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

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Entergy Operations, Inc.
Waterford Steam Electric Generating Station, Unit 3
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Technical Evaluation Report

Waterford Steam Electric Generating Station, Unit 3
Order EA-12-049 Evaluation

## 1.0 BACKGROUND

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

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

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

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

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

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

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

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

## 2.0 EVALUATION PROCESS

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

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

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

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

The technical evaluation (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. ML13063A266), and as supplemented by the first six-month status report in letter dated August 28, 2013 (ADAMS Accession No. ML13241A281), Entergy Operations, Inc. (the licensee or Entergy) provided Waterford Steam Electric Station, Unit 3's (Waterford) Integrated Plan for compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by Entergy for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the NRC staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the staff in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the Order.

## 3.1 EVALUATION OF EXTERNAL HAZARDS

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

### 3.1.1 Seismic Events.

NEI 12-06, Section 5.2 states:

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

The licensee's screening for seismic hazards, as presented in their Integrated Plan, has screened in this external hazard. The licensee confirmed on page 1 of their Integrated Plan that seismic hazards are applicable to Waterford. The licensee also stated that the seismic re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore was not assumed in their Integrated Plan.

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

#### 3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

> 1. FLEX equipment should be stored in one or more of following three configurations:
>
>    a. In a structure that meets the plant's design basis for the Safe Shutdown Earthquake (SSE)(e.g., existing safety-related structure).

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

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

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

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

With three exceptions, the licensee plans on storing FLEX equipment in an existing safety-related structure, which meets the plant's design basis for the SSE, as specified by NEI 12-06, Section 5.3.1, item 1.a. The licensee plans on storing the following three pieces of FLEX equipment outside: the booster pump used in the secondary strategy for core cooling will be stored at or near its staging area; the second SFP makeup pump will be stored in a weather-protected enclosure; and the second FLEX generator will be stored in the yard. The licensee's plan failed to address: 1) seismic interactions to ensure this equipment is not damaged by non-seismically robust equipment or structures for the portable equipment that will be stored outside; 2) how this equipment is appropriately secured to protect it during a seismic event; and, 3) where equipment such as hoses and power cables would be stored to assure protection from a seismic event. This information was provided to the licensee as a result of an audit of their Integrated Plan in order to allow it to be taken into account in the planned storage of FLEX equipment. In response to the NRC audit process the licensee indicated that any large portable equipment would be tied down to ensure protection of the equipment during a seismic event. The licensee further indicated that evaluation of stored equipment for seismic interactions would be considered and procedures and programs to be developed would consider these items. This has been identified as Confirmatory Item 3.1.1.1.A in Section 4.2.

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

3.1.1.2 Deployment of FLEX Equipment - Seismic Hazard

NEI 12-06, Section 5.3.2 states:

> The baseline capability requirements already address loss of non-seismically robust equipment and tanks as well as loss of all AC. So, these seismic considerations are implicitly addressed.
>
> There are five considerations for the deployment of FLEX equipment following a seismic event:

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

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

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

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

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

With respect to the movement of FLEX equipment during a seismic event, the licensee indicates on page 1 of the Integrated Plan that the site is not susceptible to soil liquefaction based on the soil properties and most severe earthquake conditions.

With respect to the licensee's plans for protection and accessibility of connection points, it was determined that for identified FLEX strategies, FLEX equipment will be routed through the reactor auxiliary building (RAB) which is a seismically robust structure and connection points will be made within the RAB and protected against all applicable hazards. However, on page 37 the licensee indicated that the protection of the connection points for the final phase of RCS inventory control was yet to be determined and will not be finalized until all the equipment and equipment specifications coming from the RRC are finalized. In response to the NRC audit process the licensee indicated that this information would be provided later in the design/procedure development process no later than the third six-month update report (August, 2014). This is identified as Confirmatory Item 3.1.1.2.A in Section 4.2.

The Mississippi River does not contain a dam downstream of the site and thus consideration 3 is not applicable to Waterford.

With respect to power requirements to move or deploy FLEX equipment, the licensee either stores the FLEX equipment inside the RAB or outside this structure. The need to provide access to deploy FLEX equipment through doors in the RAB is covered in Section 3.2.4.5, Protected and Internal Locked Area Access.

With respect to the licensee's plan for equipment required to move the FLEX equipment and protection of the means for moving the FLEX equipment, the licensee indicated that a tow truck could be used for debris removal and towing of the secondary FLEX generator from the storage location to the staging area, however, there was insufficient information regarding the protection of the vehicle from the event. In response to the NRC audit process the licensee provided the following information: Their strategy ensures N sets of equipment are protected and deployable under all the applicable hazards. This strategy will provide the reasonable protection required by NEI 12-06 and allow for deployment of the FLEX equipment considering all of the applicable hazards. The licensee further indicated that they will have a second set of FLEX equipment that is not required or necessarily engineered to be protected and deployable under all the applicable hazards, and that protection of the second set of FLEX equipment is not required, therefore protection of the means to move the secondary set of FLEX equipment is not required. Further, this strategy of ensuring that N sets of equipment are protected and deployable under the applicable hazards is consistent with NEI 12-06 Section 11.3, considerations 2 and 3 which state (footnotes omitted):

2. A technical basis should be developed for equipment storage for portable equipment that directly performs a FLEX mitigation strategy for core, containment, and SFP that provides the inputs, assumptions, and documented basis that the mitigation strategy and support equipment will be reasonably protected from applicable external events such that the equipment could be operated in place, if applicable, or moved to its deployment locations. This basis should be auditable, consistent with generally accepted engineering principles, and controlled within the configuration document control system.
3. FLEX mitigation equipment should be stored in a location or locations informed by evaluations performed per Sections 5 through 9 such that no one external event can reasonably fail the site FLEX capability (N).

The licensee's response goes on to say that since the primary FLEX generator is staged on the RAB roof and will be protected against all external events, no towing capability or debris removal equipment is required to implement the primary strategy, thus there is no requirement to protect the secondary generator or to ensure its deployment, therefore, there is no need to protect the debris removal or towing equipment, but for diversity debris and deployment equipment is available.

The licensee's integrated plan identified the intent to fully conform to the guidance in JLD-ISG-2012 or NEI 12-06 with a single exception related to the wet cooling tower and dry cooling towers. The lack of a means to move the FLEX equipment that is also reasonably protected from the event as described in NEI 12-06, Section 5.3.2, consideration 5, raises concerns with the potential existence of another exception to conformance to the guidance of NEI 12-06 that has not been identified. Following discussions on the subject during the audit process, the licensee clarified that at least one (N) set of equipment will be pre-staged within or upon the Nuclear Plant Island Structure (NPIS) such that each piece of equipment in that set would be protected from all external hazards applicable to the site. Some of the spare set of equipment may also be stored in the NPIS with the remainder to be stored in a location outside of the NPIS in a structure designed to protect its contents from some of the external hazards applicable to the site. For those situations where only N sets of equipment are protected and deployable considering the external hazards applicable to the site, the licensee indicated that it would apply the unavailability controls of NEI 12-06, Section 11.5.3.f and initiate action within 24 hours to restore the capability within 72 hours, rather than NEI 12-06, Section 11.5.3.b, which would allow a 90 day period of unavailability.

The unavailability controls of NEI 12-06, Section 11.5 interact with the spare capabilities specified in Section 3.2.2 on page 23 and the reasonable protection specifications of Sections 5 through 10 to establish a minimum availability of the portable FLEX equipment. Section 3.2.2 specifies that "a site should have sufficient equipment to address all units on-site, plus one additional spare, i.e., an N+1 capability, where "N" is the number of units on-site" in order to assure its reliability and availability. Section 10.1 provides that the N+1 sets of equipment should be stored in diverse locations or in structures designed to provide reasonable protection of the equipment such that there is reasonable assurance that N sets of equipment will remain deployable following a BDBEE. Section 11.5.3.b would allow portable equipment to be unavailable for 90 days provided that the site FLEX capability (N) is available, while Section 11.5.3.f specifies that if the site FLEX capability (N) is not maintained, the licensee should initiate actions within 24 hours to restore the FLEX capability and implement compensatory measures within 72 hours.

For a licensee that conforms to the guidance of NEI 12-06, Section 5.3.2, consideration 5 and provides a means to move the FLEX equipment with N+1 sets of equipment reasonably protected from the site-specific hazards and deployable to the position in which those sets of equipment would be used, the confluence of these portions of the guidance would allow a 90-day unavailability for one of the sets. If the unavailability of one of the sets were to result in the FLEX capability being lost, the unavailability would be limited by Section 11.5.3,f. to 72 hours. While Entergy does not conform to the NEI 12-06 guidance for provision of a means to move the N+1 set of FLEX equipment that is reasonably protected from the event, their recognition that this could result in the unavailability of the site FLEX capability (N) and the imposition of the corresponding unavailability controls for the pre-staged set of equipment in the NPIS can provide the equivalent level of equipment availability as if the licensee were in conformance with this portion of the guidance of NEI 12-06. Because it provides the equivalent level of equipment availability, this may be acceptable as an alternate approach to the guidance of NEI 12-06. This is identified as Confirmatory Item 3.1.1.2.B in Section 4.2.

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

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

> There are four procedural interface considerations that should be addressed.
>
> 1. Seismic studies have shown that even seismically qualified electrical equipment can be affected by BDB seismic events. In order to address these considerations, each plant should compile a reference source for the plant operators that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (see Section 3.2.1.10). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant

procedures/guidance. Guidance should include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power.

2. Consideration should be given to the impacts from large internal flooding sources that are not seismically robust and do not require ac power (e.g., gravity drainage from lake or cooling basins for non-safety-related cooling water systems).

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

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

With respect to development of a reference source to obtain necessary instrument readings, in various sections of the Integrated Plan the licensee indicates that they would develop procedures to read instrumentation locally using portable instruments.

With respect to the development of mitigating strategies for seismic hazards associated with large internal flooding sources that are not seismically robust and do not require ac power, and the use of ac power to mitigate ground water in critical locations, there was insufficient information in the Integrated Plan to conclude that these aspects of NEI 12-06 would be considered. In response to the NRC audit process, the licensee indicated that this information would be provided later in the design/procedure development process no later than the third six-month update report (August, 2014). This has been identified as Confirmatory Item 3.1.1.3.A. in Section 4.2.

Consideration 4 is not applicable to the licensee, as the Mississippi River does not contain a dam downstream of the site.

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

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

resources from off-site following a seismic event.

With respect to the licensee's plans regarding its use of the offsite resources through the industry Strategic Alliance for FLEX Emergency Response (SAFER) program, on page 12 of the Integrated Plan the licensee stated they had signed a contract with SAFER but had not yet identified the local staging area and method of transportation to the site. In response to the NRC audit process the licensee indicated that local staging area and method of transportation to the site would be provided later in the design/procedure development process and documented in the six-month update report due August 2014. This has been identified as Confirmatory Item 3.1.1.4.A. in Section 4.2.

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

3.1.2 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.

The licensee indicated on page 2 of their submittal that flooding hazards are applicable to Waterford. The maximum flood level was determined to be Elevation +27 ft. mean sea level (MSL), which would not flood the safety related buildings because of a flood wall with a height of +30 ft. MSL. The licensee identified the probable maximum flood as being from the Mississippi River, which NEI 12-06 characterizes in Table 6-1 as having warning time in days and persistence in many hours to months, depending on the cause of the flooding (hurricane or storm surge, or regional precipitation). The licensee also stated that the flooding re-evaluation pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, had not been completed and therefore not assumed in their Integrated Plan.

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 and characterization of the flooding hazard, if these requirements are implemented as described.

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

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

With three exceptions, the licensee plans on storing FLEX equipment in an existing safety-related structure, which is protected from the flooding hazard. The licensee plans on storing three pieces of FLEX equipment outside a structure. These include: 1) the booster pump used in the secondary strategy for core cooling will be stored at or near its staging area; 2) the second SFP makeup pump will be stored in a weather-protected enclosure; and, 3) the second FLEX generator will be stored in the yard.

The licensee's plan for the storage and protection of portable equipment from external flooding hazards, did not provide sufficient information to conclude that FLEX equipment stored outside a structure would be protected from flooding as provided by the considerations of NEI 12-06, Section 6.2.3.1 because: 1) it is unclear if the weather protected enclosure for the secondary SFP cooling portable pump will provide flood protection for the pump or if a procedure/guidance exists to move the secondary pump prior to a flooding event; 2) there is no information as to the storage location of the hoses and fittings necessary to connect to the portable SFP cooling pumps; the storage location of the FLEX generator cables for connection of the FLEX generators; or the storage location of the smaller diesel generators and cables used to power various strategy support equipment; and 3) there is insufficient information to determine if a procedure/guidance exists to move the secondary FLEX generator out of the flood hazard in time to avoid flood damage. This information was provided to the licensee as a result of an audit of their Integrated Plan in order to allow it to be taken into account in the planned storage of FLEX equipment.  In response to the NRC audit process the licensee indicated that one set of FLEX equipment N, including hoses, fittings, and cables, that directly support a key safety function for the mitigation of a beyond design basis external events, will be fully protected from all external events. The licensee further indicated that protection is not required for the second set of FLEX equipment or is there a need to move this equipment since the other set of FLEX equipment is fully protected.

Following discussions as part of the audit process, the licensee clarified that "[s]ome of the (+1) set of equipment may also be stored in the NPIS with the remainder to be stored in a location outside of the NPIS and in a structure designed to protect its contents from some of the external events determined to be applicable to Waterford, such as ice, seismic events, and the general environment.  The final design and location of this storage facility has not yet been determined. The reviewer notes that while the protection of FLEX equipment from the flooding hazard per NEI 12-06, Section 6.2.3.1 does not differentiate between protection of N FLEX equipment and protection N+1 FLEX equipment, this is allowable pursuant to Section 11.3, item 3.

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

3.1.2.2 Deployment of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.2 states:

> There are a number of considerations which apply to the deployment of FLEX equipment for external flood hazards:
>
> 1. For external floods with warning time, the plant may not be at power. In fact, the plant may have been shut down for a considerable time and the plant configuration could be established to optimize deployment. For example, the portable pump could be connected, tested, and readied for use prior to the arrival of the critical flood level.  Further, protective actions can be taken to reduce the potential for flooding impacts, including cooldown, borating the RCS, isolating accumulators, isolating RCP seal leak off, obtaining dewatering pumps, creating temporary flood barriers, etc. These factors can be credited in considering how the baseline capability is deployed.
>
> 2. The ability to move equipment and restock supplies may be hampered during a flood, especially a flood with long persistence. Accommodations along these lines may be necessary to support successful long-term FLEX deployment.
>
> 3. Depending on plant layout, the ultimate heat sink may be one of the first functions affected by a flooding condition. Consequently, the deployment of the FLEX equipment should address the effects of LUHS, as well as ELAP.
>
> 4. Portable pumps and power supplies will require fuel that would normally be obtained from fuel oil storage tanks that could be inundated by the flood or above ground tanks that could be damaged by the flood. Steps should be considered to protect or provide alternate sources of fuel oil for flood

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

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

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

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

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

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

The licensee identified the probable maximum flood as being from the Mississippi River, which NEI 12-06 characterizes in Table 6-1 as having warning time in days and persistence in many hours to months, depending on the cause of the flooding (hurricane or storm surge, or regional precipitation). The licensee's Integrated Plan provided insufficient information as to whether they considered the longer warning time in the development of the strategies which would enable the licensee to make use of the allowances of NEI 12-06, Section 6.2.3.2, consideration 1 for pre-event preparations. In response to the NRC audit process the licensee indicated that the limiting flood case does not need to characterized in terms of warning time as the primary FLEX strategies are within the RAB, which provides protection from flooding. Design of storage facilities, specification of FLEX equipment, protection of FLEX equipment, implementation of FLEX strategies, and protection of safety-related structures from flooding will be determined during the design development and procedure development phase. These procedures will address the persistence of an external flooding hazard and an update will be provided later in the design/procedure development process no later than the fourth six-month update report (February 2015). The licensee's implementation of flooding persistence into their FLEX strategies is identified as Confirmatory Item 3.1.2.2.A in Section 4.2.

With respect to protection of connection points, the licensee indicated that all the connection points for identified strategy implementation are protected against the flood hazard. However, the connection points for the final phase of RCS inventory control will not be determined until the strategy is finalized. This is included with Confirmatory Item 3.1.1.2.A. in Section 4.2.

With regards to consideration for movement of equipment and restocking supplies, the potential flooding impacts on fuel for FLEX equipment, access and egress impacts, and the protection of the means to move equipment in the context of a flood with long persistence, it was determined that there was insufficient information in the Integrated Plan to conclude that these aspects of NEI 12-06 Section 6.2.3.2, consideration 2, 4 and 9 will be met. In response to the NRC audit process the licensee indicated that one set of FLEX equipment (N), including hoses, fittings, and cables, that directly support a key safety function for the mitigation of a beyond design basis external events, will be fully protected from all external events and do not require movement to deploy. The licensee further indicated that there is no need to move the other set of FLEX equipment (N+1) since the N set of FLEX equipment is fully protected and will not need to be moved from a flooded area.

The reviewer notes that deployment of FLEX equipment following a flooding event per NEI 12-06, Section 6.2.3.2 does not differentiate between deployment of N FLEX equipment and deployment of N+1 FLEX equipment. This issue has been combined with Confirmatory Item 3.1.1.2.B in Section 4.1.

The licensee's approach described above, as currently understood and with the exception of the issue described above and in Confirmatory Item 3.1.1.2.B, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to deployment of FLEX equipment.

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 of the Integrated Plan the licensee indicated that procedures and guidance to support deployment and FLEX coping strategy implementation, including interfaces with emergency operating procedures (EOPs), special events procedures, abnormal operating procedures (AOPs), and system operating procedures, will be coordinated within the site procedural framework. The licensee's plan for procedural interface regarding the deployment of portable equipment in flooded conditions lacked sufficient detail to ascertain that deployment considerations would be incorporated into flood procedures or the need to deploy temporary flood barriers and extraction pumps necessary to support deployment per considerations 1, 2, and 3. In response to the NRC audit process the licensee indicated that the above information would be provided later in the design/procedure development process no later than the third six-month update report (August, 2014). This is identified as Confirmatory Item 3.1.2.3.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of the issue related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to incorporation of deployment considerations into flood procedures or the need to deploy temporary flood barriers and extraction pumps necessary to support deployment, if these considerations are implemented as described.

3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

With regards to the use of off-site resources, on page 12 of the licensee indicated that delivery of off-site equipment would be established during the development of the nuclear sites playbook. The licensee's plan for the use of offsite resources provided insufficient information to conclude that the plan will conform with 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. In response to the NRC audit process the licensee indicated that the above information would be provided later in the design/procedure development process no later than the third six-month update report (August, 2014). This has been combined with Confirmatory Item 3.1.1.4.A. in Section 4.2.

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

3.1.3 High Winds

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

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

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

On page 2 the licensee indicated that Waterford has the potential to experience damaging winds caused by a tornado exceeding 130 mph. However, the licensee failed to provide a similar statement regarding hurricane winds, while Figure 7-1 shows the site is susceptible to damaging winds caused by hurricanes exceeding 130 mph. In response to the NRC audit of Order EA-12-049 Mitigation Plans the licensee indicated that per Figure 7-1, the plant was located in the 240 to 250 mph hurricane wind contour, and per Figure 7-2 the plant is located in the 360 mph wind speed zone. Based on the technical evaluation performed by Westinghouse, it was determined that the 360 mph wind speed for tornados would bound the potential hurricane wind speed, therefore tornado attributes were used in developing the FLEX strategies.

The licensee's response did not include consideration of the warning time offered by a hurricane storm for pre-staging FLEX equipment. In addition, as described in NEI 12-06, Section 7.2.2, hurricanes can have a significant impact on local infrastructure, e.g., downed trees and flooding that should be considered in the interface with off-site resources. These items are identified as Open Item 3.1.3.A in Section 4.1.

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

3.1.3.1 Protection of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.1 states:

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

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

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

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

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

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

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

With three exceptions, the licensee plans on storing FLEX equipment in an existing safety-related structure, which is protected from high wind hazards. The licensee plans on storing three pieces of FLEX equipment outside a structure. These include: 1) the booster pump used in the secondary strategy for core cooling will be stored at or near its staging area; 2) the second SFP makeup pump will be stored in a weather-protected enclosure; and, 3) the second FLEX generator will be stored in the yard. The licensee’s plans for the storage and protection of portable equipment for the impact of severe storms with high winds did not conform to the guidance of NEI 12-06, Section 7.3.1, because there is insufficient information to conclude: 1) that the booster pump required for core cooling with steam generator available will be tied down; 2) the weather protected enclosure and/or the secondary SFP cooling makeup pump will be tied down; 3) the secondary FLEX generator will be tied down; and, 4) that plans for storage of the hoses and fittings needed for hookup of the secondary SFP cooling pump, and storage of the cables and connectors required for connection of the primary and secondary FLEX generator are protected from high winds because there is no mention of where this equipment is stored.

In response to the NRC audit process the licensee indicated that there is no requirement to protect or tie down the secondary FLEX booster pump, the secondary SFP cooling makeup pump (or its weather protected enclosure), the secondary FLEX generator, or the hoses and fittings needed for hookup of the secondary equipment from a FLEX perspective, however, FLEX equipment, like any other onsite will be secured as necessary per existing plant procedures. One set of equipment that directly supports a key safety function for the mitigation of a beyond design basis event will be fully protected from all applicable external events including the associated cables/connectors required for connection of the primary FLEX generator. The licensee further indicated that the strategy for ensuring N sets of FLEX equipment is protected and deployable under the applicable hazards is consistent with NEI 12-06, Section 11.3.

The reviewer notes that while the protection of FLEX equipment from high winds per NEI 12-06, Section 7.3.1 does not differentiate between protection of N FLEX equipment and protection of N+1 FLEX equipment, this is permissible pursuant to Section 11.3, item 3.

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

3.1.3.2 Deployment of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.2 states:

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

equipment.

With regards to taking proactive actions to reduce the potential for wind impacts, on page 10 of the Integrated Plan the licensee indicated that procedures and guidance to support deployment and FLEX coping strategy implementation, including interfaces with emergency operating procedures (EOPs), special events procedures, abnormal operating procedures (AOPs), and system operating procedures, will be coordinated within the site procedural framework. The licensee's Integrated Plan provided insufficient information to be able to conclude if procedures and programs will include taking proactive actions such as testing, connecting, and readying exposed portable equipment to reduce the potential for wind impacts. In response to the NRC audit process the licensee indicated that this information would be provided later in the design/procedure development process no later than the third six-month update report (August, 2014). This is identified as Confirmatory Item 3.1.3.2.A, in Section 4.2.

With respect to debris removal, the licensee indicated that a tow truck could be used for debris removal.

With respect to the licensee's plan for equipment required to move the FLEX equipment and protection of the means for moving the FLEX equipment, the licensee indicated that a tow truck was available for towing of the secondary FLEX generator from the storage location to the staging area, however, there was insufficient information regarding the protection of the vehicle from the high wind hazard. This has been combined with Confirmatory Item 3.1.1.2.B in Section 4.2.

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

3.1.3.3 Procedural Interfaces - High Winds Hazard

NEI 12-06, Section 7.3.3, states:

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

The licensee's plans to incorporate deployment considerations into hurricane procedures were reviewed and identified open items are discussed in Section 3.1.3.2.

3.1.3.4 Considerations in Using Offsite Resources – High Winds Hazard

NEI 12-06, Section 7.3.4 states:

> Extreme storms with high winds can have regional impacts that could have a significant impact on the transportation of off-site resources.
>
> 1. Sites should review site access routes to determine the best means to obtain

resources from off-site following a hurricane.

2. Sites impacted by storms with high winds should consider where equipment delivered from off-site could be staged for use on-site.

With regards to the use of off-site resources, on page 12 of the Integrated Plan the licensee indicated that delivery of off-site equipment would be established during the development of the nuclear sites playbook. The licensee's plan for the use of offsite resources did not conform with 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. In response to the NRC audit process the licensee indicated that the above information would be provided later in the design/procedure development process no later than the third six-month update report (August, 2014). This has been combined with Confirmatory Item 3.1.1.4.A. in Section 4.2.

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

3.1.4 Snow, Ice and Extreme Cold

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

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

On page 2 of the Integrated Plan regarding the determination of applicable extreme external hazards, the licensee indicated that Waterford was below the 35$^{th}$ parallel and thus there is no need to address the impedances caused by extreme snow and cold. However, the site is screened in as being susceptible to low to medium damage to power lines and/or existence of considerable amount of ice, therefore the licensee should address deployment for conditions of ice.

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

3.1.4.1 Protection FLEX Equipment - Ice Hazard

NEI 12-06, Section 8.3.1 states:

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

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

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

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

    c. Provided the N sets of equipment are located as described in a. or b. above, the N+1 equipment may be stored in an evaluated storage location capable of withstanding historical extreme weather conditions such that the equipment is deployable.

2. Storage of FLEX equipment should account for the fact that the equipment will need to function in a timely manner. The equipment should be maintained at a temperature within a range to ensure its likely function when called upon. For example, by storage in a heated enclosure or by direct heating (e.g., jacket water, battery, engine block heater, etc.).

With three exceptions, the licensee plans on storing FLEX equipment in an existing safety-related structure. The licensee plans on storing the following three pieces of FLEX equipment outside: the booster pump used in the secondary strategy for core cooling will be stored at or near its staging area; the second SFP makeup pump will be stored in a weather-protected enclosure; and the second FLEX generator will be stored in the yard. The licensee's plan failed to address: 1) protection from ice of the booster pump used in the secondary strategy for core cooling and heat removal during the transition phase; 2) protection from ice of the second FLEX generator; and; 3) information on the storage locations of the hoses, fittings and cables used to connect to the FLEX equipment. In response to the NRC audit process, the licensee indicated that one set of FLEX equipment N, including hoses, fittings, and cables, that directly support a key safety function for the mitigation of a beyond design basis external events, will be fully protected from all external events. The licensee further indicated that protection is not required for the second set of FLEX equipment or is there a need to move this equipment since the other set of FLEX equipment is fully protected.

The reviewer notes that while protection of FLEX equipment from the hazards of ice as provided in NEI 12-06, Section 8.3.1 does not differentiate between N FLEX equipment and N+1 FLEX equipment, this is permissible pursuant to Section 11.3, item 3.

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

3.1.4.2 Deployment of FLEX Equipment - Ice Hazard

NEI 12-06, Section 8.3.2 states:

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

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

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

3. For some sites, the ultimate heat sink and flow path may be affected by extreme low temperatures due to ice blockage or formation of frazil ice. Consequently, the evaluation should address the effects of such a loss of UHS on the deployment of FLEX equipment. For example, if UHS water is to be used as a makeup source, some additional measures may need to be taken to assure that the FLEX equipment can utilize the water.

On page 65 the licensee lists a pickup truck for use to support Core, SFP, and accessibility purposes, but does not specify whether this equipment would be capable of removing ice. The licensee’s Integrated Plan to deploy FLEX equipment in the context of ice did not provide for ice removal as specified in NEI 12-06, Section 8.3.2. In response to the NRC audit process, the licensee indicated that since the equipment for the primary strategy is stored in the RAB or on the RAB roof, and will be protected from all external events, no towing equipment or debris or ice removal equipment is required to implement the primary strategy, thus there is no requirement to protect or ensure the provisions for deployment of the secondary strategy equipment. For diversity, equipment is available for ice removal and movement of secondary equipment.

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

3.1.4.3 Procedural Interfaces – Ice Hazard

NEI 12-06, Section 8.3.3, states:

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

As discussed in Section 3.1.4.2 above, the licensee does have ice removal equipment available.

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

3.1.4.4 Considerations in Using Offsite Resources – Ice Hazard

NEI 12-06, Section 8.3.4, states:

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

With regards to the use of off-site resources, on page 12 of the Integrated Plan the licensee indicated that delivery of off-site equipment would be established during the development of the nuclear sites playbook. The licensee's plan for the use of offsite resources did not provide conform with NEI 12-06, Section 8.3.4, 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. In response to the NRC audit process the licensee indicated that the above information would be provided later in the design/procedure development process no later than the third six-month update report (August, 2014). This has been combined with Confirmatory Item 3.1.1.4.A. in Section 4.2.

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

3.1.5 High Temperatures

NEI 12-06, Section 9.2 states:

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

On page 3 of the Integrated Plan the licensee indicated that the highest temperature recorded since 1954 in New Orleans Parish was 102degrees Fahrenheit. For FLEX, Waterford will consider the site maximum expected temperatures in their specification, storage, and deployment requirements, including ensuring adequate ventilation or supplemental cooling, 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 screening for high temperature, if these requirements are implemented as described.

3.1.5.1 Protection of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

On page 3 of the Integrated Plan the licensee indicated that for FLEX equipment, the site maximum expected temperatures will be considered in their specification, storage, and deployment requirements, including ensuring adequate ventilation or supplementary cooling, if required. On page 19 and 32 the licensee indicated that all of the storage locations will be evaluated for high temperature effects and/or ventilation will be provided as required to assure no adverse effects on the FLEX equipment.

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

3.1.5.2 Deployment of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

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

On page 3 of the Integrated Plan the licensee indicated that for FLEX equipment, the site maximum expected temperatures will be considered in their specification, storage, and deployment requirements, including ensuring adequate ventilation or supplementary cooling, 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 deployment of FLEX equipment from the affects of high temperature, 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 3 of the Integrated Plan the licensee indicated that for FLEX equipment, the site maximum expected temperatures will be considered in their specification, storage, and deployment requirements, including ensuring adequate ventilation or supplementary cooling, if required.

The licensee's Integrated Plan for procedural interfaces in the context of high temperatures provided insufficient information to conclude that the effects of high temperatures will not affect the portable equipment in the locations they are intended to operate. In response to the NRC audit process, the licensee indicated that procedures will be developed or enhanced to address the effects of high temperatures on FLEX equipment and will meet the requirements of NEI 12-06, Section 9.3.3. Procurement equipment specifications will specify the extreme conditions applicable to the site and storage areas that the FLEX equipment needs to function in and procure equipment meeting these specifications.

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

## 3.2 PHASED APPROACH

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

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

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

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

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

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

NEI 12-06, Section 3.2.1.2 describes the initial plant conditions for the at-power mode of operation; Section 3.2.1.3 describes the initial conditions; and Section 3.2.1.4 describes boundary conditions for the reactor transient.

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

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).

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

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

Waterford will minimize RCP seal leakage by isolating bleed off initially and initiate a plant cooldown to a cold leg temperature of no less than 400degrees Fahrenheit. This action is completed at hour 4.

Adequate shutdown margin is maintained by making up to the RCS with borated water. Per Westinghouse Calculation CN-SEE-13-3 Rev. 1 (Case 5.2), shutdown margin is greater than $1\%\Delta\rho$ for the duration of the event for a bounding case.

Procedural guidance is being developed as recommended by WCAP-17601, promoting an early and extensive cooldown and depressurization. The licensee is a participant in the PWROG and will implement the FSGs in a timeline to support the implementation of FLEX by Fall 2015.

The cooldown and depressurization will be addressed by procedural guidance and will not be precluded due to possibility of a solid plant condition. Opening of the head vent will be used as a letdown path to allow for additional boration and RCS make up to address solid plant conditions concerns.

Backup portable pumps will be utilized to supply water to the SGs as a backup to the TDEFW pump. Pump sizing considerations have been made and documented in TR-FSE-13-12 and DAR-FSE-12-11. [Additional information on pump sizing is contained in Section 3.2.1.9]

An analysis has been performed on SIT injection in Westinghouse Calculation CN-SEE-13-3, Rev. 1 which indicates that the entire volume of the SITs will not inject into the RCS, allowing SIT isolation to prevent nitrogen injection.

The licensee will conduct a symmetric cooldown. An asymmetric cooldown would only be required if additional failures beyond NEI 12-06 guidance are assumed, therefore, no additional procedure or analysis is 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 Section 3.2 of WCAP-17601 Recommendations, if these requirements are implemented as described.

3.2.1.1 Computer Code Used for the ELAP Analysis

NEI 12-06, Section 1.3 states in part:

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

Attachment 1B on page 82 of the Integrated Plan indicates that the licensee has evaluated WCAP-17601 considering Waterford site-specific parameters and determined the conclusions of that document are applicable.

Section 4.1.2.2 of WCAP-17601 discussed the use of the CENTS code. CENTS, documented in Westinghouse topical report, WCAP-15996-A, (ADAMS Accession No. ML053320174) is an NRC-approved (ADAMS Accession No. ML032790634) computer code for calculation of the transient thermal-hydraulic (T-H) conditions in the RCS primary and secondary systems of a pressurized-water reactor (PWR) for design transient conditions.

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 Combustion Engineering Nuclear Transient Simulation (CENTS) computer code. CENTS was written to simulate the response of pressurized water reactors to non-LOCA transients for licensing basis safety analysis.

The licensee has decided to use the CENTS computer code for simulating the Extended Loss of AC Power (ELAP) transient. Although the NRC staff does acknowledge that CENTS has been reviewed and approved for performing non-LOCA transient analysis, the NRC staff has not examined its technical adequacy for simulating the ELAP transient. A generic concern associated with the use of CENTS for ELAP analysis arose because NRC staff reviews for previous applications of the CENTS code had imposed a condition limiting the code's heat transfer modeling in natural circulation to the single-phase liquid flow regime. This condition was imposed due to the lack of benchmarking for the two-phase flow models that would be LOCA scenarios. Because the postulated ELAP scenario generally includes leakage from reactor coolant pump seals and other sources, two-phase natural circulation flows may be reached in the RCS prior to reestablishing primary makeup. Therefore, the NRC staff requested that the industry provide adequate basis for reliance on simulations with the CENTS code as justification for licensees' mitigation strategies.

To address the NRC staff's concern associated with the use of CENTS to simulate two-phase natural circulation flows that may occur during an ELAP for the licensee and other CE-designed PWRs, the Pressurized Water Reactor Owners Group (PWROG) submitted a position paper (ADAMS Accession No. 13297A174) dated September 24, 2013, entitled "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on CENTS Code in Support of the Pressurized Water Reactor Owners Group (PWROG)" (ADAMS Accession No. ML13297A174 (Non-Publically Avaiable)). This position paper provided a comparison of several small-break LOCA simulations using the CENTS code to the CEFLASH-4AS code that is approved for analysis of design-basis small-break LOCAs. The analyses in the position paper show that the predictions of CENTS were similar or conservative relative to CEFLASH-4AS for key figures of merit for natural circulation conditions, including the predictions of loop flow rates and the timing of the transition to reflux boiling. The NRC staff further observed the fraction of the initial RCS mass remaining at the transition to reflux boiling predicted by the CENTS code for the ELAP simulations in WCAP-17601-P to be (1) in reasonable agreement with confirmatory analysis performed by the staff with the TRACE code and (2) within the range of results observed in scaled thermal-hydraulic tests that involved natural circulation (e.g., Semiscale Mod-2A, ROSA-IV large-scale test facility). After review of this position paper, the NRC staff endorsed a resolution through letter dated October 7, 2013 (ADAMS Accession No. ML13276A555 (Non-Publically Avaiable)). This endorsement contained one limitation on the CENTS computer code's use for simulating the ELAP event. That limitation is provided as follows:

- The use of CENTS in the ELAP analysis for CE plants is limited to the flow conditions prior to reflux boiling initiation. This is identified as Confirmatory Item 3.2.1.1.A in Section 4.2 below.

This includes providing a justification for how the initiation of reflux boiling is defined.

During the NRC audit process, the licensee informed the NRC of its intent to abide by the generic approach discussed above, including the additional conditions and limitations imposed by the staff, to address the staff's generic concern regarding the use of CENTS for beyond-design-basis ELAP analysis.

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 generic concerns, if these requirements are implemented as described.

Site Specific Concern:

In Item 13 (on page 8), the licensee indicated, that at hour 19 following the ELAP initiation, the operator is required to deploy the RCS makeup pump in order to ensure single phase natural circulation (NC). In the ELAP analysis, the use of CENTS is limited to single phase NC. Based on the licensee's statement in Item 13, the NRC staff found that the licensee's use of CENTS is in compliance with the limitations specified in the safety evaluation report approving the CENTS code. However, no CENTS-predicted RCS conditions at 19 hours are available to confirm that the RCS makeup pump is aligned for the RCS inventory control before the single phase NC ends.

During the audit process the licensee was requested to specify and justify the RCS conditions that are used to define the time when the single phase NC ends and two-phase NC begins, and compare with the CENTS-predicted RCS conditions at 19 hours to show that two-phase NC will not begin before 19 hours following the ELAP event.

In response to the NRC audit process the licensee provided the following information to address this item: Using the same methodology as the cases from WCAP-17601-P, Rev. 1, CENTS was run with a core outlet cooldown termination temperature of 400degrees Fahrenheit and the inclusion of Replacement Steam Generators. The results are documented and discussed in Westinghouse Calculation CN-SEE-II-13-3 Rev. 1 (Case 5.1.1). The criterion use to determine when single phase natural circulation is lost was based on the time at which the steam generator voiding becomes greater than 0.2 in order to keep the RCS in single phase natural circulation, when RCS make up is required at 19 hours. The NRC staff identified that the licensee's use of the maximum void fraction of 0.2 in SG tubes is different from that used in the NEI September 25, 2013 position paper, which uses the centered moving of the flow quality at the top of the SG tubes in defining reflux boing onset as the limit for the use of CENTS. This difference results in significant uncertainties in a direct comparison of the licensee's limit for use of CENTS with the limit specified in NEI position pater analysis.

To determine the adequacy of the licensee's use of CENTS, the NRC staff request the licensee to provide the following information. This is identified as Open Item 3.2.1.1.B below and in Section 4.1.

- Justify conformance to the limitations of the use of CENTS by providing the CENTS-calculated value of the centered moving of the flow quality at the top of the SG tubes, which corresponds to the maximum void fraction of 0.2 in SG tubes as conditions used to define termination of single phase natural circulation, and confirming that the value is less than the limit specified in the white paper dated September 24, 2013 for use in defining the onset of reflux boing.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that the approach is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the adequate use of CENTS. These concerns are identified as Open Item 3.2.1.1.B above and in Section 4.1.

3.2.1.2 RCP Seal Leakage Rates

NEI 12-06, Section 1.3 states:

> To the extent practical, generic thermal hydraulic analyses will be developed to support plant specific decision-making. Justification for the duration of each

phase will address the on-site availability of equipment, the resources necessary to deploy the equipment consistent with the required timeline, anticipated site conditions following the beyond-design-basis external event, and the ability of the local infrastructure to enable delivery of equipment and resources from offsite.

During an ELAP event, cooling to the RCPs seal packages will be lost and water at high temperatures will degrade seal materials, leading to seal leakages from the RCS. Without ac power available to the emergency core cooling system, the RCS inventory loss from the seal leakages for an extended time period will result in core inadequate cooling conditions. The ELAP analysis credits operator actions to align the high pressure RCS makeup sources and replenish the RCS inventory for maintaining the core covered with water. The effect of the seal leakage rates on the results of the ELAP analysis is that the greater values of the seal leakage rates will result in a shorter required operator action time for the operator to align the high pressure RCS makeup water sources.

On page 13 of the Integrated Plan, the licensee indicated that existing SBO procedures direct operators to begin a plant cooldown to a cold leg temperature of no less than 400degrees Fahrenheit. This cooldown will help minimize RCP seal leakage.

On page 28 of the Integrated Plan, in the section regarding maintaining RCS inventory control during the initial phase, the licensee provided the following information. Two functions are lost during an ELAP which challenge the ability of the RCS to maintain inventory: the inventory makeup and seal cooling. As a result, the Phase 1 activities involve a plant cooldown, which is expected to be more rapid and more targeted than currently described in SBO response procedures. This will be done to minimize RCP seal leakage and ensure passive injection of the safety injection tanks (SITs), which will replace inventory lost in Phase 1. Eventually, the SITs will be isolated (i.e., before full depletion) to prevent nitrogen injection into the RCS. The total leakage from the Waterford RCP seals is assumed to be no greater than approximately 58 gpm during Phase 1. Notably however, this peak value is associated with normal system pressure and seal leakage will decrease by one and eventually two orders of magnitude as the primary system is cooled. The assumed RCS leakage through the RCP seals is made up through SIT inventory injecting. Natural circulation is maintained by ensuring adequate RCS inventory.

On page 30 of the Integrated Plan, in the section regarding maintaining RCS inventory control during the transition phase, the licensee provided that evaluations indicate that RCS makeup will be required near the end of the 24 hour coping period due to RCP seal leakage, in order to maintain RCS inventory above the apex of the hot leg.

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

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

- A postion paper dated August 16, 2013, entitled “Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Reactor coolant (RCP) Seal

Leakage in Support of the Pressurized Water reactor Owners Group (PWROG)" (ADAMS Accession No. ML13190A201 (Non-Publically Available)).

After review of these submittals, the NRC staff has placed the certain limitations for Combustion Engineering Designed Plants (with the exception of Palo Verde Nuclear Generating Station). Those limitations provided as follows:

(1) The RCP seal initial maximum leakage rate should be greater than or equal to the upper bound expectation for the seal leakage rate for the ELAP event (15 gpm/seal) discussed in the PWROG white paper addressing the RCP seal leakage for CE plants (Reference 2). If the RCP seal leakage rate used in the plant-specific ELAP analysis is less than upper bound expectation for the seal leakage rate discussed in the whitepaper, justification should be provided.

On page 28 of the Integrated Plan, the licensee indicated that RCP seal initial maximum leakage rate is assumed to be no greater than approximately 58 gpm. This is two gpm less than the upper bound expectation for the seal leakage of 15 gpm/seal (60 gpm total) described above. Therefore, the licensee is requested to provide justification for this lower assumed value. This is identified as Open Item 3.2.1.2.A in Section 4.1.

The licensee was also requested to provide additional information as follows:

a. Discuss the analysis used to determine the RCP seal normal maximum leakage rate of 58 gpm, and address adequacy of the analysis including computer code/methodology and assumptions used. The RCP seal leakage testing data used to support the assumed leakage rate should be applicable to the Waterford RCP seals (with respect to the seal material, design and seal cooling systems) and ELAP conditions (in terms of the temperature and pressure) for an extended period consistent with the ELAP coping time.

b. Address the applicability of the information in Section 4.4.2 of WCAP-17601, Rev. 0, which states that "It has been shown that the probability of seal failure greatly increases when there is less than 50°F of subcooling in the Cold Legs." If it is applicable, confirm whether a procedure step is available or not for operators to maintain the cold leg fluid temperature with subcooling of greater than 50 $^{0}$F. If the procedure step is not available, provide justification.

c. Address the applicability of assumption 2 on page 4-35 of WCAP-17601, which states that "Once RCP seal failure occurs, the leakage flow path characteristics remain constant for the rest event." If assumption 2 is not applicable, justify the non-applicability. If it is applicable, address the adequacy of the assumption throughout the ELAP event with consideration of the information in Section 4.4.2 of WCAP-17601 quoted in above item b. Also, address the effects of the assumption on the calculated RCP seal leakage rates during the ELAP event.

d. Section 6.7 of WCAP-17601 states that "any seal temperature excursions above 500 $^{0}$F are cause for concern and need to be minimized. The upper seal stages and vapor seal should remain intact if CBO and pressure protocol is initiated soon after an ELAP. Maintaining the seal stages below 350 $^{0}$F should allow plant operators to minimize leakage to containment."

Section 6.8 of the WCAP states that "It is recommended that Westinghouse conduct further testing with current Flowserve BJ seal configurations in order to get a quantifiable assessment of seal function at extreme temperature conditions for long time periods greater than 24 hours. It is also recommended that an examination and testing with new seal materials be considered."

Address the applicability of the above statements from Sections 6.7 and 6.8 of WCAP-17601 to the ELAP analysis.

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

In response to the NRC audit process the licensee indicated that the reactor coolant pumps and N-9000 seal assemblies were manufactured by Byron Jackson (Model 36x36x39 Type DFSS) and the motor (Model No. 26X742) was manufactured by General Electric. One additional seal cartridge with an increased spring vapor stage N-9000 is also approved for the use in the pumps. The increased spring vapor stage N-9000 seal is a N-9000 seal with double the number of springs on the vapor stage.

The WCAP-17601 report does not refer to pump model numbers but does discuss Byron Jackson pumps as one of the two pumps types used at the plants the report was developed for. A 4 stage BJ N-9000/BJ/SU-Vapor Stage seal is listed incorrectly in Table 6.1-2 as the seal used by Waterford 3. The seal type used at Waterford 3 is the BJ N-9000 and is listed in Table 6.1-2. The BJ N-9000 seal was specifically addressed by the report and its failure probabilities for various RCS conditions are detailed in Table 6.5-1. Based on the licensee's response, item e. is considered acceptable.

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

In response to the NRC audit process the licensee indicated that the primary ELAP strategy is to perform a symmetric cooldown using all RCS loops. Based on the licensee's response, item f. is considered acceptable.

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

In response to the NRC audit process the licensee indicated that the verification of isolation of the RCS leakage paths, including the RCP controlled bleedoff line, is addressed early in the SBO procedure before an ELAP is required to be declared at T=1 hour. The operator action is to verify the isolation valves, including the CBO valves, are closed. The CBO valves fail closed on loss of air or power and will therefore be closed. These valves are controlled from the main control room and are also closed automatically by a CIAS signal. No operator action outside the control room is required. Later at approximately T=30 minutes, the SBO procedure addresses initial load shedding. Since the initial actions are verification of isolations occurring very early in the event, before any load shedding is required, there would be no interference with these activities. Based on the licensee's response, item g. is considered acceptable.

h. If it is intended to credit significant improvement for ELAP related to the isolation of CBO lines, confirm that CBO isolation procedures, human factors requirements, and equipment qualifications are applicable to the ELAP event and are able to be achieved within the time frames described in section 5.3.1 of WCAP-16175.

i. Discuss how the analysis calculates the pressure-dependent RCP seal leakage rates. If the analysis uses the equivalent size of the break area based on the initial total RCP leakage rate of 58 gpm to calculate the pressure-dependent RCP seal leakage rates during the ELAP, discuss whether the size of the break area is changed or not in the analysis for the ELAP event. If the size is changed, discussed the changed sizes of the break area and address the adequacy of the sizes. If the break size remains unchanged, address the adequacy of the unchanged break size throughout the ELAP event in conditions with various pressure, temperature (considering that the seal material may fail due to an increased stress induced by cooldown) and flow conditions that may involve two-phase flow which is different from the single phase flow modeled for the RCP seal tests that are used to determine the initial total RCP seal leakage rate of 58 gpm.

In response to the NRC audit process the licensee indicated that items a. through d., and h. and i. above were identified as a generic concern, which the nuclear industry will resolve generically through NEI and the applicable industry groups. Once the generic concerns are resolved, Entergy will provide an update to this information in a subsequent six-month update. Since the generic concern addressing the RCP seal leakage rate for CE plants, except Palo Verde, was resolved, the licensee is requested to provide information for above items a. through d. and h. and i. This is identified as Open Item 3.2.1.2.B above and in Section 4.1.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that the approach is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, such that there would be reasonable assurance that the requirements of Order EA-12-049] will be met with respect to RCP leakage. These concerns are identified as Open Items 3.2.1.2.A and 3.2.1.2.B above and in Section 4.1.

3.2.1.3 Decay Heat

NEI Section 3.2.1.2 states in part:

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

Westinghouse completed generic analyses for CE plants (including Waterford) as documented in WCAP-17601-P.

NEI 12-06, Table D-1, Summary of Performance Attributes for PWR Core Cooling Functions states in part:

> SG makeup rate should exceed decay heat levels at time of planned deployment in order to support restoring SG water level, e.g., 200* gpm.

The ELAP analysis referenced in the licensee's Integrated Plan credits operator actions to begin a cooldown immediately following the declaration of ELAP.

On page 13 of the Integrated Plan, the licensee indicated that existing SBO procedures direct operators to begin a plant cooldown to a cold leg temperature of no less than 400˚F which will help minimize RCP seal leakage, ensure passive injection of the safety injection tanks (SITs), and ensure natural circulation is maintained.

Based on the operator actions for the cooldown and RCS inventory makeup discussed above, the effects of the use of different values of the decay heat curve on the ELAP analysis are that the greater values of the decay heat curve will result in shorter operator action times required for the operator to complete the switchover of feedwater sources.

Assumption 4 on page 4-13 of WCAP-17601 states that decay heat is per ANS 5.1-1979 + 2 sigma, or equivalent. Address the applicability of assumption 4 to Waterford. If the ANS 5.1-1979 + 2 sigma model is used in the Waterford ELAP analysis, address the adequacy of the use of the decay heat model in terms of the plant-specific values of the following key parameters: (1) initial power level, (2) fuel enrichment, (3) fuel burnup, (4) effective full power operating days per fuel cycle, (5) number of fuel cycles, if hybrid fuels are used in the core, and (6) fuel characteristics (addressing whether they are based on the beginning of the cycle, middle of the cycle, or end of the cycle). If a different decay heat model is used, describe the specific model and address the adequacy of the model and the analytical results. This is identified as Open Item 3.2.1.3.A in Section 4.1.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that the approach is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the decay heat curve. These concerns are identified as Open Item 3.2.1.3.A above and in Section 4.1.

3.2.1.4 Initial Values for Key Plant Parameters and Assumptions

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

On page 3 and 4 of the Integrated Plan the licensee indicated that other than one deviation, assumptions are consistent with those detailed in NEI 12- 06, Section 3.2.1 and that analysis has been performed consistent with the recommendations contained within the Executive Summary of the Pressurized Water Reactor Owner's Group (PWROG) Core Cooling Position Paper (OG-12-482) and assumptions from that document are incorporated into the plant-specific analytical bases.

With respect to the UHS, the licensee is expecting that only the component cooling water and dry cooling towers will need to be made operational to reject the heat load generated post-ELAP in Phase 3. The licensee has identified this as Open Item OI5. If their analysis supports this expectation, then the licensee will not require: 1) a portable UHS pump to supply inventory to wet cooling tower (WCT) basins as part of Phase 3 coping, or 2) portable fans/motors to supplant the dry cooling towers (DCTs). DCT motors will be repowered by the 4160 V generator once available from the RRC. Associated with the resolution of Open Item OI5, some additional DCT motors may be missile protected. This is identified as

Confirmatory Item 3.2.1.4.A, in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01 or provides an acceptable alternative to the guidance to NEI 12-06, 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 initial plant conditions and initial conditions, if these requirements are implemented as described.

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states in part:

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

On pages 14 and 15 of the Integrated Plan, the licensee listed the installed instrumentation credited or recovered for maintaining core cooling and heat removal during phase 1 of an ELAP.

The licensee listed RCS Wide Range Pressure and noted that this instrument will be powered as the Phase 2 Emergency DGs are aligned. Consequently, RCS wide range pressure will not be available for indication for phase 1. RCS pressure instrumentation appears necessary to verify core cooling consistent with NEI 12-06, Section 3.2.1.10. In response to the NRC audit process, the licensee indicated that RCS wide range pressure is not utilized during the first 12 hours of the ELAP event, which is the time of deployment of the FLEX generator. Plant cooldown and depressurization uses RCS cold leg temperature as a controlling point for maintaining hot standby conditions. Also, other available indications could be used to determine RCS pressure during this time period.

The review identified a concern with the ability of FLEX instrumentation to provide operators with accurate information to ensure the maintenance of core cooling, containment, and spent fuel cooling. In response to the NRC audit process, the licensee indicated that adequate information to monitor core cooling, containment, and spent fuel cooling is provided by installed plant instrumentation and is not provided by portable equipment.

On pate 14 of the Integrated Plan the licensee states that the condensate storage pool (CSP) level instrument will not be powered by battery, but by emergency diesel generators during

Phase 2. However, the operators are required to switch suction from the CSP to the wet cooling tower basins (WCT). In addition, the licensee states it will take approximately 30 minutes to realign suction to the WCT through valves in Auxiliary Building. During the NRC audit process the licensee was requested to discuss how the operators would know to begin the procedure to switch suction sources if the level instrumentation is not available, and it takes 30 minutes for realignment. In response to the NRC audit process, the licensee indicated that switching the suction from the CSP to the WCT is expected start at 6 hours after the event. Further, they are developing a procedure to read this instrument locally using a portable instrument so there will be ample time to periodically monitor the level to support switchover operations.

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

3.2.1.6 Sequence of Events

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

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

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

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

The analysis provided in WCAP-17601-P does not include RCS makeup. During the NRC audit process, the licensee was requested to provide analysis showing that RCS makeup starting at the provided time constraint of 19 hours does not impact required actions that take place later in the Sequence of Events, including the time to switch water sources and provide mobile boration. In addition, the licensee was requested to provide an analysis showing the impact of injection on reactivity.

Page 30 of the Integrated Plan indicates that borated injection from the RWSP [Refueling Water Storage Pool] eventually re-establishes level in the pressurizer. During the NRC audit process the licensee was further requested to provide an analysis showing that the planned pumps (charging or high pressure FLEX makeup pump) will be able to provide sufficient makeup to prevent a loss of natural circulation flow when started at 19 hours.

In response to the NRC audit process the licensee indicated that RCS makeup of 25 gpm at 19 hours is necessary to maintain single phase natural circulation (per Westinghouse Calculation CN-SEE-II-13-3, Rev 1) which is within the capability of either the high pressure FLEX makeup pump (40 gpm) or a single charging pump (44 gpm). The RWSP has a volume of approximately 383,000 gal. An additional 14 gpm will eventually be needed to make up to the SFP (per Westinghouse Calculation CN-SEE-II-12-38, Rev. 0). As the strategy allows for either the CSP or RWSP to be used as a source for this makeup, the RWSP will be considered to be limiting for this response. Combining both rates, at 39 gpm, over 160 hours of makeup would be available from the RWSP thus there is no impact to the required actions listed in the sequence of events, including switching water sources and aligning mobile boration units. The mobile boration units will need to be aligned at a time greater than 72 hours accounting for RCS makeup, consistent with the sequence of events. Also note that additional sources of water are available for SFP makeup and that SFP makeup is not required until greater than 72 hours.

The licensee further states that core reactivity was analyzed through the first 72 hours of the event (Westinghouse Calculation CN-SEE-II-13-3, Rev. 1), concluding there is 2.48%$\Delta\rho$ shutdown margin at 72 hours. The calculation conservatively considered only injection from the SITs. Make up from the RWSP is at a higher boron concentration than the RCS following SIT injection and will increase shutdown margin with time.

The licensee will provide response to the site-specific issues in a subsequent six-month update. This is identified as Confirmatory Item 3.2.1.7.A in Section 4.2.

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

3.2.1.7 Cold Shutdown and Refueling

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

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

On page 14 of the Integrated Plan, the licensee indicated that for core cooling with steam generators not available cooling is maintained through makeup to the RCS and coolant boil-off. Inventory may be maintained in the vessel by ensuring adequate RCS inventory make-up from the SITs via gravity drain. The ability to gravity feed depends upon SIT fluid height/backpressure, line losses through the gravity flow path, and developed pressure within the RCS. Pressure is maintained sufficiently low in the RCS by ensuring adequate venting is established prior to entering conditions wherein SG cooling is not available as a part of shutdown risk management. The licensee noted that it is currently unclear how long gravity feed from the RWSP or SITs can be maintained in Phase 1. If this time is sufficiently short, the licensee may choose to pre-stage requisite FLEX equipment in advance of entering applicable plant configurations.

The NRC staff’s review of the Integrated Plan for Waterford revealed 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 Nuclear Energy Institute (NEI) position paper entitled “Shutdown/Refueling Modes” (ADAMS Accession No. ML13273A514); and has been endorsed by the NRC in a letter dated September 30, 2013 (ADAMS Accession No. ML13267A382).

The position paper describes how licensees will, by procedure, maintain equipment available for deployment in shutdown and refueling modes. The NRC staff concluded that the position paper provides an acceptable approach for demonstrating that the licensees are capable of implementing mitigating strategies in all modes of operation.

During the NRC audit process the licensee informed the NRC of their plans to abide by this generic resolution and their plans to address potential plant specific issues associated with implementing this resolution that were identified during the audit process. In their response, the licensee indicated that following resolution of the Generic Concern they would provide response to the site-specific issues, identified below, in a future 6-month update coordinating with the NRC on the schedule for the update. This is identified as Confirmatory Item 3.2.1.7.A, in Section 4.2.

The licensee was requested to provide information on the analysis (including methods, assumptions and results) to show that core cooling with SGs not available can be maintained through once through heat removal from the RCS via coolant boil-off. Include in the discussion:

a. Discussion of how gravity feed flow from the refueling water storage pool (RWSP) or safety injection tanks (SITs) will be monitored and throttled to match core boil-off under ELAP conditions.

b. Discussion of timing for providing primary makeup flow via gravity feed from the RWSP or SITs relative to the time of core uncovery under reduced reactor coolant system inventory conditions.

c. Discussion of what supporting equipment is implied to be operable when a steam generator is considered available to mitigate an ELAP (e.g., turbine-driven auxiliary feedwater pump, main steam relief valves, atmospheric valves (ADVs)).

d. Discussion of scenarios wherein there is neither a hot leg vent nor a steam generator available, relative to the guidance in NEI 12-06. The NRC staff understands that Generic Letter 88-17 recommended establishing a hot leg vent under conditions of reduced reactor coolant system inventory (i.e., water level lower than three feet below the reactor vessel flange), rather than on the basis of steam generator availability under ELAP conditions in shutdown and refueling modes. Further, based on the requirement for high pressure makeup specified for shutdown modes without steam generators in Table 3-2 of NEI 12-06, it is not clear that scenarios without a hot leg vent are considered beyond scope.

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 cold shutdown and refueling, if these requirements are implemented as described.

#### 3.2.1.8 Core Sub-Criticality

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

> All plants provide means to provide borated RCS makeup.

On page 13 of the Integrated Plan the licensee indicated that the existing SBO procedure direct operators to begin a cooldown to a cold leg temperature of no less than $400^{0}$F. This cooldown will help minimize RCP seal leakage, ensure passive injection of the safety injection tanks (SITs), and ensure natural circulation is maintained. The SITs will also be isolated before their full depletion to prevent nitrogen injection into the RCS. Cooldown of the RCS will result in a decrease in loss of the RCS inventory from RCP seal leakages, and, in turn, an increase in available time for the operator to take action and maintain the core covered with water. In the presence of a negative moderator temperature coefficient, the cooldown by steaming through the atmospheric dump valves (ADVs) increases positive reactivity in the core. If the control rod worth from the inserted control rods following a reactor trip and the boron concentration from the safety injection are not sufficient to overcome the positive reactivity addition from the cooldown, the reactor will return back to power. As a result of the power increase and RCS pressure decrease, the calculated departure from nucleate boiling ratios (DNBRs) may decrease, possibly causing fuel damage.

On page 30 of the Integrated Plan, the licensee indicated that RCS inventory control during phase 2 involves aligning a pump to provide borated coolant for RCS makeup. Utilizing WCAP-17601 methodology, Waterford has evaluated limiting plant specific scenarios for RCS inventory control, shutdown margin, and Mode 5/Mode 6 boric acid precipitation control and found they do not need to take actions to provide additional negative reactivity during an ELAP event for RCS temperatures in excess of 400degrees Fahrenheit so long as single phase natural circulation is maintained. In addition, if the SITs had to be isolated at the beginning of an ELAP, there is sufficient margin that boration from SIT injection is not required and the plant would remain subcritical throughout the 72 hour transient. Any risk associated with boron precipitation will be mitigated by continued provision of adequate flushing flow. Finally, these evaluations currently indicate that the site will require RCS makeup due to RCP seal leakage near the end of the 24 hour coping period to maintain RCS inventory above the apex of the hot leg. To this end, borated injection into the RCS is provided from the RWSP. This injection eventually re-establishes level in the pressurizer.

During the NRC audit process, the licensee was requested to respond to the following items:

Section 4.3.2 of WCAP-17601 indicates that one of the acceptance criteria of the ELAP analysis is to show that the core remains subcritical. Case 11 in Table 5.2.2-1 indicates that the available shutdown margin is 2.3% $\Delta\rho$ at 72 hours when considering a plant cooldown to approximately 300 $^{0}$F (cold leg) during an ELAP.

a. Confirm that the above discussed Case 11 is applicable to Waterford. If the Case 11 results are not applicable to Waterford, discuss the plant specific re-criticality analysis and show that a return power will not occur when considering a plant cooldown to a plant-specific target temperature during an ELAP.

In response to the NRC audit process, the licensee indicated that a Waterford-specific CENTS case was run based on the cases from WCAP-17601-P Rev. 1 to determine the need for boration to maintain subcriticality for end of life plant conditions. The results showed that the end of life conditions were bounding per WCAP-17601-P Rev. 1. The differences between

Case 11 from the WCAP and the updated case run were a cooldown termination temperature of 400 degrees Fahrenheit and the inclusion of Replacement Steam Generators. The results are documented and discussed in Westinghouse Calculation CN-SEE-II-13-3 Rev. 1. The licensee's response is acceptable and closes this issue.

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 plant specific re-criticality analysis, if these requirements are implemented as described in the licensee's Integrated Plan.

b. Review of the Integrated Plan revealed that the Generic Concern associated with the modeling of the timing and uniformity of the mixing of a liquid boric acid solution injected into the reactor coolant system (RCS) under natural circulation conditions potentially involving two-phase flow was applicable to Waterford.

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

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

3.2.1.9 Use of Portable Pumps

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

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

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

NEI 12-06 Section 11.2 states in part:

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

The licensee's plan for using portable pumps for maintaining core cooling & heat removal, and RCS inventory control was reviewed. On page 16 and page 30 of the Integrated Plan, the licensee discussed the use of portable pumps for maintaining RCS core cooling and heat removal and RCS inventory control, respectively. Pages 64 and 68 list the portable pumps required for the ELAP mitigation. Page 64 lists for phase 2 the EFW primary/Modes 5 and 6, EFW secondary pump (diesel), EFW secondary booster pump, Modes 5 and 6 pump (spare), two RCS Modes 1-4 pumps, two SFP pumps and two water pumps. For phase 3 page 68 lists the EFW primary/RCS Mode 5/6 backup pumps, EFW secondary pump, EFW secondary booster backup pump, RCS Modes 1-4 pump, SFP pump and water transfer pump to makeup CSP or RWSP. The flow rate and corresponding TDH [Total Developed Head] for each of the pumps are provided, except for the water transfer pump to make CSP or RWSP on page 68.

During the NRC audit process, the licensee was requested to provide the following information:

a. Specify the flow rate and corresponding TDH for the water transfer pump to make up to the CST or RWSP.

In response to the NRC audit process, the licensee provided the following additional information to address item a.

The licensee indicated that the pumps providing makeup to the CSP or RWSP must be capable of making up 380 gpm to the CSP or RWSP, which is the greatest flow rate required during either Phase 2 or Phase 3. The total dynamic head differs depending on the makeup source (Westinghouse Calculation CN-FSE-12-13) and the most limiting TDH was determined to be 82 ft (makeup from the FWST, 81.6 ft (at 380 gpm)), as specified in the Integrated Plan on page 64 and 108. This pump is additionally adequate for making up the WCT from the Mississippi River as a last resort (DAR-FSE-12-11).

b. Specify the required time for the operator to realign each of the above discussed pumps and confirm that the required times are consistent with the results of the ELAP analysis.

In response to the NRC audit process, the licensee provided the following additional information to address item b.

The licensee referred to the Enclosure to W3F1-2013-0017 (TR-FSE-13-12), which showed the timing and deployment timelines for the operators to align the indicated pumps under the various modes. A review of the enclosure confirmed that the required timing was consistent with the results of the ELAP analysis.

c. Discuss the analyses that are used to determine the required flow rate and corresponding TDH for each of the portable pumps.

In response to the NRC audit process, the licensee provided the following additional information to address item c.

The calculation was performed using AFT Fathom 7.0, validated for use by Westinghouse for modeling hydraulic performance (CN-FSE-12-13). Flow rates and corresponding TDH requirements are calculated separately for each pump dependent on what function the pump provides.

For pumps providing injection to existing plant systems, nodes were modeled for: source tank to suction connection point through existing piping; suction connection point through discharge hosing; discharge connection point to injection point through existing piping network.

For pumps providing transfer of coolant from alternant cooling source to primary cooling source, the following nodes were modeled: alternate source tank to suction connection point through existing piping; suction connection point to FLEX pump through suction hosing; FLEX pump to discharge connection point through discharge hosing; discharge connection point to primary source through existing piping.

Using the models, a flow rate through each FLEX alignment was specified to allow for determination of: size of suction and discharge FLEX pump hosing/piping; FLEX pump dynamic head at specified flowrate; FLEX pump NPSH available.

The TDH requirements are calculated using the conceptual pipe routings identified in Appendix G of W3F1-2013-0017. Because the pipe routings are conceptual, conservative assumptions are made to maximize TDH required.

d. Justify that that the required capacities of each of the above discussed portable pumps are adequate to maintain core cooling, and sub-criticality during phases 2 and 3 of ELAP. The information should include a discussion and justification of computer codes/methods and assumptions used in the analyses in above item c.

In response to the NRC audit process, the licensee provided the following additional information to address item d.

The licensee indicated that based on performing a heat transfer analysis, injecting 380 gpm of 130degrees Fahrenheit water into the steam generators was determined to be adequate to maintain core cooling with steam generators available (CN-FSE-12-13). In modes 5 and 6 with no steam generators available, RCS make up is required to be 165 gpm, within the capacity of the EFW Primary/Modes 5 & 6 pump. These flow rates are bounding for Phases 2 and 3.

Based on performing a core shutdown margin analysis using the CENTS computer code (CN-SEE-II-13-3), injecting 25 gpm of borated water to the RCS 19 hours after the event initiation in Modes 1-4 is sufficient to maintain inventory control and subcriticality, thus the 40 gpm flow rate requirement of the RCS Modes 1-4 Pump is adequate.

Based on a SFP heat up analysis (CN-SEE-II-12-38), SFP make up is required to be 126.60 gpm at 140degrees Fahrenheit for a full core off load. The SFP make up required with normal

SFP heat load is 13.60 gpm. The SFP Pumps are required to provide 250 gpm and are therefore adequate.

e. In the table of PWR portable equipment Phase 2, the licensee lists EFW primary and secondary pump. The secondary pump is listed as a diesel powered pump. In the description of the strategies employed, the licensee does not differentiate between the two pumps. During an NRC audit of Order EA-12-049 Mitigation Plans the licensee was requested to provide additional information on when and how each of these pumps will be used.

In response to the NRC audit process, the licensee provided the following additional information to address item e.

The EFW Primary pump is an electrically driven pump powered by a FLEX generator. The EFW Primary pump will draw from the CSP/WCT basins and discharge to a modified hard pipe connection on the TDEFWP discharge. The EFW Secondary pump requires an additional EFW Secondary Booster Pump, to be staged. Both the EFW Secondary and EFW Secondary Booster pumps are diesel driven pumps. The Secondary Booster Pump will draw from the WCT basin directly and provide suction to the EFW Secondary pump, which will discharge to two tees upstream of FW-179A and FW-179B.

The use of these pumps is to supply cooling water to the stream generators once the turbine driven EFW pump is no longer available and will be deployed per the sequence of events item #12.

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

### 3.2.2 Spent Fuel Pool Cooling Strategies

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

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

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

In its Integrated Plan in regards to maintaining SFP cooling, the licensee states that SFP cooling is not challenged early in the event; however, access to the SFP area as a part of Phase 2 response could be challenged due to environmental conditions local to the pool so ventilation will be established by opening the Fuel Building access door and equipment staging local to the pool will be performed. The licensee determined that SFP makeup is not required for the normal spent fuel load until 110.5 hours based on a boil off rate of 13.95 gal/min and for full core offload 10.73 hours based on a boil off rate of 129.88 gal/min. The licensee further described two acceptable means for SFP makeup and an acceptable means for SFP spray. The licensee indicated that the Phase 3 strategy would continue with Phase 2 with additional support from off-site resources.

The capacities of the SFP portable pumps, as described in licensee response to portable pump capacities in Section 3.2.1.9, were determined to be 250 gpm and therefore provide acceptable flow for makeup and spray 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 SFP cooling strategies, if these requirements are implemented as described.

3.2.3 Containment Functions Strategies

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

On page 38 of its Integrated Plan regarding maintaining containment, the licensee indicated that containment pressure and temperature are expected to increase during an ELAP due to loss of containment cooling and RCS leakage into containment but based upon the performance of the installed RCP seals, the pressure and temperature are not expected to rise to levels which could challenge the containment structure. On page 72 of the Integrated Plan, the licensee lists open item OI2, which requires an analysis to demonstrate that containment pressure and temperature will stay at acceptable levels and that no containment spray system will be required as part of FLEX. The licensee further indicated that monitoring of containment conditions will still occur and lists containment pressure and temperature instrumentation powered by the FLEX generator and will develop procedures to read this instrumentation locally.

In their 6-month update to the Integrated Plan, the licensee indicated that the analysis associated with open item OI2 was not yet complete. During the NRC audit process, the licensee committed to provide more information in a subsequent six-month update. This item has been identified as Confirmatory Item 3.2.3.A, in Section 4.2.

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

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

With respect to equipment cooling water, the licensee made no reference regarding the need for, or use of, additional cooling systems necessary to assure that coping strategy functionality can be maintained. Nonetheless, the only portable equipment used for coping strategies identified in the Integrated Plan that would require some form of cooling are portable diesel powered pumps and generators. These self-contained commercially available units would not be expected to require an external cooling system nor would they require AC power or normal access to the UHS.

On page 30 in its Integrated Plan in regards to maintaining RCS inventory control in the transition phase, the licensee states that as a first attempt, Waterford 3 will attempt to repower a charging pump to maintain RCS inventory control in Phase 2.

In reviewing the support function of equipment cooling, there is insufficient information to conclude that the licensee's plan for repowering the installed charging pump would address any cooling requirements that may be needed for the charging pump to support its operation. During the NRC audit process, the licensee was requested to provide information on how the charging pump is cooled to support its operation or provide justification for operation of the charging pump without cooling. In response to the NRC audit process, the licensee indicated that the charging pumps have an integral packing cooling and leakage collection system, which is part of the charging pump assembly. No additional cooling system is required. Based on the licensee's response, this item is considered 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 provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to equipment cooling with cooling water, if these requirements are implemented as described.

#### 3.2.4.2 Ventilation – Equipment Cooling

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

> *Plant procedures/guidance should consider loss of ventilation effects on specific energized equipment necessary for shutdown (e.g., those containing internal electrical power supplies or other local heat sources that may be energized or present in an ELAP.*
>
> ELAP procedures/guidance should identify specific actions to be taken to ensure that equipment failure does not occur as a result of a loss of forced ventilation/cooling. Actions should be tied to either the ELAP/LUHS or upon reaching certain temperatures in the plant. Plant areas requiring additional air flow are likely to be locations containing shutdown instrumentation and power supplies, turbine-driven decay heat removal equipment, and in the vicinity of the inverters. These areas include: steam driven AFW pump room, … the control room, and logic cabinets. Air flow may be accomplished by opening doors to rooms and electronic and relay cabinets, and/or providing supplemental air flow.
>
> Air temperatures may be monitored during an ELAP/LUHS event through operator observation, portable instrumentation, or the use of locally mounted thermometers inside cabinets and in plant areas where cooling may be needed. Alternatively, procedures/guidance may direct the operator to take action to provide for alternate air flow in the event normal cooling is lost. Upon loss of these systems, or indication of temperatures outside the maximum normal range of values, the procedures/guidance should direct supplemental air flow be provided to the affected cabinet or area, and/or designate alternate means for monitoring system functions.
>
> For the limited cooling requirements of a cabinet containing power supplies for instrumentation, simply opening the back doors is effective. For larger cooling loads, such as … AFW pump rooms, portable engine-driven blowers may be considered during the transient to augment the natural circulation provided by opening doors. The necessary rate of air supply to these rooms may be estimated on the basis of rapidly turning over the room's air volume.
>
> Actuation setpoints for fire protection systems are typically at 165-180°F. It is expected that temperature rises due to loss of ventilation/cooling during an ELAP/LUHS will not be sufficiently high to initiate actuation of fire protection systems. If lower fire protection system setpoints are used or temperatures are expected to exceed these temperatures during an ELAP/LUHS, procedures/guidance should identify actions to avoid such inadvertent actuations or the plant should ensure that actuation does not impact long term operation of the equipment.

On page 7 of its Integrated Plan the licensee indicated that at the start of the event, SBO actions include establishing control room ventilation, but provided no details of how or what kind of ventilation was established.

On page 54 of in its Integrated Plan the licensee indicated that the battery room would not need to be vented in Phase 1 as a negligible amount of hydrogen off-gas will accumulate prior to recharging the batteries in Phase 2. Establishing control room ventilation consistent with current SBO response procedures supports instrument function and control room habitability.

With respect to ventilation cooling as it relates to equipment protection, the licensee's plan lacked sufficient information to conclude that the plan conformed to the guidance of NEI 12-06, Section 3.2.2, paragraph (10), because:

1) No information was included to show that the ventilation in the control room will be adequate to protect energized equipment throughout the entire ELAP event, especially if the ELAP is due to high temperature hazard. In response to the NRC audit process, the licensee indicated that the information will be provided later in the design/procedure development process and anticipated to be submitted no later than the third six-month update report (August, 2014). This is identified as Open Item 3.2.4.2.A in Section 4.1.

2) No information was included to show that the affects of elevated temperatures in the battery room, especially if the ELAP is due to a high temperature hazard, have been considered. In response to the NRC audit process, the licensee indicated that the information will be provided later in the design/procedure development process and anticipated to be submitted no later than the third six-month update report (August, 2014). This is identified as Open Item 3.2.4.2.B in Section 4.1.

3) No information was included to show that the hydrogen concentration in the battery rooms will be maintained below the limits established by national codes and standards when the batteries are being recharged during Phase 2 and 3. In response to the NRC audit process, the licensee indicated that the information will be provided later in the design/procedure development process and anticipated to be submitted no later than the third six-month update report (August, 2014). This has been identified as Open Item 3.2.4.2.C, in Section 4.1.

4) No information was included to show that the loss of ventilation in the TDEFW pump room, will not affect the ability of the TDEFW pump to perform its function and assist in core cooling throughout all Phases of an ELAP. In response to the NRC audit process, the licensee indicated that the information will be provided later in the design/procedure development process and anticipated to be submitted no later than the third six-month update report (August, 2014). This is identified as Open Item 3.2.4.2.D in Section 4.1.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided such that there would be reasonable assurance that the requirements of Order EA-12-049] will be met with respect to ventilation – equipment room cooling. These questions are identified as open items above and in Section 4.1.

3.2.4.3 Heat Tracing

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

> *Plant procedures/guidance should consider loss of heat tracing effects for equipment required to cope with an ELAP. Alternate steps, if needed, should be identified to supplement planned action.*
>
> Heat tracing is used at some plants to ensure cold weather conditions do not result in freezing important piping and instrumentation systems with small

diameter piping. Procedures/guidance should be reviewed to identify if any heat traced systems are relied upon to cope with an ELAP. For example, additional condensate makeup may be supplied from a system exposed to cold weather where heat tracing is needed to ensure control systems are available. If any such systems are identified, additional backup sources of water not dependent on heat tracing should be identified.

The licensee screened out for extreme cold and snow and thus there is no need for the licensee to address loss of heat tracing.

3.2.4.4 Accessibility – Lighting and Communications

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

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

On page 7 of its Integrated Plan the licensee indicated that at hour 2 they will verify that Appendix R portable lighting remains adequate until the FLEX generator is started in Phase 2. The licensee further stated on page 54 and 56 that control room lighting is powered by the plant batteries and adequate portable lighting is provided to support activities outside of the control room. Further, smaller diesel generators will be used as necessary to power communications equipment and portable lighting.

The licensee's plan for lighting to support FLEX strategy implementation did not provide any information on whether plant procedures and guidance will include lighting such as flashlights or headlamps necessary for ingress and egress to plant areas required for deployment of the strategies. In response to the NRC audit process, the licensee indicated that an assessment of the habitability/accessibility requirements have not been completed at this time and will be provided later in the design/procedure development process and will be submitted no later than the third six-month update report (August, 2014). This is identified as Open Item 3.2.4.4.A, in Section 4.1.

The NRC staff has reviewed the licensee communications assessment (ML12306A194 and ML13053A204) in response to the March 12, 2012 50.54(f) request for information letter for Waterford and, as documented in the staff analysis (ML13127A233) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2 (8) regarding communications capabilities during an ELAP. This has been identified as Confirmatory Item 3.2.4.4.B in Section 4.2 below.

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

3.2.4.5 Protected and Internal Locked Area Access

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

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

With regards to the development of guidance and strategies with regard to the access to protected and internal locked areas, the Integrated Plan did not provide any discussion on this topic. In response to the NRC audit process, the licensee indicated that procedures are in place to control access to these areas and procedure will be revised or developed as necessary to include appropriate actions required by FLEX strategies. This has been identified as Confirmatory Item 3.2.4.5.A. in Section 4.2.

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

3.2.4.6 Personnel Habitability – Elevated Temperature

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

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

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

Section 9.2 of NEI 12-06 states,

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

SFP accessibility was discussed in Section 3.2.2 above under SFP cooling strategies.

On page 7 of its Integrated Plan regarding sequence of events, the licensee indicated that at the start of the event SBO actions would be performed, including establishing control room ventilation. The licensee also indicated that smaller diesel generators would be used as necessary to power portable fans.

The licensee's plan on personnel habitability/accessibility in an elevated temperature environment lacked information to determine that the habitability limits will be maintained and/or operator protective measures will be employed in all phases of an ELAP to ensure operators will be capable of FLEX strategy execution under adverse temperature conditions. Examples of areas of concern are the control room, TDEFW pump room, and charging pump room. In response to the NRC audit process, the licensee indicated that an assessment of the habitability/accessibility requirements have not been completed at this time and will be provided later in the design/procedure development process and will be submitted no later than the third six-month update report (August, 2014). This is identified as Confirmatory Item 3.2.4.6.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 personnel habitability/accessibility in an elevated temperature environment, if these requirements are implemented as described.

3.2.4.7 Water Sources.

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

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

> Alternate water delivery systems can be considered available on a case-by-case basis. In general, all CSTs should be used first if available. If the normal source of makeup water (e.g., CST) fails or becomes exhausted as a result of the hazard, then robust demineralized, raw, or borated water tanks may be used as appropriate.
>
> Heated torus water can be relied upon if sufficient [net positive suction head] NPSH can be established. Finally, when all other preferred water sources have been depleted, lower water quality sources may be pumped as makeup flow using available equipment (e.g., a diesel driven fire pump or a portable pump drawing from a raw water source). Procedures/guidance should clearly specify the conditions when the operator is expected to resort to increasingly impure water sources.

The licensee addressed water sources for coping strategies in its Integrated Plan on pages 13, 14, 16, and 23.

On page 72, in its Integrated Plan in regards to open items, the licensee indicated that the suction path from the TDEFWP to the WCTs would be through a non-running ACCWS pump post-ELAP. However, this will need to be confirmed as the detailed design of the primary strategy for maintaining core cooling and heat removal evolves. This is identified as Confirmatory Item 3.2.4.7.A in Section 4.2.

On page 16 of its Integrated Plan the licensee identified the indefinite supply of makeup water from the Mississippi River through a purification system. During the NRC audit process, the licensee was requested to describe how they would get water from the Mississippi River to the FLEX pumps. In response to the NRC audit process, the licensee indicated that the information will be provided later in the design/procedure development process and anticipated to be submitted no later than the third six-month update report (August, 2014). This is identified as Confirmatory Item 3.2.4.7.B, in Section 4.2.

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

3.2.4.8 Electrical Power Sources/Isolations and Interactions.

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

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

On page 56 of the Integrated Plan the licensee indicated that the Phase 2 coping strategy involves using an on-site portable FLEX generator to provide 480 V electrical power for necessary plant equipment. On page 61 the licensee indicated that Phase 3 involves receiving a medium voltage (4160 V) generator from the RRC to power certain plant equipment to aid in cooling down the plant to a stable, Mode 5 condition. It is currently estimated that the RRC will be able to provide a 2 MW Diesel Generator. The generator will re-power the existing 4160 V buses to supply power to the loads necessary for shutdown cooling. During the audit process, the licensee was requested to provide a summary of the sizing calculations used to determine the adequacy of these generators to support FLEX. In response to the NRC audit process, the licensee indicated that this information would be provided later during the design/procedure development process and submitted no later than the third 6-month update. This is identified as Open Item 3.2.4.8.A in Section 4.1 below.

On page 6 of the Integrated Plan regarding assumptions specific to the Waterford site, the licensee stated that instrumentation on FLEX equipment will be used to confirm continual performance. The licensee did not provided details of the FLEX instrumentation to ensure that electrical equipment remains protected (from an electrical standpoint – e.g., power fluctuations). In response to the NRC audit process, the licensee indicated that Instrumentation used to monitor portable FLEX electrical power equipment will be addressed during the design and procedure development phase to be submitted no later than the third six-month update report (August, 2014). The licensee also needs to provide information regarding the electrical isolation to ensure that the portable/FLEX diesel generators are isolated from Class 1E diesel generators to prevent simultaneously supplying power to same Class 1E bus. This is identified as Confirmatory Item 3.2.4.8.B., in Section 4.2.

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

3.2.4.9 Portable Equipment Fuel.

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

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

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

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

On page 8 of its Integrated Plan regarding sequence of events, the licensee indicated that at hour 22, begin FLEX equipment fuel management based on the need to support continuous operation of on-site diesel powered FLEX equipment and at hour >72, establish large fuel truck service based on fuel depletion of onsite supplies and need to fuel large equipment.

On page 56 of the Integrated Plan the licensee indicated that smaller diesel generators loaded on carts, similar to the ones used for other strategies will be used as necessary to power fuel oil transfer pumps.

On page 57 and 61 of the Integrated Plan the licensee indicated that either diesel generator 3A fuel oil transfer pump A or diesel generator 3B fuel oil transfer pump B will be repowered by the FLEX generator. Hose can be routed from the makeup piping from the pump discharge to the daytank as needed to replenish the FLEX generator fuel supply.

The Integrated Plan contained no discussion of fuel for the EFW secondary diesel driven pump described on page 64 of the Integrated Plan. The licensee was requested to provide a discussion on the diesel fuel oil supply for the diesel driven pump and how continued operation to ensure core cooling is maintained. The licensee was also requested to provide a discussion on the diesel fuel oil supply (e.g., fuel oil storage tank volume, supply pathway, etc.) for the FLEX generators and how continued operation to ensure core and SFP cooling is maintained indefinitely (i.e., Phase 2 and 3). In response to the NRC audit process, the licensee indicated that the information will be provided later in the design/procedure development process and will be submitted no later than the third six-month update report (August, 2014). This has been identified as Confirmatory Item 3.2.4.9.A., in Section 4.2, below.

As part of the audit process, the licensee was requested to clarify how fuel quality will be assured for the FLEX equipment. This is identified as Confirmatory Item 3.2.4.9.B, in Section 4.2 below.

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

3.2.4.10 Load Reduction to Conserve DC Power.

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

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

On page 7 of its Integrated Plan describing the sequence of events and time constraints, the licensee indicated that FLEX deep load shed actions are initiated at one hour after the event and no later than hour 4, the operators will establish an extended DC load shed to extend installed plant battery draw down time into Phase 2 of the ELAP when a FLEX generator will be utilized to supply required loads and / or recharge installed plant batteries. The battery chargers are energized following deployment of the FLEX generator at hour 12.

Current regulatory guidance on battery duty cycles for safety-related batteries limits qualification to 8 hours. As the FLEX generator is not deployed until hour 12, at which time the battery chargers will be energized, the licensee has provided insufficient information to support a conclusion that the Waterford 3 batteries can meet the battery duty cycles determined by calculation in order to conform to that guidance.

The NRC staff reviewed the Integrated Plan for Waterford and determined that the Generic Concern related to battery duty cycles beyond 8 hours is applicable to the plant. The Generic Concern related to extended battery duty cycles, has been resolved generically through the NRC endorsement of Nuclear Energy Institute (NEI) position paper entitled “Battery Life Issue” (ADAMS Accession no ML13241A186 (position paper) and ML13241A188 (NRC endorsement letter)).

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

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

The NRC staff concluded that the position paper provides an acceptable approach for licensees to use in demonstrating that vented lead-acid batteries can be credited for durations longer than 8 hours.

Waterford informed the NRC of their plans to abide by this generic resolution, and their plans to address potential plant-specific issues associated with implementing this resolution that was identified during the audit process. The following plant specific were identified during the NRC audit process.

The licensee’s Integrated Plan on Page 7 identifies dc load shed at hour 1 and 4. With regard to the load shedding of the dc bus in order to conserve battery capacity the licensee was requested to:

a. Provide the dc load profile for the mitigation strategies to maintain core cooling, containment, and SFP cooling during all modes of operation. In your response, describe any load shedding that is assumed to occur and the actions necessary to complete each load shed. Also provide a detailed discussion on the loads that will be shed from the dc bus, the equipment location (or location where the required action needs to be taken), and the required operator actions necessary and the time to complete each action. In your response, explain which functions are lost as a result of shedding each load and discuss any impact on defense-in-depth strategies and redundancy.

b. Identify any plant components that will change state if vital ac or dc power is lost or de-energized during the load shed. Of particularly interest is whether a safety hazard is introduced, such as de-energizing the dc-powered seal oil pump for the main generator and allowing hydrogen to escape, which could contribute to risk of fire or explosion in the vicinity from the uncooled main turbine bearings.

c. Provide the minimum voltage that must be maintained and the basis for the minimum voltage on each battery/dc bus during each Phase under all MODES of operation (consider the impact of reduced loading as a result of load shedding).

In a response to the NRC audit process the licensee indicated that the DC powered Seal Oil Pumps are powered from the non-safety related Turbine Building DC system and not the Safety Related DC buses. Therefore, this load will not be shed as part of the FLEX strategy.

Responses to the remainder of the request in a., b., and c. above will be provided later in the design/procedure development process and will be submitted no later than that third six-month update report (August, 2014). This has been documented as Open Item 3.2.4.10.A in Section 4.1.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that the approach is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to load reduction to conserve power. These concerns are identified in Open Item 3.2.4.10.A above and in Section 4.1.

## 3.3 PROGRAMMATIC CONTROLS

### 3.3.1 Equipment Maintenance and Testing.

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

> In order to assure reliability and availability of the FLEX equipment required to meet these capabilities, the site should have sufficient equipment to address all functions at all units on-site, plus one additional spare, i.e., an N+1 capability, where "N" is the number of units on-site. Thus, a two-unit site would nominally have at least three portable pumps, three sets of portable ac/dc power supplies, three sets of hoses & cables, etc. It is also acceptable to have a single resource that is sized to support the required functions for multiple units at a site (e.g., a single pump capable of all water supply functions for a dual unit site). In this

case, the N+1 could simply involve a second pump of equivalent capability. In addition, it is also acceptable to have multiple strategies to accomplish a function (e.g., two separate means to repower instrumentation). In this case the equipment associated with each strategy does not require N+1. The existing 50.54(hh)(2) pump and supplies can be counted toward the N+1, provided it meets the functional and storage requirements outlined in this guide. The N+1 capability applies to the portable FLEX equipment described in Tables 3-1 and 3-2 (i.e., that equipment that directly supports maintenance of the key safety functions). Other FLEX support equipment only requires an N capability.

NEI 12-06, Section 11.5 states:

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

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

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

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

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

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

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

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

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

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

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

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

On page 10 and 11 of its Integrated Plan discussing programmatic controls, the licensee indicated that equipment associated with these strategies would be procured as commercial grade equipment. Further, the storage, maintenance, testing, and configuration control of the equipment will be in accordance with NEI 12-06, Rev. 0, Section 11.0. The FLEX mitigation equipment will be initially tested (or other reasonable means used) to verify performance conforms to the limiting FLEX requirements. It is expected that the testing will include the equipment and the assembled sub-system to meet the planned FLEX performance. Additionally, Entergy will implement the maintenance and testing template upon issuance by the Electric Power Research Institute (EPRI). The template will be developed to meet the FLEX guidelines established in Section 11.5 of Reference 2.

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

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

During the NRC audit process, Waterford informed the NRC of their plans to abide by this generic resolution and their plans to address potential plant specific issues associated with implementing this resolution that were identified during the audit process.

The only plant specific issue identified during the review was associated with the battery duty cycle discussed as a generic concern in Section 3.2.4.10 and will be resolved under the battery duty cycle generic concern.

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

3.3.2 Configuration Control.

NEI 12-06, Section 11.8 states:

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

On page 21 of its Integrated Plan discussing programmatic controls, the licensee indicated that FLEX strategies and basis will be maintained in an overall program document and existing plant configuration control procedures will be modified to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies in accordance with NEI 12-06, Section 11.8.

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

3.3.3 Training.

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

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

2. Periodic training should be provided to site emergency response leaders on

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

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

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

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

On page 11 in its Integrated Plan in regards to training, the licensee indicated that training plans will be developed for plant groups such as the emergency response organization (ERO), Fire, Security, emergency planning/personnel (EP), Operations, Engineering, Mechanical Maintenance, and Electrical Maintenance. The training plan development will be done in accordance with Entergy procedures at Waterford using the Systematic Approach to Training, and will be implemented to ensure that the required site staff is trained prior to implementation of FLEX. The training program will comply with the requirements outlined in Section 11.6 of Reference 2.

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

## 3.4 OFFSITE RESOURCES

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

1) A capability to obtain equipment and commodities to sustain and backup the site's coping strategies.
2) Off-site equipment procurement, maintenance, testing, calibration, storage, and control.
3) A provision to inspect and audit the contractual agreements to reasonably assure the capabilities to deploy the FLEX strategies including unannounced random inspections by the Nuclear Regulatory Commission.
4) Provisions to ensure that no single external event will preclude the capability to supply the needed resources to the plant site.

5) Provisions to ensure that the off-site capability can be maintained for the life of the plant.
6) Provisions to revise the required supplied equipment due to changes in the FLEX strategies or plant equipment or equipment obsolescence.
7) The appropriate standard mechanical and electrical connections need to be specified.
8) Provisions to ensure that the periodic maintenance, periodic maintenance schedule, testing, and calibration of off-site equipment are comparable/consistent with that of similar on-site FLEX equipment.
9) Provisions to ensure that equipment determined to be unavailable/non-operational during maintenance or testing is either restored to operational status or replaced with appropriate alternative equipment within 90 days.
10) Provision to ensure that reasonable supplies of spare parts for the off-site equipment are readily available if needed. The intent of this provision is to reduce the likelihood of extended equipment maintenance (requiring in excess of 90 days for returning the equipment to operational status).

On page 12 of its Integrated Plan regarding the Regional Response Center plan, the licensee indicated that the industry would establish two (2) RRCs to support utilities during beyond design basis events. Each RRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assemble Area, established by the strategic alliance for FLEX emergency response (SAFER) team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 24 hours from the initial request.

Entergy, for the Waterford site, has signed a contract with SAFER to meet the requirements of NEI 12-06, Section 12.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01 and 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 |
|---|---|---|
| 3.1.3.A | Wind Hazard Screening - The licensee's response fails to consider the warning time offered by a hurricane storm for pre-staging FLEX equipment. In addition, as described in NEI 12-06, Section 7.2.2, hurricanes can have a significant impact on local infrastructure, e.g., downed trees and flooding that should be considered in the interface with off-site resources. | |
| 3.2.1.1.B | CENTS - Justify conformance with the limitations of the use of CENTS by providing the CENTS-calculated value of the centered moving of the flow quality at the top of the SG tubes, which | Significant |

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| | corresponds to the maximum void fraction of 0.2 in SG tubes as conditions used to define termination of single phase natural circulation, and confirming that the value is less than the limit specified in the white paper dated September 24, 2013 for use in defining the onset of reflux boing. | |
| 3.2.1.2.A | RCP Seal Leakage – Justification of less than 15 gpm per RCP seal leakage in analysis. | Significant |
| 3.2.1.2.B | RCP generic seal question | Significant |
| 3.2.1.3.A | Decay Heat – Assumption 4 on page 4-13 of WCAP-17601 states that decay heat is per ANS 5.1-1979 + 2 sigma, or equivalent. Address the applicability of assumption 4 to Waterford. If the ANS 5.1-1979 + 2 sigma model is used in the Waterford ELAP analysis, address the adequacy of the use of the decay heat model in terms of the plant-specific values of the following key parameters: (1) initial power level, (2) fuel enrichment, (3) fuel burnup, (4) effective full power operating days per fuel cycle, (5) number of fuel cycles, if hybrid fuels are used in the core, and (6) fuel characteristics (addressing whether they are based on the beginning of the cycle, middle of the cycle, or end of the cycle). If a different decay heat model is used, describe the specific model and address the adequacy of the model and the analytical results. | Significant |
| 3.2.1.8.A | Core Sub-Criticality – Additional technical justification is needed for NRC staff's acceptance of the PWROG position paper on boron mixing. | |
| 3.2.4.2.A | Ventilation - adequacy of ventilation in the control room to protect energized equipment throughout the entire ELAP event, especially if the ELAP is due to high temperature hazard. | 3.2.4.2.A thru D collectively are significant |
| 3.2.4.2.B | Ventilation - affects of elevated temperatures in the battery room, especially if the ELAP is due to a high temperature hazard. | See above |
| 3.2.4.2.C | Ventilation - hydrogen concentration in the battery rooms | See above |
| 3.2.4.2.D | Ventilation - loss of ventilation in the TDEFW pump room. | See above |
| 3.2.4.4.A | Lighting – Review the licensee's assessment of the habitability/accessibility requirements to ensure lighting is appropriately addressed. | |
| 3.2.4.8.A | Electrical Power Sources/Isolation and Interactions – Provide a summary of the sizing calculations used to determine the adequacy of the FLEX generators used to power plant electrical equipment. | |
| 3.2.4.10.A | Load Reduction to Conserve DC Power - The licensee's Integrated Plan on Page 7 identifies dc load shed at hour 1 and 4. With regard to the load shedding of the dc bus in order to conserve battery capacity:<br><br>a. Provide the dc load profile for the mitigation strategies to maintain core cooling, containment, and SFP cooling during all modes of operation. In your response, describe any load shedding that is assumed to occur and the actions necessary to complete each load shed. Also provide a detailed discussion on | Significant |

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| | the loads that will be shed from the dc bus, the equipment location (or location where the required action needs to be taken), and the required operator actions necessary and the time to complete each action. In your response, explain which functions are lost as a result of shedding each load and discuss any impact on defense-in-depth strategies and redundancy.<br><br>b. Identify any plant components that will change state if vital ac or dc power is lost or de-energized during the load shed.<br><br>c. Provide the minimum voltage that must be maintained and the basis for the minimum voltage on each battery/dc bus during each Phase under all MODES of operation (consider the impact of reduced loading as a result of load shedding). | |

## 4.2 CONFIRMATORY ITEMS

| Item Number | Description | Notes |
|---|---|---|
| Confirmatory Item 3.1.1.1.A | Seismic Protection - 1) seismic interactions to ensure equipment is not damaged by non-seismically robust equipment or structures for portable equipment that will be stored outside; 2) how large FLEX equipment such as pumps and power supplies stored inside seismic structures is appropriately secured to protect them during a seismic event; and, 3) where other portable equipment such as hoses and power cables would be stored to assure proper protection from a seismic event. | |
| 3.1.1.2.A | Seismic Deployment - protection of the connection points for Reactor Coolant System (RCS) inventory control during the final phase is yet to be determined (TBD). | |
| 3.1.1.2.B | Seismic Protection - No protection of the tow vehicle used to move the +1 FLEX generator. (Also tied into to the ability to move equipment in the flooding context discussed in Section 3.1.2.2 and wind protection for the vehicle discussed in Section 3.1.3.2) | |
| 3.1.1.3.A | Seismic Procedural Interface - seismic hazards associated with large internal flooding sources that are not seismically robust and do not require ac power, and the use of ac power to mitigate ground water in critical locations. | |
| 3.1.1.4.A | Seismic Off site resources – The licensee has not yet identified the local staging area and method of transportation to the site. | |
| 3.1.2.2.A | Flooding Deployment - Implementation of flooding persistence into their FLEX strategies for pre-event staging of FLEX equipment. | |
| 3.1.2.3.A | Flooding Procedural Interface - deployment of portable equipment in flooded conditions not incorporated into flood procedures or the need to deploy temporary flood barriers and extraction pumps necessary to support deployment. | |
| 3.1.3.2.A | Wind Deployment - whether procedures and programs will include taking proactive actions such as testing, connecting, and readying exposed portable equipment to reduce the potential for wind impacts. | |
| 3.2.1.1.A | CENTS – Verify the use of CENTS in the ELAP analysis for Waterford is limited to the flow conditions before reflux boiling initiates. This includes providing a justification for how the initiation of reflux boiling is defined. | |
| 3.2.1.4.A | Initial Values for Key Plant Parameters and Assumptions – Review analysis of UHS (licensee open item OI5) | |
| 3.2.1.7.A | Cold Shutdown and Refueling – NRC questions on the analysis (including methods, assumptions and results) to show that core cooling with SGs not available can be maintained through once through heat removal from the RCS via coolant boil-off. | |
| 3.2.3.A | Containment Functions Strategies - Review the results of the finalized containment analysis associated with open item OI2 of the Integrated Plan, which shows that containment functions will | |

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| | be (potentially) restored and maintained in response to an ELAP event. | |
| 3.2.4.4.B | Communications - Confirm that upgrades to the site's communications systems have been completed. | |
| 3.2.4.5.A | Protected and Internal Locked Area Access – Verify access plans are incorporated into FLEX strategies. | |
| 3.2.4.6.A | Personnel Habitability – Review the licensee's assessment of the habitability/accessibility requirements in all critical areas. | |
| 3.2.4.7.A | Water Sources – Verify the evaluation of the suction path from the TDEFWP to the WCTs through a non-running ACCWS pump post-ELAP confirms it is viable. | |
| 3.2.4.7.B | Water Sources – Description of how they would get water from the Mississippi River to the FLEX pumps. | |
| 3.2.4.8.B | Electrical Power Sources/Isolation and Interactions – Concern with the level of detail of the FLEX instrumentation to ensure that electrical equipment remains protected (from an electrical standpoint – e.g., power fluctuations). Also, confirm electrical isolation to ensure that the portable/FLEX diesel generators are isolated from Class 1E diesel generators to prevent simultaneously supplying power to same Class 1E bus. | |
| 3.2.4.9.A | Portable Equipment Fuel - diesel fuel oil supply for the diesel driven pump and how continued operation to ensure core cooling is maintained. Diesel fuel oil supply (e.g., fuel oil storage tank volume, supply pathway, etc.) for the FLEX generators and how continued operation to ensure core and SFP cooling is maintained indefinitely (i.e., Phase 2 and 3). | |
| 3.2.4.9.B | Portable Equipment Fuel – Discuss how fuel quality will be maintained. | |