Mega-Tech Services, LLC

Technical Evaluation Report Related to Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, EA-12-049

Revision 0

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Southern Nuclear Operating Company
Vogtle Electric Generating Plant, Units 1, and 2
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1.0 BACKGROUND

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

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

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

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

Guidance and strategies required by the Order would be available if a loss of power, motive force and normal access to the ultimate heat sink needed to prevent fuel damage in the reactor and SFP affected all units at a site simultaneously. The Order requires a three-phase approach for mitigating BDBEEs. The initial phase requires the use of installed equipment and resources

to maintain or restore key safety functions including core cooling, containment, and SFP cooling. The transition phase requires providing sufficient portable onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from offsite. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely.

NEI submitted its document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" in August 2012 (ADAMS Accession No. ML12242A378) to provide specifications for an industry-developed methodology for the development, implementation, and maintenance of guidance and strategies in response to Order EA-12-049. The guidance and strategies described in NEI 12-06 expand on those that industry developed and implemented to address the limited set of beyond-design-basis external events 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

- Spent Fuel Pool 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 stated 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 <u>TECHNICAL EVALUATION</u>

By letter dated February 28, 2013, (ADAMS Accession No. ML13059A382), and as supplemented by the first six-month status report in letter dated August 28, 2013 (ADAMS Accession No. ML1324A239), Southern Nuclear Operating Company, Inc. (the licensee or Southern) provided Vogtle Electric Generating Plant Units 1 & 2 (Vogtle or VEGP) 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 beyond-design-basis external events 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. On page 6 of the Integrated Plan, the licensee identified the seismic criteria for Vogtle included in the Unit 1 and 2 FSAR. The licensee stated that NEI 12-06, Section 5.2, requires all sites to consider the seismic hazard, thus Vogtle screens in for an assessment for seismic hazard. 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 the Integrated Plan.

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

3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

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

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

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

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

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

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

On page 11 of the Integrated Plan, the licensee stated that procedures and programs will be developed in accordance with NEI 12-06 to address storage structure requirements. On page 13, the licensee stated that they will construct structures to provide protection of the FLEX equipment to meet the requirements identified in NEI 12-06, Section 11.

The licensee's commitment to meet the storage structure considerations of NEI 12-06, Section 11.3 encompasses the storage structure considerations of Section 5.3.1 for the seismic hazard.

The licensee's Integrated Plan did not provide any information to address the securing of large portable equipment to protect them during a seismic event or to ensure unsecured and/or non-seismic components do not damage the equipment during a seismic event as required by NEI-12-06, Section 5.3.1. In response to the NRC audit process, the licensee stated that any large portable FLEX equipment stored in the proximity of permanent plant structures, systems, or components (SSCs) will be secured to ensure protection of SSCs during seismic events. Procedural guidance for storage of FLEX equipment will include provisions for prevention of seismic interaction between FLEX equipment and other 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 – seismic hazard, if these requirements are implemented as described.

3.1.1.2 Deployment of FLEX Equipment - Seismic Hazard

NEI 12-06, Section 5.3.2 states:

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

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

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

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

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

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

On page 23, 42, and 50 of the Integrated Plan, the licensee stated that storage location and structure have not yet been decided. After the structure design and location are finalized, the deployment routes will be evaluated for external hazards to demonstrate a clear deployment path.

The licensee's Integrated Plan did not list any debris removal equipment for phase 2 of the FLEX coping strategies. During the NRC audit process, the licensee was requested to provide details for their plans for providing debris removal equipment during phase 2. In response to the NRC audit process, the licensee stated that obstacles and interference reviews have shown a need for medium sized construction equipment to ensure timely clearance of any route. An example of such equipment is a wheeled loader with bucket and forklift capability. The large thick rubber tires and low-end torque provide efficient response in clearing any path under the majority of severe conditions. The drivability and operator protection provided with this equipment are also a consideration in selection. Each plant site will have the aforementioned equipment with present plans to store the equipment in the onsite FLEX equipment storage facility.

The licensee stated on page 23, of the Integrated Plan, with similar statements on pages 34, 42, and 50 in regard to protection of connections, that plant piping and valves for FLEX connections will be missile protected and enclosed within a Seismic Category 1 or seismically rugged structure. New FLEX piping shall be installed to meet necessary seismic requirements. Electrical connection points for the on-site FLEX 480 VAC DGs will be designed to withstand the applicable hazards.

On page 63 and 64 of the Integrated Plan, the licensee listed two tow vehicles, flatbed trailers to store and transport hoses, strainers, cables, and miscellaneous equipment, and three trailers

with fuel tank and portable fuel containers.

The licensee indicates that after the structure design and location are finalized, the deployment routes will be evaluated for external hazards to demonstrate a clear deployment path. Because the susceptibility of the site to the effects of soil liquefaction is not discussed in the seismic assessment section of the Integrated Plan, it was not clear that soil liquefaction would be considered for the deployment paths. In response to the NRC audit process, the licensee stated that the storage facility will be located just outside of the Protected Area within the Owner Controlled Area. Multiple haul routes will be available from the storage facility to any staging area. The storage location and appropriate haul routes will be evaluated for access per NEI 12-06, Section 5.3.2 (including liquefaction).

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-seismic hazard, if these requirements are implemented as described.

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

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

On page 17 of the Integrated Plan, the licensee stated that key reactor parameters can be determined from a local reading using standard I&C instruments.

Although the licensee indicates that key reactor parameters can be determined from a local reading using standard I&C instruments, the licensee did not provide sufficient details to address all the aspects of NEI 12-06, Section 5.3.3, Consideration 1. This is identified as Confirmatory Item 3.1.1.3.A in Section 4.2 below.

The licensee's Integrated Plan did not contain any information in regards to seismic hazards associated with large internal flooding sources that are not seismically robust and do not require ac power; or the use of ac power to mitigate ground water in critical locations. In response to the NRC audit process, the licensee stated that the evaluation of large internal flood sources that are not seismically robust and that do not require the use of ac power, has not been completed at this time; an updated response will be provided no later than the third six-month update report (August, 2014). At this time, no internal flood sources of this nature have been identified. No active ground water mitigation systems are used at Vogtle. This has been identified as Confirmatory Item 3.1.1.3.B. in Section 4.2.

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

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

On page 14 of the Integrated Plan, the licensee stated that VEGP will utilize the industry Regional Response Centers (RRCs) for Phase 3 equipment. VEGP has contractual agreements in place with the Strategic Alliance for FLEX Emergency Response (SAFER). The two industry RRCs will be established to support utilities in responding to BDBEEs. Each RRC will hold five (5) sets of equipment, four of which will be able to be fully deployed when requested; the fifth set will have equipment in a maintenance cycle. Communications will be established between the affected nuclear site and the SAFER team and required equipment mobilized as needed. Equipment will initially be moved from an RRC to a local staging area established by the SAFER team and the utility. The equipment will be prepared at the staging area prior to transportation to the site. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 24 hours from the initial request.

The licensee has provided information regarding its use of the offsite resources through the

industry SAFER program, but has not yet identified the local staging area and method of transportation. During the NRC audit process, the licensee was requested to provide additional details for assessing the best means to obtain resources from off-site following a seismic event. In response to the NRC audit process, the licensee stated that plans are to deliver equipment from offsite sources via truck or airlift. These vehicles will follow pre-selected routes directly to the plant site staging area or to an intermediate staging area approximately 25 miles from the site. The delivery of equipment from the intermediate staging area will use the same methodology. The staging areas are large hard-surfaced areas of approximately 2 to 3 acres in size. Helicopter landing considerations are accounted for in selection of the areas. These areas are designed to accommodate the equipment being delivered from the RRC. The RRC personnel will commence delivery of pre-selected equipment from the RRC upon notification by the plant site. Typically, deliveries will go by truck with preselected routes and any necessary escort capabilities to ensure timely arrival at one of the staging areas. Depending on time constraints, equipment can be flown commercially to a major airport near the plant site and trucked or air lifted from there to the staging areas. The use of helicopter delivery is typically considered when routes to the plant are impassable and time considerations for delivery will not be met with ground transportation. Multiple pre-selected routes are one method to circumvent the effects of seismic events, floods, etc. and these routes will take into account potentially impassible areas such as bridges, rivers, heavily wooded areas and towns. The drivers will have the routes marked and will be in communication with the RRC to ensure that the equipment arrives on time. Procedures will document the best means to obtain resources from offsite following a seismic event as recommended in NEI 12-06, Section 5.3.4, consideration 1. This is identified as Confirmatory Item 3.1.1.4.A in Section 4.2 below.

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

3.1.2 Flooding.

NEI 12-06, Section 6.2 states:

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

NEI 12-06, Section 6.2.1 states in part:

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

On page 6 of the Integrated Plan, the licensee stated that the external flood hazard is not

applicable as Vogtle is built above the design basis flood level. Per VEGP FSAR Chapter 2, the PMF stage is about 138 feet mean sea level (MSL) without wave run up; with wave run up due to coincident upstream dam failure, the water may reach as high as 165 feet MSL. Grade elevation of the VEGP control building, containment buildings, diesel generator buildings, and all safety-related structures is approximately 220 feet MSL. Contours and grading in the Units 3 and 4 construction area are controlled to prevent impact on flooding analysis. The site is not adjacent to a large, enclosed, or partially enclosed body of water. Therefore, Vogtle is considered a dry site and would not be affected adversely by external flooding events.

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

NEI 12-06, Section 6.2.1, Susceptibility to external flooding states in part:

> Plants that are not dry sites will perform the next two steps of the flood-induced challenge evaluation. [6.2.2. Characterization of the Applicable Flood Hazard and 6.2.3. Protection and Deployment of FLEX strategies]

Based on the above, the remaining sections of the external flood evaluation are not applicable.

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard – Not applicable
3.1.2.2 Deployment of FLEX Equipment – Flooding Hazard - Not applicable
3.1.2.3 Procedural Interfaces – Flooding Hazard - Not applicable
3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard - Not applicable

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 7 of the Integrated Plan, the licensee stated that based on the latitude and longitude of the site, hurricanes and tornados are applicable to Vogtle. Therefore, the site screens in for an assessment for the high winds hazard.

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

3.1.3.1 Protection of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.1 states:

> These considerations apply to the protection of FLEX equipment from high wind hazards:
>
> 1. For plants exposed to high wind hazards, FLEX equipment should be stored in one of the following configurations:
>
>   a. In a structure that meets the plant's design basis for high wind hazards (e.g., existing safety-related structure).
>
>   b. In storage locations designed to or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* given the limiting tornado wind speeds from Regulatory Guide 1.76 or design basis hurricane wind speeds for the site.
>
>   - Given the FLEX basis limiting tornado or hurricane wind speeds, building loads would be computed in accordance with requirements of ASCE 7-10. Acceptance criteria would be based on building serviceability requirements not strict compliance with stress or capacity limits. This would allow for some minor plastic deformation, yet assure that the building would remain functional.
>
>   - Tornado missiles and hurricane missiles will be accounted for in that the FLEX equipment will be stored in diverse locations to provide reasonable assurance that N sets of FLEX equipment will remain deployable following the high wind event. This will consider locations adjacent to existing robust structures or in lower sections of buildings that minimizes the probability that missiles will damage all mitigation equipment required from a single event by protection from adjacent buildings and limiting pathways for missiles to damage equipment.
>
>   - The axis of separation should consider the predominant path of tornados in the geographical location. In general, tornadoes travel from the West or West Southwesterly direction, diverse locations should be aligned in the North-South arrangement, where possible. Additionally, in selecting diverse FLEX storage locations, consideration should be given to the location of the diesel generators and switchyard such that the path of a single tornado would not impact all locations.
>
>   - Stored mitigation equipment exposed to the wind should be adequately tied down. Loose equipment should be in protective

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

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

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

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

On page 13 of the Integrated Plan, the licensee stated that structures will be constructed to provide protection of the FLEX equipment to meet the requirements identified in NEI 12-06 section 11. The schedule to construct the structures is still to be determined. For storage and deployment, VEGP will develop procedures and programs to address storage structure requirements and deployment/haul path requirements relative to the applicable hazards. The method of protection and potential reliance on separation for protection from tornado missiles is identified as Confirmatory Item 3.1.3.1.A in Section 4.2 below.

The licensee's commitment to meet the storage structure considerations of NEI 12-06, Section 11.3 encompasses the storage structure considerations of Section 7.3.1 for the high wind hazard.

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

3.1.3.2 Deployment of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.2 states:

> There are a number of considerations which apply to the deployment of FLEX equipment for high wind hazards:
>
> 1. For hurricane plants, the plant may not be at power prior to the simultaneous ELAP and LUHS condition. In fact, the plant may have been shut down and the plant configuration could be established to optimize FLEX deployment. For example, the portable pumps could be connected, tested, and readied for use prior to the arrival of the hurricane. Further, protective actions can be taken to reduce the potential for wind impacts. These factors can be credited in considering how the baseline capability is deployed.
>
> 2. The ultimate heat sink may be one of the first functions affected by a

hurricane due to debris and storm surge considerations. Consequently, the evaluation should address the effects of ELAP/LUHS, along with any other equipment that would be damaged by the postulated storm.

3. Deployment of FLEX following a hurricane or tornado may involve the need to remove debris. Consequently, the capability to remove debris caused by these extreme wind storms should be included.

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

5. The ability to move equipment and restock supplies may be hampered during a hurricane and should be considered in plans for deployment of FLEX equipment.

On page 23, 42, and 50 of the Integrated Plan, the licensee stated that storage location and structure have not yet been decided. After the structure design and location are finalized, the deployment routes will be evaluated for external hazards to demonstrate a clear deployment path.

The licensee's Integrated Plan did not list any debris removal equipment for phase 2 of the FLEX coping strategies. During the NRC audit process, the licensee was requested to provide details for their plans for providing debris removal equipment during phase 2. In response to the NRC audit process, the licensee stated that obstacles and interference review have shown a need for medium sized construction equipment to ensure timely clearance of any route. An example of such equipment is a wheeled loader with bucket and forklift capability. The large thick rubber tires and low-end torque provide efficient response in clearing any path under the majority of severe conditions. The drivability and operator protection provided with this equipment are also a consideration in selection. Each plant site will have the aforementioned equipment with present plans to store the equipment in the onsite FLEX equipment storage facility.

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

3.1.3.3 Procedural Interfaces - High Winds Hazard

NEI 12-06, Section 7.3.3, states:

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

The licensee did not provide any information in the Integrated Plan with regards to procedural interface considerations as they relate to severe storms with high winds. In response to the NRC audit process, the licensee stated that existing procedures for dealing with external events such as hurricanes and tornadoes and will be reviewed to ensure interface considerations for

deployment of the strategies as discussed in NEI 12-06, Section 7.3.2 are addressed.

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

3.1.3.4 Considerations in Using Offsite Resources – High Winds Hazard

NEI 12-06, Section 7.3.4 states:

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

On page 14 of the Integrated Plan, the licensee stated that VEGP will utilize the industry RRC for Phase 3 equipment. VEGP has contractual agreements in place with the SAFER. The two industry RRCs will be established to support utilities in response to BDBEEs. Each RRC will hold five sets of equipment: four of which will be able to be fully deployed when requested; the fifth set will have equipment in a maintenance cycle. Communications will be established between the affected nuclear site and the SAFER team and required equipment mobilized as needed. Equipment will initially be moved from an RRC to a local staging area established by the SAFER team and the utility. The equipment will be prepared at the staging area prior to transportation to the site. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 24 hours from the initial request.

The issue of transporting offsite equipment to the site has been previously discussed and is addressed by the licensee's plan to have alternate routes to the site available and to have air transport capability available. Procedures will document the best means to obtain resources from offsite. This is combined with Confirmatory Item 3.1.1.4.A in Section 4.2 below.

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

3.1.4 Snow, Ice and Extreme Cold

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

All sites should consider the temperature ranges and weather conditions for their site in storing and deploying their FLEX equipment consistent with normal design practices. All sites outside of Southern California, Arizona, the Gulf Coast and Florida are expected to address deployment for conditions of snow, ice, and extreme cold. All sites located North of the 35^{th} Parallel should provide the capability to address extreme snowfall with snow removal equipment. Finally, all

sites except for those within Level 1 and 2 of the maximum ice storm severity map contained in Figure 8-2 should address the impact of ice storms.

On page 6 of the Integrated Plan, the licensee stated that the site is located south of the 35th parallel thus the capability to address hindrances caused by extreme snowfall with snow removal equipment need not be provided. Icing does not occur on the lower reaches of the Savannah River based on records of minimum temperature from 1961 to 1980. Therefore, there is no risk of ice blockage of the Savannah River, frazil ice, or freezing of the below-grade UHS water source in the Nuclear Service Cooling Water (NSCW) basins. The site is located within the region characterized by Electric Power Research Institute (EPRI) as ice severity level 5. As such, the site is subject to severe icing conditions.

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

3.1.4.1 Protection of 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.).

On page 13 of the Integrated Plan, the licensee stated that for equipment protection, VEGP will construct structures to provide protection of the FLEX equipment to meet the requirements identified in NEI 12-06 section 11. VEGP will develop procedures and programs to address storage structure requirements and deployment/haul path requirements relative to the hazards applicable to VEGP. This is combined with Confirmatory Item 3.1.3.1.A in Section 4.2 below.

The licensee's commitment to meet the storage structure considerations of NEI 12-06, Section 11.3 encompasses the storage structure considerations of Section 8.3.1 for the ice hazard.

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

3.1.4.2 Deployment of Portable 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 8 of the Integrated Plan, the licensee stated that the FLEX components will be designed to be capable of performing in response to the "screened in" hazards in accordance with NEI 12-06. Portable FLEX components will be procured commercially.

The Integrated Plan did not provide any information in regards to ice removal as needed to obtain and transport equipment from storage to its location for deployment. In addition, none of the equipment listed under Phase 2 equipment was appropriate for ice removal. In response to the NRC audit process, the licensee stated that as indicated in the Integrated Plan, the site only screens in for icing for the hazards included in Section 8 of NEI 12-06. Because advance warning of freezing weather would be available, actions can be taken in advance to prepare for adverse conditions (including personnel actions). Obstacles and interference review have shown a need for medium sized construction equipment to ensure timely clearance of any route. An example of such equipment is a wheeled loader with bucket and forklift capability. The large thick rubber tires and low-end torque provide efficient response in clearing any path under the majority of severe conditions. The drivability and operator protection provided with this equipment are also a consideration in selection. Each plant site will have the aforementioned equipment with present plans to store the equipment in the onsite FLEX equipment storage facility.

The licensee's response and present plans for ice removal relies on a large construction vehicle, but still does not address the means for removal of ice and/or the ability to move FLEX equipment with severe icing present. The ability to deploy de-icing material and/or sand to allow the towing vehicles the ability to transport FLEX equipment in a severe icing hazard, such as that offered by a sand spreading machine, was not addressed. This is identified as Confirmatory Item 3.1.4.2.A in Section 4.2 below.

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

In response to the NRC audit process on off-site resources, the licensee stated that the site has procedures in place for managing icing and in general, extreme icing is not a concern for Vogtle. The plan did not provide any information as to what the plans for managing icing included, such as sand spreading and/or deicing equipment. This has been previously identified as Confirmatory Item 3.1.4.2.A in Section 4.2 below.

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

On page 14 of the Integrated Plan, the licensee stated that VEGP will utilize the industry RRC for Phase 3 equipment. VEGP has contractual agreements in place with the SAFER. The two industry RRCs will be established to support utilities in response to BDBEEs. Each RRC will hold five sets of equipment: four of which will be able to be fully deployed when requested; the fifth set will have equipment in a maintenance cycle. Communications will be established between the affected nuclear site and the SAFER team and required equipment mobilized as needed. Equipment will initially be moved from an RRC to a local staging area established by the SAFER team and the utility. The equipment will be prepared at the staging area prior to transportation to the site. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 24 hours from the initial request.

The issue of transporting offsite equipment to the site has been previously discussed and is addressed by the licensee's plan to have alternate routes to the site available and to have air transport capability available. Procedures will document the best means to obtain resources from offsite. This is combined with Confirmatory Item 3.1.1.4.A in Section 4.2 below.

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

3.1.5 High Temperatures

NEI 12-06, Section 9.2 states:

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

On page 7 of the Integrated Plan, the licensee stated that per NEI 12-06 Section 9.2, all sites will address high temperatures. The Vogtle site normal daily maximum temperature ranges from 58°F in January to 91°F in July. An extreme maximum of 106°F was recorded in July 1952. Based on a 14-year record, the average number of days in a year on which temperatures are 90°F and above is 62, with approximately one-third of these days occurring in July. Thus the Vogtle site screens in for an assessment for extreme High Temperature.

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 hazard, if these requirements are implemented as described.

3.1.5.1 Protection of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

On pages 23, 34, 41, 42, and 50 of the Integrated Plan, the licensee stated that storage structures will be ventilated to allow for equipment to function. Active cooling systems are not required, as normal room ventilation will be utilized. Procedures and programs are being developed to address storage structure requirements, haul path requirements, and FLEX equipment requirements relative to the hazards applicable to VEGP.

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 temperature hazard, if these requirements are implemented as described.

3.1.5.2 Deployment of FLEX Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

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

The licensee's plan made no reference to portable equipment design in regards to the ability to function in the conditions of high temperatures. In response to the NRC audit process, the licensee stated that equipment specifications developed for procurement of FLEX equipment will specify the extreme conditions applicable to the site for areas in which the FLEX equipment needs to function or will be stored. The FLEX equipment will be procured to comply with these requirements. As indicated in the Integrated Plan, FLEX equipment will be designed for protection from high temperatures or installed inside buildings that provide protection from high temperatures. Storage structures will be ventilated to allow for equipment to function. Active cooling systems are not required as normal room ventilation will be utilized as discussed in SNCV065-PR-002, "Engineering Report, Diverse and Flexible Coping Strategies (FLEX) in Response to NRC Order EA-12-049, Mitigation Strategies for Beyond-Design-Basis External Events."

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

3.1.5.3 Procedural Interfaces – High Temperature Hazard

NEI 12-06, Section 9.3.3 states:

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

As indicated in 3.1.5.2 above, the licensee stated that equipment specifications developed for procurement of FLEX equipment will specify the extreme conditions applicable to the site for areas in which the FLEX equipment needs to function or will be stored.

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

3.2 PHASED APPROACH

Attachment (2) to Order EA-12-049 describes the three-phase approach required for mitigating BDBEEs in order to maintain or restore core cooling, containment and spent fuel pool 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 reactor core cooling & heat removal, and reactor coolant system (RCS) inventory control 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.

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.

During the NRC audit process, the licensee was requested to specify which analysis performed in WCAP-17601-P, “Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox NSSS Designs,” ADAMS Accession No. ML130420011 (not publicly available due to proprietary content) is being applied to Vogtle. Additionally, the licensee was requested to justify the use of that

analysis by identifying and evaluating the important parameters and assumptions demonstrating that they are representative of Vogtle and appropriate for simulating the ELAP transient. In response to the NRC audit process, the licensee stated that a plant specific analysis to validate the VEGP FLEX strategies was performed by Westinghouse (LTR-FSE-12-26, Rev 1). In addition to reviewing the strategy, Westinghouse customized the generic WCAP-17601-P analysis to model the VEGP strategy. The following analyses from WCAP-17601 are directly or indirectly (i.e., directly referenced in a supporting calculation or analysis) applied in the Integrated Plan:

• Section 5.1 - General Transient Discussion/Observations (Specifically 5.1.3 -Turbine Driven Auxiliary Feedwater Pump Heat and RCS Heat Loss)

• Section 5.2 - Base Scenarios - Following Current Procedure Guidance (Specifically 5.2.2, Westinghouse AFW Consumption / CST [Condensate Storage Tank] Requirements)

• Section 5.7 - RCS Response with Little or No RCS Leakage - Safe Shutdown Seals / Low Leakage Seals/Alternate Seal Cooling Systems (Specifically 5.7.1, Westinghouse Generic Case Results)

• Additionally, the recommendations from Section 3.1 (Conclusions / Recommendations - Westinghouse) and 3.4 (Recommended Instrumentation for an ELAP) were considered and incorporated in the Integrated Plan. These analyses apply to Westinghouse NSSS designs with 4 RCS loops, consistent with Vogtle. Section 5.1 applies to all Westinghouse designs with each design receiving a specific analysis. Section 5.2 directly used VEGP as a reference case. Section 5.7.1 will apply to VEGP once the low leakage / shutdown seal packages are installed, as specified in required modifications of the 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 RCS core cooling and RCS inventory control strategies, if these requirements are implemented as described.

3.2.1.1 Computer Code Used for the ELAP Analysis

NEI 12-06, Section 1.3 states:

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

On page 11 of the Integrated Plan, the licensee stated that Westinghouse developed WCAP-17601-P to supplement the guidance in NEI 12-06 by providing additional pressurized water reactor (PWR)-specific information regarding the individual plant response to the ELAP and loss of UHS events. The document includes identification of the generic event scenario and expected plant response, the associated analytical bases and recommended actions for performance of a site-specific gap analysis. Guidance regarding plant response for core cooling, containment integrity, and spent fuel pool cooling is generally applicable to all

Westinghouse PWRs, including VEGP Units 1 and 2. LTR-PSCA-12-78, PA-PSC-0965 Core Team PWROG Core Cooling Management Interim Position Paper, Revision 0, ADAMS Accession No. ML130420011 (not publicly available due to proprietary content), provided supplementary guidance to be utilized as appropriate to develop Core Cooling and RCS Inventory coping strategies and for prediction of the plant's response. The NSSS vendor performed a site-specific evaluation associated with RCS makeup and boration requirements for VEGP, LTR-FSE-12-26 Revision 1, "Evaluations to Support SNC FLEX Strategies for Vogtle Electric Generating Plant," January 21, 2013, which was made available for audit.

On page 11 of the Integrated Plan, the licensee stated that Vogtle is a four (4) hour coping plant for Station Blackout (SBO) considerations. Applicable portions of the analysis described in the FSAR have been used as starting points for evaluations performed to meet the guidance from NEI 12-06. Key assumptions not addressed in the EA-12-049 order were per the existing SBO evaluations. Some of these SBO based assumptions used for ELAP are:

a) Credit is taken for operator actions where appropriate.
b) Equipment needed for the SBO coping duration is available at the site once Phase 2 is implemented.
c) There is reasonable assurance that the equipment will remain operable during and subsequent to an SBO event.

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 NOTRUMP computer code. NOTRUMP was written to simulate the response of pressurized water reactors to small break loss of coolant accident (LOCA) transients for licensing basis safety analysis.

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

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

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.

At the present time, the licensee is planning on installing the new safe shutdown/low leakage seal design. On page 31 of the Integrated Plan, the licensee stated that in order to maintain sufficient reactor coolant inventory, Vogtle will implement the new safe shutdown/low leakage seal design for the reactor coolant pumps (RCPs). These seals will reduce RCS leakage to a maximum of 1 gpm per RCP. Including an additional 1 gpm of unidentified leakage, the total RCS leak rate for Vogtle with shutdown RCP seals is expected to be a maximum of 5 gpm. This low leakage will delay the need for RCS makeup to prevent core uncovery to well beyond 7 days following an ELAP event. The Westinghouse RCS makeup evaluation for VEGP demonstrates that RCS makeup will be required at 46 hours to maintain single phase RCS core cooling using the steam generators; if credit is taken for two-phase RCS core cooling using the steam generators, RCS makeup would not be required until after 72 hours. However, RCS makeup will be required for supplemental boron addition for reactivity control.

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

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

After review of these submittals, the NRC staff has placed the certain limitations for

Westinghouse Designed Plants. Those limitations and their corresponding Confirmatory Item number for this TER are provided as follows:

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

(2) In some plant designs, such as those with 1200 to 1300 psia SG design pressures and no accumulator backing of the main steam system power-operated relief valve (PORV) actuators, the cold legs could experience temperatures as high as 580 ^{0}F before cooldown commences. This is beyond the qualification temperature (550 ^{0}F) of the O-rings used in the RCP seals. For those Westinghouse designs, a discussion of the information (including the applicable analysis and relevant seal leakage testing data) should be provided to justify that (1) the integrity of the associated O-rings will be maintained at the temperature conditions experienced during the ELAP event, and (2) the seal leakage rate of 21 gpm/seal used in the ELAP is adequate and acceptable. This is identified as Confirmatory Item 3.2.1.2.B in Section 4.2 below.

(3) Some Westinghouse plants have installed or will install the SHIELD shutdown seals, or other types of low leakage seals, and have credited or will credit a low seal leakage rate (e.g., 1 gpm/seal) in the ELAP analyses for the RCS response. For those plants, information should be provided to address the impacts of the Westinghouse 10 CFR Part 21 report, "Notification of the Potential Existence of Defects Pursuant to 10 CFR Part 21," dated July 26, 2013 (ADAMS No. ML13211A168) on the use of the low seal leakage rate in the ELAP analysis. This is identified as Confirmatory Item 3.2.1.2.C in Section 4.2 below.

(4) If the seals are changed to the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals, the acceptability of the use of the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals should be addressed, and the RCP seal leakages rates for use in the ELAP analysis should be provided with acceptable justification. This is identified as Confirmatory Item 3.2.1.2.D in Section 4.2 below.

During the NRC audit process, the licensee was requested to 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 control bleed off. In response to the NRC audit process, the licensee stated that the load shedding activities will not interfere with the capability of isolating RCS leakage paths. The initial loss of all AC power EOP response is to verify the RCS is isolated after verifying reactor and turbine trips. Sufficient staff will be available to perform the necessary actions.

The current understanding of the licensee's approach, as described above, is consistent with

the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the RCP seal leakages rates if these requirements are implemented as described.

3.2.1.3 Decay Heat

NEI Section 3.2.1.2 states in part:

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

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

In response to the NRC audit process, the licensee stated that a plant specific analysis to validate the FLEX strategies was performed by Westinghouse (LTR-FSE-12-26 Rev 1). In addition to reviewing the strategy, Westinghouse customized the generic WCAP-17601 analysis to model the VEGP strategy. The Westinghouse NSSS calculations documented in WCAP-17601-P using the NOTRUMP code were performed with the ANS 5.1 1979 + 2 sigma decay heat model and assumed the reactor is initially operating at 100% power (NOTRUMP reference case core power is 3723 MWt). Implementation of this model includes fission product decay heat resulting from the fission of U-235, U-238, and Pu-239 and actinide decay heat from U-239 and Np-239. The power fractions are typical values expected for each of the three fissile isotopes through a three region burn-up with an enrichment based on typical fuel cycle feeds that approach 5%. With that, a conversion ratio of 0.65 was used to derive the decay power of the two actinides U-239 and Np-239. Fission product neutron capture is treated per the ANS standard. The decay heat calculation utilizes a power history of three 540 day cycles separated by two 20 day outages that bounds initial condition 3.2.1.2 (1) of the NEI document NEI 12-06, Section 3.2.1.2 (minimum assumption of NEI 12-06 is that the reactor has been operated at 100% power for at least 100 days prior to event initiation). Therefore, the decay heat curve assumed in the Westinghouse calculations in WCAP-17601 is representative of Vogtle Units 1 and 2. The primary-side transient profile assumed in the RCS inventory control and long-term subcriticality calculations for Modes 1-4 with steam generators available is based on the Westinghouse reference coping case of WCAP-17601-P and plant-specific parameters such as reactor coolant system nominal temperature(s), pressures(s), and volumes, main steam safety valve (MSSV) setpoint pressure(s), and accumulator cover gas pressures. These calculations do not, however, include any decay heat model and rely on the case runs cited from WCAP-17601-P regarding decay heat related phenomenon. The boil-off rates used in the determining the impact of alternate coolant sources on the steam generators as well as the Mode 5/6 boric acid precipitation control calculations are determined using a time step integration of the ANS

5.1-1979 & 1994 + 2 sigma decay heat models and assumed the reactor is initially operating at 100% power for the case of steam generator feed, or had been shutdown from that condition for a duration bounding of typical refueling outage time frames for steam generators being unavailable. The integration assumes a finite irradiation of the core, a 3 region core and 2 year fuel cycles. The time for refueling is ignored. Also, during very early time frames, the power level has been increased to account for delayed fissions that are not calculated in ANS '79 or '94. These assumptions are bounding for VEGP.

The current understanding of the licensee's approach, as described above, 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 decay heat, if these requirements are implemented as described.

3.2.1.4 Initial Values for Key Plant Parameters and Assumptions

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

The Integrated Plan did not identify the assumptions to which initial key plant parameters (core power, RCS temperature and pressure, etc.) are required to conform. During the NRC audit process, the licensee was requested to include justification for the baseline assumptions used for the ELAP analysis. In response to the NRC audit process, the licensee stated that a plant specific analysis to validate the VEGP FLEX strategies was performed by Westinghouse (LTR-FSE-12-26 Rev 1). In addition to reviewing the strategy, Westinghouse customized the generic WCAP-17601-P analysis to model the VEGP strategy. The baseline assumptions used for the ELAP analyses (WCAP-17601-P and plant specific analysis performed by the NSSS vendor) for VEGP are consistent with NEI 12-06.

During the NRC audit process the licensee was requested to list the installed non-safety related systems or equipment that are credited in the ELAP analysis and included in the mitigation strategies. For all the systems or equipment, justify that they are available and reliable to provide the desired functions on demand during the ELAP conditions.

In response to the NRC audit process, the licensee stated that no installed non-safety related systems or equipment are credited in the ELAP analysis for initial response to the BDBEE for key safety functions. In some cases, connection points are being installed in non-safety related piping. However, analysis is being performed to demonstrate that the piping is seismically robust per NEI 12-06 and if necessary, modifications will be made to the piping. Additionally, each key safety function Phase 2 strategy has a primary and alternate strategy or connection.

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

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states in part:

> The parameters selected must be able to demonstrate the success of the strategies at maintaining the key safety functions as well as indicate imminent or actual core damage to facilitate a decision to manage the response to the event within the Emergency Operating Procedures and FLEX Support Guidelines or within the severe accident management guidelines (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 17, 30, 38, and 46, the licensee lists the various instrumentation available to the operators for implementation of the FLEX strategies. These instruments include the recommended instruments listed above as well as other instruments that will be available to support strategy implementation to include pressurizer level, reactor level, including CST level, turbine driven auxiliary feedwater (TDAFW) pump flow, and source and Intermediate range neutron flux.

The current understanding of the licensee's approach, as described above, 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, Section 3.2.1.7, Item 6 states:

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

The licensee provides a tabulation of the SOE timeline on Attachment 1A of the Integrated Plan and provides further details and the technical basis of the new time constraints on page 9 and 10. The licensee has indicated that a formal validation of the timeline will be performed once the procedure guidance is developed and related staffing study is completed for time 30 minutes and 50 minutes. Time 30 minutes is the time required to declare entry into an ELAP event, and time 50 minutes is the time required for the dc extended load shed to be complete. This is identified as Confirmatory Item 3.2.1.6.A of Section 4.2.

The licensee strategy involves venting the SI accumulators if necessary to avoid nitrogen injection into the RCS. These accumulators are inside containment. During the NRC audit process the licensee was requested to provide additional information on how operators will vent

the accumulators and the consequences of removing this liquid from the RCS rather than isolating the accumulators and not allowing backfill. In response to the NRC audit process, the licensee stated that strategy includes venting the safety injection (SI) accumulators to prevent nitrogen injection into the RCS. Venting is accomplished by energizing 125V dc solenoid operated valves (SOVs), which remain powered by the Class 1E dc distribution throughout the ELAP scenario, using handswitches in the main control room (MCR). The purpose of venting the accumulators is to create a pressure differential that will ensure the check valves on the accumulators close, thus preventing any loss of RCS inventory into the accumulators. Although not required by NEI 12-06, MCR indication of SI accumulator pressure is available to provide confirmation that the accumulators have been depressurized. This activity is consistent with current site EOPs.

At time 8 hours, the operators are directed to depressurize the SGs via local operation of the atmospheric relief valves (ARVs). During the NRC audit process, the licensee was requested to provide details of the motive force for the ARV operations. Specifically:

> (a) Specify the size of the ARV backup nitrogen supply source and the required time for its use as motive force to operate the ARV for mitigating an ELAP event.
>
> (b) Discuss the analysis determining the size of the subject nitrogen supply to show that the nitrogen sources are available and adequate, lasting for the required time.
>
> (c) Discuss the electrical power supply that is required for operators to throttle steam flow through the ARVs within the required time and show that the power is available and adequate for the intended use before the operator takes actions to manually operate the ARVs.
>
> (d) Discuss the operator actions that are required to operate ARVs manually and show that the required actions can be completed within the required time.

In response to the NRC audit process, the licensee stated that there is no backup nitrogen or air supply to the ARVs. The valves are normally operated by an electro-hydraulic system that can be operated when needed for depressurization/cooldown. Until that time, steam pressure is controlled at hot zero power conditions using the main steam safety valves. The ARV actuators are safety related and credited in the existing SBO analysis. The ARVs are located in the main steam valve room and are protected from the design basis hazard.

The current understanding of the licensee's approach, as described above, 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 SOE, 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.

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

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

The licensee informed the NRC of their plans to abide by and implement this generic resolution.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 28 of the Integrated Plan, the licensee stated that in preparation for RCS inventory control and long term sub-criticality, the phase 1 action will be to cool down and depressurize the RCS for injection of boron and coolant inventory via the SI accumulators. As the RCS is cooled, the level within the RCS will occupy less volume and will require makeup and boron. This borated makeup volume will be injected from the SI accumulators during normal RCS cooldown following an ELAP event. Prior to injection of the entire SI accumulator inventory, the SI accumulators will be vented if necessary to avoid nitrogen injection into the RCS, which has the potential to inhibit natural circulation.

On page 28 of the Integrated Plan, the licensee stated that because of the use of the low leakage RCP seals no additional makeup other than that of the SI accumulators will be required from an RCS inventory standpoint until Phase 3. However, the Westinghouse RCS makeup evaluation for VEGP indicates that it will be necessary to initiate supplemental boron injection (with letdown as necessary) to maintain sub-criticality. Therefore, following injection of the SI accumulators (at around 12 hours following shutdown) and prior to the peak reactivity addition resulting from xenon decay (at around 24 hours following shutdown), additional borated water will be injected into the RCS for reactivity control. A portable, electric-motor driven pump designated for RCS injection, or Mode 1-4 RCS FLEX pump, will be sized to provide sufficient borated water at the RCS injection point for meeting makeup needs associated with both primary inventory control and subcriticality requirements. Diverse connections (*primary and alternate*) for discharge of the Mode 1-4 RCS FLEX Pump are located downstream of each residual heat removal (RHR) pump on the piping that discharges to the RCS cold legs. The boric acid storage tank (BAST) is the primary source for supplemental boron addition. The minimum volume providing shutdown margin necessary to maintain the core in a subcritical state is maintained in the BAST. The borated water inventory in the refueling water storage tank (RWST) will remain available as a backup source for RCS injection and has a minimum

volume of 686,000 gallons controlled by surveillance requirement (SR) 3.5.4.1 of the VEGP technical specifications (TS). This availability is due to the preferred use of other sources of water inventory (CSTs, reactor makeup water storage tank (RMWST), and NSCW basins) during Phases 1 and 2 for core and SFP cooling strategies. The Phase 2 strategy also consists of venting the RCS as required permitting injection of the necessary borated water inventory. This action relies on remote manual operation of the 125V dc reactor head vent valves.

On page 36 of the Integrated Plan, the licensee stated that for RCS injection in Phase 3, boron mixing equipment (delivered from off-site) will be employed to restore the RWST inventory. Injection to the RCS will be through the RHR system cold leg injection paths (*primary and alternate*) using the Phase 2 RCS Inventory strategy.

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

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

During the audit process, the NRC staff asked the licensee to provide information regarding their boron mixing model. The audit questions and the licensee's responses are shown below.

NRC Question 18:

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

VEGP Response:

1. The Vogtle extended loss of alternate current (AC) power (ELAP) long-term subcriticality calculations are based on the uniform boron mixing model. The limiting long-term subcriticality cases evaluated for Vogtle assume an initial reactor coolant system (RCS) inventory based on a maximum normal operating pressure (NOP), a hot zero power (HZP) RCS temperature, a maximum normal pressurizer level, and no reactor coolant pump (RCP) seal package or RCS Technical Specifications (TS) leakage. These assumptions increase the amount

of makeup necessary to achieve the required RCS shutdown concentration. OG-13-284 provides justification for, and limitations associated with, use of the uniform boron mixing model in ELAP long-term subcriticality calculations. The Vogtle long-term subcriticality calculations meet the limitations documented in OG-13-284. This is described in more detail in the following paragraphs.

Limitation #1

"This model is based on test data that was collected for single phase flow conditions through all steam generators. The model has not been evaluated considering boron injection during other flow regimes. Allowance is provided for transition from single phase to two phase flow based on crediting the additional passive injection available during leakage scenarios. The application of this model requires feeding all steam generators until the required minimum boron injection to support sub-criticality has been achieved." The primary-system makeup strategy for Vogtle is sufficient to maintain a collapsed liquid level (CLL) at or above the top of the RCS hot-leg piping for the duration of the ELAP event; a CLL at or above the top of the hot-leg piping is considered to be a conservative criterion for maintaining single-phase natural circulation conditions in the RCS. Therefore, the long-term subcriticality calculations performed for Vogtle do not rely on the allowance for transition from single-phase to two-phase flow described in OG-13-284. The FLEX strategy for Vogtle Units 1 and 2 requires feeding all steam generators until the steam flow rate and pressure will no longer support turbine-driven auxiliary feedwater (TDAFW) pump function, which occurs after the minimum boron injection required to support subcriticality has been achieved.

Limitation #2

"This model is predicated on the use of a cold leg injection path consistent with the test results that have been cited herein. Injection through either the hot or cold legs will result in the same equilibrium concentration of boron in the system. Injection through the cold legs may be relevant to mixing phenomena that support the cited time frame for achieving target boron concentrations. Therefore, any use of non-cold leg injection paths should be evaluated to determine the impact to the mixing time." The RCS makeup strategy for Vogtle Units 1 and 2 will utilize the RCS cold legs.

Limitation #3

"The justification provided in this report provides reasonable bases for boron mixing for a period following 100 hours after shutdown. The 100 hours after shutdown is consistent with the longest duration xenon may continue to impact fuel reactivity. Boration should be provided well within this limitation and it is expected that make-up due to sub-criticality or RCS inventory needs will be required well in advance of this time frame. Boron mixing should not be credited beyond this time frame." The long-term subcriticality calculations performed for Vogtle do not credit boron mixing beyond 100 hours after shutdown. This is discussed further in the response to Limitation #5 of OG-13-284.

Limitation #4

“Boration targets for sub-criticality should be computed as described based on the most limiting scenario considering no RCS leakage.” The limiting long-term subcriticality cases evaluated for Vogtle assume an initial RCS inventory based on a maximum NOP, an HZP RCS temperature, a maximum normal pressurizer level, and no RCP seal package or RCS TS leakage. These assumptions increase the amount of makeup necessary to achieve the required RCS shutdown concentration.

Limitation #5

Timing for boron injection should be established such that the required boron concentration is achieved at least 1 hour prior to the need time determined in the core specific fuel analysis. This timing must consider both the xenon transient and plant cooldown.” The RCS makeup requirements determined for Vogtle are based on achieving the required RCS boron concentration within 24 hours of ELAP initiation. This is considered conservative since significant negative reactivity due to xenon remains well past 24 hours after ELAP initiation. Additionally, Vogtle will provide symmetric cooling using the installed TDAFW pump injection path to all steam generators until at least 25 hours after ELAP initiation.

NRC Question:

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

VEGP Response:

2. The sub-criticality analysis is documented in the analysis performed by the NSSS vendor. The analysis determined the required RCS makeup to achieve a boron concentration that corresponds to a shutdown margin of 1000 pcm. Boron concentrations of the injection sources and the RCS are assumed at their limiting (lowest) allowable values per Technical Specifications. Cases were run for both RCS makeup source from the BAST and the RWST. The analysis assumed that the RCS supplemental injection occurred following completion of the cooldown. No credit was taken for negative reactivity from xenon. The results indicate that shutdown margin is maintained with either injection source for at least 24 hours after the event. In the case where the accumulators are isolated (i.e., no credit is taken for accumulator injection), makeup is required from the BAST at 20 hours to ensure shutdown margin. Xenon presence in the core will improve shutdown margin until significantly decaying by approximately 24 hours following the start of the event. As makeup from higher boron concentration sources is limited by letdown available once the RCS is filled, a zero leakage assumption for the core is conservative for the shutdown margin calculation.

Vogtle plans to use low-leakage seals and to provide makeup at 12 hours. It is expected that

the licensee's plant would still be in single-phase natural circulation at this point. It is not expected that there will be a concern with the generic concern on modeling of boron mixing at Vogtle because of the mixing approach outlined above for the single-phase regime. However, because the low-leakage seals are not currently installed and the remainder of the generic concern has not been resolved, this subject is Confirmatory Item 3.2.1.8.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 core sub-criticality, if these requirements are implemented as described.

3.2.1.9 Use of Portable Pumps

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

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

NEI 12-06 Section 11.2 states in part:

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

On page 18 of the Integrated Plan, the licensee stated that Phase 2 requires a baseline capability for injection into the steam generators as the alternate core cooling strategy. The method for this capability will be to depressurize the steam generators for makeup with a portable pump, but will not be required until sufficient main steam is no longer available to drive the TDAFW pump turbine. However, to allow for defense-in-depth actions in the event of an unforeseen failure of the TDAFW pump, a portable pump for the Phase 2 strategy of core cooling will be deployed and made ready for use as soon as resources become available following the ELAP event.

On page 31 of the Integrated Plan, the licensee state that following injection of the SI accumulators, additional borated water will be injected into the RCS for reactivity control. A portable, electric-motor driven pump designated for RCS injection, or Mode 1-4 RCS FLEX pump, will be sized to provide sufficient borated water at the RCS injection point for meeting makeup needs associated with both primary inventory control and subcriticality requirements. Diverse connections (primary and alternate) for discharge of the Mode 1-4 RCS FLEX Pump are located downstream of each RHR pump on the piping that discharges to the RCS cold legs. The BAST is the primary source for supplemental boron addition. The minimum volume providing shutdown margin necessary to maintain the core in a subcritical state is maintained in the BAST. The borated water inventory in the RWST will remain available as a backup source for RCS injection and has a minimum volume of 686,000 gallons controlled by TS SR 3.5.4.1. This availability is due to the preferred use of other sources of water inventory (CSTs, and NSCW basins) during Phases 1 and 2 for core and SFP cooling strategies. The Phase 2 strategy also consists of venting the RCS as required permitting injection of the necessary borated water inventory. This action relies on remote manual operation of the 125V dc reactor head vent valves.

Attachment 1 on page 63 of the Integrated Plan is a table depicting the FLEX portable equipment for Phases 2 and 3 required for ELAP mitigation. The table lists three self-powered CST FLEX pumps, three self-powered SG FLEX pumps, two electric motor-driven NSCW sump pumps, three electric motor-driven Mode 1-4 RCS FLEX pumps, two electric motor-driven Mode 5-6 RCS FLEX pumps, and two electric motor-driven diesel fuel pumps for Phase 2. For Phase 3, no pumps are listed. During the NRC audit process, the licensee was requested to provide the following additional information.

a. Specify the required times 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.

b. Discuss the analyses that are used to determine the required flow rates and corresponding pressures of the portable pumps.

c. Justify each of the capacities of the pumps listed above.

d. Address the adequacy of no pumps specified in the table for use during Phase 3 or ELAP despite the reference to RRC pumps being used on page 27 and in the SOE.

In response to the NRC audit process, the licensee stated that:

a. The timing requirements for connecting the pumps for Modes 1-4 are discussed in the SOE timeline and the relevant sections of the Integrated Plan. Validation of the procedures that will contain the actions will confirm the timing. Per the staff endorsed NEI position paper for shutdown/refueling modes (Accession Number ML13267A382), specific time lines are not required to be addressed for Modes 5 and 6. Times for Phase 3 actions are contained in the Integrated Plan.

b. & c. The flow and heads identified in the Phase 2 and Phase 3 Portable Equipment tables are generally valid. The flow rates and the required pressure head will be finalized as the design progresses. The calculations are currently being prepared and the values may change slightly when the calculations are

finalized; the calculations will be made available on the ePortal no later than the third six-month update report (August, 2014). The flow rates for pumps supporting core cooling and sub-criticality are consistent with the WCAP-17601 and the plant specific LTR-FSE-12-26 analyses. Required TDH is determined by hand calculations using standard methods (e.g. Crane 410).

d. The third page of Attachment 1 in the 02-27-2013 Integrated Plan entitled PWR Portable Equipment Phase 3, specifies the following pumps: Two (2) Replacement Service Water Pumps (Provides cooling water flow from portable HX through CCW system to Phase 3 loads) and Two (2) Chilled Water Pumps (Provides chilled water flow from portable skid through Phase 3 loads). These correspond to the RRC pumps alluded to on page 27 and in the SOE (table item 13 on page 68).

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 spent fuel pool cooling piping or other alternate location capable of exceeding the boil-off rate for the design basis heat load; and alternatively 3) spray via portable monitor nozzles from the refueling deck/floor capable of providing a minimum of 200 gallons per minute (gpm) per unit (250 gpm to account for overspray). This approach will also provide a vent pathway for steam and condensate from the SFP.

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

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

On page 45 of the Integrated Plan, the licensee stated that gravity feed from the refueling water storage tank (RWST) will be established as needed during the initial phase of FLEX for SFP Cooling by manually opening valves in the flow path per existing procedure. The gravity feed flow rate for SFP makeup will be approximately 75 gpm if the RWST is near its TS minimum

volume of 686,000 gallons. In operating Modes 1 through 4, makeup will not be required until approximately 10 hours following the event; however, gravity feed will be available immediately following the ELAP event.

In operating Modes 5 and 6, gravity feed may not be available as the majority of the RWST inventory may be discharged into the refueling cavity in containment. The bounding case considers that both Units 1 and 2 are offloaded into their respective SFPs. This scenario has a time to boil in the SFPs of approximately 5 hours with a boil-off rate of nearly 125 gpm. If RWST is unavailable, transition to Phase 2 will occur after 5 hours, but will not be required for several hours after this time until water volume is evaporated from the pool at a level approximately 15 feet above the used fuel stored in the SFP racks. In this case, gravity feed from the RWST will not be a credited action for the initial phase of FLEX but will be included in FLEX support guidelines (FSGs) as a requirement if any RWST is available for gravity feed during operating Modes 5 and 6.

On page 46 of the Integrated Plan, the licensee stated that the normal SFP water level at the event initiation will be at least 23 feet over the top of irradiated fuel assemblies. Upon interruption of power to the installed SFP cooling pumps, the water inventory will heat up. Unit 1 SFP heat loads and temperatures are bounded by Unit 2 values due to the larger storage capacity in the Unit 2 SFP. Requirements for SFP makeup (which are not required until boil-off occurs in the SFPs) are based on the design basis heat loads applicable to specific operating modes as described below.

Maximum Normal Design Basis Heat Load: For an ELAP event initiated during operating Modes 1 through 4 (and Mode 5 with the SGs available), the SFP makeup flowrate is based on the maximum normal design basis heat load limit for power operation immediately following startup from a refueling outage. The SFP water inventory will heat up from 130°F to 212°F after 10 hours at which time boiling would commence. The time to reach the minimum safe shielding water coverage of 15 feet above the top of irradiated fuel is greater than 50 hours with no makeup. Total required flow to make up for boil off due to maximum normal operating heat load and temperature in both units' SFPs is no greater than 123 gpm. Since the SFP is designed so that it does not require borated water to maintain subcritical conditions, the nuclear service cooling water (NSCW) basins are the preferred source of makeup in this scenario. The RMWST and the CSTs are available as backup sources, since they may be needed for SG makeup.

Emergency Design Basis Heat Load (Full Core Offload): For an ELAP event initiated during operating Mode 6 and Mode 5 with SGs unavailable, the SFP makeup flowrate is based on the SFP cooling system design basis heat load for the emergency condition in which all fuel has been transferred from the reactor to the SFP shortly after shutdown. The time to boil is approximately 5 hours; time to reach the minimum safe shielding water coverage of 15 feet above the top of irradiated fuel is approximately 25 hours with no makeup. Total required flow to make up for boiloff due to maximum emergency core offload storage heat load and temperature in both units' SFPs is 250 gpm. Initiating Phase 2 actions at approximately 10 hours will be acceptable because only 3 feet of level will have evaporated by then. As the CSTs and RMWST will not be required for SG injection in these modes, the preferred source of makeup is the de-mineralized water inventory located in these tanks.

On page 47/48 of the Integrated Plan, the licensee presented three strategies for maintaining SFP cooling during the transition phase.

The makeup strategy method 1 directs makeup to the SFP via hoses staged on the refuel floor. This makeup strategy employs one hose that splits into separate hoses for each SFP. As the SFP area may become inaccessible as the transition phase progresses, hoses will be deployed as soon as possible to minimize the need for personnel access to the SFP area following the ELAP event.

The makeup strategy method 2 connects an adapter to an existing valve located on the SFP makeup line from the RMWST. This injection source requires operator action to isolate other valves located in the RMWST and other interfacing systems.

The primary spray strategy is provided with portable monitor nozzles from the refueling floor. The monitor nozzles are deployed as soon as possible to minimize the need for personnel access to the SFP area following the ELAP event. The spray strategy consists of dragging a hose to a pre-determined location in the SFP area, splitting flow (e.g., via pipe wye) into three separate hoses for each SFP, which connect to spray monitors located in the three most accessible corners of each SFP.

Total required flow to satisfy the spray capability for both units' SFPs via portable monitor nozzles is 500 gpm as established in NEI 12-06. This flow rate is bounding for the makeup strategies. Based on needs identified during the transition phase, makeup or spray may be chosen by connecting the appropriate hose to the discharge of a single pump capable of providing the total minimum flow for both units (i.e., a 200% capacity pump). The pump provides a minimum flow rate of 500 gpm with enough discharge pressure to provide the appropriate spray pressure from the monitor nozzles and to overcome head losses associated with discharge hoses and any other discharge connections. The water source is the inventory of each NSCW basin (approximately 3,600,000 gallons based on Technical Specifications minimum level) is capable of providing spray for both SFPs (500 gpm total flow) for approximately 120 hours. Since the NSCW basin is over 80 feet deep, a portable submersible pump will be used to provide the required suction lift so the entire inventory from the NSCW basin may be accessed. Separate sets of hoses and the necessary makeup equipment (tools, spray monitor nozzles, wyes, etc.) for hose spray and makeup will be stored in both the SFP area and in the FLEX storage structures.

On page 51 of the Integrated Plan, the licensee stated that the long term coping strategy for core cooling for the SFP will include establishing a heat sink with equipment from the RRC aligned to the CCW system, which normally cools the SFP heat exchangers. To establish flow in the SFP cooling system, power will be supplied from an off-site diesel generator to the SFP cooling system pumps by repowering the 4160V distribution system if available or by powering the pump motors directly from RRC diesel generator. If needed to maintain operating conditions in the SFP pump and heat exchanger rooms, cooling water flow will be established through the heat exchanger and pump room cooler. The room cooler fan will also be repowered.

On page 63 of the Integrated Plan, the licensee identifies portable equipment for phase 2, including two self-powered SFP FLEX Pumps (200% capacity) to provide minimum flow for spray of both SFPs (500 gpm at 115 psi minimum/200 psi maximum); Two electric motor- driven NSCW submersible sump pumps (200% capacity with 80+ feet of suction lift required) to provide access to entire water inventory of NSCW basin. The pump must be sized to provide minimum flow for supply of SFP FLEX pump (500 gpm at 50 psi minimum/100 psi maximum).

On page 56 of the Integrated Plan, the licensee stated that a baseline capability for SFP cooling is to provide a vent pathway for steam from the SFP area. This pathway will be

established by manually opening the personnel door on the south wall of the auxiliary building. Since the door is locked and closed during normal operations, the door must be opened from inside the building with support from Security personnel. In addition to the personnel door, the large missile shield doors could also be manually opened from inside the building (using a ladder to access pins at the top of the doors) to provide a large opening for ventilation. Ventilation from the auxiliary building personnel and large missile shield doors will be sufficient for the initial coping efforts due to the relatively large opening provided by these doors.

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 10 of the Integrated Plan, the licensee stated that containment integrity for Phases 1 through 3 will be evaluated by use of computer code MAAP 4.05.

On page 38 of the Integrated Plan, the licensee stated that an analysis is being performed to demonstrate that containment response following a postulated ELAP event does not challenge design limits until well after availability of RRC equipment and implementation of long term strategies to control pressure and temperature. This is identified as Confirmatory Item 3.2.3.A in Section 4.2 below.

On page 43 of the Integrated Plan, the licensee stated that the Phase 3 coping strategy required for maintaining containment integrity will be to repower a containment cooling train and use a portable pump and cooler for the heat sink. The first requirement for repowering a containment cooler train will be to provide power to the 480V, low speed fan motors. The second requirement will be to establish a lineup using FLEX hoses and a portable pump for cooling water supply from the RRC heat removal equipment to the containment coolers.

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.

On page 25 of the Integrated Plan, the licensee stated that the primary Phase 3 strategy requires heat removal equipment delivered from the RRC and a pump capable of removing heat from the reactor core in addition to other loads from the SFP and containment. The flow paths for decay heat removal use piping in the RHR system, CCW system, Essential Chilled Water (ECW), and NSCW system. Restoring the RHR system to operation requires repowering the RHR pump via a diesel generator delivered from the RRC to establish recirculation in the RCS. Repowering the RHR pumps will be completed by repowering the 4160V distribution system, if available, or by repowering the pump directly. Heat removal will be through the RHR heat exchangers. The RHR heat exchangers are cooled by flow from the CCW system. Instead of repowering the CCW pumps, flow will be established in the CCW system from a portable pump delivered from the RRC. The pump used for establishing flow to CCW will be placed in series with heat removal equipment (e.g., chiller or water to air heat exchanger) delivered from the RRC. This new established heat sink will take its suction from upstream of the selected CCW pumps in either of the CCW trains (CCW Pumps #5 or #6) and will discharge at a point in the CCW system downstream of the CCW pumps. The CCW system provides the benefit of cooling not only the RHR heat exchangers but also the SFP heat exchangers and RHR pump seal coolers.

The new heat sink will also be required to deliver cooling water to the RHR pump room coolers and RHR pump motor coolers. The RHR pump room coolers require repowering from the diesel generator delivered from the RRC. The RHR pump motors (as well as the containment coolers) are cooled by the NSCW system. The RHR pump room coolers are cooled by the ECW system. As normal NSCW and ECW will not be available following an ELAP/LUHS event, a new flow path will be established using the existing seismic category 1 NSCW and ECW piping. This strategy includes aligning particular portions of the NSCW and ECW systems piping to the newly established heat sink for decay heat removal. The off-site heat exchangers are sized to remove all decay heat from irradiated fuel located in the reactor cores, SFPs, containment, and other support loads.

On page 42 of the Integrated Plan, the licensee stated that a lineup will be established to the containment coolers using FLEX hoses and a portable pump for cooling water supply from the RRC heat removal equipment.

On page 51 of the Integrated Plan, the licensee stated that the long term coping strategy for core cooling for the SFP will include establishing a heat sink with equipment from the RRC aligned to the CCW system, which normally cools the SFP heat exchangers. To establish flow in the SFP cooling system, power will be supplied from an off-site diesel generator to the SFP cooling system pumps by repowering the 4160V distribution system if available or by powering the pump motors directly from RRC diesel generator. If needed to maintain operating conditions

in the SFP pump and heat exchanger rooms, cooling water flow will be established through the heat exchanger and pump room cooler. The room cooler fan will also be repowered.

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 – 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.

The licensee discussed ventilation cooling in the support section of the Integrated Plan, but only as it relates to personnel accessibility, although any action to maintain the various locations for FLEX implementation accessibility will offer some protection for equipment cooling. During the NRC audit process, the licensee was requested to provide a discussion of the plans for loss of ventilation cooling as it relates to equipment operability. In response, the licensee stated that the strategy for cooling equipment required to function in the Vogtle FLEX strategy is to open doors to the required rooms. As noted in the question, this is the same strategy for maintaining room temperatures for personnel accessibility, which has lower limits than equipment. Opening of the room doors allows convection air flow and provides much larger surface areas, which were initially at normal ambient operating temperatures, to become heat sinks for the installed FLEX equipment remaining in operation while the vast majority of the plant's equipment begins to cool due to being de-energized. This strategy will maintain equipment operability and personnel accessibility until phase 2 FLEX equipment is in place to start providing forced air circulation cooling.

During the NRC audit process, the licensee was requested to provide information on the adequacy of the ventilation provided in the battery room to protect the batteries from the effects of extreme high and low temperatures. In response, the licensee stated that during battery charging operations in Phases 2 and 3 in support of maintaining power to instrumentation and controls for core cooling, containment, and SFP cooling functions, ventilation may be required in the battery rooms and associated dc equipment rooms for cooling the rooms. If necessary due to extreme heat conditions, the doors will be manually propped open and forced ventilation can then be established using portable fans (electric powered from the Phase 2 EDG powering the battery chargers). For extreme cold temperatures, the battery rooms would be at their normal operating temperature at the onset of the event and the temperature of the electrolyte in the cells would build up due to the heat generated by the batteries discharging and during re-charging. The battery rooms are located substantially internal to the plant, in an environment without normal plant cooling systems running, and would not be exposed to extreme low temperatures. A calculation is being prepared to evaluate the temperature profile of the battery and dc equipment rooms and determine whether additional forced air flow for cooling is required. Adequacy of battery room ventilation for extreme temperature protection will be further defined in the design / procedure development process. This is identified as Confirmatory Item 3.2.4.2.A in Section 4.2 below.

During the NRC audit process, the licensee was requested to provide a discussion of battery room ventilation to prevent hydrogen accumulation while recharging the batteries in phase 2 or 3 to include a description of the exhaust path if it is different from the design basis. In response, the licensee stated that the goal following a BDBEE is to maintain hydrogen concentration below the combustible limit during recharging of the batteries when the normal ventilation is not available. Preliminary calculations performed for the battery rooms, with loss of ventilation, show this is accomplished with margin. With the room doors closed, the shortest time for a room to reach a 2% hydrogen (well below the combustible limit) after recharging the battery is complete, is over 2 days. Until power can be provided to the normal room ventilation system, doors will be manually propped open to allow airflow (providing cooling) through the main battery rooms and associated switchgear rooms. Opening the battery room doors allows release of accumulated hydrogen into the air volumes of the adjacent DC equipment room; adding ventilation fans enhances mixing and increases the time to reach limiting concentration to more than 1000 hours. The licensee needs to complete its evaluation and calculations to

address hydrogen accumulation in the battery rooms following a loss of ventilation. This item is identified as Confirmatory Item 3.2.4.2.B, in Section 4.2.

During the NRC audit process, the licensee was requested to provide a summary of the analysis and/or technical evaluation performed to demonstrate the adequacy of the ventilation provided in the TDAFW pump room to support equipment operation throughout all phases of an ELAP. In response, the licensee stated that the effects of loss of HVAC in the TDAFW pump room during an extended loss of ac power event are addressed by plant-specific GOTHIC evaluation. The modeled case does not credit any mitigating actions to reduce the room temperature. Maximum room temperature is approximately 116°F following 72 hours of continuous operation. This value is below 122°F (the maximum abnormal temperature for the space), through which the equipment is designed to operate for 2000 hours without accelerating normal periodic tests, inspections, and maintenance schedules to maintain equipment environmental qualification. Temperature rise in this room is mitigated by natural circulation with the entryway, which is at a lower temperature than the turbine pump room. The circulation path is through the air intake opening on the south wall. This opening is a 72" wide x 60" high screened vent through the south wall that connects the room with the door-less entryway outside. This flow path contains a pneumatic damper that fails open.

During the NRC audit process, the licensee provided a summary of the main steam valve rooms temperature and indicated that the maximum normal temperature in these rooms is 115°F and an abnormal temperature may reach 126°F. During an ELAP event, shift operators may be dispatched to manually reposition ARVs for SG depressurization. Each manual operating station is near wall openings that communicate with ambient outdoor environment. Continuous occupancy of these rooms is not required. Plant experience indicates the main steam valve rooms will remain accessible and habitable during these activities.

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

3.2.4.3 Heat Tracing

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

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

In its Integrated Plan, the licensee did not address the loss of heat tracing. The licensee

screened in for extreme icing and thus there is a need for the licensee to address loss of heat tracing effects on FLEX strategies in its Integrated Plan. During the NRC audit process, the licensee was requested to discuss the loss of heat tracing as it relates to implementing FLEX strategies. In response, the licensee stated that most connections for FLEX equipment are located inside of structures; these and all other connections for FLEX equipment are evaluated during the design process to identify the need for protection in accordance with NEI 12-06, including the provisions of Section 3.2.2, Guideline (12). At this time in the design process, no requirement for heat tracing has been identified. As noted in the Integrated Plan, the Vogtle site screens in for an assessment for extreme cold for icing only, therefore, the need for heat tracing is not anticipated.

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

3.2.4.4 Accessibility – Lighting and Communications

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

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

On page 53 of the Integrated Plan regarding safety function support (lighting) for the initial phase, the licensee stated that operators will align MCR lighting in the "horseshoe" area to the associated unit's D Battery. Analysis indicates that execution of specified load shed actions outlined in plant procedures provides a reliable source of illumination for more than 13 hours. As an alternate strategy, VEGP will rely on portable battery powered lighting to perform MCR functions.

During the review it was noted that the plan only addresses lighting in the MCR and does not address lighting in areas such as the TDFWP room, the battery room and other locations that may require emergency lighting to support implementation of FLEX strategies. During the NRC audit process the licensee was requested to provide a discussion of accessibility as it relates to lighting in other areas of the plant where FLEX implementation and monitoring is required. In response, the licensee stated that part of the standard gear/equipment of operators with duties in the plant (outside the MCR) includes flashlights. Procedures for implementation of the FLEX strategies will include guidance on equipment necessary to facilitate the actions necessary for the FLEX strategies, including the need for flashlights. Sufficient spare flashlights and batteries will be available to respond to this event. Portable dc powered area lights will be stored as Phase 2 equipment for use as necessary. When Phase 2 FLEX diesel generators are connected to the battery chargers, power will be available to provide essential lighting to the

MCR. Although not credited, in addition, Appendix R lighting provides for emergency lighting in select areas of the plant including the MCR, where operators or maintenance personnel may need to perform actions, during loss of power conditions. The Appendix R lights have batteries that last for a minimum of 8 hours.

The NRC staff has reviewed the licensee communications assessment (ADAMS Accession Nos. ML12306A201 and ML13056A139) in response to the March 12, 2012 50.54(f) request for information letter for VEGP and, as documented in the staff analysis (ADAMS Accession No. ML13123A128) 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. Further review is required to confirm any required communication updates have been installed. This has been identified as Confirmatory Item 3.2.4.4.A in Section 4.2 below.

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

Although the licensee's plan addresses blocking open doors for personnel habitability/accessibility (e.g., MCR doors, battery room doors, TDAFW room doors), the plan does not address an overall strategy for access to other areas of the plant that may require additional actions to obtain access such as other areas in the protected area and internal locked areas.

During the NRC audit process, the licensee was requested to provide a discussion on the plans for entrance into protected areas and internal locked areas as discussed above. In response, the licensee stated that procedures exist and FSGs will be developed to ensure that operators can access the required areas in the event of a loss of power. Additional details on controls for access to security controlled or internal locked areas where ELAP would disable normal controlled access will be contained in the FSGs or associated procedures. This information may be in general terms due to Safeguards/SUNSI concerns.

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

assurance that the requirements of Order EA-12-049 will be met with respect to protected and internal locked area access, if these requirements are implemented as described.

3.2.4.6 Personnel Habitability – Elevated Temperature

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

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

Section 9.2 of NEI 12-06 states,

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

On page 11 of the Integrated Plan, the licensee stated that environmental conditions within the station areas will be evaluated utilizing methods and tools in NUMARC 87-00 or Gothic 8.0 (EPRI software).

On pages 53, 54, 56, and 57 of the Integrated Plan, the licensee addresses accessibility for the various areas required to implement coping strategies, including the following areas:

> MCR accessibility - Under ELAP conditions with no mitigating actions taken, initial analysis projects the control room to surpass 110°F (the assumed maximum temperature for efficient human performance as described in NUMARC 87-00) in a time of approximately 9 hours. The Phase 1 FLEX strategy will be to block open the MCR access doors when the MCR temperature reaches 98°F (the assumed outside temperature at the time of event occurrence). This strategy will open the MCR to the structure exterior at plant grade level and provide enough ventilation to equalize the MCR temperature to approximately that of the outside air. During cold weather, the ventilation flow can be limited to keep the MCR at a habitable temperature. During Phase 2, portable ventilation fans powered by electric generators or gas powered portable fans can be used for ventilation.
>
> TDAFW pump room accessibility - During operation, there will be a considerable heat load within the room from the steam turbine and associated piping.

Operation of TDAFW without forced ventilation was evaluated for the SBO condition. This conservative calculation, which ignored heat sinks and heat transfer out of the room, determined that with no ventilation, the room would heat up to 121°F during the 4 hour SBO coping period. To mitigate this temperature increase, the FLEX strategy relies on opening and securing the door and vent louvers to TDAFW pump room (note that the vent louvers fail open). A walkdown of this room concluded that the ventilation path using this strategy would provide substantial air flow via heat-induced natural circulation sufficient to maintain accessibility of the room for manual operation if required and to maintain equipment temperatures within operating limits. Site industrial safety procedures currently address activities with a potential for heat stress to prevent adverse impacts on personnel.

Battery and switchgear rooms - During the ELAP event, the 125V dc and inverter-fed 120V ac electrical distributions are energized and maintain power to instrumentation and controls. Until power can be provided to the normal room ventilation system, doors will be manually propped open to allow airflow (providing cooling) through the main battery rooms and associated switchgear rooms. The Phase 2 support strategy includes connecting a portable diesel generator to supply the electrical distribution for the Class 1E battery chargers. During subsequent battery charging operations, hydrogen will be released into the battery rooms. If necessary to provide room cooling or to prevent hydrogen buildup, forced ventilation can be established using portable fans (electric powered from the Phase 2 FLEX DG powering the battery chargers).

Auxiliary building “D” level corridor - The Phase 2 support strategy includes connecting a portable diesel generator to supply the electrical distribution for RCS Inventory strategies that rely on portable FLEX pumps (nominally 100 horsepower) located in the auxiliary building “D” level corridor. Temperature in these areas will remain low enough so as to not impact habitability or equipment operation given the heat load and building size.

SFP area venting - This pathway will be established by manually opening the personnel door on the south wall of the auxiliary building. The auxiliary building personnel door is locked and closed during normal operations and must be opened from inside the building with support from security personnel. In addition to the personnel door, the large missile shield doors could also be manually opened from inside the building (using a ladder to access pins at the top of the doors) to provide a large opening for ventilation. Ventilation from the auxiliary building personnel and large missile shield doors will be sufficient for the initial coping efforts due to the relatively large opening provided by these doors.

In regards to the main control room, if the temperature of the control room does approach outside air temperature, it is possible that the environmental conditions within the control room would exceed the habitability limits defined in NUMARC 87-00 for efficient human performance. NUMARC 87-00 provides the technical basis for this habitability standard as MIL-STD-1472C, which concludes that 110°F is tolerable for light work for a 4 hour period while dressed in conventional clothing with a relative humidity of ~30%. During the NRC audit process, the licensee was requested to provide more information concerning the analysis performed to conclude the continued habitability of the control room including postulated outside air temperature, the heat loads from personnel in the control room, and any additional relief efforts

for the control room staff (e.g. short stay time cycles, use of ice vests/packs, supplies of bottled water, etc.). In response, the licensee stated that long-term habitability in the MCR will be assured by monitoring of control room conditions, heat stress countermeasures, and rotation of personnel to the extent feasible. The impact to habitability would be primarily from elevated temperatures. Initially, there would be some delay in the MCR air temperature increasing to outside air temperature. Therefore, the Vogtle FLEX Support Guidelines will provide guidance for control room staff to evaluate the control room temperature and take actions as necessary. In addition, current general site training includes a module on the recognition of dehydration along with methods to cope. Bottled water is available on site. Site procedures already use passive cooling technologies for response personnel.

During the NRC audit process, the licensee was requested to provide additional information to support personnel habitability in the TDAFW pump room. In response, the licensee stated that as stated, doors will be opened and vent louvers are open. TDAFW pump room habitability will be assured by, heat stress countermeasures, and rotation of personnel to the extent feasible. The impact to habitability would be primarily from elevated temperatures. Therefore, the Vogtle FLEX Support Guidelines will provide guidance for personnel to evaluate the room temperature and take actions as necessary. In addition, current general site training includes a module on the recognition of dehydration along with methods to cope. Bottled water is available on-site. Procedures already use passive cooling technologies for response personnel.

During the NRC audit process, the licensee was request to provide additional information regarding the habitability evaluation done for the fuel handling building (FHB). In response, the licensee stated that as stated in the Integrated Plan, the initial means for SFP makeup uses installed plant equipment and piping and does not require FHB accessibility. Under worst case assumptions, SFP heat up will not reach boiling until T=10 hours and habitability of the SFP room will not be adversely impacted until several hours subsequently. Current time to boil is maintained in the control room based on this information and prior to the SFP room becoming inaccessible, personnel are sent to the FHB to deploy the prestaged mitigating equipment (hoses, nozzles, etc.) so that if required later in the event, connections to the hoses can be made from a remote nonhazardous location outside the FHB and SFP makeup/spray commenced safely. As stated in the Integrated Plan, personnel doors and the missile shield doors will be opened. FHB habitability will be assured by, heat stress countermeasures, and rotation of personnel to the extent feasible. The impact to habitability would be primarily from elevated temperatures. Therefore, the FSGs will provide guidance for personnel to evaluate the room temperature and take actions as necessary. In addition, current general site training includes a module on the recognition of dehydration along with methods to cope. Bottled water is available on-site. Procedures already use passive cooling technologies for response personnel.

In addition, the licensee stated that the design basis requires the battery room ventilation to maintain the hydrogen concentration below 2 % in accordance with the Institute of Electrical and Electronics Engineers (IEEE) 484 and not to the 1% limit per the National Fire Code. The licensee further stated that because FLEX strategy is BDB guidance, the design basis requirements do not apply as the goal in these catastrophic events is to maintain hydrogen concentration below the combustible limit. Preliminary calculations performed for the battery rooms, with loss of ventilation, show this is accomplished with margin. With the room doors closed, the shortest time for a room to reach 2% hydrogen (well below the combustible limit) after recharging the battery is complete is over 2 days. Opening the room doors will extend this, and adding ventilation fans increases the time to more than 1000 hours. Until power can be provided to the normal room ventilation system, doors will be manually propped open to allow

airflow (providing cooling) through the main battery rooms and associated switchgear rooms.

In addition, the licensee stated that operators are trained on working in high temperature areas in the plant. Entry into and work in high temperature environments are governed by the plant's industrial safety procedures with controls for work in heat stress situations. During Phase 2 portable ventilation fans powered by electric generators or gas powered portable fans will be employed as necessary. The procedures governing implementation of FLEX strategies will include the necessary guidance for placement and operation of FLEX equipment including the necessary provisions for venting engine driven 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 personnel habitability – elevated temperature, 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/UHS 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 [Net Positive Suction Head] 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 for RCS core cooling and heat removal. Makeup flow is immediately established to the SG during the initial phase of the ELAP strategies.

On page 15 of the Integrated Plan, the licensee stated that to support the primary core cooling strategy, suction to the TDAFW pump will be from the seismic category 1 CSTs, which are also protected from tornado missiles. Each unit has two CSTs, each with a normal operating inventory equal to 417,600 gallons (835,200 gallons total) of de-mineralized water.

A backup water source is provided by the RMWST (127,000 gallons of demineralized water). These water sources are suffieicnt to provide SG makeup until the Phase 3 strategies using the new UHS with heat removal equipment delivered from off-site are operational. The licensee stated that the CSTs and the RMWST are estimated to provide SG makeup for greater than 140 hours. The NSCW basins will be available if additional sources of water are needed for SG makeup.

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

3.2.4.8 Electrical Power Sources/Isolations and Interactions.

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

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

On page 56 of the Integrated Plan, the licensee stated that the Phase 2 strategy will be to stage and connect a 600 kW, 480 vac DG to power select loads including one battery charger for each of the four Class 1E 125 vdc Switchgear (providing continuity of power for lighting in the "horseshoe" area of the MCR), the RCS FLEX pump, and the plant public address system. The Phase 2 FLEX DGs are capable of starting without external equipment and have their own fuel transfer pumps. Other equipment provided for this strategy includes portable switchgear and quick connect power cables for connecting to multiple, separate loads concurrently. Diverse connection points are provided locally at the individual loads.

On page 58 of the Integrated Plan, the licensee stated that modifications to install a 480V distribution panel in the control building, including transfer switches, and cable routing to enable connection of on-site FLEX DG is needed to minimize the time and resource requirements to implement the applicable strategies.

On page 61 of the Integrated Plan, the licensee stated that the Phase 3 strategies uses large 4160 VAC off-site FLEX DGs from the RRC to restore power to the essential electrical distribution system and/or select loads as needed to support indefinite coping. Loads that will be powered by the off-site FLEX DG include RHR pumps and various additional components supplied by the RRC (e.g., makeup water treatment system, replacement service water pumps). Additional plant equipment will be loaded onto the off-site FLEX DGs as needed to support plant restoration.

With regard to electrical isolations and interactions, the licensee's plan did not describe how the portable/FLEX diesel generators and the Class 1E diesel generators are isolated to prevent simultaneously supplying power to the same Class 1E bus. During the NRC audit process the

licensee was requested to describe how electrical isolation will be maintained such that (a) Class1E equipment is protected from faults in portable/FLEX equipment and (b) multiple sources do not attempt to power electrical buses.

In response, the licensee stated that (a) appropriate controls for the equipment will be implemented in procedures to ensure compliance with NEI 12-06 section 3.2.2.13; however, the primary goal of FLEX diesel generators is to power components credited in the FLEX strategy and not to protect Class 1E equipment; and (b) at the onset of the ELAP, Class 1E diesel generators are assumed to be unavailable to supply the Class 1E buses. Portable generators are used in response to an ELAP in FLEX strategies for Phases 2 and 3. At the point when ELAP mitigation activities require tie-in of FLEX generators, in addition to existing electrical interlocks, procedural controls, such as inhibiting DG start circuits and breaker rack outs, will be employed to prevent simultaneous connection of both the FLEX generators and Class 1E diesel generators to the same ac distribution system or component. Should the Class 1E DGs become available during the BDBEE, they could be restarted to provide power to their associated buses to repower divisional loads where safe and appropriate; this would also be procedurally controlled. FLEX strategies, including the transition from installed sources to portables sources (and vice versa), will be addressed in the FLEX procedures and guidance.

During the NRC audit process, the licensee was requested to provide a summary of the sizing calculation for the FLEX generators to show that they can supply the loads assumed in Phases 2 and 3.

In response, the licensee stated that the loading calculations for the 480V DGs for Phase 2 and the 4160V generators for Phase 3 have been completed and are awaiting site approval. The licensee further stated that these calculations seek to make conservative estimates for the total loads in Phase 2 and Phase 3 and that the 480V loads required for core cooling in the designed FLEX strategies are listed for Units 1 and 2 in its respective calculation's appendices. The licensee stated that a load stepping sequence is accomplished by starting all battery chargers and battery ventilation fans in load step 1, and the boron injection pump in load step 2. Load step 2 is calculated assuming that the total load from load step 1 is in running condition and its starting transients have subsided. The licensee stated that the 4160V loads required for core cooling in the designed FLEX strategies are listed for Units 1 and 2 in its respective calculation's Appendices, which sum up the loading requirements for the generator in both starting and running conditions. The licensee stated that the generators have not yet been selected but will be sized in accordance with industry criteria and capable of carrying the calculated loads, with margin. For Phase 2, the calculation recommends using a Kohler brand diesel generator to satisfy the sizing criteria and total loads. For Phase 3, any generator that satisfies the kW, KVAR, and kVA demands during running and the starting kVA requirement is acceptable. This is identified as Confirmatory Item 3.2.4.8.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 electrical power sources/isolations and interactions, if these requirements are implemented as described.

3.2.4.9 Portable Equipment Fuel.

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

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

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

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

On page 56 of the Integrated Plan, the licensee stated that for refueling the portable DGs, diesel fuel is available from many sources (e.g., diesel fuel oil storage tanks, the vehicle garage diesel fuel storage tank, and nearby off-site diesel fuel storage) and can be retrieved and transported using a portable fuel pump and transfer carts. The 4 underground fuel oil storage tanks (two per Vogtle unit) are seismically qualified and capable of storing a TS required minimum of 68,000 gallons each with a nominal capacity of 80,000 gallons each. This stored quantity of fuel will meet the fuel demand for all of the FLEX equipment well into Phase 3.

On page 63 of the Integrated Plan, the licensee listed three self-powered CST FLEX pumps, three self-powered SG FLEX pumps, and two self-powered SFP FLEX pumps. The licensee's plan did not discuss the refueling plans for these pumps. During the NRC audit process, the licensee was requested to provide a discussion of the refueling plans for the FLEX equipment, including how fuel oil quality is maintained. In response the licensee stated that diesel fuel can be retrieved and transported using transfer carts. The fuel can be transferred from the onsite storage sources to the transfer carts by the repowering the existing fuel oil transfer pumps (directly powering them with FLEX generators) or by the use of FLEX portable pumps. Fuel can be transferred from the transfer carts to the diesel driven FLEX equipment via FLEX portable diesel fuel oil transfer pumps. In accordance with NEI 12-06, Section 3.2.2, the required "N" sets of portable fuel tanks and portable diesel fuel oil transfer pumps will be stored in the FLEX storage facility. The four underground fuel oil storage tanks are seismically qualified and have a capacity of 80,000 gallons each. The Vogtle Units 1 and 2 TS require that each fuel oil storage tank contain at least 68,000 gallons of fuel. Since this fuel is used by the emergency diesel generators (EDGs), no additional measures are necessary to ensure adequate fuel oil quality. Fuel stored in fuel tanks for the various FLEX portable equipment will be maintained in the site preventative maintenance (PM) program according to the manufacturer's recommendations and existing site practices. Preliminary results for total fuel requirements and refueling intervals for each diesel driven FLEX pump, generator, and truck are available. The total diesel fuel consumption of all the diesel driven FLEX equipment during the initial 72 hours is 12,400 gallons. Fuel is transported to each diesel driven FLEX component on a trailer towed by a truck. The method of transferring fuel from the underground fuel oil storage tanks to the trailer and from the trailer to the diesel driven FLEX equipment is still in development; an updated response will be provided no later than the third six-month update report (August, 2014). As discussed in Section 1 of the Integrated Plan, Vogtle is considered a dry site. The haul routes of transporting fuel to the various FLEX portable equipment will not be affected by external flooding; these routes are the same haul routes for deployment of the FLEX equipment which are evaluated for external hazards. The pending development plans for refueling of portable equipment is identified as Confirmatory Item 3.2.4.9.A in Section 4.2 below.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 9 and 10 of the Integrated Plan, the licensee indicates that the extended load shed is complete within 1 hour of the event and the 480V Flex DGs will be available at any point past 12 hours to restore power to on battery charger on each Class 1E 125Vdc distribution bus.

The NRC staff reviewed the licensee's Integrated Plan and determined that the generic concern related to battery duty cycles beyond 8 hours is applicable to the plant. This generic concern has been resolved generically through the NRC endorsement of Nuclear Energy Institute (NEI) position paper entitled "Battery Life Issue" (ADAMS Accession Nos. ML13241A186 (position paper) and ML13241A188 (NRC endorsement letter)).

The purpose of the generic concern and associated endorsement of the position paper was to resolve concerns associated with Order Integrated Plan submittals in a timely manner and on a generic basis, to the extent possible, and provide a consistent review by the NRC staff. 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 requirements of Order EA-12-049.

The generic concern related to extended battery duty cycles required clarification of the capability of the existing vented lead-acid station batteries to perform their expected function for durations greater than 8 hours throughout the expected service life of the battery. The position paper provided sufficient basis to resolve this concern by developing an acceptable method for demonstrating that batteries will perform as specified in a plant's Integrated Plan. The methodology relies on the licensee's battery sizing calculations developed in accordance with the IEEE Standard 485, "Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations," load shedding schemes, and manufacturer data to demonstrate that the existing vented lead-acid station batteries can perform their intended

function for extended duty cycles (i.e., beyond 8 hours).

The NRC staff concluded that the position paper provides an acceptable approach for licensees to use in demonstrating that vented lead-acid batteries can be credited for durations longer than 8 hours. The NRC staff will evaluate a licensee's application of the guidance (calculations and supporting data) in its development of the final Safety Evaluation documenting review of the licensee's Integrated Plan.

Vogtle informed the NRC of their plan 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. Specific issues are presented below.

During the NRC audit process, the licensee was requested to provide the basis for the minimum dc bus voltage that is required to ensure proper operation of all required electrical equipment. In response, the licensee stated that calculation X3CF14, Class 1E Battery Station Blackout Extended Coping Time Study, has been prepared and is currently undergoing comment incorporation; the calculation is being prepared and will be posted to the ePortal when completed in accordance with the guidance in the industry white paper on Extended Battery Duty Cycles. This calculation confirms the Class 1E batteries for Trains A, B, C, and D are capable of maintaining critical loads for 10 hours prior to reaching the minimum voltage during an ELAP event, with margin. The current licensing basis minimum battery voltages are identified in calculation X3CF02, Class 1E Battery Systems; the minimum voltage for each battery is:

Battery 1AD1B / 2AD1B - 109.7 V
Battery 1BD1B / 2BD1B - 109.7 V
Battery 1CD1B / 2CD1B - 108.3 V
Battery 1DD1B / 2DD1B - 106.2 V

The licensee stated that the Class 1E batteries are capable of maintaining critical loads for 10 hours prior to reaching the minimum voltage during an ELAP event, with margin. However, on page 10 of the Integrated Plan the licensee stated that the 480V Flex DGs will be available at any point past 12 hours to restore power to one battery charger on each Class 1E 125Vdc distribution bus. The licensee's response does not address the additional 2 hours that the critical loads would be powered from the Class 1E batteries. This is identified as Open Item 3.2.4.10.A in Section 4.1 below.

During the NRC audit process, the licensee was requested to provide the dc load profile with the required loads for the mitigating strategies to maintain core cooling, containment, and SFP cooling. In response, the licensee stated that the FLEX strategy station battery run-time was calculated in accordance with the IEEE-485 methodology using manufacturer discharge test data applicable to the licensee's FLEX strategy as outlined in the NEI white paper on Extended Battery Duty Cycles. The detailed licensee calculations, supporting vendor discharge test data, FLEX strategy battery load profile, and other inputs/initial conditions required by IEEE-485 will be available on the ePortal for documents and calculations no later than the third six-month update report (August, 2014). Southern Nuclear will comply with the guidance in the endorsed NEI white paper. This is identified as Confirmatory Item 3.2.4.10.B in Section 4.2 below.

During the NRC audit process, the licensee was requested to identify any plant components that will change state if vital ac or dc power is lost or de-energized during the load shed. Of particular interest is whether a safety hazard is introduced, such as deenergizing 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.

The licensee was further requested to identify dc breakers that must be opened as a part of the load shed evolution. In response, the licensee stated that dc loads that are shed for ELAP are allowed to be shed in the existing SBO coping strategy. Therefore, the necessary impacts have already been addressed and procedures exist for shedding these loads. DC power to the generator non-safety related hydrogen seal oil pumps is provided from non-safety related, non-seismic batteries located in the turbine building. Those batteries will not be load shed in response to the ELAP event. The loss of the generator seal oil pumps as a result of the event could lead to loss of hydrogen from the main generator creating a potential hazard. Even though the turbine building may be damaged by the BDBEE and it may not be possible to vent the hydrogen in a controlled manner. Procedures for venting the generators are included in the Loss of All AC Power procedure (ECA-0.0).

During the NRC audit process, the licensee was requested to provide a detailed discussion on the loads that will be shed from the dc bus, the equipment location (or location where the required action needs to be taken), and the required operator actions needed to be performed and the time to complete each action. The licensee was also requested to explain which functions are lost as a result of shedding each load and discuss any impact on defense in depth and redundancy.

In response, the licensee stated that dc loads that are shed for ELAP are specified in the existing SBO coping strategy as dc loads that may be shed during loss of all ac. Therefore, the necessary impacts have already been addressed and procedures exist for shedding these loads. As stated on page 10 of the Integrated Plan:

> The DC buses are located in Switchgear Rooms on the Bravo level of the control building and are readily accessible to the operator. Load stripping consists of opening 43 breakers in Unit 1 and 43 breakers in Unit 2 using local control switches. As an operator aid, the breakers/control switches will be appropriately identified (labeled) to show which are required to be opened to facilitate an extended load shed. From the time that ELAP conditions are declared, it is reasonable to expect that operators can complete the DC bus load shed in approximately 20 minutes. Validation of the procedures that will contain the actions will confirm the timing.

The licensee further stated in their response that NEI 12-06 Section 3.2.2 paragraph 6 states: "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"; therefore, redundancy is not required. The Vogtle load shedding strategy maintains power to 3 of 4 instrument channels so redundancy is retained. Upon restoration of power to the safety related battery chargers from the FLEX diesel generator, it will be possible to restore the fourth channel of control room instrumentation.

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 dc power. These questions are identified as Open Item 3.2.4.10.A in Section 4.1 below.

3.3 PROGRAMMATIC CONTROLS

3.3.1 Equipment Maintenance and Testing.

NEI 12-06, Section 3.2.2, following item (15) states:

> 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.

[1] Testing includes surveillances, inspections, etc.

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

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

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

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

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

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

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

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

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

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

processes.

During the NRC audit process, the licensee stated that Vogtle will utilize the EPRI technical report and will utilize the EPRI developed FLEX Equipment and Testing templates for developing programs for maintenance and testing of FLEX equipment.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01 and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 13 of the Integrated Plan, the licensee stated that the equipment for ELAP will have unique identification numbers. Installed structures, systems and components pursuant to 10CFR 50.63(a) will continue to meet the augmented quality guidelines of Regulatory Guide 1.155, Station Blackout. For design control, VEGP will follow the current programmatic control structure for existing processes such as design and procedure configuration.

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

3.3.3 Training.

NEI 12-06, Section 11.6 provides that:

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

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

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

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

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

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

On page 20 of the Integrated Plan, the licensee stated that new training of station staff and emergency response personnel will be performed in 2014, prior to the 1st VEGP unit design implementation. These programs and controls will be implemented in accordance with the Systematic Approach to Training or other standard plant training processes where applicable.

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

[2] The Systematic Approach to Training (SAT) is recommended.
[3] Emergency response leaders are those utility emergency response personnel assigned leadership roles, as defined by the Emergency Plan, for managing emergency response to design basis and beyond-design-basis plant emergencies.

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 14 of the Integrated Plan, the licensee stated that VEGP will utilize the industry RRC for Phase 3 equipment. VEGP has contractual agreements in place with SAFER. The two industry RRCs will be established to support utilities in response to BDBEEs. Each RRC will hold five 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. Communications will be established between the affected nuclear site and the SAFER team and required equipment mobilized as needed. Equipment will initially be moved from an RRC to a local staging area established by the SAFER team and the utility. The equipment will be prepared at the staging area prior to transportation to the site. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 24 hours from the initial request.

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

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.2.1.8.A	Core Sub-Criticality - Confirm resolution of boron mixing generic issue.	
3.2.4.10.A	Load Reduction to Conserve DC Power - The licensee stated that the Class 1E batteries are capable maintaining critical loads	

	for 10 hours prior to reaching the minimum voltage during an ELAP event, with margin. However, on page 10 of the Integrated Plan the licensee stated that the 480V Flex DGs will be available at any point past 12 hours to restore power to one battery charger on each Class 1E 125Vdc distribution bus. The licensee's response does not address the additional 2 hours that the critical loads would be powered from the Class 1E batteries and whether the minimum voltage would be exceeded during this time.	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.3.A	Procedural Interface Considerations (Seismic) – Confirm FLEX support guideline to provide operators with direction on how to establish alternate monitoring and control capabilities.	
3.1.1.3.B	Procedural Interface Considerations (Seismic) – Confirm evaluation of large internal flooding sources that are not seismically robust and do not require ac power. Should be included in the August 2014 6-month update.	
3.1.1.4.A	Off-Site Resources – Confirm RRC local staging area, evaluation of access routes, and method of transportation to the site.	
3.1.3.1.A	Storage & Protection of FLEX equipment (High winds and extreme cold) – Confirm that the licensee has provided appropriate protection against tornado missiles, taking into account data available on typical tornado damage widths and paths if separation is relied upon. Confirm that the licensee will provide appropriate protection against cold temperatures to allow the FLEX equipment to function.	
3.1.4.2.A	Deployment – Ice Hazard. Confirm the ability to deploy FLEX equipment in an ice hazard. Should include such means as de-icing, or sanding to allow the transport vehicle the ability to move the FLEX equipment.	
3.2.1.1.A	Reliance on the NOTRUMP code for the ELAP analysis of Westinghouse plants is limited to the flow conditions prior to reflux condensation initiation. This includes specifying an acceptable definition for reflux condensation cooling.	
3.2.1.2.A	RCP Seal Leakage - For the plants using Westinghouse RCPs and seals that are not the SHIELD shutdown seals, the RCP seal initial maximum leakage rate should be greater than or equal to the upper bound expectation for the seal leakage rate for the ELAP event (21 gpm/seal) discussed in the PWROG white paper addressing the RCP seal leakage for Westinghouse plants. If the RCP seal leakage rates used in the plant-specific ELAP analyses are less than the upper bound expectation for the seal leakage rate discussed in the whitepaper, justification should be provided. If the seals are changed to non-Westinghouse seals, the acceptability of the use of non-Westinghouse seals should be	

	addressed, and the RCP seal leakage rates for use in the ELAP analysis should be provided with acceptable justification.	
3.2.1.2.B	RCP Seal Leakage - In some plant designs, such as those with 1200 to 1300 psia SG design pressures and no accumulator backing of the main steam system power-operated relief valve (PORV) actuators, the cold legs could experience temperatures as high as 580 ^{0}F before cooldown commences. This is beyond the qualification temperature (550 ^{0}F) of the O-rings used in the RCP seals. For those Westinghouse designs, a discussion of the information (including the applicable analysis and relevant seal leakage testing data) should be provided to justify that (1) the integrity of the associated O-rings will be maintained at the temperature conditions experienced during the ELAP event, and (2) the seal leakage rate of 21 gpm/seal used in the ELAP is adequate and acceptable.	
3.2.1.2.C	RCP Seal Leakage - Some Westinghouse plants have installed or will install the SHIELD shutdown seals, or other types of low leakage seals, and have credited or will credit a low seal leakage rate (e.g., 1 gpm/seal) in the ELAP analyses for the RCS response. For those plants, information should be provided to address the impacts of the Westinghouse 10 CFR Part 21 report, "Notification of the Potential Existence of Defects Pursuant to 10 CFR Part 21," dated July 26, 2013 (ADAMS No. ML13211A168) on the use of the low seal leakage rate in the ELAP analysis.	
3.2.1.2.D	RCP Seal Leakage Rates - If the seals are changed to the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals, the acceptability of the use of the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals should be addressed, and the RCP seal leakages rates for use in the ELAP analysis should be provided with acceptable justification.	
3.2.1.6.A	Sequence of Events – Confirm that the final timeline has been time validated after detailed designs are completed and procedures are developed.	
3.2.3.A	Containment – Confirm containment analysis supports no action until after 7 days following ELAP event.	
3.2.4.2.A	Ventilation – Equipment Cooling – Confirm results of battery room and dc equipment room temperature profile calculation and whether additional extreme temperature measures as required for protection of batteries from extreme high and low temperatures.	
3.2.4.2.B	The licensee needs to complete its evaluation and calculations to address hydrogen accumulation in the battery rooms following a loss of ventilation.	
3.2.4.4.A	Communications - Confirm that upgrades to the site's communications systems have been completed.	
3.2.4.8.A	Electrical Power Sources – Confirm load calculations for the phase 2 and 3 FLEX generators will support supplied loads.	
3.2.4.9.A	Portable Equipment Refueling – Confirm the development of portable equipment refueling plans.	
3.2.4.10.B	Load reduction to conserve dc power – Confirm licensee	

	calculations, supporting vendor discharge test data, FLEX strategy battery load profile, and other inputs/initial conditions required by IEEE-485.	