of the Integrated Plan, the licensee stated that the SRVs and HCVS are used to protect containment. Torus venting using the HCVS will be initiated when torus water temperature is around 200 degrees Fahrenheit. And the licensee also stated on page 21 of the Integrated Plan that the coping strategy includes a plan to add water to the torus to increase its heat capacity and the available Net Positive Suction Head (NPSH) for the RCIC pump.

Also on Page 32 of the Integrated Plan, the licensee stated, in part, that:

> The drywell gas temperature fluctuates between 250 and 275ºF during the first eight hours after scram. Shortly after torus venting is initiated, the drywell temperature drops to about 240ºF but very quickly recovers to about 260ºF and stabilizes at approximately that value at least until 24 hours after scram (Reference 3 [NEDC-33771P]). The design basis temperature for the drywell is 250ºF for 24 hours and 200ºF for 100 days (Reference 1 [HCGS Environmental Design Criteria]). The drywell temperature exceeds the design basis temperature by a maximum of 25ºF for short periods of time and remains about 10ºF above design basis for at least 24 hours. These conditions may reduce the service life of certain critical components but will not result in any short term failures. Operator action is not required to address drywell temperature.

During the audit process, the licensee stated that HCGS has a 12" diameter, hardened wetwell vent. Figure D-2 of NEDC-33771P, which was cited as a reference, nor Figure D-11 of NEDC-33771P, which most appropriately models the 12" diameter configuration, did not support the conclusion that the drywell temperature limits would be exceeded by a maximum of 25 degrees Fahrenheit. The licensee was requested to provide a listing of critical drywell components that may be affected by the elevated temperature (e.g., drywell seals and penetrations). During the audit process, the licensee addressed this issue by stating that they are currently performing a HCGS-specific MAAP analysis to establish the expected drywell and wetwell temperatures during the FLEX event. The licensee also stated that the UFSAR design temperature of the drywell is 340 degrees Fahrenheit, not the 250 degrees Fahrenheit listed in the original Integrated Plan. In a future six-month update, the licensee will provide a summary of the results and any changes to the strategies to maintain containment. The MAAP analysis and results need to be provided for review. This is combined with Confirmatory Item 3.2.3.A in Section 4.2.

The NRC staff also considers the adoption of Revision 3 to the BWROG EPG/SAG by licensees to be a Generic Concern (and thus an open item) because the BWROG has not addressed the potential for the revised venting strategy to increase the likelihood of detrimental effects on containment response relative to currently accepted venting strategies for events in which the venting strategy is invoked. In particular it has not been shown that the potential for negative pressure transients, hydrogen combustion, or loss of containment overpressure (as needed for pump NPSH) is not significantly different when implementing Revision 3 of the EPG/SAG as compared to Revision 2 of the EPG/SAG. Revision 3 provides for earlier venting than previous revisions. The BWR procedures are structured such that the new venting strategy is not limited to use during the BDBEEs that are the subject of EA-12-049, but could also be implemented during a broad range of events. Acceptance of EPG/SAG, Revision 3, including any associated plant-specific evaluations, is identified as Open Item 3.2.3.C in Section 4.1, below.

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

The licensee made no reference in the Integrated Plan regarding the need for, or use of, additional cooling systems necessary to assure that coping strategy functionality can be maintained. Nonetheless, the only coping strategy equipment 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.

Per UFSAR Section 5.4.6, "Reactor Core Isolation Cooling (RCIC) System," and UFSAR Figure 5.4-10, "Reactor Core Isolation Coolant System," the cooling water for the RCIC system turbine lube-oil cooler and barometric condenser is supplied from the discharge of the RCIC pump.

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

3.2.4.2 Ventilation – Equipment Cooling

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

> *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 [auxiliary feedwater] AFW pump room, HPCI and RCIC pump rooms, 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 HPCI, RCIC, and AFW pump rooms, portable engine-driven blowers may be considered during the transient to augment the natural circulation provided by opening doors. The necessary rate of air supply to these rooms may be estimated on the basis of rapidly turning over the room's air volume.
>
> Temperatures in the HPCI pump room and/or steam tunnel for a BWR may reach levels which isolate HPCI or RCIC steam lines. Supplemental air flow or the capability to override the isolation feature may be necessary at some plants. The procedures/guidance should identify the corrective action required, if necessary.

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

On pages 46, 47, 49 and 50 of the Integrated Plan, the licensee stated that the following environmental conditions would exist during an ELAP:

Regarding the MCR, shortly after the onset of an ELAP, station operators will block open MCR doors, open various electrical cabinet doors, and remove ceiling tiles in accordance with HC.OP-AB.ZZ-0135(Q), “Station Blackout//Loss of Offsite Power//Diesel Generator Malfunction,” and HC.OP-AB.HVAC-0001(Q), “HVAC.” These actions will mitigate MCR temperature rise until Phase 2 actions can be implemented. The licensee also stated that in Phase 2, supplemental ventilation will be provided for the operators in the MCR using portable fans for air circulation as necessary to maintain a temperature below 110 degrees Fahrenheit. Portable fans will be powered by the FLEX portable diesel generator. Circulation will be established from outdoors by propping open the doors at the south end of the auxiliary building, the doors in and out of the stairwell and the MCR room doors. Additional analysis will be performed to support the preliminary assessment related to Phase 1 and to determine the timing and scope of the supplemental cooling, or heating required, and the results of this analysis will be provided in a six-month status report.

For the RCIC Room, the licensee stated that the FSGs will direct station operators to prop open the RCIC room doors and doors in adjacent rooms to establish natural circulation to mitigate room temperature rise after the ELAP condition is determined. Additional analysis of the RCIC room will be performed to assure that these areas remain accessible and temperatures are within the equipment functional limitations. If changes to the Phase 1 strategy are required as a result of the analysis they will be provided in a six-month status report. For Phase 2, the strategy for maintaining the environment of the RCIC room will be the same as in Phase 1. If required, the RCIC room will be provided with supplemental ventilation using portable fans to lower the room temperature. Portable fans will be powered by the FLEX DG. Additional analysis will be performed to determine the timing and scope of the supplemental cooling required, and the results of this analysis will be provided in a future six-month submittal.

For the Torus room, the licensee stated that additional analysis will be performed to assure that temperatures are within the equipment functional limitations. If changes to the Phase 1 strategy are required as a result of the analysis they will be provided in a six-month status report. Personnel access to the Torus area during Phase 1 is not required. Personnel access to the torus room will not be required to accomplish the FLEX strategies in Phase 2.

Regarding the Battery Rooms, the licensee stated that hydrogen generation is only a concern when batteries are charging, and therefore hydrogen generation will not occur during Phase 1. Additional analysis of the battery rooms will be performed to assure that these areas remain accessible and temperatures are within the equipment functional limitations. If changes to the Phase 1 strategy are required as a result of the analysis they will be provided in a six-month status report. In Phase 2 Battery room cooling and hydrogen ventilation may be required.

Portable fans, if required, will be placed outside the battery room doors to circulate air through the rooms for cooling and to mitigate hydrogen buildup. An increase in room temperature may impact the battery capacity; however, a reduction in the battery capacity in Phase 2 is not significant because the FLEX DG will recharge the batteries. Additional analysis will be performed to determine the timing and scope of the supplemental cooling or hydrogen ventilation required, and the results of this analysis will be provided in a six-month status report.

For ventilation, the licensee stated that no forced ventilation is expected to be required during Phase 1 as described above for each area. Plant doors may be opened as necessary to provide additional ventilation. For Phase 2, ventilation for the RCIC Room, Battery Rooms, and MCR will be provided from portable fans that will be powered from the FLEX DG if required. Plant doors may be opened as necessary to provide additional ventilation

There are insufficient details regarding the effects of loss of ventilation in the HPCI/RCIC pump rooms, to conclude that the equipment in the HPCI/RCIC pump rooms will perform its function and assist in core cooling throughout all Phases of an ELAP. The licensee was request to provide a detailed summary of the analysis and/or technical evaluation performed to demonstrate the adequacy of the ventilation provided in the HPCI/RCIC pump rooms to support equipment operation throughout all phases of an ELAP. During the audit process, the licensee addressed these issues by stating that GOTHIC modeling and room temperature calculations of plant strategic areas (including pathways for access to equipment) are being developed to determine environmental room temperatures for a 72-hour period. The results of the GOTHIC evaluation need to be available for review. This is identified as Confirmatory Item 3.2.4.2.A in Section 4.2.

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 affects 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 requested 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. During the audit process, the licensee addressed these issues by stating that GOTHIC modeling and room temperature calculations of plant strategic areas (including pathways for access to equipment) are being developed to determine environmental room temperatures for a 72-hour period. The results of the GOTHIC evaluation need to be available for review. This is identified as Confirmatory Item 3.2.4.2.B in Section 4.2.

During the audit process, the licensee was requested to provide discussion of battery room ventilation to prevent hydrogen accumulation while recharging the batteries in phase 2 or 3, and to include a description of the exhaust path if it is different from the design basis. The licensee addressed this issue by stating that HCGS is performing GOTHIC calculations for the battery rooms. Those calculations will include temperature conditions as well as hydrogen accumulation. From that information, HCGS will determine the actions necessary to prevent unacceptable hydrogen accumulation. The results of the GOTHIC calculation need to be available for review. This is identified as Confirmatory Item 3.2.4.2.C in Section 4.2.

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

On page 29 of the Integrated Plan, the licensee stated that actions will be required to ensure the FLEX DG is operating to provide power to the Class 1E 480 Vac unit substations and breaker line-up is complete to power up the electrical heat trace panel. The Class 1E 480 Vac unit substations are located in the auxiliary 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 provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to heat tracing, if these requirements are implemented as described.

3.2.4.4 Accessibility – Lighting and Communications.

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

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

On pages 47 and 50 of the Integrated Plan, the licensee stated that lighting will be required for operator actions and access in the plant to implement actions associated with the SBO procedure. Local battery-powered emergency lights provide emergency lighting and the availability of this lighting is at least eight hours. Control Room emergency lighting will be available because the 125 Vdc systems will have power supplied to the battery chargers from the FLEX DG. Portable lights will be available for use in areas that require operator access to perform Phase 2 equipment connections. These lights will either be battery powered, or will be capable of being powered by the FLEX DG. During the audit process, the licensee stated that safety related areas of the plant are equipped with battery backed Appendix R area lighting rated for eight hours. In addition, flashlights are available for use.

The NRC staff has reviewed the licensee communications assessment (ADAMS Accession No. ML12306A249) required in response to the March 12, 2012 10 CFR 50.54(f) request for information letter for HCGS and, as documented in the staff analysis (ADAMS Accession No. ML13130A387) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2 Guideline (8) regarding communications capabilities during an ELAP. This has been identified as Confirmatory Item 3.2.4.4.A in Section 4.2 for confirmation that upgrades to the site's communications systems have been completed.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and 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 support for accessibility for operator actions, 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.

A review was made of the Integrated Plan for coping strategies discussing personnel access to plant protected and locked areas during an ELAP to support strategies for maintaining core, containment and SFP cooling. The licensee provided a discussion of area access in the audit process that sufficiently addressed access to plant perimeter and interior areas during an ELAP. The discussion included the administrative authority and methods for gaining plant access.

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 locked internal plant 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.

Refer to Section 3.2.4.2, "Ventilation – Equipment Cooling," for the licensee information related to the MCR, RCIC and HPCI rooms, torus room and battery rooms.

The licensee's discussion regarding environmental conditions of the various areas and ventilation as described in Section 3.2.4.2, are based on preliminary analysis. The licensee was requested to provide additional information that describes the completed analysis for the MCR, RCIC room, HPCI room (if needed), torus room, and battery rooms. During the audit process, the licensee addressed these issues by stating that GOTHIC modeling and room temperature calculations of plant strategic areas (including pathways for access to equipment) are being developed to determine environmental room temperatures for a 72-hour period. The results of the GOTHIC evaluation need to be available for review. This is identified as Confirmatory Item 3.2.4.6.A in Section 4.2.

For fuel handling floor habitability, on page 40 of the Integrated Plan, the licensee stated that after the commencement of boiling, the fuel handling floor will become uninhabitable. Preparations to position FLEX hoses on the fuel handling floor should be completed well in advance of the onset of boiling. However, if the fuel handling floor becomes uninhabitable and the hose jumper at the 201 ft elevation can not be used, a second option will be to run a hose jumper from the tap at the 162 ft elevation to the existing B.5.b pipe running from the gamma scan room at the 162 ft elevation to the SFP spray nozzles. Since the fuel handling floor will become uninhabitable shortly after boiling starts, all preparations to secure a FLEX hose or pipe to the SFP needs to be complete before six hours after loss of cooling. Replenishment water should start about the time that boiling begins but must start before the fuel is uncovered. Attachment 1A-SFP, of the Integrated Plan, shows that transfer of torus water to the SFP can start approximately seven hours after loss of cooling.

There is insufficient information provided in the integrated plan to demonstrate that potential high temperature and high humidity in the fuel handling floor area has been addressed with regard to accessibility, other than stating that it is not accessible shortly after boiling. 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 accessibility for operator actions 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.

Throughout HCGS's Integrated Plan, the licensee identifies, in part, the following sources of water (the following order does not reflect water preference):

- CST (if available)
- Torus

- CST dike (if CST fails during event, the dike has the capacity to contain the entire inventory of the CST)
- Hotwell
- Demineralized Water
- Firewater
- Delaware River
- Cooling Tower Basin

On page 15 of the Integrated Plan, the licensee described that if the CST is known to be damaged but the dike maintains useable water inventory and the suction piping in the CST is not obstructed, coping strategies will continue to use inventory from the damaged CST until it is exhausted before using river water. The Integrated Plan is silent regarding water quality either from the CST dike (if available) or the Delaware River. It is not evident that the plan has addressed the quality of this water (e.g., suspended solids especially during flood conditions) and the potential that its use could result in a restriction of coolant flow across the fuel assemblies to an extent that would inhibit adequate flow to the core. The licensee addressed this issue during the audit process and stated that the HCGS FLEX strategy provides for access to sequentially lesser quality water. If necessary, the FLEX strategies ultimately rely on river water from the UHS (Delaware River) as the indefinite supply of water. The diesel-driven FLEX UHS pumps are provided with strainers to minimize suction of debris into the system. In addition, the licensee stated that with the primary FLEX connection to the keepfill system, this will allow injection through RHR, core spray, RCIC and HPCI. If needed, based on water quality, RHR, core spray and HPCI can be used to inject inside the core shroud and provide core flooding capabilities without relying on the flow through the bottom of the core for reflood.

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

3.2.4.8 Electrical Power Sources/Isolations and Interactions

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

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

On pages 23 of the Integrated Plan, the licensee stated that for Phase 2, dc power will be provided by connecting the 480V FLEX DG to recharge batteries and provide continuous dc power for RCIC operation, HPCI operation, SRV operation, Hardened Containment Vent System operation, critical instrumentation, and emergency lighting.

On pages 23 through 25 of the Integrated Plan, the licensee described that the FLEX DG and a FLEX distribution panel will be pre-staged in one of the rooms in the Unit 2 auxiliary building that satisfies the guidelines of NEI 12-06, Section 5.3. In addition, the FLEX DG will be seismically restrained for long-term storage. The power from the FLEX DG will be distributed, as needed, as follows:

- Pre-run cables will be run from the FLEX panel to receptacles near the unit substations in the Unit 1 switchgear rooms. Back-feed breakers will be installed in the unit substations and wired out to nearby receptacles. Cable jumpers will be fabricated to make the final connection between the pre-run FLEX cable receptacle and the unit substation back-feed breaker receptacle.
- Pre-run cable will be installed that can be used as a backup if 480 VAC distribution equipment does not function as required. Backup cable will be pre-run from the FLEX generator distribution panel to receptacles near the battery chargers for the 250 VDC battery chargers and to receptacles near the two 125 VDC battery chargers. Cable jumpers will be fabricated to make the final connection between the pre-run FLEX cable receptacle and the battery charger receptacles.
- Install a spare breaker in a Class 1E MCC located in the reactor building and fed from either the “A” or “B” channel unit substation. Pre-run cable from the back-feed breaker to a receptacle near the FLEX header pump. Fabricate a temporary jumper cable jumper to connect the FLEX header pump starter to the receptacle. Power will be provided to the FLEX header pump by first energizing the 480 VAC unit substation as described above, then feeding power from the unit substation to the MCC.
- Pre-run backup cable from the FLEX generator distribution panel to a receptacle near the FLEX header pump and the torus water clean-up (TWCU) pump motors.

During the review of the Integrated Plan, it was not clear how the portable/FLEX diesel generators and the Class 1E diesel generators are isolated to prevent simultaneously supplying power to the same Class 1E bus. During the audit process, the licensee addressed this issue by stating that the design of the electrical system to support FLEX modifications is in progress. That design will include the details on how to connect to, and interface with existing plant equipment. Details of the design will be provided in a future six-month update. The details on how the FLEX DG connects to, and interfaces with existing plant equipment need to be provided for review. This is identified as Confirmatory Item 3.2.4.8.A in Section 4.2.

The licensee was requested to provide the technical basis for the selection and size of the FLEX generators to be used in support of the coping strategies in Phases 2 and 3. During the audit process, the licensee addressed this issue by stating that the design of the electrical system to support FLEX modifications is in progress. It will include the sizing of the FLEX DG. Details of the design will be provided in a future six-month update. The FLEX DG sizing evaluation/calculation needs to be provided for review to ensure that FLEX DGs are capable of providing power to loads assumed in Phases 2 and 3. This is identified as Confirmatory Item 3.2.4.8.B in Section 4.2.

The licensee was requested to provide a detailed electrical one-line diagram showing how the 480V FLEX DGs (and any portable generators) will/can be connected into the existing electrical distribution system. During the audit process, the licensee addressed this issue by stating that the design of the electrical system to support FLEX modifications is in progress. That design will include appropriate one-line diagrams. Details of the design will be provided in a future six-month update. The FLEX DG one-line electrical diagrams need to be provided for review. This is identified as Confirmatory Item 3.2.4.8.C in Section 4.2.

The licensee was also asked to provide a discussion on the electrical cable pathway for each FLEX Diesel Generator and requested to provide a conceptual sketch of the proposed cable paths. During the audit process, the licensee addressed this issue by stating that the design of the electrical system to support FLEX modifications is in progress. That design will include cable routing and a conceptual sketch of cable pathways. Details of the design will be provided in a future six-month update. The details on cable routing and a conceptual sketch of cable pathways need to be provided for review. This is identified as Confirmatory Item 3.2.4.8.D in Section 4.2.

On page 23 of the Integrated Plan the licensee has stated that the 480 Vac FLEX DGs are pre-staged. The licensee also stated that the FLEX DG is to be used to supply all FLEX related loads for HCGS simultaneously for Phase 2 mitigating strategies.

This use of pre-staged generators appears to be an alternative to NEI 12-06. The licensee has not provided sufficient information to demonstrate that the approach meets the NEI 12-06 provisions for pre-staged portable equipment. Additional information is needed from the licensee to determine whether the proposed approach provides an equivalent level of flexibility for responding to an undefined event as would be provided through conformance with NEI 12-06. Therefore, this is identified as Open Item 3.2.4.8.E in Section 4.1 relative to the flexibility of permanently staged generators.

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

3.2.4.9 Portable Equipment Fuel.

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

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

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

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

On page 50 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.

It was not clear how fuel oil will be provided to the site for "indefinite" coping capabilities. During the audit process, the licensee addressed this issue by stating that the initial fuel oil supply will be from the on-site safety related EDG's installed fuel oil storage tanks and day tanks. This will provide a minimum of 180,000 gallons of fuel oil stored in seismic category 1 fuel oil tanks. Additionally, the licensee described that with consumption rates for Phase 2 equipment, which includes a 600 kw generator (42.8 gallons per hour (gph)) and the UHS pump (19.7 gph) at full load is 62.5 gph. If the consumption is 100 gph, the on-site fuel supply would last 75 days. The licensee also stated that fuel oil supplies are available through the SAFER group that can be driven or airlifted to the site (24 to 72 hours after notification to SAFER)

The licensee's Integrated Plan did not provide any information regarding on-site refueling logistics and capabilities after 24 hours. The licensee was requested to describe plans for supplying fuel oil to FLEX equipment (i.e., fuel oil storage tank volume, supply pathway, etc.). In addition, the licensee was requested to explain how fuel quality will be assured if stored for extended periods of time. During the audit process, the licensee addressed these issues by stating that the fuel stored in the fuel oil tanks is sampled and analyzed in accordance with the Technical Specification surveillance requirements. A protocol for sampling and testing of fuel oil contained in the FLEX equipment during storage will be developed. The supply to refuel FLEX equipment will be from the repowered Fuel Oil Transfer Pumps, which pump fuel to the day tanks. Piping connections will be installed and routed from the installed day tank discharge piping to an area in close proximity to the deployed FLEX DGs. The installed diesel fuel oil piping will be qualified as seismically robust and located within existing safety related structures. A connection will also be available at the west side of the auxiliary building to supply fuel via a trailer mounted tank to the diesel driven UHS pumps.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and 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 46 of the Integrated Plan, the licensee stated that battery life will be extended through deep load shedding on each battery. With this deep load shedding strategy, it is expected that the station batteries will be extended through Phase 1 and do not require portable supplemental charging before six hours for the most limiting battery. Additional analysis will be performed to support this expectation. If analysis results require a change in strategy, that change will be communicated in a six-month status report. This approach will reduce critical instrument diversity as only one division of critical instrumentation will remain powered.

The information presented above is based on "preliminary" information. Because of this, there is insufficient information to demonstrate reasonable assurance of conformance with the guidance of NEI 12-06, Section 3.2.2 guideline (6) regarding the development of procedures and guidance for stripping loads. During the audit process, the licensee addressed this issue by stating that HCGS is currently developing ETAP models for battery load profiles for the safety related 125 and 250 Vdc batteries for a BDBEE. These models will be based on a deep load shed to minimize the drain on the batteries and extend their life. The load profiles will demonstrate the duration of time the station can expect to have dc power available on the 125 and 250 Vdc vital busses. The results of this analysis will be documented in a calculation and will be available in a future six-month update. The load profile calculation with results needs to be available for review. This is identified as Confirmatory Item 3.2.4.10.A in Section 4.2.

The licensee's strategy includes performing load shed of the dc bus. Typically, a backup dc seal oil pump maintains sufficient seal oil pressure to prevent the escape of hydrogen from the main generator casing. In the event the licensee loses ac power and sheds the seal oil pump off the dc bus the consequences of a potential fire and explosion from the release of hydrogen from the main generator should be evaluated. During the audit process, the licensee addressed this issue by stating that the loss of the seal oil pumps and subsequent loss of main generator hydrogen pressure is addressed in HC.OP-AB.BOP-0002, "Main Turbine," which has the operators vent the Main Generator to the outside atmosphere.

The licensee was requested to provide additional guidance on how battery load shed to conserve dc power will be implemented. In addition, information was requested regarding the battery availability and battery load shed analysis. During the audit process, the licensee addressed this issue by stating that the results of the load profile calculation will be compared to the Integrated Plan and staffing study to determine the duration of battery life needed to allow for adequate time to implement the FLEX power restoration. If that comparison determines that "deep load shed" is required to extend battery life, the selected loads will be identified in applicable FSGs. The deep load shed and FSGs will be addressed in a future six-month update.

The licensee was requested to provide 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. During the audit process, the licensee addressed this issue by stating that HCGS is currently developing ETAP models for battery load profiles for the safety related 125 and 250 Vdc batteries for a BDBEE. These models will be based on a deep load shed to minimize the drain on the batteries and extend their life. The load profiles will demonstrate the duration of time the station can expect to have dc power available on the 125 and 250 Vdc vital busses. The results of this analysis will be documented in a calculation and will be available in a future six-month update. The load profile calculation with results needs to be available for review. This has been combined with Confirmatory Item 3.2.4.10.A in Section 4.2.

The licensee was requested to provide the minimum voltage that must be maintained and the basis for the minimum voltage on the dc bus. During the audit process, the licensee addressed this issue by stating that HCGS is using the current design minimum voltages for FLEX, which is a minimum battery terminal voltage for 125 Vdc batteries of 108 Vdc and minimum battery terminal voltage for 250 Vdc batteries of 210 Vdc.

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 load reduction to conserve dc power, if these requirements are implemented as described.

3.3 PROGRAMMATIC CONTROLS

3.3.1 Equipment Maintenance and Testing.

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

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

NEI 12-06, Section 11.5 states:

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

2. Portable equipment that directly performs a FLEX mitigation strategy for the core, containment, or SFP should be subject to maintenance and testing[1] guidance provided in INPO AP 913, Equipment Reliability Process, to verify 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.

[1] Testing includes surveillances, inspections, etc.

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

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

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

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

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

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

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

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

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

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

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

During the audit 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 equipment maintenance and testing, if these requirements are implemented as described.

3.3.2 Configuration Control.

NEI 12-06, Section 11.8 provides that:

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

On page 12 of the Integrated Plan, the licensee stated that HCGS will implement an administrative program for implementation of the HCGS 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 preventive maintenance (PM) processes will be established for all components, and testing procedures will be developed and frequencies established based on the type of equipment and considerations made within EPRI guidelines.

PSEG's plans for development and implementation of a configuration control process were not discussed in the Integrated Plan. The licensee did not address considerations 1, 2 and 3. During the audit process, the licensee addressed this issue by stating that NEI 12-06, Section 11.8 considerations 1, 2, and 3 will be addressed in the appropriate facility documents.

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

3.3.3 Training.

NEI 12-06, Section 11.6 provides that:

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

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

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

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

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

On page 12 of the Integrated Plan, the licensee stated that the existing PSEG training and qualification processes will be used to develop the training of plant staff in alignment with the implementation of FLEX strategies.

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

3.4 <u>OFF SITE RESOURCES</u>

NEI 12-06, Section 12.2 lists the following minimum capabilities for offsite resources for which

[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.

each licensee should establish the availability of:

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

On page 13 of the Integrated Plan, 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; the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment will be delivered to within 25 miles of the site within 24 hours from the initial request.

The Integrated Plan did not address when the RRC assistance would be requested (not on the timeline) and what administrative procedure or program would trigger that request. During the audit process, the licensee addressed this issue by describing that Abnormal Operating Procedures and Emergency Operating Procedures would be entered at the start of the event. At approximately one hour into the event, the ELAP would be identified and declared. Applicable procedures now under development would then be entered to mitigate the event that would address requesting assistance from the RRC. The timeline for notification to the RRC would be between one and two hours from the start of the event with expected delivery of equipment to be 24 hours after RRC notification (25 to 26 hours). Correction to the HCGS Integrated Plan will be made and provided in a future six-month update.

There was insufficient information in the Integrated Plan regarding the contractual arrangements to demonstrate that PSEG would meet the guidelines of NEI 12-06, Section 12.2 listed above. During the audit process, the licensee addressed this issue by stating the PSEG is a participant in the SAFER. PSEG is establishing contracts with SAFER and developing the playbook to meet NEI 12-06 Section 12.2.

The licensee's plans, as discussed above, for the use of off-site resources conform to the minimum capabilities specified in NEI 12-06 Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies (item 1 above). Insufficient information has been provided regarding considerations 2 through 10 listed above. During the audit process, the licensee addressed this issue by stating the PSEG is a participant in the SAFER. PSEG is establishing contracts with SAFER and developing the playbook to meet NEI 12-06 Section 12.2.

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

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.2.3.C	With regard to maintaining containment, the implementation of BWROG EPG/SAG, Revision 3, including any associated plant-specific evaluations, must be completed in accordance with the provisions of NRC letter dated January 9, 2014, ADAMS Accession No. ML13358A206.	
3.2.4.8.E	The use of pre-staged FLEX generators appears to be an alternative to NEI 12-06. The licensee has not provided sufficient information to demonstrate that the approach meets the NEI 12-06 provisions for pre-staged portable equipment. Additional information is needed from the licensee to determine whether the proposed approach provides an equivalent level of flexibility for responding to an undefined event as would be provided through conformance with NEI 12-06.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.1.A	Confirm licensee's evaluation of the HCGS Unit 2 structures verifies that the structures will meet the considerations described in NEI 12-06, Section 5.3.1	

3.1.2.3.A	Confirm that the procedures and programs for deployment of portable equipment in a flooding event conforms to NEI 12-06, Section 6.2.3 considerations 1 (incorporation of actions necessary to support flooding deployment considerations into procedures) and 2 (additional guidance may be required to address the deployment of FLEX for flooded conditions). Additionally, procedures and programs need to address hazard concerns related to high winds, snow, ice and extreme cold and high temperatures.	
3.1.3.1.A	Confirm that the licensee's separation of equipment stored outside is sufficient to preclude all sets of equipment from being damaged by a single tornado.	
3.2.1.1.A	From the June 2013 position paper, benchmarks must be identified and discussed which demonstrate that MAAP4 is an appropriate code for the simulation of an ELAP event at your facility.	
3.2.1.1.B	Confirm that the collapsed vessel level in the MAAP4 analysis remains above Top of Active Fuel (TAF) and the cool down rate is within technical specification limits.	
3.2.1.1.C	Confirm that MAAP4 is used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper.	
3.2.1.1.D	Confirm that in using MAAP4, the licensee identifies and justifies the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236). This should include response at a plant-specific level regarding specific modeling options and parameter choices for key models that would be expected to substantially affect the ELAP analysis performed for that licensee's plant. Although some suggested key phenomena are identified below, other parameters considered important in the simulation of the ELAP event by the vendor / licensee should also be included as follows: Nodalization, General two-phase flow modeling, Modeling of heat transfer and losses, Choked flow, Vent line pressure losses, and Decay heat.	
3.2.1.1.E	Confirm that the specific MAAP4 analysis case that was used to validate the timing of mitigating strategies in the Integrated Plan is identified and available for NRC staff to view. Alternately, a comparable level of information may be included in the supplemental response. In either case, the analysis should include a plot of the collapsed vessel level to confirm that TAF is not reached (the elevation of the TAF should be provided) and a plot of the temperature cool down to confirm that the cool down is within technical specification limits.	

3.2.1.2.A	Insufficient information was provided relative to recirculation pump seal or other sources of leakage used in the ELAP analysis. Additional information is required to evaluate the amount of seal leakage that was used in the HCGS transient analyses and how the seal leakage was determined. This information will need to include the technical basis for the assumptions made regarding the leakage rate through the recirculation pump seals and also other sources. Also include the assumed pressure-dependence of the leakage rate, and whether the leakage was determined or assumed to be single-phase liquid, two-phase mixture, or steam at the donor cell, and discuss how mixing the leakage flow with the drywell atmosphere is modeled.	
3.2.1.3.A	The SOE Timeline in the Integrated Plan is tentative. The licensee addressed this issue during the audit process by describing that the SOE timeline presented in the Integrated Plan will be finalized based on plant-specific analysis, procedure development and timeline validation. Confirm that the final SOE timeline is acceptable.	
3.2.1.3.B	The licensee stated that they are performing a HCGS specific MAAP4 analysis consistent with the NRC endorsement letter to NEI dated October 3, 2013 (Adams Accession Letter ML13275A318), to validate the timeline and NEDC-33771-P applicability. Confirm that the results of the evaluation and validation of the SOE timeline are acceptable.	
3.2.1.4.A	Additional technical basis or a supporting analysis is needed for both FLEX pumping system (one engine/pump located at the SWIS and one motor/pump located in the reactor building) capabilities considering the pressure within the RPV and the loss of pressure along with details regarding the FLEX pump supply line routes, length of runs, connecting fittings, to show that the pumps are capable of injecting water into the RPV with a sufficient rate to maintain and recover core inventory for both the primary and alternate flow paths as well as supplying water the SFP. The licensee addressed these issues during the audit process and stated that this analysis will be performed as part of the design change process. Confirm that the analysis results are acceptable.	
3.2.1.6.A	Confirm that the results of the final sizing calculations for the SRVs accumulators, the final temperature profile of the drywell, DC coping results and the results of the GOTHIC temperature modeling for the reactor building are acceptable.	
3.2.2.A	Confirm that the licensee's final SFP cooling timeline is valid for the required response actions	
3.2.3.A	A site-specific analysis (MAAP) will be performed to determine the correct time to open the HCVS vent and the expected drywell and wetwell temperatures during the	

	BDBEE. This information will be included in a future six-month update. The site-specific analysis needs to include a listing of critical drywell components that may be affected by the elevated temperatures (e.g., drywell seals and penetrations). Confirm that the analysis results are acceptable.	
3.2.3.B	The NRC staff questioned the ability of RCIC to operate with suction temperatures up to 230 degrees Fahrenheit. During the audit process, the licensee addressed this issue by stating that a RCIC durability study is in progress. Confirm that the results are acceptable.	
3.2.4.2.A	Confirm that the GOTHIC analysis and/or technical evaluation performed to demonstrate the adequacy of the ventilation provided in all plant strategic areas (including pathways for access to equipment) to support essential equipment operation throughout all phases of an ELAP is acceptable.	
3.2.4.2.B	Confirm 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. Confirm the adequacy of the ventilation provided in the battery room to protect the batteries from the effects of extreme high and low temperatures.	
3.2.4.2.C	Confirm that the GOTHIC calculations for the battery rooms include the effects of hydrogen accumulation and confirm the actions necessary to prevent unacceptable hydrogen accumulation.	
3.2.4.4.A	Confirm that the upgrades to the plant communication systems discussed in the licensee communications assessment (ADAMS Accession No. ML12306A249) in response to the March 12, 2012 50.54(f) request for information letter for HCGS and documented in the staff analysis (ADAMS Accession No. ML13130A387) have been completed.	
3.2.4.6.A	Confirm that the GOTHIC modeling and room temperature calculations of plant strategic areas (e.g. MCR, RCIC room, HPCI room (if needed), torus room, and battery rooms including pathways for access to equipment) show acceptable results for personnel habitability and equipment compatibility.	
3.2.4.6.B	Confirm that potential high temperature and high humidity in the SFP and fuel handling floor area has been addressed with regard to accessibility.	
3.2.4.8.A	Confirm that the design of the FLEX electrical hookups include the details on how to connect to, and interface with existing plant equipment.	
3.2.4.8.B	Confirm that the sizing of the FLEX DGs is adequate to supply the planned loads.	
3.2.4.8.C	Confirm that the FLEX electrical one-line diagrams are satisfactory.	

3.2.4.8.D	Confirm that cable routing of the FLEX electrical cables is satisfactory.	
3.2.4.10.A	Confirm that the analysis of battery load profiles for the safety related 125 and 250 Vdc batteries for a BDBEE demonstrate satisfactory load profiles and battery life.	