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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Duke Energy Carolinas, LLC
Catawba Nuclear Station, Units 1 & 2
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Technical Evaluation Report

Catawba Nuclear Station, Units 1 & 2
Order EA-12-049 Evaluation

1.0 BACKGROUND

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

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

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

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

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

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

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

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

2.0 EVALUATION PROCESS

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

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

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

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

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

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

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

3.0 TECHNICAL EVALUATION

By letter dated February 28, 2013, (ADAMS Accession No. ML13066A173), and as supplemented by the first six-month status report in letter dated August 28, 2013 (ADAMS Accession No. ML13298A010), Duke Energy Carolinas, LLC (the licensee or Duke) provided Catawba Nuclear Station, Unit 1 and Unit 2's (Catawba or CNS) Integrated Plan for compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by Duke for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the NRC staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the staff in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the Order.

3.1 EVALUATION OF EXTERNAL HAZARDS

Sections 4 through 9 of NEI 12-06 provide the NRC-endorsed methodology for the determination of applicable extreme external hazards in order to identify potential complicating factors for the protection and deployment of equipment needed for mitigation of BDBEEs leading to an extended loss of all alternating current (ac) power (ELAP) and loss of normal access to the ultimate heat sink (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.

On page 1 of the Integrated Plan, the licensee states that the current Safe Shutdown Earthquake (SSE) for CNS is 0.15 g acting horizontally and 0.10 g acting vertically. The licensee confirmed on page 1 of their Integrated Plan that seismic hazards are applicable to Catawba. The licensee also stated that the seismic re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore was not assumed in their Integrated Plan.

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 pages 19, 30, 38, 47, and 58 of its Integrated Plan the licensee described that portable equipment will be stored in structures to be designed in accordance with ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures.* The structures will consist of three FLEX storage facilities (N+1 where N is the number of units). In its August 2013 six-month update to the Integrated Plan, the licensee described that the locations of two of the three FLEX storage facilities have been changed as originally shown in the Integrated Plan. During the audit process the licensee provided further information that a single hardened storage facility will be constructed to withstand all external hazards applicable to the site, rather than using three separate FLEX storage facilities.

In the Integrated Plan, the licensee did not address the guidelines in NEI 12-06 Sections 5.3.1, Considerations 2 and 3. During the audit process, the licensee was asked to provide information describing how they intend to conform to the guidance listed in NEI 12-06 Sections 5.3.1, considerations 2 and 3. In response, the licensee stated that large portable FLEX equipment in the FLEX storage building will be strapped to anchor bolts embedded in the floors to prevent seismic interactions with other equipment. The licensee stated that smaller equipment will be restrained in boxes or on substantial shelving to prevent seismic interaction with other equipment. In addition, the licensee stated that the FLEX storage building will be spatially separated from other non-seismic/unsecured components to preclude seismic interactions.

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

3.1.1.2 Deployment of FLEX Equipment - Seismic Hazard

NEI 12-06, Section 5.3.2 states:

> 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 8 in its Integrated Plan, the licensee described that deployment routes to be utilized to transport FLEX equipment to the deployment areas will be established and included in an administrative program in order to keep pathways clear or actions to clear the pathways to be accessible during all modes of operation. As described above in Section 3.1.1.1, the licensee has revised its storage facility approach to utilize a single hardened building. During the audit process the licensee further described that since a final location for the building has been selected, formal evaluation of potential deployment routes and concerns such as soil liquefaction can proceed. This is identified as Confirmatory Item 3.1.1.2.A in Section 4.2.

Insufficient information was originally provided in the Integrated Plan to show that accessibility to at least one connection point of FLEX equipment is limited to seismically robust structures. This access includes both the connection point and any areas that plant operators will have to access to deploy or control the capability. During the audit process the licensee provided further information that there is at least one FLEX equipment connection point located within seismically robust structures. Alternate access paths into the Auxiliary (Aux) Building via non-seismic structures are being evaluated to determine if those paths would be available following a seismic event.

During the audit process the licensee provided additional information that failure of the downstream Lake Wylie dam is assumed in a seismic event. However, the Standby Nuclear Service Water Pond (SNSWP) is the UHS and is qualified to withstand loss of Lake Wylie.

Insufficient information was originally provided in the Integrated Plan to show that 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. During the audit process the licensee described that although the FLEX storage facilities design has not been finalized, it intends that doors will not require power to open or close. If power is required, the use of small, portable FLEX generators will be enabled. The licensee further added that, "it has also been confirmed that other barriers/doors in the deployment path can be manually opened."

On page 9 of its Integrated Plan the licensee stated that debris removal equipment will be stored in one of the diverse protected facilities. This particular machine will also be capable of transporting the various pieces of FLEX equipment around the site. Such a machine was not listed on pages 64 and 65 of the Integrated Plan in the list of Pressurized Water Reactor (PWR) Portable Equipment Phase 2. During the audit process the licensee described that it intends to purchase a pickup truck capable of towing all Phase 2 equipment (other than the large generators). Both the pickup truck and debris removal machine will be stored in the FLEX equipment facility.

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

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

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

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

Regarding procedural interfaces, the CNS Integrated Plan contains numerous descriptions of general procedural guidance being developed that are reasonably applicable to FLEX implementation from all analyzed hazards. On page 10 the licensee described that in accordance with Section 11.4.1 of NEI 12-06, FLEX Support Guidelines (FSGs) will be developed to provide pre-planned FLEX strategies for accomplishing specific tasks. The FSGs will support Emergency Operating Procedures (EOPs), Abnormal Operating Procedures (AOPs), Extensive Damage Mitigation Guidelines (EDMGs), and Severe Accident Mitigation Guidelines (SAMGs) strategies.

On page 55 of its Integrated Plan the licensee described that handheld instruments with procedural guidance will be used to tap into the instrument loops locally and monitor essential parameters.

With regard to impacts from non-seismic, large internal flooding sources, during the audit process the licensee provided additional information describing that the predominant non-seismic piping in the Auxiliary Building consists of Fire Protection piping. In an ELAP, with no power to the fire pumps, only the water contained in the piping could contribute to internal flooding. An evaluation of potential internal Auxiliary Building flooding is ongoing and sump pumps are being procured to respond to internal flooding. Further discussion of this topic is included in Section 3.1.2.2, below. This is identified as Confirmatory Item 3.1.1.3.A in Section 4.2.

As described above in Section 3.1.1.2, failure of the downstream Lake Wylie dam is assumed in a seismic event. Deployment of equipment to or on the site would not be affected by a failure of the Lake Wylie dam. Further discussion of this topic is included in Section 3.1.1.4, below.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces considering the seismic hazard, 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 12 of its Integrated Plan the licensee described that it will utilize the nuclear industry established Regional Response Centers (RRCs). Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area. Communications will be established between CNS and the Strategic Alliance for Flex Emergency Response (SAFER) team and required equipment moved from the local staging area to the site as needed. First arriving equipment, as established during development of the site's playbook, will be delivered to the site within 24 hours from the initial request. A contract has been signed between the site and the Pooled Equipment Inventory Company RRC to provide Phase 3 services and equipment.

During the audit process the licensee provided additional information regarding delivery of offsite resources. There are two routes along local roads that can be used for ground access. If these are impassable, the RRC has provisions for airlifting equipment to the site. CNS has existing helicopter landing sites and additional areas on site could be used.

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

3.1.2 Flooding.

NEI 12-06, Section 6.2 states:

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

NEI 12-06, Section 6.2.1 states 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.

As described in its UFSAR, Section 2.4.2.2, and repeated on page 1 of its Integrated Plan, the licensee specified that CNS is subject to external flooding from Probable Maximum Floods (PMF) resulting from Probable Maximum Precipitation (PMP) events, Standard Project Floods (SPF) equal to 1/2 of the PMF, failures of upstream dams, a combination of dam failures and SPF's, Seiche, Hurricanes, and Storm Surge. Based on NTTF Recommendation 2.3 Flooding walkdowns and updated information from CNC-1114.00-00-0040, "Yard Drainage Results," CNC-1206.03-00-0142, "Flooding of Safety Related Structures Due to Excessive Rainfall," was revised to more accurately reflect potential flooding concerns at the site due to local intense PMP events. Modifications have been or will be installed to raise penetrations or provide additional barriers to mitigate or reduce flooding issues. Because the local intense PMP event occurs over a period of about 6 hours, there would be sufficient warning to pre- stage or move equipment and personnel if required. The duration of the event is also factored into the timing of various mitigation strategies.

On page 4 of its Integrated Plan the licensee described that the flooding and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 are not completed and therefore are not assumed in the Integrated Plan. As the re-evaluations are completed, appropriate issues will be entered into the corrective action program and addressed on a schedule commensurate with other licensing bases changes.

Thus, CNS screens in for the flooding hazard.

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

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

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

As described above in Section 3.1.1.1, the licensee's plans for storage and protection of FLEX equipment for all hazards have evolved. During the audit process the licensee provided further information that a single hardened storage facility will be constructed to withstand all external hazards applicable to the site.

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

3.1.2.2 Deployment of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.2 states:

> There are a number of considerations which apply to the deployment of FLEX equipment for external flood hazards:
>
> 1. For external floods with warning time, the plant may not be at power. In fact, the plant may have been shut down for a considerable time and the plant configuration could be established to optimize FLEX deployment. For example, the portable pump could be connected, tested, and readied for use prior to the arrival of the critical flood level. Further, protective actions can be taken to reduce the potential for flooding impacts, including cooldown, borating the RCS, isolating accumulators, isolating RCP seal leak off, obtaining dewatering pumps, creating temporary flood barriers, etc. These factors can be credited in considering how the baseline capability is deployed.
>
> 2. The ability to move equipment and restock supplies may be hampered during a flood, especially a flood with long persistence. Accommodations along these lines may be necessary to support successful long-term FLEX deployment.
>
> 3. Depending on plant layout, the ultimate heat sink may be one of the first functions affected by a flooding condition. Consequently, the deployment of the FLEX equipment should address the effects of LUHS, as well as ELAP.
>
> 4. Portable pumps and power supplies will require fuel that would normally be obtained from fuel oil storage tanks that could be inundated by the flood or above ground tanks that could be damaged by the flood. Steps should be considered to protect or provide alternate sources of fuel oil for flood conditions. Potential flooding impacts on access and egress should also be considered.
>
> 5. Connection points for portable equipment should be reviewed to ensure that they remain viable for the flooded condition.
>
> 6. For plants that are limited by storm-driven flooding, such as Probable Maximum Surge or Probable Maximum Hurricane (PMH), expected storm conditions should be considered in evaluating the adequacy of the baseline deployment strategies.
>
> 7. Since installed sump pumps will not be available for dewatering due to the ELAP, plants should consider the need to provide water extraction pumps

capable of operating in an ELAP and hoses for rejecting accumulated water for structures required for deployment of FLEX strategies.

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

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

On page 8 in its Integrated Plan, the licensee described that deployment routes to be utilized to transport FLEX equipment to the deployment areas will be established and included in an administrative program in order to keep pathways clear or actions to clear the pathways to be accessible during all modes of operation. As described above in Section 3.1.1.1, the licensee has revised its storage facility approach to utilize a single hardened building. During the audit process the licensee further described that since a final location for the building has been selected, formal evaluation of potential deployment routes and concerns such as flooding levels can proceed. This was previously identified as Confirmatory Item 3.1.1.2.A in Section 4.2.

As discussed in Section 3.1.2, above, because the local intense PMP event occurs over a period of about 6 hours, there would be sufficient warning to pre-stage or move equipment and personnel if required. The duration of the event is also factored into the timing of various mitigation strategies.

On page 56 in its Integrated Plan, for Phase 2, the licensee described that fuel oil will be provided from the buried, safety related, Emergency Diesel Generator (EDG) fuel oil tanks using portable fuel oil transfer pumps. The fuel oil will be pumped into a portable tank stored in a FLEX equipment facility for delivery to portable equipment when required. As specified in NEI 12-06, Section 3.2.1.3, initial condition (5), 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 61 in its Integrated Plan, for Phase 3, the licensee described that additional diesel fuel will be brought in from offsite resources when required.

On page 67 in its Integrated Plan in the table listing Phase 3 Response Equipment, a line item for “Fuel Requirements” is included that described that no fuel from off site sources is expected to be required for at least 14 days. The licensee will perform a detailed fuel consumption analysis for the portable FLEX equipment to support this expectation.

Further discussion regarding fuel for portable pumps and power supplies is contained in Section 3.2.4.9, Portable Equipment Fuel, below.

In several sections of its Integrated Plan, the licensee described that FLEX equipment system connections will be located above expected flood levels.

Because it is not a coastal site, CNS is not limited by storm driven flooding.

With regard to dewatering structures due to flooding, on page 6 of its Integrated Plan in the Sequence of Events (SOE) and Time constraints, item 4 at time 5 hours, the licensee described the need to provide pumping capacity to control level in the turbine driven auxiliary feed water pump (TDAFWP) pit sump. The licensee's analysis indicates 6 hours are available until the TDAFWPs in both units are submerged. Additional analysis is required to verify adequate pump head exists to overcome potential Turbine Building flooding.

During the audit process the licensee described that normal water inputs into the TDAFWP pit sump will need to be removed from the pit using a small portable pump powered by a stand alone generator. Additional pumps and hose will be procured to satisfy N+1 criterion. Three large sump pumps are also being procured. One pump will be permanently staged in each unit's Auxiliary Feedwater (AFW or CA) pump room and the third pump will be permanently staged in the common area of the 534 foot elevation in the Aux Building (one floor up from the lowest elevation in the building). These pumps have been sized to pump water from these locations out to the yard via fire hose and will be powered from the Phase 2 generators which will need to be in place within the first 8 hours of the event. This conflicts with the 5 hour estimate from the SOE, described above, for the need to provide pumping capacity to control level in the TDAFWP pit sump. The licensee's analysis indicates 6 hours are available until the TDAFWPs in both units are submerged. This is identified as Open Item 3.1.2.2.A in Section 4.1

The licensee further described that a seismically robust electrical "backbone" distribution network is planned to be installed within the Aux Building to facilitate connecting power during an event from the Phase 2 generators to the various pieces of FLEX equipment and Motor Control Centers (MCCs).

Regarding the use of temporary flood barriers, as discussed above in Section 3.1.2, the licensee described that modifications have been or will be installed to raise penetrations or provide additional barriers to mitigate or reduce flooding issues.

On page 9 of its Integrated Plan the licensee stated that debris removal equipment will be stored in one of the diverse protected facilities. This particular machine will also be capable of transporting the various pieces of FLEX equipment around the site. Such a machine was not listed on pages 64 and 65 of the Integrated Plan in the list of PWR Portable Equipment Phase 2. During the audit process the licensee described that it intends to purchase a pickup truck capable of towing all Phase 2 equipment (other than the large generators). Both the pickup truck and debris removal machine will be stored in the FLEX equipment facility.

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

3.1.2.3 Procedural Interfaces – Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

> The following procedural interface considerations should be addressed.
>
> 1. Many sites have external flooding procedures. The actions necessary to support the deployment considerations identified above should be incorporated into those procedures.

2. Additional guidance may be required to address the deployment of FLEX for flooded conditions (i.e., connection points may be different for flooded vs. non-flooded conditions).

3. FLEX guidance should describe the deployment of temporary flood barriers and extraction pumps necessary to support FLEX deployment.

Regarding procedural interfaces, the CNS Integrated Plan contains numerous descriptions of general procedural guidance being developed that are reasonably applicable to FLEX implementation from all analyzed hazards. On page 10 the licensee described that in accordance with Section 11.4.1 of NEI 12-06, FSGs will be developed to provide pre-planned FLEX strategies for accomplishing specific tasks. The FSGs will support EOPs, AOPs, EDMGs, and SAMGs strategies.

Regarding FLEX connection points for flooding conditions, in several sections of its Integrated Plan, the licensee described that FLEX equipment system connections will be located above expected flood levels.

Flood barriers and water extraction are discussed above in Section 3.1.2.2.

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

3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

As described in Section 3.1.2, CNS is not impacted by persistent floods.

On page 12 of its Integrated Plan the licensee described that it will utilize the nuclear industry established RRCs. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area. Communications will be established between CNS and the SAFER team and required equipment moved from the local staging area to the site as needed. First arriving equipment, as established during development of the site's playbook, will be delivered to the site within 24 hours from the initial request. A contract has been signed between the site and the Pooled Equipment Inventory Company RRC to provide Phase 3 services and equipment.

During the audit process the licensee provided additional information regarding delivery of offsite resources. There are two routes along local roads that can be used for ground access. If these are impassable, the RRC has provisions for airlifting equipment to the site. CNS has existing helicopter landing sites and additional areas on site could be used.

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

3.1.3 High Winds

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

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

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

On page 2 of its Integrated Plan the licensee described that CNS UFSAR Section 2.3.1.2 and 3.5.1.4 state that the station is subject to severe storms and hurricanes that have the potential to produce tornados and tornado missiles. Per UFSAR Section 2.1.1.1 the station center is located at latitude 35 degrees – 3 minutes - 5 seconds north and longitude 081 degrees - 4 minutes - 10 seconds west. Per Figure 7-1 of NEI 12-06, peak hurricane wind speeds at CNS could be between 150 and 160 miles per hour. From UFSAR Section 2.4.5.1, the maximum design basis wind speeds due to a hurricane would be 116 miles per hour. Per Figure 7-2 of NEI 12-06, tornado design wind speeds for the site would be around 175 miles per hour. From UFSAR Section 3.3.2.1, the design tornado used in calculating tornado loadings of Category I structures is in conformance with Regulatory Guide 1.76 with the following exceptions: 1) Rotational (Tangential) wind speed is 300 mph; 2) Translational speed is 60 mph; 3) Radius of maximum rotational speed is 240 feet.

Thus, CNS screens in for the high winds hazard.

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

As described above in Section 3.1.1.1, the licensee's plans for storage and protection of FLEX equipment for all hazards have evolved. During the audit process the licensee provided further information that a single hardened storage facility will be constructed to withstand all external hazards applicable to the site.

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

3.1.3.2 Deployment of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.2 states:

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

On page 2 of its Integrated Plan, the licensee described that because hurricanes are slow moving and relatively predictable, pre-staging equipment and having adequate staff on site will be administratively controlled. This will be a major consideration when developing mitigation guidelines because damage from hurricanes can be widespread and significantly affect infrastructure.

CNS is not a coastal site and thus, is not subject to hurricane storm surge.

Regarding storm related debris in the UHS, FLEX equipment hose suction will be equipped with strainers. On page 16 of its Integrated Plan the licensee described that a diesel driven portable pump taking suction from the UHS via hoses and strainers will be one method for providing steam generator (SG) makeup.

On page 9 of its Integrated Plan the licensee stated that debris removal equipment will be stored in one of the diverse protected facilities. This particular machine will also be capable of transporting the various pieces of FLEX equipment around the site. Such a machine was not listed on pages 64 and 65 of the Integrated Plan in the list of PWR Portable Equipment Phase 2. During the audit process the licensee described that it intends to purchase a pickup truck capable of towing all Phase 2 equipment (other than the large generators). Both the pickup truck and debris removal machine will be stored in the FLEX equipment facility.

On page 8 in its Integrated Plan, the licensee described that deployment routes to be utilized to transport FLEX equipment to the deployment areas will be established and included in an administrative program in order to keep pathways clear or actions to clear the pathways to be accessible during all modes of operation. As described above in Section 3.1.1.1, the licensee has revised its storage facility approach to utilize a single hardened building. During the audit process the licensee further described that since a final location for the building has been selected, formal evaluation of potential deployment routes and concerns such as hurricane effects can proceed. This was previously identified as Confirmatory Item 3.1.1.2.A in Section 4.2.

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

3.1.3.3 Procedural Interfaces - High Winds Hazard

NEI 12-06, Section 7.3.3, states:

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

Regarding procedural interfaces, the CNS Integrated Plan contains numerous descriptions of general procedural guidance being developed that are reasonably applicable to FLEX implementation from all analyzed hazards. On page 10 the licensee described that in accordance with Section 11.4.1 of NEI 12-06, FSGs will be developed to provide pre-planned FLEX strategies for accomplishing specific tasks. The FSGs will support EOPs, AOPs, EDMGs, and SAMGs 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 procedural interfaces for high wind hazards, if these requirements are implemented as described.

3.1.3.4 Considerations in Using Offsite Resources – High Winds Hazard

NEI 12-06, Section 7.3.4 states:

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

On page 12 of its Integrated Plan the licensee described that it will utilize the nuclear industry established RRCs. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area. Communications will be established between CNS and the SAFER team and required equipment moved from the local staging area to the site as needed. First arriving equipment, as established during development of the site's playbook, will be delivered to the site within 24 hours from the initial request. A contract has been signed between the site and the Pooled Equipment Inventory Company RRC to provide Phase 3 services and equipment.

During the audit process the licensee provided additional information regarding delivery of offsite resources. There are two routes along local roads that can be used for ground access. If these are impassable, the RRC has provisions for airlifting equipment to the site. CNS has existing helicopter landing sites and additional areas on site could be used.

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

3.1.4 Snow, Ice and Extreme Cold

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

All sites should consider the temperature ranges and weather conditions for their site in storing and deploying their FLEX equipment consistent with normal design practices. All sites outside of Southern California, Arizona, the Gulf Coast and Florida are expected to address deployment for conditions of snow, ice, and extreme cold. All sites located North of the 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 2 of its Integrated Plan, the licensee described that per UFSAR Section 2.1.1.1, the station center is located at latitude 35 degrees – 3 minutes - 5 seconds north and longitude 081 degrees - 4 minutes - 10 seconds west.

Thus, CNS is located North of the 35^{th} parallel and should provide the capability to address extreme snowfall with snow removal equipment.

Also on page 2 of its Integrated Plan, the licensee described that CNS UFSAR Table 2-29 contains Environmental Data from 1940 to 1980 obtained from the National Oceanic and Atmospheric Administration. The maximum and minimum temperatures for the Catawba site from 1940 to 1980 were 104 degrees F and -5 degrees F. The maximum amount of snow/sleet for a month was 19.3 inches. The maximum amount of snow/sleet in a 24 hour period was 16.5 inches. Since Catawba is located in what is considered to be a temperate climate, storage and operation of the FLEX equipment is not considered to be an issue. The only concern relative to this hazard is the movement of the FLEX equipment around the site and the availability of adequate staffing during periods of significant ice and/or snow. Water temperatures in the UHS will not reach a point where ice formation is an issue, as described in UFSAR Section 2.4.7 and 2.4.11.2.

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

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

NEI 12-06, Section 8.3.1 states:

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

at a temperature within a range to ensure its likely function when called upon. For example, by storage in a heated enclosure or by direct heating (e.g., jacket water, battery, engine block heater, etc.).

As described above in Section 3.1.1.1, the licensee's plans for storage and protection of FLEX equipment for all hazards have evolved. During the audit process the licensee provided further information that a single hardened storage facility will be constructed to withstand all external hazards applicable to the site.

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

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

NEI 12-06, Section 8.3.2 states:

> There are a number of considerations that apply to the deployment of FLEX equipment for snow, ice, and extreme cold hazards:
>
> 1. The FLEX equipment should be procured to function in the extreme conditions applicable to the site. Normal safety-related design limits for outside conditions may be used, but consideration should also be made for any manual operations required by plant personnel in such conditions.
>
> 2. For sites exposed to extreme snowfall and ice storms, provisions should be made for snow/ice removal, as needed to obtain and transport 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 2 of its Integrated Plan, the licensee described that since CNS is located in what is considered to be a temperate climate, storage and operation of the FLEX equipment is not considered to be an issue. The only concern relative to this hazard is the movement of the FLEX equipment around the site and the availability of adequate staffing during periods of significant ice and/or snow. Water temperatures in the UHS will not reach a point where ice formation is an issue, as described in UFSAR, Sections 2.4.7 and 2.4.11.2.

During the audit process the licensee provided additional information describing that personnel will be adequately dressed and will follow safety protocols for cold and heat when performing manual operations to support the mitigating strategies.

On page 9 of its Integrated Plan, the licensee described that equipment associated with the mitigation strategies will meet industrial grade and/or National Fire Protection Association

(NFPA) standards. Equipment used for the FLEX strategies will meet or exceed all design requirements for flow, temperature, pressure, and seismic ruggedness. All equipment is commercially available such that parts and repairs are readily available.

On page 9 of its Integrated Plan the licensee stated that debris removal equipment will be stored in one of the diverse protected facilities. This particular machine will also be capable of transporting the various pieces of FLEX equipment around the site. Such a machine was not listed on pages 64 and 65 of the Integrated Plan in the list of PWR Portable Equipment Phase 2. During the audit process the licensee described that it intends to purchase a pickup truck capable of towing all phase 2 equipment (other than the large generators). Both the pickup truck and debris removal machine will be stored in the FLEX equipment facility.

Also during the audit process, the licensee described that normal snow removal equipment (trucks with snow plows) and supplies (salt, brine) on site will be available to ensure travel paths are clear and accessible during frozen precipitation events.

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

3.1.4.3 Procedural Interfaces – Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.3, states:

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

Regarding procedural interfaces, the CNS Integrated Plan contains numerous descriptions of general procedural guidance being developed that are reasonably applicable to FLEX implementation from all analyzed hazards. On page 10 the licensee described that in accordance with Section 11.4.1 of NEI 12-06, FSGs will be developed to provide, pre-planned FLEX strategies for accomplishing specific tasks. It is reasonable to expect that procedural enhancements would involve addressing the effects of snow and ice on transport of the FLEX equipment.

As discussed in Section 3.1.4.2 above, on page 9 of its Integrated Plan the licensee stated that debris removal equipment will be stored in one of the diverse protected facilities. This particular machine will also be capable of transporting the various pieces of FLEX equipment around the site. Such a machine was not listed on pages 64 and 65 of the Integrated Plan in the list of PWR Portable Equipment Phase 2. During the audit process the licensee described that it intends to purchase a pickup truck capable of towing all Phase 2 equipment (other than the large generators). Both the pickup truck and debris removal machine will be stored in the FLEX equipment facility.

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

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

NEI 12-06, Section 8.3.4, states:

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

On page 12 of its Integrated Plan the licensee described that it will utilize the nuclear industry established RRCs. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area. Communications will be established between CNS and the SAFER team and required equipment moved from the local staging area to the site as needed. First arriving equipment, as established during development of the site's playbook, will be delivered to the site within 24 hours from the initial request. A contract has been signed between the site and the Pooled Equipment Inventory Company RRC to provide Phase 3 services and equipment.

During the audit process the licensee provided additional information regarding delivery of offsite resources. There are two routes along local roads that can be used for ground access. If these are impassable, the RRC has provisions for airlifting equipment to the site. CNS has existing helicopter landing sites and additional areas on site could be used.

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

3.1.5 High Temperatures

NEI 12-06, Section 9.2 states:

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

On page 2 of its Integrated Plan, the licensee described that CNS UFSAR Table 2-29 contains Environmental Data from 1940 to 1980 obtained from the National Oceanic and Atmospheric Administration. The maximum and minimum temperatures for the Catawba site from 1940 to 1980 were 104 degrees F and -5 degrees F.

Catawba screens in for the High Temperature hazard.

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

3.1.5.1 Protection of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

As described above in Section 3.1.1.1, the licensee's plans for storage and protection of FLEX equipment for all hazards have evolved. During the audit process the licensee provided further information that a single hardened storage facility will be constructed to withstand all external hazards applicable to the site.

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

3.1.5.2 Deployment of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

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

On page 2 of its Integrated Plan, the licensee described that since CNS is located in what is considered to be a temperate climate, storage and operation of the FLEX equipment is not considered to be an issue.

During the audit process the licensee provided additional information describing that the FLEX building specification to be developed will include design features to account for temperature extremes related to equipment protection and deployment. This will be in the form of adequate and multiple entry/exit door designs and heating, ventilating, and air conditioning (HVAC) systems if required. Further, the licensee described that personnel will be adequately dressed and will follow safety protocols for cold and heat when performing manual operations to support the mitigating strategies.

On page 9 of its Integrated Plan, the licensee described that equipment associated with the mitigation strategies will meet industrial grade and/or NFPA standards. Equipment used for the FLEX strategies will meet or exceed all design requirements for flow, temperature, pressure, and seismic ruggedness. All equipment is commercially available such that parts and repairs are readily available.

On page 9 of its Integrated Plan the licensee stated that debris removal equipment will be stored in one of the diverse protected facilities. This particular machine will also be capable of transporting the various pieces of FLEX equipment around the site. Such a machine was not listed on pages 64 and 65 of the Integrated Plan in the list of PWR Portable Equipment Phase 2. During the audit process the licensee described that it intends to purchase a pickup truck capable of towing all Phase 2 equipment (other than the large generators). Both the pickup truck and debris removal machine will be stored in the FLEX equipment facility.

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

3.1.5.3 Procedural Interfaces – High Temperature Hazard

NEI 12-06, Section 9.3.3 states:

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

In several sections of its Integrated Plan, the licensee described that CNS procedures and programs are being developed to address storage structure requirements, deployment path requirements, and FLEX equipment requirements relative to the hazards applicable to CNS. Further, the CNS Integrated Plan contains numerous descriptions of general procedural guidance being developed that are reasonably applicable to FLEX implementation from all analyzed hazards. On page 10 the licensee described that in accordance with Section 11.4.1 of NEI 12-06, FSGs will be developed to provide pre-planned FLEX strategies for accomplishing specific tasks. It is reasonable to expect that procedural enhancements would involve addressing the effects of high temperatures on the FLEX equipment.

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

3.2 PHASED APPROACH

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

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

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

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

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

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

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

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 ac power and loss of normal access to the UHS for an ELAP event.

Section 3.1 of WCAP-17601-P discusses the Pressurized Water Reactor Owners Group's (PWROG) recommendations that cover the following subjects for consideration in developing FLEX mitigation strategies: (1) initiation of cooldown, (2) development of inventory coping time, (3) instrumentation required for attaining core cooling, (4) sub-criticality study, (5) maintaining adequate shutdown margin by various sources, (6) the use of safe shutdown (SSD) low-leakage seals, (7) feedwater interruption times, (8) feeding a single SG, (9) prevention of nitrogen injection from accumulators, and (10) cooldown limits on SGs.

During the NRC audit process, the licensee was requested to discuss their position on each of the recommendations discussed above for developing the FLEX mitigation strategies. Specifics of the request included listing the recommendations that are applicable to the plant, providing rationale for the applicability, addressing how the applicable recommendations are considered in the ELAP coping analysis, discussing the plan to implement the recommendations, and providing the rationale for each of the recommendations that are determined not to be applicable to the plant. In response to the NRC audit process the licensee provided the following additional information to address the above items:

(1) Initiation of cooldown – will be initiated at about two hours in accordance with Owner's group guidance.

(2) Development of inventory coping time – Primary makeup will be initiated to ensure Primary inventory and shutdown margin within required time limits in accordance with FSG-1 (Long Term Inventory Control) and FSG-8 (Alternate NC System Boration).

(3) Instrumentation required for attaining core cooling – Instrumentation will be maintained in accordance with NEI 12-06 and Owner's group recommendations. Additional contingencies for loss of all indication will be developed in FSG-7 (Loss of Vital Instrumentation or Control Power) in accordance with PWROG guidance to support future ELAP FLEX strategies. Additionally, there are contingency plans for defense in depth, such as getting local instrument readings with portable hand held devices.

(4) Sub-criticality study – Duke will do a plant specific shutdown margin calculation in accordance with Owners group guidance.

(5) Maintaining adequate shutdown margin by various sources – Catawba will use the protected [refueling water storage tank] FWST (RWST)[1] as the borated water source for shutdown margin.

(6) The use of safe shutdown (SSD) low leakage seal – Catawba will not employ the use of safe shutdown (SSD) low leakage seals. CNS does not have low leakage seals, and has no FLEX related plan to install them.

(7) Feedwater interruption times – there are no anticipated feedwater interruption times in the Catawba strategy. Catawba plant design change will provide automatic alignment to a contained volume of RC (Condenser Cooling) water [contained in underground condenser cooling water pipe]. The RC water will provide adequate time for operators to align and establish long term makeup to the essential service water header, which also serves as a feedwater makeup source.

(8) Feeding a single SG – CNS intent is to perform the initial cooldown with all SGs. There is no plan to feed only one SG.

(9) Prevention of nitrogen injection from accumulators – Catawba cooldown strategy and limitations is in accordance with owner's group guidelines intended to prevent injection of CLA nitrogen. Power will be provided to close the CLA isolation valves when needed.

[1] Due to naming conventions at Catawba, this tank is called both the FWST and the RWST. In this document we will refer to it as the FWST (RWST).

(10) Cooldown limits on SGs – Catawba primary cooldown will be in accordance with owner's group guidance, and existing emergency operating procedure (EOP) guidance EP/1(2)/A/5000/ECA-0.0, "Loss of all ac power," (ECA-0.0) at less than 100°F/hr, to a SG pressure of approximately 225 psig. Limiting the primary cooldown rate will limit the SG rate.

Also, during the audit process, the licensee described that the CNS ELAP strategies are based in part on Westinghouse PWROG Core Cooling Position Paper (PA-PSC-0965) Revision 0, dated November 2012 (ADAMS Accession No. ML130420011). Section III of this paper states the following for the Westinghouse nuclear steam supply systems (NSSS) plants:

> Current/ELAP Case – Section 5.2.1 and 5.2.2 in WCAP 17601 – initiates an operator controlled symmetric cooldown of the RCS at 75°F/hr at 2 hours following event initiation and RCS cooldown is terminated when SG pressure reaches 300 psia (RCS cold leg temperature of 425°F). This is done to prevent injection of accumulator cover gas into the RCS.

The licensee described that this particular process is currently applied via ECA 0.0 and demonstrates a bounding core uncovery time of ~55 hours and also the ability to maintain the reactor in a subcritical state. Section IV.C.2 of the paper also states:

> When transferring to the Portable Low Pressure Feedwater pump, PORV (ADV) capability for the number of SG(s) intended to be fed will need to be checked. The steam release capability for SG(s) being fed must match the flow required to remove decay heat one hour after reactor trip at the target SG pressure.

The licensee described that preliminary analysis indicates that only two of four SGs will be required when using the Portable Low Pressure Feedwater pump strategy. This is being validated and will be formally documented in a station calculation.

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 RCS Cooling and Heat Removal, and RCS Inventory Control Strategies, if these requirements are implemented as described.

3.2.1.1 Computer Code Used for the ELAP Analysis

NEI 12-06, Section 1.3 states in part:

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

The licensee has provided an SOE in their Integrated Plan, which included the time constraints and the technical basis for the site. That SOE is based on a reference case Westinghouse NSSS designed plant analysis using the industry-developed NOTRUMP computer code. NOTRUMP was written to simulate the response of PWRs to small break Loss of Coolant

Accident (LOCA) transients for licensing basis safety analysis.

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

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

The licensee'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 computer codes used to perform ELAP analysis if these requirements are implemented as planned.

3.2.1.2 Reactor Coolant Pump Seal Leakage Rates

NEI 12-06, Section 1.3 states:

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

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

During the audit process CNS provided additional information describing that the four CNS RCPs in each unit are model 93AS (W11010A1) with Westinghouse Standard 8 inch bellows #3 seals. This combination of pump and seal is similar to the model 93A. The ELAP analysis performed in Section 5.2.1 of WCAP-17601-P simulates a model 93A RCP with 21 gpm seal leakage, and is applicable to CNS. CNS assumes an additional 1 gpm (total for all four pumps per unit) for uncertainty in the ELAP analysis. RCS cooldown will be initiated at 2 hours into the ELAP event and will be conducted in accordance with ECA-0.0 at less than 100 degrees F/hour to an SG pressure of approximately 225 psig. This is within vendor guidelines and will cool the RCP seals as the RCS system is cooled. The RCPs are secured at the onset of the event and seal cooling is not re-established since the CNS alternate seal injection is not seismically rated and is not credited to start in an ELAP event. Westinghouse will be contracted to assist CNS in providing further information regarding seal leakage.

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

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

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

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

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

The licensee stated that their seal leakage rate is assumed to be 21 gpm/seal. Therefore, this limitation is met.

(2) In some plant designs, such as those with 1200 to 1300 psia SG design pressures and no accumulator backing of the main steam system power-operated relief valve (PORV) actuators, the cold legs could experience temperatures as high as 580 ^{0}F before cooldown commences. This is beyond the qualification temperature (550 ^{0}F) of the O-rings used in the RCP seals. For those Westinghouse designs, a discussion of the information (including the applicable analysis and relevant seal

leakage testing data) should be provided to justify that (1) the integrity of the associated O-rings will be maintained at the temperature conditions experienced during the ELAP event, and (2) the seal leakage rate of 21 gpm/seal used in the ELAP is adequate and acceptable.

Catawba has safety related nitrogen accumulator back-up supplies for the SG PORV's. The PORV lift setpoint is 1125 psig and the cold leg temperature is not expected to challenge the O-rings.

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

Catawba's Integrated Plan does not reflect installation of SHIELD seals. Therefore, this limitation is not applicable.

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

Catawba's Integrated Plan does not reflect installation of SHIELD seals. Therefore, this limitation 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 the reactor coolant pump seal leakages rates, if these requirements are implemented as planned.

3.2.1.3 Decay Heat

NEI Section 3.2.1.2 states in part:

> The initial plant conditions are assumed to be the following:
>
> (1) Prior to the event the reactor has been operating at 100 percent rated thermal power for at least 100 days or has just been shut down from such a power history as required by plant procedures in advance of the impending event.

On page 4 of its Integrated Plan the licensee described that the PWROG position paper PA-PSC-0965 (PWROG Core Cooling Position Paper) and WCAP-17601-P response for ELAP apply to CNS unless other specific guidance overrides these analyses.

The Integrated Plan contained insufficient information to address the applicability of assumption 4 on page 4-13 of WCAP-17601, which states that "Decay heat is per ANS 5.1-1979 + 2 sigma, or equivalent." If the ANS 5.1-1979 + 2 sigma model is used in the ELAP analysis, values of the following key parameters used to determine the decay heat should be specified and the adequacy of the values used: (1) initial power level, (2) fuel enrichment, (3) fuel burnup, (4) effective full power operating days per fuel cycle, (5) number of fuel cycles, if hybrid fuels are used in the core, and (6) fuel characteristics are based on the beginning of the cycle, middle of the cycle, or end of the cycle.

During the audit process the licensee provided additional information that Westinghouse will be assisting CNS in providing further information regarding decay heat modeling. This is identified as Confirmatory Item 3.2.1.3.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 decay heat modeling, if these requirements are implemented as planned.

3.2.1.4 Initial Values for Key Plant Parameters and Assumptions

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

On page 4 of its Integrated Plan the licensee described that the PWROG position paper PA-PSC-0965 (PWROG Core Cooling Position Paper) and WCAP-17601-P response for ELAP apply to CNS unless other specific guidance overrides these analyses.

On page 72 of its Integrated Plan, Attachment 1B, NSSS Significant reference Analysis Deviation Table, the licensee described that it will apply a cooldown rate of 100 degrees F/hr and target SG pressure of 225 psig rather than the WCAP values of 70 degrees F/hr and target SG pressure of 300 psia. CNS has chosen to use cooldown rates and target SG pressures from existing EOP guidance (ECA-0.0). CNS considers this acceptable based on Section IV-C of the PWROG Position Paper.

On page 5 of its Integrated Plan the licensee described that CNS has no known deviations to the guidelines in JLD-ISG-2012-01 and NEI 12-06. If deviations are identified, then the deviations will be communicated in a future six-month update following identification. No such deviations were identified in the first six month update, dated August 13, 2013.

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

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states, in part:

> The parameters selected must be able to demonstrate the success of the

strategies at maintaining the key safety functions as well as indicate imminent or actual core damage to facilitate a decision to manage the response to the event within the Emergency Operating Procedures and FLEX Support Guidelines or within the SAMGs. Typically these parameters would include the following:

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

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

On pages 14, 27, and 35 of its Integrated Plan the licensee listed the key parameters necessary to support strategy implementation:

RCS Hot Leg Temperature (Thot)
RCS Cold Leg Temperature (Tcold)
RCS Wide Range (WR) Pressure
SG Narrow Range (NR) Level
SG WR Level
Core Exit Thermocouple Temperature
Pressurizer Level
Reactor Vessel Level Indicating System
AFW Pump Flow
SG Pressure
Battery Capacity/DC Bus Voltage
Neutron Flux
Wide-range (Gammametrics) neutron source range flux monitoring
Refueling Water Storage Tank (FWST) Level
Containment sump wide-range level
Pressurizer PORV (Power Operated Relief Valve) position indication
Containment wide-range pressure

On page 43 of its Integrated Plan the licensee described that a modification will install two separate wide-range level instruments for the SFP in accordance with NEI 12-02, *Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,"* Revision 1.

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

3.2.1.6 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, in part, addresses the minimum baseline capabilities:

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

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

In the Integrated Plan the licensee provides the current SOE timeline as a tabulation of strategies in Attachment 1A, pages 68 - 71. On pages 5 - 7 in the Integrated Plan the licensee provided further detail of the current SOE and lists the strategies from Attachment 1A that have new time constraints required for success. At the time of submittal of the integrated plan, twenty one items were listed having new time constraints. Inasmuch as most of these have one or more licensee tracking Open Items associated with them, it is clear that the CNS FLEX strategy is evolving.

On page 54 of its Integrated Plan the licensee described that an Emergency Response Organization (ERO) Staffing Analysis will be performed in accordance with NTTF Recommendation 9.3 and NEI 12- 01 (Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities). The staffing analysis will ensure adequate on-shift and augmented staff are available to support, install, and operate FLEX mitigation strategy equipment.

For the twenty one strategies with new time constraints, a technical basis and justification is provided that the time line can reasonably be met.

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 Sequence of Events, if these requirements are implemented as planned.

3.2.1.7 Cold Shutdown and Refueling

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

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

modes.

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

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

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

3.2.1.8 Core Sub-Criticality

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

> All plants provide means to provide borated RCS makeup.

On page 26 of its Integrated Plan the licensee described that there is not a Catawba strategy to maintain RCS inventory in Phase I, since core uncovery does not occur for 55 hours according to the PWROG generic analysis and greater than 72 hours according to the McGuire/Catawba specific analysis.

On pages 28 and 29 of its Integrated Plan the licensee described that due to leakage past the RCP seals, the core will eventually uncover if reactor makeup is not established. In order to compensate for the loss of inventory and ensure the reactor remains sub-critical, the PWROG Core Cooling Position Paper provides three options for reactor makeup:

1. High pressure pump (estimated to be greater than or equal to 1600 psig)
2. Low pressure pump (approximately 650 psig)
3. Passive Cold Leg Accumulator (CLA) injection

The licensee described that Catawba will employ the first option listed (high pressure pump) as its primary reactor makeup method since it requires less analysis than the other approaches and can be implemented earlier in the event.

CNS did not provide information regarding the boron mixing model in its Integrated Plan. During the NRC audit process, the licensee was requested to respond to the following items:

1. Discuss whether the uniform boron mixing model was used in the ELAP analysis. If the perfect boron mixing model was used, address the compliance with the

recommendations discussed in the PWROG position paper related to the boron mixing model. If a different model was used, address the adequacy of the use of the boron mixing model in the ELAP analysis with support of an analysis and/or boron mixing test data applicable to the ELAP conditions, where the RCS flow rate is low and the RCS may involve two-phase flow. Also, discuss how the boron concentration in the borated water added to the RCS is considered in the cooldown phase of the ELAP analysis, considering that it needs time for the added borated water to mix with water in the RCS.

2. Discuss the results of the plant specific boration analysis and show that the core will remain sub-critical throughout the ELAP event for the limiting condition with respect to shutdown margin. Note that the limiting conditions with respect to shutdown margin may be different than for the core cooling analysis (e.g., no seal leakage versus the maximum postulated value).

During the NRC audit process, the licensee described that for item 1 the ELAP criticality analysis for CNS is still being evaluated and assumes a uniform mixing model consistent with the PWROG position paper dated August 15, 2013 (withheld from public disclosure due to proprietary content). The strategy limitations as documented in that paper will be met in the shutdown margin calculation and overall FLEX strategy. For item 2, the licensee described that adequate shutdown margin will be demonstrated based on the following limiting assumptions:

1. End-Of-Cycle conditions, to maximize moderator temperature coefficient feedback.
2. Boron concentration targets based on K-eff < 0.99
3. Technical Specifications minimum boron concentration in the FWST (RWST)
4. Explicit modeling of xenon decay
5. No seal leakage

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

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

(1) The required timing for providing borated makeup to the primary system should consider conditions with no reactor coolant system leakage and with the highest applicable leakage rate for the reactor coolant pump seals and unidentified reactor coolant system leakage.

(2) For the condition associated with the highest applicable reactor coolant system leakage rate, two approaches have been identified, either of which is acceptable to the staff:

a. Adequate borated makeup should be provided such that the loop flow rate in two-phase natural circulation does not decrease below the loop flow rate corresponding to single-phase natural circulation.

b. If loop flow during two-phase natural circulation has decreased below the single-phase natural circulation flow rate, then the mixing of any borated primary makeup added to the reactor coolant system is not to be credited until one hour after the flow in all loops has been restored to a flow rate that is greater than or equal to the single-phase natural circulation flow rate.

(3) In all cases, credit for increases in the reactor coolant system boron concentration should be delayed to account for the mixing of the borated primary makeup with the reactor coolant system inventory. Provided that the flow in all loops is greater than or equal to the corresponding single-phase natural circulation flow rate, the staff considers a mixing delay period of one hour following the addition of the targeted quantity of boric acid to the reactor coolant system to be appropriate.

At the time the audit was conducted, the licensee had neither (1) committed to abide by the generic approach discussed above, including the additional conditions specified in the NRC's endorsement letter, nor (2) identified an acceptable alternate approach for justifying the boric acid mixing assumptions in the analyses supporting its mitigating strategy. As such, resolution of this concern is identified as Open Item 3.2.1.8.A in Section 4.1.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that the approach is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to core sub-criticality. These concerns are identified as Open Item 3.2.1.8.A above and in Section 4.1.

3.2.1.9 Use of Portable Pumps

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

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

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.

The licensee described the use of portable pumps in numerous sections of its Integrated Plan.

On pages 16 and 17 of its Integrated Plan the licensee described that the Condenser Cooling Water (RC) and Nuclear Service Water (RN) static inventory will eventually be depleted at around 16 hours into the event. Phase 2 will then be implemented using the following approach:

A diesel driven portable pump taking suction from the UHS via hoses and strainers will discharge into a new connection on the A (primary connection point) or B (alternate connection point) Train RN system supply header. This will provide an uninterrupted water supply to the TDAFWP for SG makeup. When temperatures/steam pressures become too low for TDAFWP operation or failure of the TDAFWP occurs, SG makeup will be provided by a second diesel driven low pressure portable pump. The second pump will take suction from the diesel driven portable pump located at the UHS. The discharge of the second pump will be into new Auxiliary Feedwater system connections located in the Category I doghouses downstream of the containment isolation valves.

A low pressure pump (approximately 300 gpm at 100 psig) will provide borated makeup to the reactor coolant system if the event were to occur during a refueling outage. This pump will be staged locally in the Category I Auxiliary Building.

Diesel fuel oil for the FLEX equipment will be obtained from the safety related underground Emergency Diesel Generator (EDG) storage tanks using a new connection being added to seismically qualified Unit 1 and Unit 2 Diesel Fuel Oil (FD) system piping located above flood levels in the yard. The diesel fuel will be pumped out of the underground tanks and transferred to a portable storage tank using a diesel driven portable transfer pump.

On pages 28 and 29 of its Integrated Plan the licensee described that due to leakage past the reactor coolant pump seals, the core will eventually uncover if reactor makeup is not established. In order to compensate for the loss of inventory and ensure the reactor remains sub-critical, the PWROG Core Cooling Position Paper provides three options for reactor makeup:

1. High pressure pump (estimated to be greater than or equal to 1600 psig)
2. Low pressure pump (approximately 650 psig)
3. Passive Cold Leg Accumulator (CLA) injection

Catawba will employ the first option listed (high pressure pump) as its primary reactor makeup method since it requires less analysis than the other approaches and can be implemented earlier in the event. A low pressure pump (approximately 300 gpm at 100 psig) will provide borated makeup to the reactor coolant system if the event were to occur during a refueling outage.

During the audit process the licensee provided additional information describing that additional pumps will be purchased that will be used for the low pressure SG makeup and Modes 5 and 6 RCS makeup strategies. These pumps will be capable of supplying 300 gpm at a discharge pressure of 400 psig. This is a change from that described in the original Integrated Plan.

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

3.2.2 Spent Fuel Pool Cooling Strategies

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

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

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

On page 43 of its Integrated Plan the licensee described that a modification will install two redundant level instruments in accordance with NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" (Reference 23) to measure SFP level down to the top of the fuel racks.

Based on licensee calculation DPC-1201.30-00-0012, SFP Loss of Cooling Heatup Time Determination due to Decay Heat, Rev 3, for the worst case heat load scenario, the SFP will begin to boil after an ELAP/LUHS event in 8.8 hours. This scenario assumes a maximum starting SFP temperature of 125 degrees F and a full core offload during an outage after 6 days. The licensee plans to open Spent Fuel Pool bay doors after 8-hours to provide ventilation to avoid adverse Auxiliary Building conditions due to SFP boiling.

During normal operation (21 days after the beginning of a refueling outage and initial SFP temperature of 125 degrees F), SFP level can be maintained at least 10 feet above the top of the fuel (above which personnel access to the SFP operating deck is still viable) for 202.9 hours with no makeup. For normal operating conditions, boiling will begin in 37.0 hours.

Since sufficient time exists to establish SFP makeup strategies before boiling or access becomes a concern, no Phase 1 actions are considered necessary.

On page 45 of its Integrated Plan the licensee described that makeup to the SFP during Phase 2 will be similar to existing B.5.b strategies. The worst case heat load corresponding to a full core off load 6 days after a shutdown will produce evaporation rates of 96.8 gpm per pool. The portable diesel pumps have more than enough capacity to maintain SFP levels given this worst case evaporation rate. The Catawba SFP has been analyzed to remain subcritical with zero boron credited, i.e. a complete dilution scenario, as long as the fuel assemblies remain covered and the parameters in Technical Specifications remain in effect.

On page 51 of its Integrated Plan the licensee described that long term SFP cooling will be accomplished by powering the installed Component Cooling (KC) and SFP cooling (KF) pumps using a portable generator obtained from the RRC to provide cooling via normal means. Cooling of the KC system heat exchanger will be from the normal essential service water (RN) system that is being supplied from the portable diesel driven pump located at the SNSWP (UHS).

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

3.2.3 Containment Functions Strategies

NEI 12-06, Table 3-2 and Appendix D provide some examples of acceptable approaches for demonstrating the baseline capability of the containment strategies to effectively maintain containment functions during all phases of an ELAP. For example: Containment pressure control/heat removal utilizing containment spray or repowering hydrogen igniters for ice condenser containments.

On page 35 of its Integrated Plan the licensee described that the Catawba reactor building includes a metal containment vessel and annulus region between the metal containment and a reinforced concrete enclosure. As described in UFSAR Section 6.2.1.1.2 the containment vessel design pressure is 15 psig. The Catawba containment is initially passively cooled by an ice condenser. A containment analysis was performed based on reactor coolant pump seal leakage that decreased with reactor coolant system pressure over time indicating that the design pressure in containment would not be exceeded prior to 72 hours. Although the function between leakage and time may change somewhat when the FSGs are implemented, because action will be proactively taken to both restore reactor inventory and cool down and depressurize the reactor coolant system to limit leakage, containment pressure is still expected to remain below the design pressure for 72 hours.

On page 37 of its Integrated Plan the licensee described that for the primary strategy one train of hydrogen igniters will be re-powered and restored to service in Phase 2. Manual containment isolation will also be completed by the end of Phase 2. Containment spray capability will be restored in accordance with PWROG generic FLEX Support Guidelines. An analysis will be performed to validate that containment spray for temperature/pressure control is not required over the long term. This is identified as Confirmatory Item 3.2.3.A in Section 4.2. For the alternate strategy the opposite train of hydrogen igniters will be re-powered and restored to service in Phase 2. If the long term containment analysis determines that containment temperature and/or pressure will reach unacceptable levels over the long term, connections installed for B.5.b containment spray strategies will be used with the portable diesel driven pumps to supply water from the UHS to the connections located in the Aux building.

Also, calculation DPC-1227.00-00-0024, "Annulus Conditions Following Station Blackout," Revision 1, verifies the annulus portion of the containment does not increase in pressure or temperature above design limits for the long term since it passively relieves through the annulus HVAC system (VE) exhaust dampers which fail open. This calculation ensures the annulus pressure does not exceed the containment pressure when containment is cooled with the spray header and also ensures the annulus region can be accessed by personnel if necessary.

On page 41 of its Integrated Plan the licensee described that long term containment pressure/temperature control will be accomplished by powering the installed KC and Containment Spray (NS) pumps using a portable generator obtained from the RRC to provide containment spray via normal means. Cooling of KC will be from the normal RN system that is being supplied from the portable diesel driven pump located at the SNSWP (UHS).

Regarding power to hydrogen igniters, on page 55 of the Integrated Plan the licensee described that the primary strategy will be a back feed connection receptacle that will be added to selected MCCs to allow the MCC to be powered from a portable diesel generator. Selected components from these motor control centers may then be operated using this power feed. For the alternate strategy, normal power supplies will be disconnected near the selected component. An alternate supply cable will be connected to the selected component and connected to a disconnect device and portable diesel generator.

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

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.

On page 4 of its Integrated Plan the licensee described that in accordance with NEI 12-06 Section 3.2.1.8, maximum environmental room temperatures for habitability or equipment operation may be based on NUMARC (Nuclear Management and Resources Council) 87-00 guidance if other design basis information or industry guidance is not available. Extreme high temperatures are not expected to impact the utilization of offsite resources or the ability of personnel to implement the required FLEX strategies.

Otherwise, the licensee's Integrated Plan did not identify whether additional strategies were needed to provide cooling functions for existing plant equipment or portable FLEX equipment to assure that coping strategy functionality could be maintained.

During the audit process the licensee provided additional information describing that existing plant equipment or portable FLEX equipment is either self-cooled or will be provided the necessary cooling via FLEX or Safety Function Support equipment. An outside engineering firm has also been contracted to perform various room temperature analyses which will provide a better idea of the environmental conditions expected during the event. Pending the outcome of these analyses, CNS implied that appropriate actions to provide additional cooling equipment and strategies will be taken. This is identified as Confirmatory Item 3.2.4.1.A in Section 4.2.

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

3.2.4.2 Ventilation – Equipment Cooling

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

> *Plant procedures/guidance should consider loss of ventilation effects on specific energized equipment necessary for shutdown (e.g., those containing internal electrical power supplies or other local heat sources that may be energized or present in an ELAP.*
>
> ELAP procedures/guidance should identify specific actions to be taken to ensure that equipment failure does not occur as a result of a loss of forced ventilation/cooling. Actions should be tied to either the ELAP/LUHS or upon reaching certain temperatures in the plant. Plant areas requiring additional air flow are likely to be locations containing shutdown instrumentation and power supplies, turbine-driven decay heat removal equipment, and in the vicinity of the inverters. These areas include: steam driven AFW pump room, … the control room, and logic cabinets. Air flow may be accomplished by opening doors to rooms and electronic and relay cabinets, and/or providing supplemental air flow.
>
> Air temperatures may be monitored during an ELAP/LUHS event through operator observation, portable instrumentation, or the use of locally mounted thermometers inside cabinets and in plant areas where cooling may be needed. Alternatively, procedures/guidance may direct the operator to take action to

provide for alternate air flow in the event normal cooling is lost. Upon loss of these systems, or indication of temperatures outside the maximum normal range of values, the procedures/guidance should direct supplemental air flow be provided to the affected cabinet or area, and/or designate alternate means for monitoring system functions.

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

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

On page 4 of its Integrated Plan the licensee described that in accordance with NEI 12-06, Section 3.2.1.8, the maximum environmental room temperatures for habitability or equipment operation may be based on NUMARC 87-00 guidance if other design basis information or industry guidance is not available. Extreme high temperatures are not expected to impact the utilization of offsite resources or the ability of personnel to implement the required FLEX strategies.

On page 53 of its Integrated Plan the licensee described that a NUMARC type analysis has been performed that demonstrates control room temperatures remain below 120 degrees F during a Station Blackout Event (SBO) of 4 hours without opening any control room doors. Additional cooling is expected if action is taken to open the control room doors sooner, at around 2 hours after the event occurs.

On pages 55 and 56 of its Integrated Plan the licensee described that to enhance control room temperature margins and personnel comfort, various doors will be opened to provide an air exchange flow path with the outside. Additional cooling will be provided if required by using portable fans powered from small portable FLEX diesel generators. Existing analyses will be validated to demonstrate that control room and TDAFWP room temperatures would remain acceptable with no additional action. Explosion proof portable fans will be placed in vital battery rooms when the batteries are being charged to ensure hydrogen accumulation does not exceed flammability limits. Current air flow from the battery rooms is around 110 cfm and each 8 inch FLEX fan is capable of moving approximately 600 cfm of air.

On page 61 in its Integrated Plan the licensee described that additional ventilation needs, if required, will be provided from equipment obtained from the RRC. This equipment could consist of fans and portable cooling units.

During the audit process the licensee provided additional information describing that an outside engineering firm has been contracted to perform various room temperature analyses which include other areas of the plant where operator action will be required in addition to the Control Room and TDAFWP room. The HVAC analysis will determine temperature and environmental conditions expected due to an ELAP event in areas where FLEX credited equipment are located or where personnel responding to the event are or will be located. These analyses shall document temperatures and other environmental conditions (i.e. humidity, hydrogen concentration, habitability issues). Pending the outcome of these analyses, CNS implied that appropriate actions to provide additional cooling equipment and strategies will be taken. This was previously identified as Confirmatory Item 3.2.4.1.A in Section 4.2.

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

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.

As previously established in Section 3.1.4 of this review, CNS is subject to extreme cold temperatures in accordance with NEI 12-06, Section 8.2.1.

On page 7 of its Integrated Plan, in the section Sequence of Events, Discussion of Time Constraints, item 18, the licensee described that at time 48 hours - Evaluate need to provide freeze protection for instrumentation located in Doghouses and yard. 48 hours is based on engineering judgment. Evaluation will be performed to determine actual action time.

Otherwise, no discussion of freeze protection, including loss of existing heat tracing due to loss of ac power, was provided in the integrated plan.

During the audit process the licensee provided additional information describing that evaluations to address the needs for freeze protection are ongoing, and once completed, additional freeze protection measures will be added if necessary. This is identified as Confirmatory Item 3.2.4.3.A in Section 4.2.

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

3.2.4.4 Accessibility – Lighting and Communications

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

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

On page 53 in its Integrated Plan, for Phase 1, the licensee described that portable lighting will be procured to ensure operators and emergency personnel can safely move through the plant during an ELAP event. Post Fire Safe Shutdown lighting is available in many areas where manual actions (e.g. connecting hoses, routing power cables, or operating pumps) are necessary. The Post Fire Safe Shutdown lights have self-contained batteries with an 8 hour life. Evaluations related to lighting needs are being performed to determine what should be purchased and what, if anything, should be modified.

On page 55 in its Integrated Plan, for Phase 2, the licensee described that additional portable lighting will be procured to provide lighting in the yard, to replace some of the permanent lighting, and to enhance lighting in other areas of the plant as deemed necessary.

On page 61 in its Integrated Plan, for Phase 3, the licensee described that additional portable lighting will be procured from the RRC when required to provide lighting in the yard, to replace some of the permanent lighting, and to enhance lighting in other areas of the plant as deemed necessary.

Confirmatory Item 3.2.4.4.A is identified in Section 4.2, pending completion of additional evaluation of lighting requirements by the licensee.

Regarding communications, on page 56 of its Integrated Plan the licensee described that CNS did not try to assess the survivability of primary or backup communications systems described in the Emergency Plan (E-Plan) or Emergency Plan Implementing Procedures (EPIPs) during an ELAP event. Instead, Catawba elected to conservatively assume that land line and cellular based communications systems would not be relied upon. As a result of this assessment, no improvements will be made to existing onsite and offsite communications systems and their required normal and/or backup power supplies. During an ELAP event, onsite communications will be established via existing hand-held radios (line-of-sight) and offsite communications will be established via hand-held satellite phones.

Further, the licensee described that Catawba will comply with the requirements associated with the NRC's request for information regarding recommendation 9.3, of the NTTF Review of

Insights from the Fukushima Dai-Ichi Accident. Strategies to mitigate the loss of communication systems will be developed in accordance with the NRC's request for information associated with NTTF Recommendation 9.3 and NEI 12-01 - Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities.

The licensee provided communications assessment in its letters dated October 31, 2012, and February 22, 2013 (ADAMS Accession Nos. ML12311A028 and ML13058A066) in response to the NRC's March 12, 2012, 50.54(f) request for information letter for Catawba. As documented in the NRC staff analysis provided by letter dated May 13, 2013 (ADAMS Accession No. ML13108A152), the NRC staff has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2 (8) regarding communications capabilities during an ELAP. Confirmation will be required that upgrades to the site's communications systems have been completed. This has been identified as Confirmatory Item 3.2.4.4.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 lighting and communications, if these requirements are implemented as described.

3.2.4.5 Protected and Internal Locked Area Access

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

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

On page 4 of its Integrated Plan the licensee described that access through security fences, doors, and other barriers will be unimpeded and not require additional resources.

During the audit process the licensee provided additional information describing that access through security fences will be provided by the onsite security personnel. Access through vehicle barriers can also be accomplished by the onsite security personnel. Access through internal security doors will be unimpeded. CNS added that an ELAP-type event would initiate the callout of all available Security personnel.

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

3.2.4.6 Personnel Habitability – Elevated Temperature

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

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

Section 9.2 of NEI 12-06 states,

> 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.

On page 4 in its Integrated Plan the licensee described that in accordance with NEI 12-06 Section 3.2.1.8, maximum environmental room temperatures for habitability or equipment operation may be based on NUMARC 87-00 guidance if other design basis information or industry guidance is not available. Extreme high temperatures are not expected to impact the utilization of offsite resources or the ability of personnel to implement the required FLEX strategies.

On page 53 in its Integrated Plan the licensee described that a NUMARC type analysis has been performed that demonstrates control room temperatures remain below 120 degrees F during an SBO of 4 hours without opening any control room doors. Additional cooling is expected if action is taken to open the control room doors sooner, at around 2 hours after the event occurs.

On pages 55 and 56 of its Integrated Plan the licensee described that to enhance control room temperature margins and personnel comfort, various doors will be opened to provide an air exchange flow path with the outside. Additional cooling will be provided if required by using portable fans powered from small portable diesel generators. Existing analyses will be validated to demonstrate that control room and TDAFWP room temperatures would remain acceptable with no additional action. Explosion proof portable fans will be placed in vital battery rooms when the batteries are being charged to ensure hydrogen accumulation does not exceed flammability limits. Current air flow from the battery rooms is around 110 cfm and each 8 inch FLEX fan is capable of moving approximately 600 cfm of air.

On page 61 in its Integrated Plan the licensee described that additional ventilation needs, if required, will be provided from equipment obtained from the RRC. This equipment could consist of fans and portable cooling units.

During the audit process the licensee provided additional information describing that an outside engineering firm has also been contracted to perform various room temperature analyses which will provide a better idea of the environmental conditions expected during the event. Pending the outcome of these analyses, CNS implied that appropriate actions to provide additional cooling equipment and strategies will be taken. This was previously identified as Confirmatory Item 3.2.4.1.A in Section 4.2.

On page 11 of its Integrated Plan the licensee described that portable FLEX equipment such as pumps, air compressors, and generators will be given specific identifiers/labels maintained in the Equipment Data Base.

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

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.

On pages 13 of 93 of its Integrated Plan, in the section regarding the safety function "Maintain

Core Cooling & Heat Removal, PWR Installed Equipment Phase 1," the licensee described that at the initiation of the event, operators will enter the Loss of All AC Power EOP. The FSGs will be entered when the Emergency and Standby Shutdown Facility diesel generators are confirmed to be unavailable and off-site power cannot be restored per the dispatcher or visual verification of physical damage to infrastructure at site. During cooldown the TDAFWP will deliver condensate grade water to the SGs if available. However, if a seismic or high wind event has occurred, the condensate sources of water may not be available and swap over to the Condenser Cooling Water system (RC) inventory should be confirmed. Use of the condenser cooling water inventory can support heat removal for at least 3 hours. Guidance will be provided to align the static water supply contained in the nuclear service water (RN) system piping to the TDAFWP prior to depleting the condenser cooling water inventory. Based on Auxiliary Feedwater flow rates, the static water inventory in the RN piping added to the condenser cooling water volume will provide approximately 16 hours of TDAFWP operation before make up via portable pumps will be required.

On pages 16 and 17 of its Integrated Plan, in the section regarding safety function "Maintain Core Cooling & Heat Removal, PWR Portable Equipment Phase 2," the licensee described the Primary and Alternate strategies for makeup flow to the SGs for core cooling as follows:

Primary Strategy:

The Condenser Cooling Water (RC) and RN static inventory will eventually be depleted at around 16 hours into the event. Phase 2 will then be implemented using the following approach:

A diesel driven portable pump taking suction from the UHS via hoses and strainers will discharge into a new connection on the A (primary connection point) or B (alternate connection point) Train RN system supply header. The RN to auxiliary feedwater (CA) system isolation valves located in the Category I Auxiliary Building will be manually opened. This will provide an uninterrupted water supply to the TDAFWP for SG makeup.

Alternate Strategy:

When temperatures/steam pressures become too low for TDAFWP operation or failure of the TDAFWP occurs, SG makeup will be provided by a second diesel driven low pressure portable pump. The second pump will take suction from the diesel driven portable pump located at the UHS. The discharge of the second pump will be into new CA system connections located in the Category I doghouses downstream of the containment isolation valves. The B.5.b SG injection connections may be used as an optional flow path if needed. Procedural guidelines will direct these activities.

During the audit process the licensee provided additional information describing that Engineering Changes for both units are currently being designed to provide an automatic alignment of the TDAFWP suction to the RC system seismically qualified piping. This re-alignment will occur upon a loss of power. And the components associated with this automatic action will be qualified for and protected from all ELAP events. Prior to exhausting the RC system supply of water (at approximately 48 hours) the safety related RN system will be manually aligned to provide a suction source to the TDAFWP.

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 planned.

3.2.4.8 Electrical Power Sources/Isolations and Interactions.

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

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

On page 55 in its Integrated Plan the licensee described that a back feed connection receptacle will be added to selected MCCs to allow the MCC to be powered from a portable FLEX diesel generator. Selected components from these motor control centers may then be operated using this power feed. Alternatively, normal power supplies will be disconnected near the selected component. An alternate supply cable will be connected to the selected component and connected to a disconnect device and portable diesel generator. Procedural guidelines will direct these activities.

During the audit process the licensee provided additional information describing that electrical isolation during FLEX deployment will be procedurally controlled. The portable FLEX electrical distribution will be regulated and include circuit breakers in the circuits feeding the class 1E busses. All breakers except the target loads including the plant installed main and alternate feed to the bus will be opened to prevent paralleling sources.

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

3.2.4.9 Portable Equipment Fuel.

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

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

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

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

On page 56 in its Integrated Plan, for Phase 2, the licensee described that fuel oil will be provided from the buried EDG fuel oil tanks, which are safety related and robust, using portable fuel oil transfer pumps. The fuel oil will be pumped into a portable tank stored in a FLEX equipment facility for delivery to portable equipment when required.

On page 61 in its Integrated Plan, for Phase 3, the licensee described that additional diesel fuel will be brought in from offsite resources when required.

On page 67 in its Integrated Plan in the table listing Phase 3 Response Equipment, a line item for "Fuel Requirements" is included that described that no fuel from off site sources is expected to be required for at least 14 days. The licensee will perform a detailed fuel consumption analysis for the portable FLEX equipment to support this expectation.

During the audit process the licensee provided additional information describing that a portable fuel oil pump skid is to be purchased that can be used to pump fuel oil from the safety related EDG tanks via new safety related piping connection points being added. There are eight EDG tanks (two per EDG) with a total minimum Technical Specification capacity of 77,100 gallons for each EDG, for a total of 308,400 gallons. The fuel removed from the underground tanks will be transferred to a 1000 gallon portable tank that will have a 12 Vdc pump attached. This portable tank will be pulled around the site via previously qualified transportation paths to the various pieces of FLEX equipment needing refueling. The 1000 gallon portable tank will remain empty until needed. Existing administrative controls on EDG fuel oil supplies ensure adequate fuel quality. Any fuel in the tanks of FLEX equipment is treated with stabilizers and the equipment is run during preventive maintenance which should detect any degraded fuel issues.

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 53 of its Integrated Plan, for Phase 1, the licensee described that a vital battery load reduction scheme has been developed that includes shedding loads not required for the FLEX strategy. The instrumentation to remain powered is consistent with the instrumentation outlined in PWROG generic FLEX Support Guidelines and Interfaces, Supplement 14 - PWROG ELAP Instrumentation Recommendations. Phase 1 requires non-essential loads to be removed between 2.5 and 3.5 hours into the event. This will maintain all four channels functional for at least 8 hours.

On page 55 in its Integrated Plan, for Phase 2, the licensee described that back feed connection receptacles will be added to selected MCCs to allow these MCCs to be powered from a portable FLEX diesel generator. The repowered MCCs will then be able to feed the A Train, B Train, and spare battery chargers. The battery chargers will be aligned to the batteries prior to battery voltage decreasing below acceptable values. This will allow all channels of vital instrumentation to be maintained. The spare battery charger will provide redundancy as a backup for either train.

In the Integrated Plan, SOE timeline, on pages 69 and 70 the licensee described that charging to Vital Batteries A and D would commence by 8 hours and charging to Vital Batteries B and C would commence by 15 hours.

During the audit process the licensee provided additional information describing that the load shed plan is documented in Appendix A of calculation CNC-1381.05-00-0122, “Station Blackout Battery Sizing Calculation for the 125 VDC Vital I&C Batteries.” All four vital batteries per unit will be maintained in service throughout the ELAP event. All required instrumentation and control loads are powered from these batteries and the associated 120 Vac inverters. The calculation referenced shows that with load stripping all batteries are capable of maintaining greater than 110 Vdc for longer than 8 hours. All breakers to be opened for shedding loads are located in the battery room two levels below the Main Control Room. Portable generators will be in place within 8 hours of the event and will be used to begin recharging the batteries.

Also during the audit process, the licensee described that the main generator Emergency Seal Oil Pump Motor is fed from non-safety 250 Vdc battery 1(2) system. The breaker feeding this load is not to be shed. The Loss of All AC Power procedure highlights the importance of this breaker and the hydrogen procedure provides guidance for emergency vent of the generator hydrogen if the main and emergency seal oil pumps are lost.

The NRC staff determined that the Generic Concern related to battery duty cycles beyond 8 hours is applicable to the plant for Vital Batteries B and C. The Generic Concern related to extended battery duty cycles, has been resolved generically through the NRC endorsement of NEI position paper entitled “Battery Life Issue” (ADAMS Accession Nos. ML13241A186 (position paper) and ML13241A188 (NRC endorsement letter)).

The purpose of the Generic Concern and associated endorsement of the position paper was to resolve concerns associated with Order Integrated Plan submittals in a timely manner and on a generic basis, to the extent possible, and provide a consistent review by the NRC. Position papers provided to the NRC by industry further develop and clarify the guidance provided in NEI 12-06 related to industry’s ability to meet the intent of Order EA-12-049.

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

The licensee'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 battery 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[2] guidance provided in INPO AP 913, Equipment Reliability Process, to verify proper function. The maintenance program should ensure that the FLEX equipment reliability is being achieved. Standard industry templates (e.g.,

EPRI) and associated bases will be developed to define specific maintenance and testing including the following:

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

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

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

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

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

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

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

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

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

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

Regarding the attributes of NEI 12-06, Section 3.2.2, following guideline (15), N+1 quantities of FLEX equipment:

On pages 64 – 66 of its Integrated Plan, and as supplemented by additional information provided during the audit process (discussed in various sections of this TER, above) the licensee lists types and quantities of portable equipment needed to support the mitigating strategies. The list includes appropriate N+1 quantities of major components like pumps and generators to the extent they are specified for particular strategies. Minimum quantities of miscellaneous equipment such as cable and hoses may not reasonably be determined at this stage of FLEX strategies development.

On pages 10 and 11 in its Integrated Plan the licensee described that initial testing of the FLEX mitigation equipment to ensure it meets design requirements will be successfully completed prior to being placed in service. The portable FLEX mitigation equipment used to provide core cooling, SFP cooling (makeup), and containment integrity will be maintained and tested to ensure its reliable operation. This will be done by adding this equipment to the Periodic Maintenance (PM) program. The PM program will provide the process controls needed to perform periodic maintenance and testing of the designated FLEX equipment. Current maintenance and testing is performed via a vendor contract based on manufacturer recommendations and NFPA codes. Future PM requirements may be based on standard industry templates if approved by all interested parties. Unavailability of the FLEX mitigation equipment and system connections will be controlled by giving these components a special code in the Work Control program. Use of this code will ensure that the FLEX components are returned to service within 90 days provided N sets of equipment and alternate connections remain available. If the portable FLEX equipment is unavailable for more than 90 days, then equivalent supplemental equipment will be brought to the site. If the portable FLEX equipment becomes unavailable such that the site FLEX capability (N) is not maintained, actions will be initiated within 24 hours to restore the site FLEX capability (N) and compensatory measures (e.g., use of alternate suitable equipment or supplemental personnel) will be implemented 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 Electric Power Research Institute (EPRI) technical report on preventive maintenance of FLEX equipment, submitted by NEI by letter dated October 3, 2013 (ADAMS Accession No. ML13276A573). The NRC staff's endorsement letter is dated October 7, 2013 (ADAMS Accession No. ML13276A224).

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

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

3.3.2 Configuration Control.

NEI 12-06, Section 11.8 states:

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

On page 11 in its Integrated Plan the licensee described that the FLEX program including the bases and strategies will be contained in a future document. Portable FLEX equipment such as pumps, air compressors, and generators will be given specific identifiers/labels maintained in the Equipment Data Base. Periodic surveillance procedures and Operator rounds will be developed to verify that all FLEX equipment is in its proper storage location and not degraded. Existing plant configuration control procedures will be modified to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.

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

3.3.3 Training.

NEI 12-06, Section 11.6, Training, states:

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

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

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

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

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

On page 11 in its Integrated Plan General the licensee described that personnel responsible for responding to BDBEEs will receive initial and periodic training to maintain proficiency of the mitigation strategies. The groups involved in training will initially include Operations, Maintenance, Security, and the ERO. Training will comply with all accredited processes and programs. In accordance with Section 11.6 of NEI 12-06, the integrated FLEX drills should be organized on a team or crew basis and be conducted periodically if appropriate. Time sensitive actions shall be evaluated at least every eight years or less. It is not the intent to connect to or operate permanently installed equipment during these drills and demonstrations.

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

3.4 OFFSITE RESOURCES

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

1) A capability to obtain equipment and commodities to sustain and backup the site’s coping strategies.

2) Off-site equipment procurement, maintenance, testing, calibration, storage, and control.

3) A provision to inspect and audit the contractual agreements to reasonably assure the capabilities to deploy the FLEX strategies including unannounced random inspections by the Nuclear Regulatory Commission.

4) Provisions to ensure that no single external event will preclude the capability to supply the needed resources to the plant site.

5) Provisions to ensure that the off-site capability can be maintained for the life of the plant.

6) Provisions to revise the required supplied equipment due to changes in the FLEX strategies or plant equipment or equipment obsolescence.

7) The appropriate standard mechanical and electrical connections need to be specified.

8) Provisions to ensure that the periodic maintenance, periodic maintenance schedule, testing, and calibration of off-site equipment are comparable/consistent with that of similar on-site FLEX equipment.

9) Provisions to ensure that equipment determined to be unavailable/non-operational during maintenance or testing is either restored to operational status or replaced with appropriate alternative equipment within 90 days.

10) Provision to ensure that reasonable supplies of spare parts for the off-site equipment are readily available if needed. The intent of this provision is to reduce the likelihood of extended equipment maintenance (requiring in excess of 90 days for returning the equipment to operational status).

On page 12 of its Integrated Plan the licensee described that it will utilize the nuclear industry established RRCs. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area. Communications will be established between CNS and the SAFER team and required equipment moved from the local staging area to the site as needed. First arriving equipment, as established during development of the site's playbook, will be delivered to the site within 24 hours from the initial request. A contract has been signed between the site and the Pooled Equipment Inventory Company RRC to provide Phase 3 services and equipment.

The licensee's integrated plan did not include details of the management of the RRCs as specified in considerations 2 through 10. This has been identified as Confirmatory Item 3.4.A in Section 4.2.

During the audit process the licensee provided additional information regarding delivery of offsite resources. There are two routes along local roads that can be used for ground access. If these are impassable, the RRC has provisions for airlifting equipment to the site. CNS has existing helicopter landing sites and additional areas on site could be used. Further, the licensee added that the "Playbook" developed by the SAFER team and utility will address the considerations of 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 subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to off site resources, if these requirements are implemented as described.

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.1.2.2.A	Resolve the conflict between the need to pump the TDAFW pump pit before submergence at 6 hours and deploying generators to power the sump pumps by 8 hours.	
3.2.1.8.A	Core Sub-Criticality - Confirm resolution of the generic concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the reactor coolant system under natural circulation conditions potentially involving two-phase flow.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.2.A	Seismic Deployment (applicable to all hazards deployment) - since a final location for the building has been selected, formal evaluation of potential deployment routes and concerns such as soil liquefaction can proceed. Confirm attributes of deployment routes, including liquefaction potential.	
3.1.1.3.A	Procedural Interfaces – Seismic – Confirm completion of evaluation of potential internal Aux Building flooding and appropriate actions and procurement of sump pumps.	
3.2.1.1.A	Reliance on the NOTRUMP code for the ELAP analysis of Westinghouse plants is limited to the flow conditions prior to reflux condensation initiation. This includes specifying an acceptable definition for reflux condensation cooling.	
3.2.1.3.A	Westinghouse will be assisting CNS in providing further information regarding decay heat modeling. Evaluate for applicability and implementation.	
3.2.3.A	Licensee will confirm that the final containment analysis validates that containment spray for temperature/pressure control is not required over the long term, or will provide procedures to cool the containment.	
3.2.4.1.A	Room temperature analyses being performed will provide a better idea of the environmental conditions expected during the event. Confirm completion of analyses and appropriate actions.	
3.2.4.3.A	Evaluations to address the needs for freeze protection are in progress. Confirm completion of evaluations and appropriate actions.	
3.2.4.4.A	Confirm evaluations for additional lighting have been completed (licensee's open item 45 and 59), and appropriate actions taken.	
3.2.4.4.B	Confirm upgrades to the site's communication systems have been completed.	

3.4.A	Offsite Resources - Confirm NEI 12-06 Section 12.2, Guidelines 2 through 10, are addressed with SAFER.	