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

December 9, 2013

Exelon Generation Company, LLC
Clinton Power Station, Unit 1
Docket No. 50-461

Prepared for:

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Contract NRC-HQ-13-C-03-0039
Task Order No. NRC-HQ-13-T-03-0001
Job Code: J4672
TAC No.: MF0901

Prepared by:

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

1.0 BACKGROUND

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

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

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

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

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

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

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

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

2.0 EVALUATION PROCESS

In accordance with the provisions of Contract NRC-HQ-13-C-03-0039, Task Order No. NRC-HQ-13-T-03-0001, Mega-Tech Services, LLC (MTS) performed an evaluation of each licensee's Integrated Plan. As part of the evaluation, MTS, in parallel with the NRC staff, reviewed the original Integrated Plan and the first 6-month status update, and conducted an audit of the licensee documents. The staff and MTS also reviewed the licensee's answers to the NRC staff's and MTS's questions as part of the audit process. The objective of the evaluation was to assess whether the proposed mitigation strategies conformed to the guidance in NEI 12-06, as endorsed by the positions stated in JLD-ISG-2012-01, or an acceptable alternative had been proposed that would satisfy the requirements of Order EA-12-049. The audit plan that describes the audit process was provided to all licensees in a letter dated August 29, 2013 from Jack R. Davis, Director, 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 (TE) in Section 3.0 documents the results of the MTS evaluation and audit results. Section 4.0 summarizes Confirmatory Items and Open Items that require further evaluation before a conclusion can be reached that the Integrated Plan is consistent with the guidance in NEI 12-06 or an acceptable alternative has been proposed that would satisfy the requirements of Order EA-12-049. For the purpose of this evaluation, the following definitions are used for Confirmatory Item and Open Item.

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

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

3.0 TECHNICAL EVALUATION

By letter dated February 28, 2013, (ADAMS Accession No. ML13064A274), and as supplemented by the first six-month status report in letter dated August 28, 2013 (ADAMS Accession No. ML13241A241), Exelon Generation Company, LLC (the licensee or Exelon) provided Clinton Power Station's (CPS) Integrated Plan for Compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by the licensee for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the NRC staff in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the Order.

3.1 EVALUATION OF EXTERNAL HAZARDS

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

3.1.1 Seismic Events.

NEI 12-06, Section 5.2 states:

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

On page 1, in the section of its Integrated Plan regarding determination of applicable extreme external hazards, the licensee referenced the Updated Final Safety Analysis Report (UFSAR) Section 3.7.1.1, which states that the seismic criteria for CPS includes two design basis earthquake spectra: Operating Basis Earthquake (OBE) and the Safe Shutdown Earthquake (SSE). The licensee reviewed UFSAR section 2.5.4.8 to perform a limited evaluation of the liquefaction potential outside the power block area for a safe shutdown earthquake (SSE) event. The licensee concluded that there are no liquefaction susceptible soils within the area of the principal structures for an SSE event with a maximum horizontal and vertical acceleration equal to 0.25 g. Therefore, the likelihood of liquefaction at the site is low. The licensee concluded that the Clinton site screens in for an assessment for seismic hazard except for soil liquefaction.

The licensee stated on page 4 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 seismic screening 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 17, 26, 33, and 43, in the sections of its Integrated Plan regarding the strategies for maintaining core cooling, maintaining containment, spent fuel cooling and for safety systems support, respectively, the licensee stated that portable equipment from seismic hazards in the transition phase (phase 2) will be stored in structures designed in accordance with the guidance of NEI 12-06 Section 11. Section 11 provides general storage design guidance but does not provide the details for protection from the seismic hazards as delineated in NEI 12-06, Section 5.3.1. Each section of the Integrated Plan describing storage protection from hazards makes reference to Section 11 rather than to the specific protection requirements described in NEI 12-06 for the applicable hazard. The licensee's proposed protection strategy is too generic for each hazard section. This is identified as Confirmatory Item 3.1.1.1.A in Section 4.2 below.

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

3.1.1.2 Deployment of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.2 states:

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

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

With regard to consideration 1 above, the topic of liquefaction has been previously addressed in this report and determined not to be a concern for Clinton Power Station (CPS) for the mitigation strategies.

With regard to consideration 2, the Integrated Plan did not provide sufficient information to conclude that for each mitigation strategy discussed, operators will have access through seismically robust structures to deploy the strategy. As an example, on page 27 of the Integrated Plan, the deployment plan describes using hoses to connect the FLEX alternate suppression pool cooling pump to the suppression pool and residual heat removal (RHR) heat exchanger connections. The plan presents insufficient information to demonstrate that the haul path from the hose storage location to the connection point will be through seismically robust areas. This issue is identified as Confirmatory Item 3.1.1.2.A in Section 4.2 below.

On page 40, in the Safety Functions Support section of its Integrated Plan, the licensee explained that provisions will be made for accessing the UHS should the downstream main dam fail during a seismic event. In this event, the surface of the lake could drop from approximately 690’ elevation to 675’ elevation. The licensee addressed this issue in the 6-month update by stating that the FLEX pumps will include a deployable booster pump to enable access to the UHS if the dam has failed. This strategy addresses consideration 3 above.

With regard to consideration 4, it was not evident from the review of the Integrated Plan whether or not electrical power will be necessary to move or to deploy mitigation strategies (e.g., to open the door from a storage location). If necessary, provisions will be required to provide appropriate power sources. This issue is identified as Confirmatory Item 3.1.1.2.B in Section 4.2 below.

On page 49 of the Integrated Plan, in the list of phase 2 equipment, the licensee identifies a "heavy duty truck" for the purpose of hauling equipment. The equipment is considered FLEX equipment by the licensee, and although not explicitly stated, it is assumed by the reviewer that the storage will be commensurate with that for other FLEX equipment, in conformance with consideration 5 listed above.

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

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

> There are four procedural interface considerations should be addressed.
>
> 1. Seismic studies have shown that even seismically qualified electrical equipment can be affected by beyond-design-basis seismic events. In order to address these considerations, each plant should compile a reference source for the plant operators that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (see Section 3.2.1.10). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance should include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power.
>
> 2. Consideration should be given to the impacts from large internal flooding sources that are not seismically robust and do not require ac power (e.g., gravity drainage from lake or cooling basins for non-safety-related cooling water systems).
>
> 3. For sites that use ac power to mitigate ground water in critical locations, a strategy to remove this water will be required.
>
> 4. Additional guidance may be required to address the deployment of equipment for those plants that could be impacted by failure of a not seismically robust downstream dam.

On pages 15, 17, 23, and 25, in the sections of the Integrated Plan describing key reactor parameters, there is no indication of whether the instruments listed are local or powered, and if powered, whether these instruments could be impacted by circumstances described in NEI 12-06, Section 5.3.3 Consideration 1, noted above. In addition, the plan did not include consideration of critical actions to perform until alternate indications can be connected nor did it address guidance to include instructions on how to control critical equipment without control power. During the audit process, the licensee addressed these issues by stating that instrument readouts required for mitigating strategies are located in the main control room and, with the exception of the suppression pool temperature, all instruments will remain powered throughout the event. Suppression pool temperatures are obtained by obtaining resistance readings in the control room in accordance with existing Station Blackout (SBO) procedures. NEI 12-06, Section 5.3.3, Consideration 1, however, specifies that a similar capability to obtain necessary instrument readings should be available for all seismically qualified electrical equipment without regard to whether the electrical power will be available because of the potential for seismic effects on the equipment itself. With regard to control and logic power, the power will remain available or will be restored utilizing the FLEX generator in all cases except for the suppression pool cleanup and transfer pumps. These pumps will require a strategy to provide control power to the pump motor supply breakers. The licensee stated that this additional strategy will be provided in a future 6-month update. There needs to be methods for obtaining necessary instrument readings and an additional strategy for the pump control power. This is identified as Confirmatory Item 3.1.1.3.A in Section 4.2 below.

With regard to NEI 12-06, Section 5.3.3 (2) and (3) noted above, the licensee's plans did not adequately address the procedural interface considerations for seismic hazards associated with large internal flooding sources that are not seismically robust and do not require ac power, or the use of ac power to mitigate ground water in critical locations. During the audit process, the licensee addressed these issues by stating that design features are incorporated into the Clinton plant to protect the structures from external flooding. The emergency core cooling system (ECCS) pump cubicles are protected from internal floods. Design features include water stops, water seal rings for penetrations and walls, and waterproof doors and hatches. Also, plant structures are designed to withstand the effects of groundwater. Although the licensee's response addressed the external flooding issues and the internal flooding issue for the ECCS pump cubicles, it is not clear that the internal flooding potential will not affect aspects of the mitigation strategies other than the ECCS pumps. This is identified as Confirmatory Item 3.1.1.3.B in Section 4.2 below.

NEI 12-06, Section 5.3.3 consideration (4) is addressed in Section 3.1.1.2 of this report by explaining the use of booster pumps if necessary when UHS water level is low.

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 procedural interfaces if these requirements are implemented as described.

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

On page 12, in the section of its Integrated Plan regarding the Regional Response Center Plan, the licensee describes the plan for use of offsite resources. The licensee has contractual agreements in place with the Strategic Alliance for FLEX Emergency Response (SAFER). The industry will establish two (2) Regional Response Centers (RRC) to support utilities during a BDBEE. Each RRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 24 hours from the initial request.

The review of the licensee's plans for the use of offsite resources determined that insufficient information was provided to demonstrate conformance with the guidance above. Specifically, no information was provided regarding the identification of the local arrival staging area or a description of the methods to be used to deliver the equipment to the site. During the audit process the licensee stated that information will be provided in a future 6-month update to address the issue. This is identified as Confirmatory Item 3.1.1.4.A in Section 4.2 below.

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

3.1.2 Flooding

NEI 12-06, Section 6.2 states:

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

NEI 12-06, Section 6.2.1 states in part:

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

On pages 1 and 2, in the section of the Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that the cooling lake is designed to withstand the effects of a probable maximum storm occurring over the entire drainage basin upstream of the dam site. Results of the hydrologic analyses discussed in UFSAR Sections 2.4.3 and 2.4.8 show that a probable maximum flood (PMF) runoff into the lake routed through the spillways will raise the lake water level to elevation 708.8 feet at the dam site. The backwater effect along the North Fork finger will raise the PMF water level at the station site to elevation 708.9 feet with wind effects raising that to a maximum of 713.8 ft. The station's

Seismic Category I structures at grade elevation of 736 feet will not be affected by the PMF design conditions. In addition, the circulating water screen house is designed to withstand the effects of a PMF through the following design features:

- Water stops provided in all construction joints up to the maximum flood level.
- Water seal rings provided for all penetrations in exterior walls below the maximum flood level.
- Watertight doors designed to withstand the hydrostatic head of the maximum flood level are provided for all doorways located on both the entrance walls and the internal walls of the Shutdown Service Water (SX) pump rooms which are below the maximum flood level.
- Hatches provided on the roof of the SX pump structure (elevation 730 feet) for access during PMF.

The licensee concludes that, in accordance with NEI 12-06 Section 6.2.1, Susceptibility to External Flooding, CPS screens in for an assessment for external flood hazard since the safety related components in the circulating water screen house below the PMF elevation are “kept dry" by the design features listed above.

While the licensee has identified the source of flooding as “a probable maximum storm,” the applicable flooding hazard is not characterized in terms of persistence. During the audit process, the licensee addressed this issue by stating that there are multiple access routes to the site, direct routes from the east, west and south, and rural roads independent of the direct routes. In addition, data provided in the USAR Section 2.4.2.1 indicates that the plant and access routes are, by design, well above any flooding level subject to a persistence flooding condition.

The licensee stated on page 4 that the flood 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 the flood hazard if these requirements are implemented as described.

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

> These considerations apply to the protection of FLEX equipment from external flood hazards:
>
> 1. The equipment should be stored in one or more of the following configurations:
>
>   a. Stored above the flood elevation from the most recent site flood analysis.

The evaluation to determine the elevation for storage should be informed by flood analysis applicable to the site from early site permits, combined license applications, and/or contiguous licensed sites.

b. Stored in a structure designed to protect the equipment from the flood.

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

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

On page 4, in the section of its Integrated Plan regarding key assumptions associated with implementation of FLEX strategies, the licensee explained that primary and secondary storage locations for FLEX equipment have not been selected. This is identified as Confirmatory Item 3.1.2.1.A in Section 4.2 below.

The Integrated Plan references NEI 12-06 Section 11 but not Section 6.2.3.1 for storage guidance regarding flood hazards. This is combined with Confirmatory Item 3.1.1.1.A in Section 4.2 below.

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

3.1.2.2 Deployment of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.2 states:

There are a number of considerations that 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 reactor coolant system (RCS), isolating accumulators, isolating reactor coolant pump (RCP) seal leak off, obtaining dewatering pumps, creating temporary flood barriers, etc. These factors can be credited in considering how the baseline capability is deployed.

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

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

4. Portable pumps and power supplies will require fuel that will 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 10, in the section of its Integrated Plan describing how strategies will be deployed in all modes, the licensee stated that transportation routes from the equipment storage area to the FLEX staging areas are not yet identified. In addition, the licensee stated that the identification of storage areas, and creation of the administrative program are self identified open items. Because the locations and deployment routing, and the administrative program are yet to be determined, the plan does not provide sufficient information to demonstrate that the guidance of NEI 12-06, Section 6.2.3.2 will be met regarding considerations related to storage locations (considerations 1, 2, 4, 6, and 8). This is identified as Confirmatory Item 3.1.2.2.A in Section 4.2 below.

Access to the UHS is discussed on page 40 of the Integrated Plan. The Plan calls for deploying a portable diesel driven pump to the UHS and it is understood by the reviewer that the actual point of water extraction can be determined based on circumstances. This addressed consideration 3 above.

In each section of the Integrated Plan, in the each safety function descriptions of "Deployment Conceptual Modifications", the licensee has provided a description of how the connection points for each proposed modification is protected from the hazards. These provisions have addressed consideration 5.

The Integrated Plan did not address the need to remove accumulated water from structures in the event that installed sump pumps are not available (consideration 7). This is identified as Confirmatory Item 3.1.2.2.B in Section 4.2 below.

As previously discussed, the licensee identifies a "heavy duty truck" for the purpose of hauling equipment. This addressed consideration 9 listed above.

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

3.1.2.3 Procedural Interfaces – Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

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

On page 10 in the section of the Integrated Plan describing how the strategies will be deployed in all modes, the licensee stated that an administrative program will be developed to ensure pathways remain clear or compensatory actions will be implemented to ensure all strategies can be deployed during all modes of operation. Because the administrative program and, procedures and plans are pending, the Integrated Plan does not provide reasonable assurance that all considerations of NEI 12-06, Section 6 will be met. This is identified as Confirmatory Item 3.1.2.3.A in Section 4.2 below.

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

3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

On page 12, in the section of its Integrated Plan regarding the RRC plan, the licensee discussed the provisions for offsite resources. Equipment will be moved from an RRC to a local assembly area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. However, the licensee does not identify a local staging area or provide a description of the methods to deliver the equipment to the site. The licensee's Integrated Plan does not provide sufficient information to determine the strategy will conform to the guidance in NEI 12-06, Section 6.2.3.4 due to the absence of identification of the local staging area and a description of the methods to be used to deliver the equipment to the site. This is combined with Confirmatory Item 3.1.1.4.A in Section 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 off site resources if these requirements are implemented as described.

3.1.3 High Winds

NEI 12-06, Section 7, provides the NRC-endorsed screening process for evaluation of high wind hazards. This screening process considers the hazard due to hurricanes and tornadoes.

The 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, in the section of its Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that CPS is located at 40° 10' 19.5" North latitude and 88° 50' 3" West longitude. NEI 12-06 Figure 7-2, Recommended Tornado

Design Wind Speeds for the 10^{-6}/year Probability Level indicates Clinton is in Region 1, which corresponds to a recommended tornado design wind speed of 200 mph. Therefore, CPS screens in for an assessment for high winds and tornados, including missiles produced by these events. Although the licensee did not address the impact of a hurricane in the Integrated Plan CPS is beyond the range of high winds from a hurricane per NEI 12-06 Figure 7-1. The reviewer concluded that a hurricane hazard is not applicable and need not be addressed.

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

3.1.3.1 Protection of FLEX Equipment - High Wind Hazard

NEI 12-06, Section 7.3.1 states:

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

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

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

On pages 18, 26, 33, and 43, in the sections of its Integrated Plan regarding the strategies for maintaining core cooling, maintaining containment, spent fuel pool cooling, and safety function support, respectively, the licensee stated that protection of associated portable equipment from hazards from severe storms with high winds will be provided in structures designed in accordance with the guidance of NEI 12-06 Section 11. The Integrated Plan references NEI 12-06 Section 11 but not Section 6.2.3.1 for storage guidance regarding high winds. This is combined with Confirmatory Item 3.1.1.1.A in Section 4.1 below.

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

3.1.3.2 Deployment of FLEX Equipment – High Wind Hazard

NEI 12-06, Section 7.3.2 states:

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

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

in considering how the baseline capability is deployed.

2. The ultimate heat sink may be one of the first functions affected by a hurricane due to debris and storm surge considerations. Consequently, the evaluation should address the effects of ELAP/LUHS, along with any other equipment that will 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.

As previously addressed in this report, CPS is not subject to hurricane hazards and, therefore, need not address consideration 1, 2 and 5 above.

On page 49, in the section of its Integrated Plan describing response equipment and commodities necessary in phase 2, the licensee listed a heavy duty truck capable hauling equipment and debris removal. That strategy has addressed considerations 3, 4 and 5 above.

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

3.1.3.3 Procedural Interfaces – High Wind Hazard

NEI 12-06, Section 7.3.3, states:

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

On page 8 in the section of the Integrated Plan describing how the strategies will be deployed in all modes, the licensee stated that an administrative program will be developed to ensure pathways remain clear or compensatory actions will be implemented to ensure all strategies can be deployed during all modes of operation. Because the administrative program and procedures and plans are pending, the Integrated Plan does not provide reasonable assurance that the guidance of NEI 12-06 will be met. This is combined with Confirmatory Item 3.1.2.3.A in Section 4.2 below.

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

3.1.3.4 Considerations in Using Offsite Resources – High wind hazard

NEI 12-06, Section 7.3.4 states:

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

On page 12, in the section of its Integrated Plan regarding the RRC plan, the licensee discussed the provisions for off site resources. Equipment will be moved from an RRC to a local assembly area established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. However, the licensee does not identify a local staging area or provide a description of the methods to deliver the equipment to the site. The licensee's Integrated Plan does not provide sufficient information to determine the strategy will conform to the guidance in NEI 12-06, Section 6.2.3.4. This is combined with Confirmatory Item 3.1.1.4.A in Section 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 offsite resources if these requirements are implemented as described.

3.1.4 Snow, Ice and Extreme Cold

As discussed in NEI 12-06, Section 8.2.1:

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

On page 2 in the section of its Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that the Clinton site is located at 40° 10' 19.5" North and 88° 50' 3" West. In addition, CPS is located within the region characterized by EPRI as ice severity level 5 (NEI 12-06, Figure 8-2, Maximum Ice Storm Severity Maps). Consequently, CPS is subject to severe icing conditions that could also cause catastrophic destruction to electrical transmission lines. The licensee concludes that CPS screens in for an assessment for snow, ice, and extreme cold 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 if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.1 states:

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

On page 18, 26, 34, and 43, in the sections of its Integrated Plan regarding the strategies for maintaining core cooling, containment, spent fuel cooling, and safety function support, respectively, the licensee stated that protection of associated portable equipment from hazards from snow, ice, and extreme cold will be in structures designed in accordance with the guidance of NEI 12-06 Section 11. The Integrated Plan did not reference Section 8.3.1 for specific storage guidance regarding snow, ice and extreme cold. This is combined with Confirmatory Item 3.1.1.1.A in Section 4.1 below.

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

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

NEI 12-06, Section 8.3.2 states:

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

On page 11, in the section of its Integrated Plan describing programmatic controls to support strategies, the licensee states that FLEX equipment will be procured in accordance with NEI 12-06 Section 11. Section 11 states that equipment capacities should ensure that strategies can be effective over a range of plant and environmental conditions. However the licensee does not address the effects of snow, ice, and extreme cold on the ability of plant personnel to perform manual operations, if necessary. This is identified as Confirmatory Item 3.1.4.2.A.

The licensee's strategy includes the use of a "heavy duty truck" for debris removal and equipment hauling. However, the licensee does not discuss whether the truck is capable of or equipped for snow and ice removal. The licensee does not provide sufficient information in their Integrated Plan to determine if the licensee will conform to guidance in NEI 12-06 Section 8.3.2, Consideration 2. This is identified as Confirmatory Item 3.1.4.2.B in Section 4.2 below.

The licensee does not provide information in the Integrated Plan that address NEI 12-06, Section 8.3.2, Consideration 3, regarding ice blockage or frazil ice. This is identified as Open Item 3.1.4.2.C in Section 4.1 below.

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

3.1.4.3 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 transporting the FLEX equipment.

> This includes both access to the transport path, e.g., snow removal, and appropriately equipped vehicles for moving the equipment.

As discussed in Section 3.1.4.2, the licensee has not provided sufficient information with regard to clearing pathways to demonstrate that its plans adequately address the effects of snow and ice on transporting the equipment. This is combined with Confirmatory Item 3.1.4.2.B in Section 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 procedural interfaces if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.4, states:

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

On page 12 in the section of its Integrated Plan regarding the RRC plan, the licensee identified that CPS has contractual agreements in place with the Strategic Alliance for FLEX Emergency Response (SAFER) for the delivery of offsite resources. However, the licensee has not identified local staging areas or developed methods for delivery of the equipment to the site. The licensee does not provide sufficient information in the Integrated Plan to determine that the licensee The licensee does not provide sufficient information in the Integrated Plan to determine that the licensee will conform with NEI 12-06, Section 8.3.4 This is combined with previous Confirmatory Item 3.1.1.4.A in Section 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 off site resources if these requirements are implemented as described.

3.1.5 High Temperatures

NEI 12-06, Section 9 states:

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

On page 3, in the section of its Integrated Plan regarding the determination of applicable extreme external hazards, the licensee stated that, as per NEI 12-06 section 9.2, all sites are required to consider the impact of extreme high temperatures. Central Illinois summers are warm and humid, with periods of extremely hot weather over 100°F. The Clinton site screens in for an assessment for extreme 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 screening if these requirements are implemented as described.

3.1.5.1 Protection of FLEX Equipment – High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

As discussed in previous sections of this report, the licensee's Integrated Plan committed to provide protection of FLEX equipment in structures constructed to meet the guidance of NEI 12-06 Section 11. The Plan does not address storage guidance for high temperature hazards in accordance with Section 9.3.1 noted above. This is combined with Confirmatory Item 3.1.1.1.A in Section 4.1 below.

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

3.1.5.2 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.

There was insufficient information provided in the Integrated Plan to demonstrate that the guidance for deployment noted above was addressed. During the audit process, the licensee addressed these issues by stating that storage building proposals include meeting the guidance to provide ventilation, and that they will meet the guidance specified in NEI 12-06. With regard to manual operations required by operators, the licensee stated that strategies do not require extreme exertion outdoors or in storage buildings on the part of the operators. Only final connection and startup procedures need to be performed.

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

3.1.5.3 Procedural Interfaces - High Temperature Hazard

NEI 12-06, Section 9.3.3 states:

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

On page 18, 26, 34, and 43, in the section of its Integrated Plan regarding the strategies for maintaining core cooling, containment, spent fuel pool cooling, and safety function support, respectively, the licensee stated that procedures and programs will be developed to protect portable equipment from external hazards and will include procedures and programs to address requirements for storage structures, for haul path requirements and for 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 procedures if these requirements are implemented as described.

3.2 PHASED APPROACH

Attachment (2) to Order EA-12-049 describes the three-phase approach required for mitigating beyond-design-basis external events in order to maintain or restore core cooling, containment and spent fuel pool cooling capabilities. The phases consist of initial phase using installed equipment and resources, followed by a transition phase using portable onsite equipment and consumables and a final phase (phase 3) using offsite resources.

To meet these EA-12-049 requirements, Licensees will establish a baseline coping capability to prevent fuel damage in the reactor core or spent fuel pool and to maintain containment capabilities in the context of a beyond-design-basis external event that results in the loss of all ac power, with the exception of buses supplied by safety-related batteries through inverters, and loss of normal access to the UHS. As described in NEI 12-06, Section 1.3, "[p]lant-specific analyses will determine the duration of each phase." This baseline coping capability is supplemented by the ability to use portable pumps to provide RPV/RCS/SG makeup in order to restore core or spent fuel pool capabilities as described in NEI 12-06, Section 3.2.2, consideration (13). This approach is endorsed in NEI 12-06, Section 3, by JLD-ISG-2012-01.

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

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

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 2.1, strategies that have a time constraint to be successful should be identified and a basis provided that the time can be reasonably met. NEI 12-06, Section 3 provides the performance attributes, general criteria, and baseline assumptions to be used in developing the technical basis for the time constraints. Since the event is a beyond-design-basis event, the analysis used to provide the technical basis for time constraints for the mitigation strategies may use nominal initial values (without uncertainties) for plant parameters, and best-estimate physics data. All equipment used for consequence mitigation may 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) the performance attributes as discussed in Appendix C.

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

3.2.1.1 Computer Code Used for ELAP Analysis

NEI 12-06, Section 1.3 states:

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

The licensee has provided a Sequence of Events (SOE) in their Integrated Plan, which included the time constraints and the technical basis for the site. That SOE is based on an analysis using the industry-developed Modular Accident Analysis Program (MAAP) Version 4 computer code. MAAP4 was written to simulate the response of both current and advanced light water reactors to LOCA and non-LOCA transients for probabilistic risk analyses as well as severe accident sequences. The code has been used to evaluate a wide range of severe accident phenomena, such as hydrogen generation and combustion, steam formation, and containment heating and pressurization.

The licensee has decided to use the MAAP4 computer code for simulating the Extended Loss of ac Power (ELAP) event. While the NRC staff does acknowledge that MAAP4 has been used many times over the years and in a variety of forums for severe and beyond design basis analysis, MAAP4 is not an NRC-approved code, and the NRC staff has not examined its technical adequacy for performing thermal-hydraulic analyses. Therefore, during the review of licensees' Integrated Plans, the issue of using MAAP4 was raised as a generic concern and was addressed by the Nuclear Energy Institute (NEI) in their position paper dated June 2013, entitled "Use of Modular Accident Analysis Program (MAAP4) in Support of Post-Fukushima Applications" (ADAMS Accession No. ML13190A201). After review of this position paper, the

NRC staff endorsed a resolution through letter dated October 3, 2013 (ADAMS Accession No. ML13275A318). This endorsement contained five limitations on the MAAP4 computer code's use for simulating the ELAP event for Boiling Water Reactors (BWRs). Those limitations and their corresponding Confirmatory Item numbers for this TER are provided as follows:

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

(2) The collapsed level must remain above Top of Active Fuel (TAF) and the cool down rate must be within technical specification limits. (This is Confirmatory Item 3.2.1.1.B)

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

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

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

    (This is Confirmatory Item 3.2.1.1.D)

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

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

3.2.1.2 Recirculation Pump Seal Leakage Models

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

On page 7 of 230 in Section 3.1 of reference document CL-MISC-009 Revision 1, “MAAP4 Analysis to Support FLEX Initial Strategy,” it is stated that “RCS leakage is 100 gpm (RR seals) conservatively assumed to begin at T=0. The leakage is modeled as a hole of fixed size that yields 100 gpm leakage at 1000 psig of RPV pressure. At lower RPV pressure, the flow rate will decrease. This is a conservative representation.”

No justification for the assumptions made regarding the leakage rate of 100 gpm was provided in the Integrated Plan. Also, additional details are needed on the assumed pressure-dependence of the leakage rate. In addition, further clarification is needed on whether the leakage was determined or assumed to be single-phase liquid, two-phase mixture, or steam at the donor cell, and discuss how mixing of the leakage flow with the drywell atmosphere is modeled. The licensee addressed these issues in a response to the audit process. The licensee stated that the 100 gpm primary coolant leakage is consistent with existing Clinton SBO licensing basis. The RCS leakage is calculated by MAAP4 based on dynamic upstream and downstream conditions. The licensee further stated that RCS leakage (at the junction donor cell, upstream mode) would be single phase liquid. Also, the Clinton MAAP4 model assumes a single node drywell.

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 recirculation pump seal leakage models if these requirements are implemented as described.

3.2.1.3 Sequence of Events

NEI 12-06 makes reference to an event timeline and time constraints in several sections of the document, for example Sections 1.3, Section 3.2.1.7 principle (4), Section 3.2.2 guideline (1) and Section 12.1.

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

> Each site should establish the minimum coping capabilities consistent with unit-specific evaluation of the potential impacts and responses to an ELAP and LUHS. In general, this coping can be thought of as occurring in three phases:
>
> - Phase 1: Cope relying on installed plant equipment.
> - Phase 2: Transition from installed plant equipment to on-site FLEX equipment.
> - Phase 3: Obtain additional capability and redundancy from off-site equipment until power, water, and coolant injection systems are restored or commissioned.
>
> In order to support the objective of an indefinite coping capability, each plant will be expected to establish capabilities consistent with Table 3-1 (BWRs) . Additional explanation of these functions and capabilities are provided in Appendices C.

In response to the need to identify expected time constraints, the license's Integrated Plan for Clinton includes a discussion of time constraints on pages 5 through 9 and a Sequence of Events Timeline, Attachment 1A, on pages 52 and 53. The licensee stated on page 5 of the Integrated Plan in the section on sequence of events, that the times to complete actions in the events timeline are based on operating judgment, the conceptual designs, and the current supporting analyses. The licensee further stated that final timeline will be time validated once detailed designs are completed and procedures are developed. And finally, the licensee confirmed this intention in the August 2013 6-month update and stated that the results will be provided in a future 6-month update.

Based on the foregoing statements, the information in the Sequence of Events Timeline on pages 52 and 53 is tentative. Insufficient information is presently available to demonstrate that the time constraints for implementing coping strategies for core cooling and maintaining containment are satisfied. This is identified as Confirmatory Item 3.2.1.3.A in Section 4.2 below.

On page 16 of the Integrated Plan, the licensee stated that in order to accomplish low pressure RPV makeup when RCIC is no longer available, external water connections will be hard-piped to a location that supports connection to the modified low pressure core spray (LPCS) or alternatively, to the residual heat removal (RHR) C injection header. Portable diesel driven pumps will be utilized to provide this secondary low pressure supply. Although the plan indicates that portable diesel driven pumps will be used when RCIC is no longer available, there is no event on the timeline for staging the portable FLEX pumps for this use. This issue will need to be addressed in the final timeline and is combined with Confirmatory Item 3.2.1.3.A above.

On page 53 of the Integrated Plan, Attachment 1A, Sequence of Events Timeline, the licensee stated in Item 21, that supplemental main control room (MCR) ventilation per CPS 4200.01C001, MCR Cooling During a SBO, would be initiated. However, in the "Remarks" column of that item, and on Page 41, the licensee refers to submitting a strategy and support analysis in a future update to provide for maintaining main control room temperature. This issue will be discussed in detail later in this report in Section 3.2.4.6 regarding personnel habitability.

On page 52 of the Integrated Plan, Attachment 1A, Sequence of Events Timeline, the licensee stated in Item 1 that the RCIC pump has started. On page 53 of the plan, Item 28, hour 24-72 hours, the licensee stated that critical functions will be maintained using RCIC. Successful continued use of the RCIC pumps is dependent on adequate cooling of the RCIC pump room. This issue will be discussed in detail later in this report in Section 3.2.4.2 regarding equipment cooling.

On pages 13, 22, 30 and 38 of its Integrated Plan, the submittal includes the following footnote:

> Coping modifications consist of modifications installed to increase initial coping time, i.e., generators to preserve vital instruments or increase operating time on battery powered equipment.

It was not clear what is meant by 'initial' coping time nor what, if any, modifications would be installed to increase the initial coping time. During the audit process, the licensee addressed this concern by stating that the initial coping time in the Clinton strategy is the time the Division 1 battery is supplying power for RCIC, safety relief valves (SRVs) and vital instrumentation. No modifications are planned to extend the initial coping time.

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 described.

3.2.1.4 Systems and Components for Consequence Mitigation

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

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

And,

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

NEI 12-06, Section 3.2.1.12 states:

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

On page 14 of the Integrated Plan regarding maintaining core cooling, phase 1, the licensee stated that during phase 1, RPV makeup is provided from RCIC with suction from the suppression pool, and that RPV pressure control is provided by the SRVs.

The RCIC suction is normally aligned to the RCIC Storage Tank (RCICST) and would switch over to the suppression pool (SP) when RCICST is not available. It was not clear from the information presented in the plan that the RCICST is qualified for all potential ELAP events. If not, and ELAP conditions significantly damage RCICST, the switchover instrumentation would need to remain operational and maintain RCIC injection to RPV without interruption. Additional information was needed to address this potential scenario and should include whether switch-over function is automatic, fail-safe, and whether function logic and hardware, related piping, valves, systems, structures, and components (SSCs), and RCICST water level instrumentations to support the switchover function are of safety grade and are qualified for all potential ELAP events including seismic, tornado/high winds and flooding. If not, information is needed to justify how switchover from RCICST to SP will be assured in ELAP conditions if the RCICST is not available.

During the audit process, the licensee addressed these issues as follows: The RCIC storage tank is not qualified to all potential ELAP events. At the minimum storage tank level, an automatic, safety grade switchover to a seismic Category I supply (i.e., the suppression pool) will occur to maximize the utilization of the RCIC injection source. The instrumentation required to transfer the RCIC pump suction from the RCIC storage tank to the suppression pool is redundant and safety grade. The RCIC storage tank level instrumentation is seismically qualified and is not routed through nonseismic areas. In addition, the level transmitters, sensing lines, and process taps are physically located in the fuel building to protect against instrument line freezing. The RCIC storage tank level instrumentation and logic are powered from Division 1 Nuclear System Protection System (NSPS) power supply system. NSPS is designed to provide adequate uninterrupted power to all the NSPS loads during all modes of operation including abnormal and accident conditions. The valves involved in the switchover are supplied from the Division 1 class 1E direct current (dc) power system that supplies 125-VDC power to unit Class 1E loads. The system includes batteries, battery chargers, motor control centers, and dc distribution panels. The RCIC piping and components located outside the Containment building are protected from the externally generated missiles by Seismic Category I structures including room walls.

On pages 16 of the Integrated Plan regarding portable equipment to maintain core cooling, phase 2, the licensee describes the configuration where low pressure RPV makeup is provided when RCIC is no longer available. That configuration includes portable FLEX pumps, external water connections, piping modifications and the use of fire hose. Insufficient technical information is presented or referenced in the plan to confirm the ability of the portable FLEX pumps to deliver the required flow through the system of flex hoses, couplings, valves, elevation changes, etc. for this strategy. The licensee stated in a note on page 19 that the engineering designs for compliance with NRC Order EA-12-049 are not finalized. The licensee further stated that analysis will be performed to validate that the plant modifications, selected equipment, and identified mitigating strategy can satisfy the safety function guidance of NEI 12-06. Because insufficient pump and flow technical data is presently available to demonstrate adequate head and flow will be provided for cooling strategies, there is no reasonable assurance that the plan will conform with the guidance of NEI 12-06, Section 11. This is identified as Confirmatory Item 3.2.1.4.A in Section 4.2, below.

Although the FLEX pumps will take suction from the ultimate heat sink, the Integrated Plan is silent regarding water quality. It was not evident that the plan has addressed the quality of this water (e.g., suspended solids especially during flood conditions) and the potential that its use could result in a restriction of coolant flow across the fuel assemblies to an extent that would inhibit adequate flow to the core. During the audit process, the licensee addressed this issue by stating that the primary sources for reactor cooling are RCIC and suppression pool cleanup and transfer pumps and both have suction strainers to limit solids from being injected into the reactor coolant system. The concerns related to raw water injection by FLEX strategies are being addressed by the BWROG and the resulting evaluation will be included in a future 6-month update. This is identified as Confirmatory Item 3.2.1.4.B in Section 4.2, below.

On pages 20, 28, 36, and 46 in the Integrated Plan sections on core cooling, maintaining containment, spent fuel pool cooling and safety function support, the licensee stated phase 1 and 2 strategies will provide sufficient capability that no additional phase 3 strategies are required. However, on those same pages, the licensee also stated that phase 3 equipment for Clinton would include backup portable pumps and generators and that the portable pumps will be capable of providing the necessary flow and pressure as outlined in phase 2. The licensee further stated that the portable generators will be capable of providing the necessary 480 volt power requirements for phase 2.

Because the plan makes reference to use of the phase 3 equipment as backup, the Integrated Plan should address the guidance of NEI 12-06, Section 12.1 noted above regarding site procedures for phase 3 implementation. During the audit process, the licensee addressed this issue by stating that strategies for the deployment of phase 3 equipment will be developed and incorporated into pre-planning guidance.

On page 24 of the Integrated Plan, the licensee stated that suppression pool water addition is required to maintain RCIC pump net positive suction head (NPSH). However, no technical details or discussions of existing conservatisms or margin were provided to conclude that the available NPSH will be sufficient. Insufficient information is provided to conclude that the NPSHA is sufficient to support continued operation of the RCIC pump throughout the time in the ELAP event in which the pump's operation is credited. During the audit process, the licensee addressed this concern by stating that the MAAP4 analysis predicts the worst case NPSH at 38.2 ft. is reached during a 30 minute interval prior to the RCIC suction being swapped to the RHR HX condensate outlet. This condition was then compared to the nominal required NPSH of 21 ft. and was verified to be acceptable.

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

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 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:
>
> - RPV Level
> - RPV Pressure
> - Containment Pressure
> - Suppression Pool Level
> - Suppression Pool Temperature
> - SFP Level
>
> The plant-specific evaluation may identify additional parameters that are needed in order to support key actions identified in the plant procedures/guidance or to indicate imminent or actual core damage

Although the Integrated Plan listed instrumentation credited for the coping strategies for maintaining core cooling and maintaining containment, the licensee did not indicate whether the installed instruments would need to be supplied from backup or temporary power sources in an ELAP event. Also, more information is needed to describe the instrumentation that will be used to monitor portable/FLEX electrical power equipment including their associated measurement tolerances/accuracy to ensure that: 1) the electrical equipment remains protected (from an electrical power standpoint – e.g., power fluctuations) and 2) the operator is provided with accurate information to maintain core cooling, containment, and spent fuel cooling. During the audit process, the licensee addressed the topic of power supplies for instrumentation by stating that the RPV and suppression pool level, and the RPV and containment pressure instruments, will be powered by the Division 1 inverter which is powered from the Division 1 batteries and charger. This power source will be maintained during ELAP conditions. The suppression pool, drywell, and primary containment temperature may be obtained manually in accordance with Station Blackout procedures. The licensee's response resolves the concern regarding instrumentation power supplies. However, the concern remains regarding the tolerances/accuracies of the instrumentation used to monitor portable/FLEX electrical power equipment. This is identified as Confirmatory Item 3.2.1.5.A in Section 4.2 below.

The potential loss of indication for key parameters due to seismic events and the need to address how critical equipment will be controlled was discussed in Section 3.1.1.3 of this report and has been previously identified as Confirmatory Item 3.1.1.3.A in Section 4.2 below.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, 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 Motive Power, Valve Controls and Motive Air System

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

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

And,

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

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

A motive air system discussed in the Integrated Plan is related to the operation of the safety relief valves (SRVs). On page 9 of the Integrated Plan in the section regarding maintaining containment, the licensee states that each SRV is provided with an air accumulator and that, additionally, nine (9) of the SRVs are capable of being supplied with actuating air from backup air bottles located in the Auxiliary Building. According to engineering documents referenced in the Integrated Plan, these bottles are designed to support 100 day post-LOCA actuation. The bottles and associated system components are safety related and this design feature is part of the station blackout plans. The licensee further stated that a FLEX air compressor will be staged to make up to the automatic depressurization system (ADS) backup air bottles, if required.

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

3.2.1.7 Cold Shutdown and Refueling

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

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

A review was made of the coping strategies discussed by the licensee on pages 10 and 11 of the Integrated Plan to maintain core cooling during an ELAP with LUHS that occurs when the reactor is in Cold Shutdown or Refueling.

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

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

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

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

3.2.1.8 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's strategy for all three functions, core cooling, maintaining containment, and spent fuel pool cooling, utilized a system of one pump piggy backed onto another pump into the Shutdown Service Water (SX) system (Reference Integrated Plan page 57, attachment Figure 2 - Mechanical Conceptual Sketch.) It was not clear how this one configuration will maintain all three functions. In addition, it was not clear if the currently unused SX piping will remain available in ELAP conditions. The licensee's audit response and the August 2013 6-month update addressed these issues, by stating that the cooling water will be supplied by a diesel driven pump pre-staged at the Unit 2 side of the circulating water screen house to enable access to the UHS. These FLEX pumps will have deployable booster pumps to enable access to the UHS if necessary to provide adequate NPSH to the main FLEX pumps. These pumps will be sized to accommodate all three functions; 2000 gpm to the RHR HX, 89 gpm to the suppression pool as needed, 100 gpm to the spent fuel pool, and 250 gpm for spent fuel pool spray. The unused portion of the SX piping is protected from all external hazards except flooding. Appropriately sized hoses will be available to use in the event of flooding.

The final design calculations required to support the pump flow and head requirements were discussed previously in this report and were previously identified as Confirmatory Item 3.2.1.4.A in Section 4.2 below.

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

3.2.2 Spent Fuel Pool Cooling Strategies

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

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

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

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

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

On page 31 of the Integrated Plan, the licensee concludes that in the worst case configuration, the time to boil in the Spent fuel Pool is 3.2 hours and 38.65 hours for water level to reach the top of active fuel. Using those assumptions, the licensee concludes that no phase 1 actions are required and their plan is to move directly to phase 2 strategies.

On page 32 of the Integrated Plan, the licensee explained that after the SFP reaches the boiling point, a source of makeup water will need to be provided to ensure the fuel in the SFP remains cool and radiological conditions on the fuel handling floor do not degrade. The seismically qualified emergency SFP makeup supply from the SX system will be used to supply cooling water to the SFP. Alternatively, a fire hose can be connected to the external water connection and routed up the fuel building east or west stairwell to the fuel handling floor, utilizing a nozzle restrained at the SFP handrail. By T_0+12 hours, the SX supply header will be pressurized from the external water connection, and if needed, a fire hose on the fuel handling floor will also be available as an alternate SFP makeup supply.

On page 32 of the Integrated Plan, the licensee stated that evaluation of the spent fuel pool area for steam and condensation had not yet been performed and when complete, the results and the vent path strategy, if needed, will be provided in a future 6-month update. Because the evaluation of the spent fuel pool area for steam and condensation has not yet been performed, insufficient information is available to demonstrate reasonable assurance that the plan will conform with NEI 12-06, Table C-3. This is identified as Open Item 3.2.2.A. in Section 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 spent fuel pool cooling if these requirements are implemented as described.

3.2.3 Containment Functions Strategies

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

Furthermore, Tables 3-1 and C-2 both include a Containment Integrity safety function for BWRs with Mark III containments. Specifically, the guidance of NEI 12-06 directs licensees with Mark III containments to re-power the permanently installed containment hydrogen igniters as a part of their strategy.

The licensee's primary strategy for removing heat from containment is to initially add cooler water to the suppression pool inventory and subsequently provide the necessary on-site support equipment to utilize the residual heat removal (RHR) heat exchangers. On page 24 of the Integrated Plan, the licensee explained that during phase 2, a pre-staged 480 vac generator will be lined up to repower the upper containment pool makeup to suppression pool valves. This action will drain water from the upper pools to the suppression pool which will extend the time before suppression pool cooling is required to avoid significant containment pressurization. The strategy for the suppression pool cooling pump configuration originally proposed in the Integrated Plan was modified in the 6-month update. The new configuration utilizes one of two installed plant suppression pool cleanup and transfer pumps, repowered by FLEX generators, to circulate suppression pool water through the shell side of a RHR heat exchanger using abandoned RHR steam condensing mode piping. Water from the external connections will supply the heat exchanger tube side.

There were two concerns identified for this new configuration. First, it is not clear how the abandoned RHR piping used will be returned to an operable status. The licensee addressed this concern during the audit process by stating that the plan to restore and maintain the RHR piping to operable status will be provided in a future 6-month update. This is identified as Confirmatory Item 3.2.3.A in Section 4.2 below.

The discussion provided for the phase 2 strategy describes using one of the suppression pool cleanup and transfer pumps as the primary pump for the suppression pool cooling function. This leaves the other available to provide a spare capability equivalent to what would be required for portable FLEX equipment pursuant to NEI 12-06. This is appropriate because the suppression pool cleanup and transfer pumps are not safety related, but are located in a seismic class I structure that would afford them reasonable protection against the relevant hazards. It is not clear from the licensee's Integrated Plan that current maintenance and testing for these pumps would conform to the standards for FLEX equipment because the pumps are not currently relied upon to mitigate accidents or transients or the consequences of a beyond-design-basis event. This concern is identified as Confirmatory Item 3.2.3.B in Section 4.2

below.

Although NEI 12-06, Table 3-1 indicates heat removal as one of the safety functions, the Integrated Plan appears to correlate containment integrity solely with ensuring containment pressure limits are not exceeded. This is evident by the fact that the essential containment instrumentation listed on page 25 of the Integrated Plan does not include a means for measuring containment temperature. In general, excessive temperatures could result in a loss of containment integrity due to the failure of containment penetration seals or other portions of the containment boundary. Furthermore, excessive temperatures may need to be monitored to ensure the qualification range of necessary measurement instruments located in the containment is not exceeded. During the audit process, the licensee addressed this issue by stating that the suppression pool, drywell, and primary containment temperature may be obtained manually in accordance with Station Blackout procedures. The licensee further stated that the containment strategy makes this information available but the data is not tied to any operator actions. The expected peak temperatures predicted by MAAP4 calculations are 185.06 degrees F for the air space of the wetwell and 253.8 degrees F for the drywell. The drywell temperature peak is well below the design limit of 330°F, but the wetwell air space peak temperature is marginally above the 185 degree limit. Because of the unresolved concerns related to the MAAP4 analyses, and because the licensee will need to address the potential for wetwell air space temperatures exceeding the 185 degree design limit, the concerns are identified as Confirmatory Item 3.2.3.C in Section 4.2 below.

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

3.2.4 Support Functions

3.2.4.1 Equipment Cooling - Cooling Water

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

> *Plant procedures/guidance should specify actions necessary to assure that equipment functionality can be maintained (including support systems or alternate method) in an ELAP/LUHS or can perform without ac power or normal access to the UHS.*
>
> Cooling functions provided by such systems as auxiliary building cooling water, service water, or component cooling water may normally be used in order for equipment to perform their function. It may be necessary to provide an alternate means for support systems that require ac power or normal access to the UHS, or provide a technical justification for continued functionality without the support system.

The licensee made no reference in the Integrated Plan regarding the need for, or use of, additional cooling systems necessary to assure that coping strategy functionality can be maintained. Nonetheless, the only coping strategy equipment identified in the Integrated Plan that would require some form of cooling are portable diesel powered pumps and generators. These self-contained commercially available units would not be expected to require an external cooling system nor would they require alternating current (ac) power or normal access to the 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 cooling water for equipment cooling if these requirements are implemented as described.

3.2.4.2 Ventilation - Equipment Cooling

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

> *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, HPCI and RCIC pump rooms, the control room, and logic cabinets. Air flow may be accomplished by opening doors to rooms and electronic and relay cabinets, and/or providing supplemental air flow.
>
> Air temperatures may be monitored during an ELAP/LUHS event through operator observation, portable instrumentation, or the use of locally mounted thermometers inside cabinets and in plant areas where cooling may be needed. Alternatively, procedures/guidance may direct the operator to take action to provide for alternate air flow in the event normal cooling is lost. Upon loss of these systems, or indication of temperatures outside the maximum normal range of values, the procedures/guidance should direct supplemental air flow be provided to the affected cabinet or area, and/or designate alternate means for monitoring system functions.
>
> For the limited cooling requirements of a cabinet containing power supplies for instrumentation, simply opening the back doors is effective. For larger cooling loads, such as HPCI, RCIC, and AFW pump rooms, portable engine-driven blowers may be considered during the transient to augment the natural circulation provided by opening doors. The necessary rate of air supply to these rooms may be estimated on the basis of rapidly turning over the room's air volume.
>
> Temperatures in the HPCI pump room and/or steam tunnel for a BWR may reach levels that isolate HPCI or RCIC steam lines. Supplemental air flow or the capability to override the isolation feature may be necessary at some plants. The procedures/guidance should identify the corrective action required, if necessary.

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

On pages 38 and 41, in the section of its Integrated Plan regarding phase 1 and 2 safety function support, the licensee discussed the battery room ventilation and potential for hydrogen buildup. The licensee stated that the battery room doors will be blocked open when battery charging commences to minimize the potential for an explosive concentration to build up inside the rooms. The licensee further stated that battery room conditions will be evaluated and a strategy developed to maintain acceptable conditions. The information provided regarding battery room ventilation did not address potential temperature increases/decreases on the station batteries due to loss of battery ventilation resulting from an ELAP. A discussion is also needed on hydrogen limits in battery room while charging the batteries during Phase 2 and 3. During the audit process, the licensee process confirmed that battery room ventilation information will be provided in a future 6-month update. This is identified as Confirmatory Item 3.2.4.2.A in Section 4.2 below.

Also on page 38, the licensee proposed the use of a portable fan during phase 1 to provide Main Control Room ventilation. It was not clear how power was to be provided to the fan in phase 1. During the audit process, the licensee addressed this issue by stating that the SBO main control room cooling fan is gasoline powered. The licensee further stated on page 41 regarding phase 2 main control room cooling that further analysis is needed to develop strategies. These strategies and supporting analysis are to be provided in a future 6-month update. This is identified as Confirmatory Item 3.2.4.2.B in Section 4.2 below.

On page 41, in the section of the integrated report regarding safety function support, the licensee discussed the RCIC room ventilation. The licensee stated that the RCIC pump room will reach 145°F within 42 hours if no action is taken. To improve conditions in the pump room for equipment protection and personnel access, the doors between the pump room and the access aisle will be opened and a portable blower will inject air into the room. The security door between the auxiliary and turbine building basement will be opened to provide a source of air for the blower. Analysis results demonstrate that with these actions taken, the temperature in the room will remain below 145°F.

The Integrated Plan relies on S&L Calculation 2013-01301, Revision 1, 11332-295, Transient Analysis of RCIC Pump Room for Extended Loss of A-C Power, to develop compensatory actions to ventilate the RCIC Pump Room. A review of this calculation document confirmed that the analysis was conducted by and the results were approved by Sargent & Lundy. The study assumed initial and ongoing heat loads consistent with design requirements and the results were accurately reflected in the Integrated Plan.

On page 41, in the section of its Integrated Plan regarding safety function support, phase 2, the licensee stated that inverter room conditions will be evaluated and a strategy will be developed to maintain acceptable conditions. The strategy and associated support analyses will be submitted in a future 6-month update. This is identified as Confirmatory Item 3.2.4.2.C in

Section 4.2 below.

In general, the discussion of ventilation in the submittal provides insufficient information on the impact of elevated temperatures, as a result of loss of ventilation and/or cooling, on the support equipment being credited as part of the ELAP strategies (e.g., electrical equipment in the RCIC pump rooms). As an example, there is no discussion regarding whether the initial temperature condition assumed the worst-case outside temperature with the plant operating at full power. No list was provided or referenced of electrical components located in the pump rooms that are necessary to ensure successful operation of required pumps. Also, no information was provided regarding the qualification level for temperature and pressure for these electrical components for the duration that the pumps are assumed to perform its mitigating strategies function. During the audit process, the licensee explained that these issues will be addressed by providing information in a 6-month update. These issues are identified as Confirmatory Item 3.2.4.2.D in Section 4.2 below.

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

3.2.4.3 Heat Tracing

NEI 12-06, Section 3.2.2, Guideline (12) provides that:

> *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.

It was not clear from the information provided in the Integrated Plan whether or not freezing of piping or instrument lines have been addressed. During the audit process, the licensee addressed this issue by stating that Clinton has identified no potential for freezing of piping or instrument lines required or 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 heat tracing if these requirements are implemented as described.

3.2.4.4 Accessibility - Lighting and Communications

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

> *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.

The NRC staff has reviewed the licensee communications assessment (ML12306A199 and ML13056A135) in response to the March 12, 2012 50.54(f) request for information letter for CPS and, as documented in the staff analysis (ML13114A067) 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. This has been identified as Confirmatory Item 3.2.4.4.A in Section 4.2 below for confirmation that upgrades to the site's communications systems have been completed.

The licensee's plans for the development of guidance and strategies with regard to the provision of portable lighting devices provided insufficient information to demonstrate there is reasonable assurance that the guidance and strategies developed will conform to the guidance of NEI 12-06 above. During the audit process, the licensee addressed this issue by stating that the FLEX electrical strategy provides power to standby lighting panels and by stating that temporary lighting will be available using light stands, light strings and extension cords, and flashlights and headlamps. In addition, the FLEX guidance procedures will address this strategy.

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

3.2.4.5 Protected and Internal Locked Areas

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

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

The licensee's Integrated Plan provided insufficient information regarding the development of guidance and strategies with regard to the access to the protected area and internal locked areas. During the audit process, the licensee included a description of the approach for the security force to respond to conditions presented by a beyond-design-basis event. The approach includes coordination of security assets with the operations shift manager and emergency director, and additional security staffing if deemed necessary by a formal evaluation of event requirements.

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 areas if these requirements are implemented as described.

3.2.4.6 Personnel Habitability - Elevated Temperature

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

> *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.

On page 41 of the Integrated Plan, in the section describing safety function support for phase 2, the licensee stated that the RCIC pump room will reach 145°F within 42 hours if no action is taken. To improve conditions in the pump room for equipment protection and personnel access, the doors between the pump room and the access aisle will be opened and a portable blower will inject air into the room. The security door between the Auxiliary and Turbine Building basement will be opened to provide a source of air for the blower. With these actions taken, the temperature in the room will remain below 145°F.

The actions described above are designed to maintain the RCIC Room "below 145° F." Temperatures in that range would require industrial safety procedures and equipment to prevent adverse impacts on personnel due to heat stress. However, there is no discussion in the Integrated Plan regarding procedures or protective clothing to protect operators or any discussion on the extent of potential operator stay times in these locations. During the audit process, the licensee process addressed this issue by stating that strategies provide for remote operation of RCIC. The only planned entry into the RCIC pump room would be to implement a forced ventilation strategy and that industrial safety equipment is available if necessary for personnel protection against high temperature environments.

On page 41 of the Integrated Plan, in the section describing safety function support for phase 2, the licensee stated that habitability conditions will be evaluated and a strategy will be developed to maintain main control room habitability. Because the strategies are not yet developed, this is identified as Confirmatory Item 3.2.4.6.A in Section 4.2 below.

Also on page 41 of the Integrated Plan, in the section describing safety function support for phase 2, the licensee stated that, regarding habitability, the evaluation of the spent fuel pool area for steam and condensation has not yet been performed. The licensee further stated that the need for further analysis of fuel building conditions during an ELAP/LUHS and mitigating actions is a self-identified open item and closure of this item will be documented in a future 6-month update. This concern has been previously discussed in this report and is combined with Confirmatory Item 3.2.2.A in Section 4.2 below.

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

3.2.4.7 Water Sources

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

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

> using available equipment (e.g., a diesel driven fire pump or a portable pump drawing from a raw water source). Procedures/guidance should clearly specify the conditions when the operator is expected to resort to increasingly impure water sources.

The licensee has addressed water sources for coping strategies on pages 16, 24, 32, and 40 of the Integrated Plan, where reference is made to portable pumps taking suction from the ultimate heat sink. On page 40, the licensee stated that a portable diesel driven pump will be able to be deployed to the Ultimate Heat Sink (UHS) at the Circulating Water Screen House *(*699' elevation).

However, on page 1, the licensee stated that flooding analyses predicted that high water levels and wind and wave runup would result in a maximum water level to the 713.8 foot elevation. The information presented in the Integrated Plan indicates that the deployment site for the portable pump at 699 ft. elevation would not be protected from the flooding hazard water level of 713.8 ft. elevation. During the audit process, the licensee addressed this issue by providing additional information regarding the deployment of the FLEX pumps. Procedures will be revised to provide direction to maintain ELAP capability in the event of rising lake levels. The FLEX pumps will be staged at the 699 ft. elevation to allow for prompt deployment but, in the event of flooding, the pumps will be moved from the 699 ft. storage location and positioned on the screen house access road to keep ahead of rising water.

Also, another issue regarding FLEX water sources was previously discussed in Section 3.1.4.2 with regard to ice and frazil ice blocking water flow in the Ultimate Heat Sink. This was previously identified as Open Item 3.1.4.2.C in Section 4.1 below.

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

3.2.4.8 Electrical Power Sources, Isolations and Interactions.

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

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

On page 40 of its Integrated Plan, in the section discussing phase 2 safety function support, the licensee described the provisions for electrical power. The licensee stated that key portions of the Division 1, Division 2, and non-divisional 480 VAC distribution system will be able to be re-energized from a pre-staged primary FLEX generator or a portable alternate FLEX generator. The primary FLEX generator and switchgear will be permanently housed in the Unit 2 side of the Control and Diesel Generator buildings and the connecting cabling will be pre-routed from the vicinity of the primary FLEX switchgear to the vicinity of the Division 1 480 VAC unit substations which will have connection points for an external source of power. The alternate (N+1) portable FLEX generator will able to be deployed to an external electrical connection point. On page 6 of the six month update, dated August 28, 2013 (ML13241A241), the licensee states that they are proposing to pre-stage both the primary and alternate FLEX generator in the Unit 2 side of the Control/Diesel Generator building. This appears to be an alternative approach for satisfying the Mitigating Strategies Order. Insufficient information has been provided by the licensee in order to determine whether this provides an equivalent level of protection as would be provided through conformance with NEI 12-06. Therefore, this is identified as Open Item 3.2.4.8.A in Section 4.1 below.

There was insufficient information provided in the plan regarding electrical isolations and interactions. It was not clear how the portable/FLEX diesel generators and the Class 1E diesel generators would be isolated to prevent simultaneously supplying power to the same Class 1E bus. During the audit process, the licensee addressed this issue by stating that power leads from the FLEX generator will not be connected to the Class 1E electrical equipment during normal operation. When FLEX power is connected to the unit substations during an ELAP, the main supply breakers will be opened per the associated FLEX guidance procedures. This will prevent unintentional powering of the bus from multiple sources.

On page 50, in the Integrated Plan, the submittal includes a table that lists additional equipment, "Medium Voltage and Low Voltage Diesel Generators", for phase 3; however, this equipment is not discussed in the body of the Integrated Plan. Furthermore, the licensee noted in the plan that additional phase 3 equipment is not needed beyond phase 2. It is not clear from the information presented in the plan regarding a) when and how the "Medium Voltage and Low Voltage Diesel Generators" identified in the table would be used, and what loads would be served, or b) what generating capacity would be provided. During the audit process, the licensee provided a discussion on this issue and explained that the strategies for the deployment of phase 3 equipment will be developed and incorporated into pre-planned guidance. The guidance will provide flexible and diverse direction for the acquisition, deployment, connection, and operation of the equipment. Because the guidance is pending, this is identified as Confirmatory Item 3.2.4.8.B in Section 4.2 below.

The Integrated Plan does not provide information or references regarding sizing calculations for the FLEX generators to demonstrate they can adequately provide power to the assumed loads. The licensee's response addressed this issue by stating that the FLEX generator sizing calculations will be submitted in a future 6-month update. This is identified as Confirmatory Item 3.2.4.8.C in Section 4.2 below.

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

3.2.4.9 Portable Equipment Fuel

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

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

NEI 12-06, Section 3.2.1.3, consideration (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 41, in the section of its Integrated Plan regarding phase 2 of the safety function support, the licensee stated that fuel oil to diesel driven pumps and generators will be supplied by the quantity of fuel in the tanks located on the skids of the portable equipment and by fuel tanks contained on the back of the FLEX truck. When required, fuel oil will be obtained from the Division 1, or alternatively the Division 2 DG fuel oil storage tank. The 480 VAC FLEX generator will supply power to the DG fuel oil transfer pump that will provide the DG day tank with a continuous supply of fuel oil. The DG day tank drain line will be used to supply a portable 120 VAC pump via a flexible hose connected to the drain line.

It was not clear from the description provided in the plan whether or not the Division 1 and Division 2 DG fuel oil storage tanks are protected from all hazards of NEI 12-06 Sections 4 through 9. In addition, it was not clear regarding tank volume, supply pathway and fuel quality that the fuel oil supply is sufficient to support the strategies. And finally, it was not clear how fuel oil will be provided to the site to meet the NEI 12-06 objective for "indefinite coping capabilities (NEI 12-06, Section 1.3). During the audit process, the licensee addressed these issues by providing a discussion as follows: The station diesel generator fuel tanks are installed in seismic category 1 structures and protected from all of the external hazards. The Division 1 and 2 tank volumes are 51,000 and 45,000 gallons, respectively, in addition to the 731 gallon day tank. Access to the fuel oil storage tank consists of attaching a portable 120 volt ac pump to the day tank drain and providing a hardened wall penetration to the outside. Hoses will be provided to direct the fuel from there to the FLEX generator or to the FLEX truck fuel tanks to transport to other locations. The day tank will be maintained full by the fuel oil transfer pumps that are energized from the FLEX generator. The quality of the fuel stored in the installed diesel generator fuel oil storage tank is assured by existing station procedures. The licensee also stated that fuel quality concerns and an indefinite fuel supply will be addressed in a future 6-month update. The concern regarding fuel quality and concern with regard to providing an indefinite fuel supply remain to be addressed and are identified by Confirmatory Item 3.2.4.9.A in Section 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, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to fuel oil supply 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) provides that:

> *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 52 of the Integrated Plan, the licensee states that load shedding will be executed in accordance with station blackout procedures. On page 40 of the Integrated Plan, the licensee stated that FLEX generators will be lined up to provide power to the battery chargers at T=+5 hours.

However, the plan does not provide the dc load profile required to support the mitigation strategies. Additional information is required such as: what loads will be shed from the bus, location of equipment remaining and any operator actions required to provide power, minimum voltages expected/required, and any adverse impacts of functions lost as a result of load shed. There is no discussion in the plan regarding the potential for components to change state if vital power is lost or whether plant components will be impacted by the manipulation of dc breakers. During the audit process, the licensee addressed these issues by stating that the dc load profile is consistent with the current SBO DC load profile. There are no additional dc loads shed or added for the FLEX strategies. The load shedding actions are performed at a single panel located in the auxiliary building and the operation can be completed within one hour. This time has been validated. The licensee also stated that there is no impact to defense in depth or on redundancy. The procedure clearly indicates the circuits that need to be restored if the Division 1 DG becomes available and Division 1 ECCS is required. And finally, the licensee referred to the analysis EC 391824, FLEX Battery Coping Study as confirmation of the minimum voltages expected/required.

As noted above, the licensee's strategy includes performing load shed of the dc bus. Typically, a backup dc seal oil pump maintains sufficient seal oil pressure to prevent the escape of hydrogen from the main generator casing. The plan did not address the scenario whereby ac power is lost and the seal oil pump power is shed from the dc bus. During the audit process, the licensee process addressed this issue by stating that the SBO procedure provides direction to vent hydrogen from the main 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 provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to load reduction to conserve 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, in the paragraph following item (15) provides that:

> 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 provides that:

1. FLEX mitigation equipment should be initially tested or other reasonable means used to verify performance conforms to the limiting FLEX requirements. Validation of source manufacturer quality is not required.
2. Portable equipment that directly performs a FLEX mitigation strategy for the core, containment, or SFP should be subject to maintenance and testing[1] guidance provided in INPO AP 913, Equipment Reliability Process, to verify proper function. The maintenance program should ensure that the FLEX equipment reliability is being achieved. Standard industry templates (e.g., EPRI) and associated bases will be developed to define specific maintenance and testing including the following:
    a. Periodic testing and frequency should be determined based on equipment type and expected use. Testing should be done to verify design requirements and/or basis. The basis should be documented and deviations from vendor recommendations and applicable standards should be justified.
    b. Preventive maintenance should be determined based on equipment type and expected use. The basis should be documented and deviations from vendor recommendations and applicable standards should be justified.
    c. Existing work control processes may be used to control maintenance and testing. (e.g., PM Program, Surveillance Program, Vendor Contracts, and work orders).
3. The unavailability of equipment and applicable connections that directly performs a FLEX mitigation strategy for core, containment, and SFP should be managed such that risk to mitigating strategy capability is minimized.
    a. The unavailability of installed plant equipment is controlled by existing plant processes such as the Technical Specifications. When installed

[1] Testing includes surveillances, inspections, etc.

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.

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

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

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

3.3.2 Configuration Control

NEI 12-06, Section 11.8 provides that:

1. The FLEX strategies and basis will be maintained in an overall program document. This program document will also contain a historical record of previous strategies and the basis for changes. The document will also

contain the basis for the ongoing maintenance and testing programs chosen for the FLEX equipment.

2. Existing plant configuration control procedures will be modified to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies.
3. Changes to FLEX strategies may be made without prior NRC approval provided:
   a) The revised FLEX strategy meets the requirements of this guideline.
   b) An engineering basis is documented that ensures that the change in FLEX strategy continues to ensure the key safety functions (core and SFP cooling, containment integrity) are met.

On page 11, in the section of the Integrated Plan regarding programmatic controls, the licensee stated that the licensee will implement an administrative program related to configuration management. A plant system designation will be assigned to FLEX equipment that requires configuration controls associated with systems. The licensee stated that equipment associated with these strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control as outlined in JLD-ISG-2012-01, Section 6, and NEI 12-06, Section 11.

The licensee's plans for development and implementation of a configuration control process for the strategies are consistent with normal plant configuration control processes. Because the plan for configuration control is consistent with normal plant configuration control programs, the reviewer concludes that it is reasonable to assume the considerations noted above will be addressed.

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

3.3.3 Training

NEI 12-06, Section 11.6, Training, provides that:

1. Programs and controls should be established to assure personnel proficiency in the mitigation of beyond-design-basis events is developed and maintained. These programs and controls should be implemented in accordance with an accepted training process.
2. 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 the section of the Integrated Plan describing the training plan, the licensee stated that training materials for FLEX will be developed for all station staff involved in implementing FLEX strategies. For accredited training programs, the Systematic Approach to Training, SAT, will be used to determine training needs. For other station staff, a training overview will be developed per the change management plan. The reviewer concluded that use of the licensee's existing proceduralized site training regimen as described, provides reasonable assurance of a training program to meet the considerations above.

The licensee’s approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 the Integrated Plan, the licensee provided a description of planned arrangements for off site resources and stated that contractual agreements are in place with the Strategic Alliance for the FLEX emergency response. Review of the licensee's use of off site resources, as described in the Integrated Plan, provides reasonable assurance that the proposed arrangement will conform to the guidance found in NEI 12-06, Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies (guideline 1). However, the plan failed to provide any information as to how conformance with NEI 12-06, Section 12.2 guidelines 2 through 10 will be met. This is identified as Confirmatory Item 3.4.A in Section 4.2 below.

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

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.1.4.2.C	No information was provided in the Integrated Plan to address the ultimate heat sink and the potential that the flow path may be affected by ice blockage or formation of frazil ice due to extreme low temperatures.	
3.2.4.8.A	On page 6 of six month update, dated August 28, 2013 (ML13241A241), the licensee states that they are proposing to pre-stage both the primary and alternate FLEX generator in the Unit 2 side of the Control/Diesel Generator building. This appears to be an alternative approach for satisfying the Mitigating Strategies order. Insufficient information has been provided by the licensee in order to determine whether this provides an equivalent level of protection as would be provided through conformance with NEI 12-06.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.1.A	Each section of the Integrated Plan describing protection of equipment from the hazards makes reference to NEI 12-06, Section 11 rather than to the protection guidance described in NEI 12-06 for the applicable hazard; that is 6.2.3.1 for floods, 7.3.1 for wind, etc. The licensee's proposed protection strategy needs to be specific for each hazard.	
3.1.1.2.A	The Integrated Plan did not provide sufficient information to conclude that for each mitigation strategy discussed, operators would have access through seismically robust structures to deploy the strategy. As an example, on page 27 of the Integrated Plan, the deployment plan describes using hoses to connect the FLEX alternate suppression pool cooling pump to the suppression pool and residual heat removal (RHR) heat exchanger connections. Licensee needs to address this issue generically.	
3.1.1.2.B	It was not evident from the review of the Integrated Plan whether or not electrical power would be necessary to move or to deploy mitigation strategies (e.g., to open the door from a storage location). If necessary, provisions would be necessary to provide that power source.	
3.1.1.3.A	The licensee should develop a reference source that provides approaches for obtaining necessary instrument readings for instruments in addition to the existing guidance for the suppression pool temperature instrument. The suppression pool cleanup and transfer pumps will require a strategy to provide control power to the pump motor supply breakers.	
3.1.1.3.B	The licensee discussed how internal flooding is mitigated for ECCS pump cubicles, but it is not clear whether or not other mitigation strategies may be susceptible to the internal flooding hazard.	
3.1.1.4.A	With regard to the use of off site resources, no information was provided regarding the identification of the local arrival staging area or a description of the methods to be used to deliver the equipment to the site. During the audit process, the licensee stated that information will be provided in a future 6-month update to address the issue.	
3.1.2.1.A	On page 4, in the section of its Integrated Plan regarding key assumptions associated with implementation of FLEX strategies, the licensee explained that primary and secondary storage locations for FLEX equipment have not been selected. Storage locations must be selected that protect FLEX equipment from all hazards.	
3.1.2.2.A	With regard to deployment during flood conditions, the licensee stated that transportation routes from the equipment storage area to the FLEX staging areas are not yet identified. The licensee also stated that the identification of storage areas is part of a self identified open item.	

3.1.2.2.B	The Integrated Plan did not address the potential need to remove accumulated water from structures in the event that installed sump pumps are not available.	
3.1.2.3.A	The administrative program and procedures for deployment from storage and staging areas in flood conditions or after a tornado are not yet developed.	
3.1.4.2.A	The licensee does not address the effects of snow, ice, and extreme cold on the ability of plant personnel to perform manual operations	
3.1.4.2.B	Although debris removal and haul requirements are addressed as previously discussed in this report, there is insufficient information in the Integrated Plan to conclude the licensee will conform to guidance with respect to the removal of snow and ice from haul pathways and staging areas.	
3.2.1.1.A	Need benchmarks to demonstrate MAAP4 is the appropriate code for simulation of ELAP.	
3.2.1.1.B	Collapsed level must remain above Top of Active Fuel and cool down rate must meet technical specifications.	
3.2.1.1.C	MAAP4 use must be consistent with June 2013 position paper.	
3.2.1.1.D	In using MAAP4, the licensee must identify and justify the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the "MAAP4 Application Guidance, Desktop Reference for Using MAAP4 Software, Revision 2" (Electric Power Research Institute Report 1020236).	
3.2.1.1.E	The specific MAAP4 analysis case that was used to validate the timing of mitigating strategies in the Integrated Plan must be identified and should be available on the ePortal for NRC staff to view. Alternately, a comparable level of information may be included in the supplemental response.	
3.2.1.3.A	The sequence of events timeline is not final. The licensee stated that the final sequence of events timeline will be time validated once detailed designs are completed and procedures are developed. The licensee stated that the results will be provided in a future 6-month update. Also, the final sequence of events timeline needs to identify when the FLEX pump is staged to supply backup for RCIC.	
3.2.1.4.A	The licensee has not yet completed the analyses to demonstrate adequate head and flow will be provided by the FLEX pumps for cooling strategies.	
3.2.1.4.B	The concerns related to raw water injection by FLEX strategies are being addressed by the BWROG and the resulting evaluation will be included in a future 6-month update.	
3.2.1.5.A	Additional information is needed to address the associated measurement tolerances/accuracy of instrumentation used to monitor portable/FLEX electrical power equipment to ensure that: 1) the electrical equipment remains protected (from an electrical power standpoint – e.g., power fluctuations) and 2) the operator is provided with accurate information to maintain core cooling, containment, and spent fuel cooling.	

3.2.2.A	The licensee stated that evaluation of the spent fuel pool area for steam and condensation had not yet been performed. The results of this evaluation and the vent path strategy, if needed, will be provided in a future 6-month update.	
3.2.3.A	The licensee plans to circulate suppression pool water through the shell side of a residual heat removal (RHR) heat exchanger using abandoned RHR steam condensing mode piping. It is not clear how the abandoned RHR piping used will be returned to an operable status. The licensee stated the plan to restore and maintain the RHR piping to operable status will be provided in a future 6-month update.	
3.2.3.B	It is not clear from the licensee's Integrated Plan that current maintenance and testing for the suppression pool cleanup and transfer pumps would conform to the standards for FLEX equipment because the pumps are not currently relied upon to mitigate accidents or transients or the consequences of a beyond-design-basis event.	
3.2.3.C	The expected peak temperatures predicted by MAAP4 calculations are 185.06 degrees F for the wetwell air space and 253.8 degrees F for the drywell. The wetwell air space peak is marginally above the 185 degree limit for the containment. Because there are unresolved concerns with the MAAP4 analyses, the licensee will need to address the potential for wetwell air space temperatures exceeding the 185 degree design limit.	
3.2.4.2.A	The information provided in the Integrated Plan regarding battery room ventilation did not address potential temperature increases/decreases on the station batteries due to loss of battery ventilation resulting from an ELAP. A discussion is also needed on hydrogen limits in battery room while charging the batteries during Phase 2 and 3.The licensee stated that battery room ventilation information will be provided in a future 6-month update.	
3.2.4.2.B	The licensee stated on page 41 regarding phase 2 main control room cooling that further analysis is needed to develop strategies. These strategies and supporting analysis are to be provided in a future 6-month update	
3.2.4.2.C	On page 41, in the section of the Integrated Plan regarding safety function support, phase 2, the licensee stated that inverter room conditions will be evaluated and a strategy will be developed to maintain acceptable conditions. The strategy and associated support analyses will be submitted in a future 6-month update	
3.2.4.2.D	In general, the discussion of ventilation in the submittal provides insufficient information on the impact of elevated temperatures, as a result of loss of ventilation and/or cooling, on the support equipment being credited as part of the ELAP strategies (e.g., electrical equipment in the RCIC pump rooms). As an example, there is no discussion regarding whether the initial temperature condition assumed the worst-case outside temperature with the plant operating at full power. No list was provided or referenced of electrical components located in the pump rooms that are	

	necessary to ensure successful operation of required pumps. Also, no information was provided regarding the qualification level for temperature and pressure for these electrical components for the duration that the pumps are assumed to perform its mitigating strategies function. During the audit process, the licensee explained that these issues will be addressed by providing information in a 6-month update.	
3.2.4.4.A	Confirm upgrades to communication system that resulted from the licensee communications assessment. Reference assessment correspondence ML12306A199 and ML13056A135.	
3.2.4.6.A	On page 41 of the Integrated Plan, in the section describing safety function support for phase 2, the licensee stated that habitability conditions will be evaluated and a strategy will be developed to maintain Main Control Room habitability.	
3.2.4.8.B	On page 50, in the Integrated Plan, the submittal includes a table that lists additional equipment, "Medium Voltage and Low Voltage Diesel Generators", for phase 3; however, this equipment is not discussed in the body of the Integrated Plan. It is not clear from the information presented in the plan regarding; when and how the "Medium Voltage and Low Voltage Diesel Generators" identified in the table would be used, what loads would be served, or what generating capacity would be provided. The licensee stated the strategies for the deployment of phase 3 equipment would be developed and incorporated into pre-planned guidance. The guidance will provide flexible and diverse direction for the acquisition, deployment, connection, and operation of the equipment	
3.2.4.8.C	The Integrated Plan does not provide information or references regarding sizing calculations for the FLEX generators to demonstrate they can adequately provide power to the assumed loads. The licensee's response addressed this issue by stating that the FLEX generator sizing calculations will be submitted in a future 6-month update.	
3.2.4.9.A	The licensee did not address assessing and maintaining fuel quality for fuel oil supplies to the FLEX equipment. Also, the licensee did not address a concern with regard to providing an indefinite fuel supply.	
3.4.A	The Integrated Plan failed to provide any information as to how conformance with NEI 12-06, Section 12.2 guidelines 2 through 10 will be met regarding the capabilities of the off site resources.	