Mega-Tech Services, LLC

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

Revision 1

January 6, 2014

Exelon Generation Company
Limerick Generating Station, Units 1and 2
Docket No. 50-352 and 50-353

Prepared for:

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

Contract NRC-HQ-13-C-03-0039
Task Order No. NRC-HQ-13-T-03-0001
Job Code: J4672
TAC Nos.: MF0847 and MF0848

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Technical Evaluation Report

Limerick Generating Station, Units 1 And Unit 2
Order EA-12-049 Evaluation

## 1.0 BACKGROUND

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

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

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

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

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

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

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

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

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

## 2.0 EVALUATION PROCESS

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

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

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

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

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

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

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

## 3.0 TECHNICAL EVALUATION

By letter dated February 28, 2013, (ADAMS Accession No. ML13060A127), and as supplemented by the first six-month status report in letter dated August 28, 2013 (ADAMS Accession No. 13240A266), Exelon Generation Company, LLC (hereinafter referred to as the licensee or Exelon) provided the Limerick Generating Station's (LGS) Integrated Plan for Compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by the licensee for the maintenance or restoration of core cooling, containment, and SFP cooling capabilities following a BDBEE, including modifications necessary to support this implementation, pursuant to Order EA-12-049. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the NRC staff in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful

implementation of the actions needed to achieve full compliance with the Order.

## 3.1 EVALUATION OF EXTERNAL HAZARDS

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

### 3.1.1 Seismic Events.

NEI 12-06, Section 5.2 states:

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

On page 1 of the Integrated Plan, in the section regarding determination of applicable extreme external hazards, the licensee stated that per the UFSAR Section 2.5, the seismic criteria for LGS include two design basis earthquake spectra: Operating Basis Earthquake (OBE) and the Design Basis Earthquake (DBE). The DBE and the OBE are 0.15g and 0.075g, respectively. Per NEI 12-06, all sites will consider the seismic hazard. The licensee further stated that based on the UFSAR, the soil at the seismic Category I spray pond was analyzed for liquefaction potential. The soils at other seismic Category I facilities were not analyzed since these soils are not saturated and the potential for becoming saturated is negligible. Based on the UFSAR, the spray pond does not have a soil liquefaction concern. In summary, Limerick site screens in for an assessment of seismic hazards, as required for all plants per NEI 12-06.

The licensee also stated on page 4 that the seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore were not assumed in their Integrated Plan.

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

3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

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

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

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

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

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

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

On pages 21, 32, 40, and 51 in the sections of the Integrated Plan regarding the strategies for maintaining core cooling, containment, spent fuel cooling and for safety systems support, respectively, the licensee stated that protection of associated portable equipment from seismic hazards in the transition phase (Phase 2) would be provided by constructing structures that meet the guidelines of NEI 12-06 Section 11. Section 11 provides general storage design guidance but does not provide the details for protection from the seismic hazards as delineated in NEI 12-06, Section 5.3.1, consideration 1 above. This comment is generic. Each section of the Integrated Plan describing storage protection from the external hazards makes reference to Section 11 rather than to the specific protection guidelines described in NEI 12-06 for the applicable hazard; for example, Section 6.2.3.1 for floods, Section 7.3.1 for wind, etc. The licensee addressed this issue during the audit process by committing to conform to the applicable sections of NEI 12-06 related to each hazard, such as Section 5.3.1, 6.2.3, 7.3.1, etc.

Although the licensee has indicated in the Integrated Plan that the Limerick procedures and programs are being developed to address storage structure guidelines, there is insufficient information in the plan to demonstrate that these procedures and programs will provide for securing large portable equipment to protect them during a seismic event or to ensure unsecured and/or non-seismic components do not damage the equipment as is specified in NEI 12-06, Section 5.3.1, considerations 2 and 3. The licensee addressed these issues during the audit process by stating that anchor points, sufficient clearance or other applicable means will be used to ensure seismic interaction do not impact the station's ability to implement FLEX equipment. Also, all equipment stored within the building will be secured, or will be within secured storage cabinets to protect equipment during a seismic event.

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 guidelines of Order EA-12-049 will be met with respect to equipment protection if these guidelines 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.

As previously noted in Section 3.1.1 of this report, Limerick does not have a soil liquefaction concern per information in the UFSAR. Therefore, consideration 1 above is not applicable to the Limerick plant. Also, because the spray pond meets the design criteria for emergency cooling, and is a self-contained seismic structure, consideration 3 is also not applicable.

With regard to consideration 2 above, the Integrated Plan stated that for core cooling, maintaining containment and spent fuel pool cooling, the FLEX connections were located in the Category 1 Spray Pond Pumphouse. The Integrated Plan stated that the electrical FLEX connections were located at the emergency diesel generator motor control centers. These locations are, by design, in robust structures.

With regard to consideration 4 above, the Integrated Plan did not address whether or not power would be required to move or deploy equipment. This is identified as Open Item 3.1.1.2.A in

Section 4.1.

On page 58 of the Integrated Plan, the licensee identifies a "Heavy Duty Truck" to be used to transport equipment, thus addressing consideration 5 above.

The licensee’s approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Open Items provides reasonable assurance that the guidelines of Order EA-12-049 will be met with respect to equipment deployment if these guidelines 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 pages 17, 21, 25, 29, 31, and 35, in the sections describing strategy key instrument parameters, there is no indication of whether the instruments listed are local or powered, and if powered, whether these instruments could be impacted by circumstances described in NEI 12-06, Section 5.3.3 consideration 1 noted above. In addition, the plan did not include consideration of critical actions to perform until alternate indications could be connected nor did it address guidance to include instructions on how to control critical equipment without control power. The licensee addressed this issue during the audit process by stating that the credited instruments listed in the Integrated Plan are powered from safety-related battery sources. The

licensee further stated that the ELAP strategy is designed to restore ac power to these batteries before they are depleted. However, the licensee did not address actions to be taken if instruments were lost due to a seismic event as postulated in consideration 1 above. This is identified as Open Item 3.1.1.3.A in Section 4.2.

With regard to NEI 12-06, Section 5.3.3 considerations (2) and (3) noted above, the licensee's plans did not adequately address the procedural interface considerations for seismic hazards associated with large internal flooding sources that are not seismically robust and do not require ac power; or the use of ac power to mitigate ground water in critical locations. The licensee addressed these two considerations during the audit process as follows: Regarding consideration (2), the large internal flooding sources that are not seismically robust are the circulating water lines from the cooling tower to the condenser. Upon a postulated rupture of these lines, flooding would be localized to the condenser bay until it reaches the grade elevation. The water would then flow into the plant yard and would not adversely impact any equipment necessary to support the FLEX equipment. Regarding consideration (3), the Limerick Station does not use ac power to mitigate groundwater. Any ground water into the plant would be gravity drained through floor drains into a sump where it would be collected. The licensee concluded that ground water intrusion is not an issue at Limerick.

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

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

On page 13 of the Integrated Plan, in the section regarding the Regional Response Center (RRC) Plan, the licensee stated that LGS has contractual agreements in place with the Strategic Alliance for FLEX Emergency Response (SAFER). The licensee further stated that the industry will establish two RRCs to support utilities during beyond design basis events. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from a RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 24 hours from the initial request.

The licensee’s plans for the use of offsite resources provided insufficient information regarding the identification of the local arrival staging area and a description of the methods to be used to deliver the equipment to the site. The licensee addressed these concerns during the audit process by stating that the licensee is actively involved in industry initiatives to establish RRCs to meet the guidelines of NEI 12-06 to provide Phase 3 equipment to the site. This includes the SAFER plan that will contain implementation details for generic and specific equipment obtained from the RRC. This plan will also contain the logistics for equipment transportation, area set up, and other needs for ensuring the equipment and commodities to sustain the site's coping strategies. The final development of these plans is identified as Confirmatory Item 3.1.1.4.A.

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 guidelines of Order EA-12-049 will be met with respect to offsite resources if these guidelines 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 1 and 2 of the Integrated Plan, in the section regarding the determination of applicable extreme external hazards, the licensee stated that the design basis flood level of the Schuylkill River at the site is 207 feet, including wave activity. The shortest horizontal distance from the contour at elevation 207 feet to the nearest safety-related structure is approximately 200 feet. Grade level is no lower than elevation 215' at any of the safety-related structures, and none of the safety-related structures has exterior openings below elevation 217'. Therefore, the safety-related structures are secure from Schuylkill River flooding and no special provisions for flood protection are necessary. Therefore, Limerick is built above the design basis flood level and is considered "dry" by the NEI guidance and dry sites are not required to evaluate flood-induced challenges.

The licensee further states that the other area reviewed for effects of flooding was the spray pond. Based on the UFSAR, the maximum flood level at the spray pond is 254.9 feet. The lowest elevation for the spray pond pump house is 268 feet. Therefore, the spray pond pump house does not have a flooding concern.

The licensee also noted that the Limerick Station has been analyzed for a Local Intense Precipitation (LIP). Based on the results and due to the analyzed flood planes for Limerick, the station will need to ensure storage and deployment of equipment is not impeded due to a transient flood (i.e. LIP). Thus the Limerick site screens in for an assessment for storage and transportation of equipment during a Local Intense Precipitation for external flooding.

The licensee stated on page 4 that the flooding re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore were not assumed in their Integrated Plan.

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

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

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

As noted in Section 3.1.2 of this report, the Limerick plan is considered "dry" with respect to a flooding hazard and therefore, consideration 1 above is not applicable.

With regard to consideration 2 above, on page 2 in the section of the Integrated Plan regarding the flood analysis, the licensee discussed the need to ensure storage and deployment of

equipment is not impeded due to a transient flood (LIP). Also, on page 22, in the discussion of protection of equipment from flood hazards, and repeated in other safety function sections, the licensee stated that procedures and programs will be developed to address storage structure guidelines, haul path guidelines, and FLEX equipment guidelines relative to the flood hazards.

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 guidelines of Order EA-12-049 will be met with respect protection of equipment if these guidelines are implemented as described.

3.1.2.2 Deployment of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.2 states:

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

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

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

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

As discussed in a previous section, the Limerick site is designated a "dry site." Nonetheless, on page 2 in the section of the Integrated Plan regarding the flood analysis, the licensee discussed the need to ensure deployment of equipment is not impeded due to a transient flood (LIP). The reviewer concluded that although the licensee has recognized the need to address the impact of a transient flood, the considerations above applicable to this hazard, considerations 2, 4, 5, and 8, were not discussed in the Integrated Plan. Thus, an assessment by the licensee is necessary to confirm that the licensee's FLEX strategy and procedures address considerations 2, 4, 5, and 8 of NEI 12-06, Section 6.2.3.2, as it relates to a transient flood as a result of LIP. This is identified as Open Item 3.1.2.2.A in Section 4.1. This evaluation should include confirming that procedures address these considerations.

Consideration 9 was addressed in that the licensee has identified a heavy duty truck to move or transport equipment. Also, the licensee discussed the need to develop procedures on page 22 to address haul path guidelines to address flooding impacts.

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

3.1.2.3 Procedural Interfaces – Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

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

Because the licensee has determined that Limerick is a "dry site" except for local intense

precipitation, the need for procedural guidelines to address the flood hazard are limited to transient flood conditions. The issue of procedurally addressing transient flood conditions is combined with previous Open Item 3.1.2.2.A identified in the Section 3.1.2.2 above.

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

3.1.2.4 Considerations in Using Offsite Resources – Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

On page 13 of the Integrated Plan, the licensee stated that LGS has contractual agreements in place with the SAFER. As part of the agreement, equipment will be moved from the RRC location to the site. However, the subject of flooding hazards with regard to transporting offsite equipment to the site is not specifically addressed. This concern was discussed as part of the audit process. The licensee responded by stating that the "Limerick site is classified as a dry site, therefore equipment delivery at the site will not be impacted by flood conditions." The licensee has not addressed the potential for flooding conditions at the offsite receiving area or for flooding along transportation routes to the Limerick site. During the audit process the licensee stated that it is actively involved in industry initiatives to establish RRCs to meet the guidelines of NEI 12-06 to provide Phase 3 equipment to the site. This includes the SAFER plan that will contain implementation details for generic and specific equipment obtained from the RRC. This plan will also contain the logistics for equipment transportation, area set up, and other needs for ensuring the equipment and commodities to sustain the site's coping strategies. The final development of these plans is combined with Confirmatory Item 3.1.1.4.A and should address the potential for flooding conditions from LIP.

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 guidelines of Order EA-12-049 will be met with respect to offsite resources if these guidelines are implemented as described.

3.1.3 High Winds

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

susceptible to different high wind conditions to allow characterization of the applicable high wind hazard.

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

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

On page 2 of the Integrated Plan, in the section regarding the determination of applicable extreme external hazards, the licensee stated that LGS is located at approximately 40°13'26" north latitude and 75°35'16" west longitude. Per Figure 7-1 of NEI 12-06, Limerick is susceptible to hurricanes due to location. Per Figure 7-1, peak wind gusts at Limerick will be between 130 and 140 mph. Also, according to the UFSAR and Figure 7-2 of NEI 12-06, LGS is susceptible to tornado induced winds and is classified as Region 2 with maximum wind speeds of 170 mph. Therefore, based on the above, LGS screens in for an assessment of severe storms with high winds for both hurricanes and tornados.

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 guidelines of Order EA-12-049 will be met with respect high wind screening if these guidelines 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 pages 22, 32, 41, and 52 in the sections of its Integrated Plan regarding the strategies for maintaining core cooling, maintaining containment, SFP cooling, and safety function support, respectively, the licensee stated that protection of associated portable equipment from hazards from severe storms with high winds would be provided in structures constructed to meet the guidelines of NEI 12-06 Section 11. However, the Integrated Plan did not specifically address the considerations above. As noted previously, the licensee addressed this during the audit process and stated that NEI 12-06, Section 7.3.1 would be addressed. The licensee further stated that FLEX pumps, generators, hose trailers, and the haul and debris removal truck will be stored in protected buildings. However, the licensee had not determined if it would use robust buildings meeting the site design basis for safety related structures or, use two buildings

separated by an adequate distance meeting ASCE 7-10. The reviewer concluded that either approach would satisfy the guidance considerations of NEI 12-06, Section 7.3.1 above.

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

3.1.3.2 Deployment of FLEX Equipment – High Wind Hazard

NEI 12-06, Section 7.3.2 states:

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

The Integrated Plan did not address potential impacts from wind generated debris in the ultimate heat sink per the guidance of consideration 2 above. During the audit process, the licensee addressed water quality (e.g., suspended solids especially during flood conditions, or from high wind debris) in the UHS by explaining that that river water going into the spray pond is passed through a screen with 0.25 inch openings and the spray pond pump house suctions have 0.50 inch stationary screens. The licensee further stated that the design of the FLEX pump suction will determine if additional screens are required. The final resolution addressing the potential for debris as a result of extreme external hazards (e.g., suspended solids especially during flood conditions, or from high wind debris) restricting coolant flow to the core and in the core is combined with Confirmatory Item 3.2.1.8.A in Section 4.2.

On page 58 of the Integrated Plan describing response equipment and commodities necessary

in the Phase 2, the licensee listed a “heavy duty truck" to be used for refueling and to transport portable equipment and clear debris. As previously noted in this report, the licensee plans to store the truck in a protected storage building. On page 63, in the table for Phase 3 response equipment, the licensee lists debris clearing equipment under “Heavy Equipment.” The reviewer concluded that these plans address considerations 3, 4, and 5 above.

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

3.1.3.3 Procedural Interfaces – High Wind Hazard

NEI 12-06, Section 7.3.3, states:

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

On page 11 of the Integrated Plan describing how the strategies will be deployed in all modes, the licensee stated that an administrative program will be developed to ensure pathways remain clear or compensatory actions will be implemented to ensure all strategies can be deployed during all modes of operation. This administrative program will also ensure the strategies can be implemented in all modes by maintaining the portable FLEX equipment available to be deployed during all modes.

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 guidelines of Order EA-12-049 will be met with respect procedural interfaces if these guidelines are implemented as described.

3.1.3.4 Considerations in Using Offsite Resources – High Wind Hazard

NEI 12-06, Section 7.3.4 states:

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

On page 13 of the Integrated Plan, the licensee stated that LGS has contractual agreements in place with the SAFER. As part of the agreement, equipment will be moved from the RRC location to the site. However, with regard to considerations 1 and 2 above, the impact of high wind hazards when transporting offsite equipment to the site is not specifically addressed.

During the audit process the licensee stated that it is actively involved in industry initiatives to establish RRCs to meet the guidelines of NEI 12-06 to provide Phase 3 equipment to the site. This includes the SAFER plan that will contain implementation details for generic and specific equipment obtained from the RRC. This plan will also contain the logistics for equipment transportation, area set up, and other needs for ensuring the equipment and commodities to sustain the site's coping strategies. The final development of these plans is combined with Confirmatory Item 3.1.1.4.A and should address the impact of high wind hazards.

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 guidelines of Order EA-12-049 will be met with respect to offsite resources if these guidelines are implemented as described.

3.1.4 Snow, Ice and Extreme Cold

As discussed in NEI 12-06, Section 8.2.1:

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

On page 3 of the Integrated Plan, in the section regarding the determination of applicable extreme external hazards, the licensee stated that the LGS site is located above the 35th parallel and thus the capability to address impedances caused by extreme snowfall need to be provided. Also, per Figure 8-2 of the NEI 12-06, LGS is classified as a Level 4 Ice Severity. In summary, an assessment for impact of snow, ice, and extreme cold will need to be completed for storage and deployment of the FLEX equipment.

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

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

NEI 12-06, Section 8.3.1 states:

> These considerations apply to the protection of FLEX equipment from snow, ice, and extreme cold hazards:
>
> 1. For sites subject to significant snowfall and ice storms, portable FLEX equipment should be stored in one of the two configurations.
>
>     a. In a structure that meets the plant's design basis for the snow, ice and cold conditions (e.g., existing safety-related structure).

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

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

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

On pages 22, 32, 41 in the sections of the Integrated Plan regarding the strategies for maintaining core cooling, containment, spent fuel cooling, and safety function support, respectively, the licensee stated that protection of associated portable equipment from hazards from snow, ice, and extreme cold would be provided in structures constructed to meet the guidelines of NEI 12-06 Section 11. However, the Integrated Plan did not specifically address the considerations of NEI 12-06, Section 8.3.1 above. The licensee addressed this concern during the audit process and confirmed that Limerick will conform to the guidelines of NEI 12-06, Section 8.3.1.

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

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

NEI 12-06, Section 8.3.2 states:

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

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

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

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

On page 11 of the Integrated Plan, in the section describing how strategies will be deployed in all modes, the licensee stated that deployment of FLEX is expected for all modes of operation. The licensee further stated that transportation routes will be developed from the equipment storage area to the FLEX staging areas and that an administrative program will be developed to ensure pathways remain clear or compensatory actions will be implemented to ensure all strategies can be deployed during all modes of operation. In addition, the licensee stated that the administrative program will ensure the strategies can be implemented in all modes by maintaining the portable FLEX equipment available to be deployed during all modes.

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 guidelines of Order EA-12-049 will be met with respect deployment if these guidelines are implemented as described.

3.1.4.3 Procedural Interfaces – Snow, Ice, and Extreme Cold Hazard

NEI 12-06, Section 8.3.3, states:

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

As discussed above in Section 3.1.4.2 of this report, the licensee has committed to develop an administrative program to ensure pathways remain clear or compensatory actions will be implemented to ensure all strategies can be deployed during all modes of operation.

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

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

NEI 12-06, Section 8.3.4, states:

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

On page 13 of the Integrated Plan, the licensee stated that LGS has contractual agreements in place with the SAFER. As part of the agreement, equipment will be moved from the RRC location to the site. However, the impact of snow, ice and wind hazards when transporting offsite equipment to the site is not specifically addressed. During the audit process the licensee stated that it is actively involved in industry initiatives to establish RRCs to meet the guidelines of NEI 12-06 to provide Phase 3 equipment to the site. This includes the SAFER plan that will contain implementation details for generic and specific equipment obtained from the RRC. This plan will also contain the logistics for equipment transportation, area set up, and other needs for ensuring the equipment and commodities to sustain the site's coping strategies. The final development of these plans is combined with Confirmatory Item 3.1.1.4.A and should address the impact of snow, ice and extreme cold hazard.

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

3.1.5 High Temperatures

NEI 12-06, Section 9 states:

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

On page 4 of the Integrated Plan, in the section regarding the determination of applicable extreme external hazards, the licensee noted that NEI 12-06 states that all sites must consider high temperatures. Therefore, LGS must assess high temperatures for the protection and deployment 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 guidelines of Order EA-12-049 will be met with respect to screening for high temperature hazards if these guidelines 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 22, 33, 41 in the sections of the Integrated Plan regarding the strategies for maintaining core cooling, containment, spent fuel cooling, and safety function support, respectively, the licensee stated that protection of associated portable equipment from high temperature hazards would be provided in structures constructed to meet the guidelines of NEI 12-06, Section 11. However, the Integrated Plan did not specifically address the considerations of NEI 12-06, Section 9.3.1 above. The licensee addressed this concern during the audit process and confirmed that Limerick will conform to the guidelines of NEI 12-06, Section 9.3.1.

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

3.1.5.2 Deployment of FLEX Equipment – High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

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

There was insufficient information provided in the Integrated Plan to demonstrate that the impact of high temperature was addressed for the deployment of equipment per the guidance of NEI 12-06. The licensee addressed this issue during the audit process by stating that portable equipment in the storage facilities will be specified to operate under high temperature conditions. The licensee further stated that the design of the storage facilities will include provisions to ensure the equipment storage facilities are not impacted by high temperatures. Detailed information will be provided in a future 6-month update to the Integrated Plan. This is identified as Confirmatory Item 3.1.5.2.A in Section 4.2.

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

3.1.5.3 Procedural Interfaces - High Temperature Hazard

NEI 12-06, Section 9.3.3 states:

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

On page 22, 33, 41, and 53 regarding the strategies for maintaining core cooling, containment, SFP cooling, and safety function support, respectively, the licensee stated that procedures and programs will be developed to address storage structure guidelines, haul path guidelines, and FLEX equipment guidelines relative to the external hazards applicable to LGS.

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 guidelines of Order EA-12-049 will be met with respect procedural interfaces if these guidelines are implemented as described.

## 3.2 <u>PHASED APPROACH</u>

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

To meet these EA-12-049 requirements, Licensees will establish a baseline coping capability to prevent fuel damage in the reactor core or SFP and to maintain containment capabilities in the

context of a BDBEE that results in the loss of all ac power, with the exception of buses supplied by safety-related batteries through inverters, and loss of normal access to the UHS. As described in NEI 12-06, Section 1.3, "[p]lant-specific analyses will determine the duration of each phase." This baseline coping capability is supplemented by the ability to use portable pumps to provide reactor pressure vessel (RPV)/reactor makeup in order to restore core or SFP capabilities as described in NEI 12-06, Section 3.2.2, Guideline (13). This approach is endorsed in NEI 12-06, Section 3, by JLD-ISG-2012-01.

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

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

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

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

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

3.2.1.1. Computer Code Used for ELAP Analysis.

NEI 12-06, Section 1.3 states in part:

> To the extent practical, generic thermal hydraulic analyses will be developed to support plant specific decision-making. Justification for the duration of each phase will address the on-site availability of equipment, the resources necessary to deploy the equipment

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

The licensee has provided a Sequence of Events (SOE) in their Integrated Plan, which included the time constraints and the technical basis for the site. Because comments in the Integrated Plan made reference to different analyses, it was not clear to the reviewer what analysis was used to develop or support the timeline for the events related to core cooling. However, information provided in the 6-month update (Attachment 2 to the original Plan, NSSS Significant Reference Analysis Deviations Table), and information provided during the licensee's response to the audit process, provided a clear reference to the use of the Modular Accident Analysis Program (MAAP) analysis for Limerick.

MAAP was written to simulate the response of both current and advanced light water reactors to loss of coolant accident (LOCA) and non-LOCA transients for probabilistic risk analyses as well as severe accident sequences. The code has been used to evaluate a wide range of severe accident phenomena, such as hydrogen generation and combustion, steam formation, and containment heating and pressurization.

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

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

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

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

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

considered important in the simulation of the ELAP event by the vendor / licensee should also be included.

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

This is Confirmatory Item 3.2.1.1.D in Section 4.2.

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

The concern regarding the MAAP limitations was addressed during the audit process. The licensee stated that Limerick will provide a letter to the NRC documenting compliance with generic approach and addressing the limitations for the use of MAAP.

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 guidelines of Order EA-12-049 will be met with respect to the use of computer codes if these guidelines are implemented as described.

3.2.1.2. Recirculation Pump Seal Leakage Models.

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

The Integrated Plan listed reference document, LG-MISC-012, MAAP Analysis to Support FLEX Initial Strategy, Revision 1. Within that document, the general assumption made for the input data for seal leakage was discussed on page 11 of 114 as follows:

> The seal leakage assumed from each reactor recirculation pump due to loss of seal water is 18 gpm per pump (total of 36 gpm).

No technical basis is presented in the Integrated Plan or in the reference document for the assumed 36 gpm reactor recirculation pump seal leakage. The licensee addressed this question during the audit process by stating that during the resolution phase of the Station Blackout (SBO) Rule (Nuclear Utility Management and Resources Council document 87-00, Revision 1, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station

Blackout at Light Water Reactors," dated November 20, 1987), the use of an assumed leakage of 18 gpm per pump was found to be acceptable. The licensee further stated that this value was used in their MAAP analysis. The reviewer noted that although the 18 gpm is not specified in NUMARC 87-00, the value is noted as acceptable in a subsequent Station Blackout NRC Rulemaking Issue document SECY-94-225, dated August 26, 1994 (Section 3.3.1).

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

3.2.1.3 Sequence of Events

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

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

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

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

In response to the need to identify expected time constraints, the Integrated Plan includes a discussion of time constraints on pages 6 through 10 and, a Sequence of Events Timeline, Attachment 1A, on pages 64 through 67.

On page 7 the licensee stated that initial calculations were used to determine the fuel pool timelines and that formal calculations will be performed to validate this information during development of the SFP cooling strategy detailed design, and will be provided in a future 6-month update. Also, on page 9, the licensee stated that preliminary analysis shows that with containment venting in progress, makeup to the Suppression Pool will be required at approximately 65 hours from the beginning of the event to ensure suppression pool level remains above 13.5 feet. In another example, on page 66 the licensee states that the action to initiate early containment venting is based on preliminary analysis. These statements demonstrate that portions of the sequence of events are preliminary. However, the licensee further stated that the "times to complete actions in the events timeline are based on operating judgment, the conceptual designs, and the current supporting analyses. The final timeline will

be time validated once detailed designs are completed and procedures are developed. The results will be provided in a future 6-month update." Further review of the final update is identified as Confirmatory Item 3.2.1.3.A in Section 4.2.

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

3.2.1.4 Systems and Components for Consequence Mitigation

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

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

And,

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

NEI 12-06, Section 3.2.1.12 states:

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

On page 9 of the Integrated Plan in the section regarding the sequence of events, the licensee states that additional work will be performed during detailed design development to ensure suppression pool temperature will support RCIC operation, in accordance with approved boiling-water reactor owners group (BWROG) analysis, throughout the event. The NRC staff is aware of the two BWROG reports on the subject, GE Task Report 0000-0143-0382-R0, "RCIC System Operation in Prolonged Station Blackout - Feasibility Study," January 2012, and 0000-0155-0154-R0, "RCIC Pump and Turbine Durability Evaluation – Pinch Point Study," February 2013, neither of which has been submitted for NRC review. During the audit process, the licensee was requested to confirm that when the detailed design for Limerick is complete, a discussion would be provided to address the applicability of the BWROG analyses on the subject and any procedural or plant modifications planned to facilitate the continued operation of RCIC will be included in a future submittal to the NRC. The licensee responded that the detailed design will determine containment heatup rate and the subsequent impacts on RCIC operation and the need for any modifications. This will include a review of the BWROG reports. Verification that the issue is addressed is identified as Confirmatory Item 3.2.1.4.A in Section 4.2.

An additional concern was raised during the audit process regarding whether or not there were any safety trips to RCIC from room or area switches that would impact RCIC operation. The licensee responded by stating that, as noted in the Integrated Plan, temperatures are not expected to reach 158 °F. The licensee identified two switch set points that were beyond that temperature but pointed out that the "RCIC Equipment Room Delta Temperature High" setpoint was 109 °F. It was not clear to the reviewer from the added discussion whether or not any of the setpoints would have an adverse impact on the planned use of the RCIC as a mitigation strategy. Further clarification is needed for this issue. This is identified as Confirmatory Item 3.2.1.4.B in Section 4.2.

It was not clear from a review of the Integrated Plan whether any non-safety equipment was being relied upon as part of the FLEX strategies. The licensee addressed this concern during the audit process by stating that Limerick is not relying on any non-safety related installed systems or equipment for the ELAP mitigation strategies currently used. If, during the detailed design development, it is determined that non-safety equipment will need to be credited, this will be addressed in a future 6-month update.

On pages 25, 35, 44, and 55, in the sections on core cooling, maintaining containment, SFP cooling and safety function support, the licensee stated that Phase 3 equipment for Limerick includes backup portable pumps and generators. The portable pumps will be capable of providing the necessary flow and pressure as outlined in the Phase 2 responses. The licensee further stated that the portable generators will be capable of providing the necessary 480 volt power guidelines as outlined in Phase 2 response for safety functions support. Because the plan makes reference to use of the Phase 3 equipment as backup, the Integrated Plan should address the guidance of NEI 12-06 regarding site procedures for Phase 3 implementation. The licensee addressed this concern during the audit response and stated that Limerick would ensure connection capabilities of the Phase 3 offsite equipment to site systems and would develop any procedural guidance required for those connections. This is identified as Confirmatory Item 3.2.1.4.C. in Section 4.2.

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

3.2.1.5 Monitoring Instrumentation and Controls

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

> The parameters selected must be able to demonstrate the success of the strategies at maintaining the key safety functions as well as indicate imminent or actual core damage to facilitate a decision to manage the response to the event within the Emergency Operating Procedures and FLEX Support Guidelines or within the SAMGs. Typically these parameters would include the following:
>
> - RPV Level
> - RPV Pressure
> - Containment Pressure
> - Suppression Pool Level

- Suppression Pool Temperature
- SFP Level

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

The lists of instruments provided in the Integrated Plan are consistent with those identified in NEI-12-06 to support mitigation strategies. However, the lists did not indicate whether the installed instruments would need to be supplied from backup or temporary power sources in an ELAP event. The licensee refined the information regarding power sources for instrumentation in the response to the audit process. The licensee stated that: 1) The current FLEX plan will ensure backup power to Division 1 and Division 2 battery chargers and will maintain dc power throughout the event. 2) The instrumentation required and the power sources are as follows:

| | | |
|---|---|---|
| RPV Level | LI-42-*R610 | Division 1 |
| Suppression Pool Temperature | TI-41-*02 | Division 1 |
| RPV Pressure | PI-49-*R602 | Division 1 |
| Drywell Pressure | PI-42-*70-1 | Division 2 |
| Drywell Level | LIS-55-*N662 | Division 2 |

The licensee further stated that the drywell temperature readings would be obtained from panels in the control room in accordance with existing Station Blackout procedures and that drywell temperature monitoring will be maintained throughout the event.

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 guidelines of Order EA-12-049 will be met with respect to monitoring instrumentation and controls if these guidelines are implemented as described.

3.2.1.6 Motive Power, Valve Controls and Motive Air System

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

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

And,

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

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

On page 15 of the Integrated Plan in the section regarding Phase 1 core cooling, the licensee stated that the primary containment instrument gas (PCIG) system provides a safety-related

gas supply for the automatic depressurization system (ADS) valves in the event that the non-safety related normal PCIG supply is unavailable. These long-term gas supplies have been designed to remain operable following a loss of offsite power and either set of bottles will supply the ADS valves with sufficient nitrogen for seven days of operation. In that there is no provision for a FLEX backup supply for motive force to operate the ADS valves for venting, it is not clear how the Integrated Plan addresses the guideline of NEI 12-06 for supporting key safety functions indefinitely. The licensee addressed this concern during the audit process and stated that current procedures provide guidance for connection of nitrogen bottles external to the reactor building. These connections will be used to connect additional bottles (nitrogen or air) or a diesel powered air compressor for long term operation.

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

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

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

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

The licensee discussed this issue during the audit process. The licensee stated that Limerick plans to abide by the generic resolution. Furthermore, the licensee stated that a review is in progress to develop a plan to address potential plant specific issues associated with implementing the generic approach. The results and conclusions of this review will be provided in a future 6-month update. This is identified as Confirmatory Item 3.2.1.7.A in Section 4.2.

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

3.2.1.8 Use of Portable Pumps

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

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

NEI 12-06 Section 11.2 states in part:

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

The Integrated Plan provides descriptions of the use of portable pumps and the associated configurations for core cooling, maintaining containment and for SFP cooling. For core cooling, two diesel driven portable pumps will take suction on the spray pond and discharge into the common residual heat removal service water (RHRSW) systems, which will then be cross-connected to the respective unit's residual heat removal (RHR) System. The system is common to the two reactor units, and consists of two trains. Each train services one RHR heat exchanger in each unit, and provides sufficient cooling for safe shutdown, cooling and accident mitigation of both units. A similar configuration is described in the Integrated Plan for suppression pool cooling utilizing the spray pond as the water source. The same portable pumps will be utilized for SFP cooling through modifications made to facilitate the required flow path.

The Integrated Plan described the use of FLEX pumps taking suction from the spray pond, but is silent regarding water quality. It is not evident that water quality (e.g., suspended solids especially during flood conditions, or from high wind debris) and the potential for entrained debris resulting in a restriction of coolant flow across the fuel assemblies to an extent that would inhibit adequate flow to the core has been adequately addressed. The licensee discussed this concern during the audit process and stated that river water going into the spray pond is passed

through a screen with 0.25 inch openings and the spray pond pump house suctions have 0.50 inch stationary screens. The licensee further stated that the design of the FLEX pump suction will determine if additional screens are required. The final resolution addressing the potential for debris as a result of extreme external hazards (e.g., suspended solids especially during flood conditions, or from high wind debris) restricting coolant flow in the core is identified as Confirmatory Item 3.2.1.8.A in Section 4.2.

Although the Integrated Plan provides a description of the use of portable pumps, insufficient technical information is presented or referenced in the plan to confirm the ability of the portable FLEX pumps to deliver the required flow through the system of flex hoses, couplings, valves, elevation changes, etc. for the configurations described. However, on page 24 of the Integrated Plan, the licensee stated that the engineering designs for compliance with NRC Order EA-12-049 are not finalized. Analysis will be performed to validate that the plant modifications, selected equipment, and identified mitigating strategy can satisfy the safety function guidelines of NEI 12-06. The licensee further stated that once these designs and mitigating strategies have been fully developed, Exelon will update the Integrated Plan for LGS during a scheduled 6-month update. The finalized design demonstrating that adequate pump flows are available for mitigating strategies is identified as Confirmatory Item 3.2.1.8.B in Section 4.2.

The Integrated Plan described a strategy of taking suction from spray pond using a FLEX Pump and discharging water into RHR SW piping. The licensee's strategy is to create a flow path for this water into RHR system piping and into RCS. During the audit process, the NRC staff requested additional information:

1) The staff requested information on the modifications required to get the water from SW side to the RCS side.
2) The staff requested confirmation that the RHR SW piping from the spray pond pump house to the point where the RHR SW piping will be modified to flow into RHR side, is qualified to withstand an ELAP event.
3) The staff requested the licensee to describe how long it would take to initiate and complete the actions to provide RCS makeup from the spray ponds through the RHR system.

The licensee provided the following information in response to the request:

1) Each unit currently has a cross connect valve between one train of RHR and one loop RHRSW. A FLEX modification on each unit will install a cross connection between a different RHR train and the other loop of RHRSW.
2) The RHRSW piping is buried from the ultimate spray pond to the entrance to the RHR rooms. This piping is seismically designed.
3) The detailed timelines for the FLEX pump setup and connections are a function of the detailed design. As the detailed designs are completed, Limerick will ensure that equipment can be set up and operational within the required times.

The Integrated Plan describes an alternate method of supplying makeup to the RCS and suppression pool that involves the same configuration as the primary method, that is, injecting to RHR SW then into RHR and finally into the RCS or the suppression pool. It is not clear that this configuration meets the guidelines of NEI 12-06 for diversity. The licensee addressed this concern during the audit process by stating that two separate flow paths from the spray pond are used. The primary and secondary methods use different loops of the seismically robust RHR service water system to convey cooling water. These flow paths are physically diverse for

the entire route from the spray ponds. The NRC staff noted that the use of injection points in different loops with flow paths that are physically diverse the entire route from the spray pond is in accordance with NEI 12-06.

On page 14 in the Integrated Plan, in the section describing BWR Installed Equipment Phase 1, Reactor Level Control, it is stated that the RCIC pump can take suction from the condensate storage tank (CST) or from the suppression pool. And, if the CST is unavailable, suction will be transferred to the suppression pool. Per design, the RCIC suction is normally aligned to condensate storage tank (CST), and is switched over to suppression pool (SP) when CST water level is low. The NRC staff requested additional information related to this strategy during the audit process. Specifically:

1) Is the CST qualified for all potential ELAP events? If not,

2) In the event ELAP conditions significantly damage CST, provide information with a discussion that supports a) the instrumentation to switch RCIC suction from CST to SP will remain operational, b) the switchover function will be accomplished in a timely manner, and c) that RCIC injection to RPV will remain uninterrupted. The discussion should include whether switchover function during ELAP will be carried out manually or automatically; and if manually, then whether it is carried out from the main control room, or from the remote control panel, or from any other secured and accessible location. The discussion should further address whether the switchover function is fail-safe, and the function logic, software, hardware, all related piping, valves, systems, structures and components (SSCs), and CST water level instrumentations to support the switchover function, either manually or automatically, are of safety grade and are qualified for all potential ELAP events including seismic, tornado/high winds, flooding and missiles. If not, then justify how switchover of RCIC suction from CST to SP will be successful in ELAP conditions if the CST is not available.

The licensee provided the following response to the questions posed during the audit process:

1) The CST is not qualified to survive an ELAP or a BDBEE. It is assumed the CST will fail and that suppression pool water will be used as the water source for the RCIC.

2) The station blackout procedures provide direction to transfer the RCIC from the CST to the suppression pool. The RCIC suction valves and the associated logic that are required to reposition the suction valves are powered from the Division 1 dc system. The valves and instrumentation required are all located in the reactor enclosure and are protected from the external hazards. The instrumentation is fail-safe in that CST failure would appear as a low CST and swap to suppression pool for RCIC suction.

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 guidelines of Order EA-12-049 will be met with respect to portable pumps if these guidelines are implemented as described.

### 3.2.2 Spent Fuel Pool Cooling Strategies

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

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

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

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

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

On page 39 of the Integrated Plan, the licensee stated that two diesel driven portable pumps will take suction from the spray pond and discharge into the common RHRSW systems, which will then be cross-connected to the respective unit's RHR system. The licensee further stated that a new RHRSW to RHR crosstie on each unit will include a quick hose connection that can be used to supply water from the RHRSW into a hose attached to a new run of piping and additional hoses that can be used to provide the capability for overspray of the SFPs. The licensee also described an alternate method of cooling utilizing the fire protections system.

On page 37 of the Integrated Plan, the licensee concluded that upon loss of SFP cooling, the non-outage time for water level to reach the top of active fuel is 138 hours and for outage worst case conditions, that time is 28 hours. Using those assumptions, the licensee concluded initiation of SFP cooling coping strategies could begin at 12 hours or 8 hours depending on whether the initial condition is Mode 1 or an outage, respectively. However, on page 37, the licensee stated that the "an initial evaluation was performed to determine the fuel pool timelines." The licensee further stated that formal calculations will be performed to validate this information during development of the detailed design, and will be provided in a future 6-month

update. This is identified as Confirmatory Item 3.2.2.A in Section 4.2.

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

### 3.2.3 Containment Functions Strategies

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

On page 27 of the Integrated Plan in the section regarding maintaining containment, Phase 1, the licensee stated that the strategy at Limerick for the ELAP is to commence early containment venting at approximately 6 hours into the event. The licensee discussed this briefly during the audit response by acknowledging that this is a generic event and is being addressed by the NRC and BWROG but the licensee did not state a plan of action. The NRC staff considers the adoption of Revision 3 to the BWROG Emergency Procedure Guidelines (EPG)/Severe Accident Guidelines (SAG) by licensees to be a Generic Concern (and thus an open item for the licensee) because the BWROG has not addressed the potential for the revised venting strategy to increase (relative to currently accepted venting strategies) the likelihood of detrimental effects on containment response for events in which the venting strategy is invoked. In particular it has not been shown that the potential for negative pressure transients, hydrogen combustion, or loss of containment overpressure (as needed for pump NPSH) is not significantly different when implementing Revision 3 of the EPG/SAG vs. Revision 2 of the EPG/SAG. Revision 3 provides for earlier venting than previous revisions. The BWR procedures are structured such that the new venting strategy is not limited to use during the BDBEEs that are the subject of EA-12-049, but could also be implemented during a broad range of events. Acceptance of EPG/SAG Revision 3, including any associated plant-specific evaluations (or an alternate method) is identified as Open Item 3.2.3.A in Section 4.1.

With the overarching assumption that the EPG/SAG Revision 3 guidance will be approved by the NRC staff, the licensee performed a MAAP Analysis to demonstrate that containment functions will be maintained in all phases of an ELAP by following their proposed strategy. (Note: See section 3.2.1.1 for Confirmatory Items associated with the use of the MAAP code.) The containment design pressure for LGS is 55 psig, and the drywell design temperature is 340°F. By opening the hardened wetwell vent at 27 psia (approximately 6.8 hours into the ELAP event), the peak drywell pressure was also limited to 27 psia and the peak drywell temperature was approximately 250°F in the 72-hour analyzed time period.

Although NEI 12-06, Table 3-1 indicates heat removal as one of the safety functions, the Integrated Plan appears to correlate containment integrity solely with ensuring containment

pressure limits are not exceeded. This was evident by the fact that the essential containment instrumentation listed on page 31 of the Integrated Plan did not include a means for measuring containment temperature. In general, excessive temperatures could result in a loss of containment integrity due to the failure of containment penetration seals or other portions of the containment boundary. Furthermore, excessive temperatures may need to be monitored to ensure the qualification range of necessary measurement instruments located in the containment is not exceeded. The licensee addressed the monitoring of drywell temperature during the audit process and this topic was previously discussed in Section 3.2.1.5 of this report. The licensee stated that drywell temperature monitoring will be maintained throughout the event.

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

### 3.2.4 Support Functions

#### 3.2.4.1 Equipment Cooling - Cooling Water

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

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

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

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 guidelines of Order EA-12-049 will be met with respect to equipment cooling, if these guidelines are implemented as described..

#### 3.2.4.2 Ventilation – Equipment Cooling

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

*Plant procedures/guidance should consider loss of ventilation effects on specific energized equipment necessary for shutdown (e.g., those containing internal electrical power supplies or other local heat sources that may be energized or present in an ELAP.*

ELAP procedures/guidance should identify specific actions to be taken to ensure that equipment failure does not occur as a result of a loss of forced ventilation/cooling. Actions should be tied to either the ELAP/LUHS or upon reaching certain temperatures in the plant. Plant areas requiring additional air flow are likely to be locations containing shutdown instrumentation and power supplies, turbine-driven decay heat removal equipment, and in the vicinity of the inverters. These areas include: steam driven [auxiliary feedwater] AFW pump room, HPCI and RCIC pump rooms, the control room, and logic cabinets. Air flow may be accomplished by opening doors to rooms and electronic and relay cabinets, and/or providing supplemental air flow.

Air temperatures may be monitored during an ELAP/LUHS event through operator observation, portable instrumentation, or the use of locally mounted thermometers inside cabinets and in plant areas where cooling may be needed. Alternatively, procedures/guidance may direct the operator to take action to provide for alternate air flow in the event normal cooling is lost. Upon loss of these systems, or indication of temperatures outside the maximum normal range of values, the procedures/guidance should direct supplemental air flow be provided to the affected cabinet or area, and/or designate alternate means for monitoring system functions.

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

Temperatures in the HPCI pump room and/or steam tunnel for a BWR may reach levels which isolate HPCI or RCIC steam lines. Supplemental air flow or the capability to override the isolation feature may be necessary at some plants. The procedures/guidance should identify the corrective action required, if necessary.

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

On page 50 of the Integrated Plan, in the section regarding safety function support, the licensee discussed the battery room ventilation for Phase 2 and stated that it is expected that the rise in temperature due to the loss of ventilation will not adversely affect the

functionality of the batteries. The licensee further stated that the battery room doors will be opened to prevent the occurrence of high hydrogen concentration in the rooms once the battery chargers are re-energized. It was not clear from the information presented in the Integrated Plan what analysis or technical basis was used to conclude that the battery room temperature rise is inconsequential. Also, no discussion was presented to address possible low temperature effects. The licensee is requested to provide information on the adequacy of the ventilation provided in the battery room to protect the batteries from the effects of elevated or lowered temperatures. These concerns are identified as Confirmatory Item 3.2.4.2.A in Section 4.2.

Furthermore, it was not clear what technical basis substantiates that propping open the battery room doors will be successful in preventing high hydrogen concentrations. The licensee addressed this concern during the audit process. The licensee stated that battery room ventilation will be addressed through procedure changes and that the proposed methods of ventilation, open doors and fans, will be confirmed during the detailed design process. This is identified as Confirmatory Item 3.2.4.2.B in Section 4.2.

With regard to elevated temperatures in general, the licensee had not provided a discussion in the Integrated Plan on the impact of elevated temperatures, as a result of loss of ventilation and/or cooling, on electrical equipment being credited as part of the ELAP strategies (e.g., electrical equipment in the RCIC pump rooms). Such a discussion should specify whether the initial temperature condition assumed the worst-case outside temperature with the plant operating at full power as well as provide the list of electrical components that are located in the pump rooms that are necessary to ensure successful operation of required pumps. For completeness, the discussion should have provided the qualification level for temperature and pressure for these electrical components for the duration that the pumps are assumed to perform its mitigating strategies function. This is identified as Open Item 3.2.4.2.C in Section 4.1.

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

It was not clear from the information provided in the Integrated Plan whether or not freezing of piping or instrument lines had been addressed. The licensee addressed this concern during the audit process by stating that Limerick has identified no potential for freezing of piping or instrument lines (currently installed) that are required for the FLEX strategies. The external connection piping described in the Integrated Plan is normally dry until it is used for FLEX strategies.

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

3.2.4.4 Accessibility - Lighting and Communication

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.

The licensee's plans for the development of guidance and strategies with regard to the provision of portable lighting provided no information to demonstrate there is reasonable assurance that the guidance and strategies developed will conform to the guidance of NEI 12-06 Section 3.2.2 (8) regarding provisions for portable lighting devices. The licensee addressed this concern during the audit process by stating that plant procedures are being developed to provide guidance for plant personnel to have all necessary equipment for the performance of FLEX activities. Existing emergency procedures include provisions for temporary lighting and periodic checks of equipment storage to verify lighting equipment and batteries are available and functional.

The NRC staff has reviewed the licensee communications assessment (ML12306A199 and ML13056A135) in response to the March 12, 2012 50.54(f) request for information letter for Limerick and, as documented in the staff analysis (ML13114A067) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2, Guideline (8) regarding communications capabilities during an ELAP. Verification of required upgrades has been identified as Confirmatory Item 3.2.4.4.A in Section 4.2.

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

closure of issues related to the Confirmatory Item, provides reasonable assurance that the guidelines of Order EA-12-049 will be met with respect to communication and lighting if these guidelines 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.

The licensee's Integrated Plan provided insufficient information related to the development of guidance and strategies with regard to the access to the protected area and internal locked areas to demonstrate conformance with NEI 12-06. Updated information provided by the licensee as part of the audit response addressed this issue by stating that keys for access to the plant are available to security, the shift manager and to the radiation protection group. The licensee further stated that plant areas requiring access as part of the FLEX response, will be evaluated to determine if sufficient keys are available or if additional keys will be required. This is identified as Confirmatory Item 3.2.4.5.A in Section 4.2.

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

3.2.4.6 Personnel Habitability - Elevated Temperature

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

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

implementing the FLEX strategies.

On page 47 of the Integrated Plan, in the section describing safety function support for Phase 1, the licensee stated that during an ELAP, the RCIC room temperature is predicted to reach 156 °F within 1.5 hours. The present plan is open the Unit 1 and 2 RCIC room doors and blowout panels within 1.5 hours to limit room temperature rise. The licensee further stated that the temperature limit for the RCIC room is 158° F, based on the environmental qualification (EQ) of the equipment in the RCIC room. The actions described are designed to maintain the RCIC Room "below 158 °F." If entry into that area was required, temperatures in that range would require industrial safety procedures and equipment to prevent adverse impacts on personnel due to heat stress. However, there was no discussion in the Integrated Plan regarding procedures or protective clothing to protect operators or any discussion on the extent of potential operator stay times in these locations. The licensee addressed these concerns during the audit process and stated that the Station Blackout procedures presently address the RCIC ventilation activities. These activities include opening a blowout panel to provide a vent path from the RCIC room to the much larger safeguard valve room. The blowout panel is accessed from an area that does not involve entry into the RCIC room. The licensee further stated that engineering calculations show that once the blowout panels are opened, temperatures drop to 133 to 134.4 °F. No local operation of RCIC is assumed and these temperatures are below the EQ limits.

The licensee stated that Limerick intends on maintaining operational command and control within the main control room (MCR). The licensee further stated that several actions can be taken in accordance with site procedures to reduce the heat load in the MCR and extend the time of its habitability. The use of portable fans with other procedurally directed actions will need to be implemented to prevent MCR temperature from exceeding 120° F. Habitability conditions will be evaluated and a strategy will be developed to maintain the main control room habitability. The strategy and associated support analyses will be provided in a future 6-month update. This is identified as Confirmatory Item 3.2.4.6.A in Section 4.2.

The 120 degree F temperature limit noted above is a concern. Even with the steady-state condition of less than 120 °F, the environmental conditions within the main control room could remain beyond the uppermost habitability temperature limit defined in NUMARC 87-00 for efficient human performance. The licensee addressed this concern during the audit response by stating that the 120 °F upper limit is based on the current design and licensing basis for compliance with the Station Blackout Rule. Habitability will be addressed by monitoring the main control room conditions, by utilizing heat stress countermeasures, and by rotation of personnel to the extent feasible. The FLEX support procedures will provide guidance for control room staff to evaluate the control room temperature and take actions as necessary.

With regard to the fuel building habitability, the licensee acknowledged that the evaluation of the SFP area for steam and condensation has not yet been performed. The need for further analysis of fuel building conditions during an ELAP/LUHS and mitigating actions is a licensee self identified open item. The licensee stated that the final resolution of this concern would be documented in a future 6-month update. This is identified as Confirmatory Item 3.2.4.6.B in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the

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

3.2.4.7 Water Sources.

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

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

The licensee has addressed water sources for coping strategies in numerous examples in the Integrated Plan. These strategies have been discussed previously in this report and the issue of water quality as a result of extreme external hazards (e.g., suspended solids especially during flood conditions, or from high wind debris) was discussed in Section 3.2.1.8 and captured in previously identified Confirmatory Item 3.2.1.8.B.

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 guidelines of Order EA-12-049 will be met with respect to water sources if these guidelines 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 49 of the Integrated Plan, in the section discussing Phase 2 safety function support, the licensee provided a description of the primary electrical support strategy. The licensee stated that power from the FLEX generators will be provided through FLEX electrical connections from the emergency diesel generator 480 VAC for Unit 2. The motor control centers (MCCs) will back feed the 480V emergency buses to provide power for Division I, II and III emergency loads. In order to power an individual battery charger, the generator is connected to the MCC corresponding to the appropriate electrical division. Once the correct MCC is powered, the individual critical load will be powered.

It was not clear from the information provided how the portable/FLEX diesel generators and the Class 1E diesel generators would be isolated to prevent simultaneously supplying power to the same Class 1E bus. The licensee addressed this concern during the audit process and stated that administrative controls will be used to ensure multiple sources do not attempt to power electrical buses. The licensee also stated that the FLEX generators will not be connected to any existing electrical equipment during normal operation. The generators and cables will only be connected after the postulated event for use as a mitigation strategy.

The Integrated Plan did not provide information regarding the technical basis for the selection and size of the FLEX generators to be used in support of the coping strategies. Supporting information should be provided to address both Phase 2 and 3 power requirements. The licensee addressed the topic of generator sizing during the audit process by stating that the information would be provided in a future 6-month update. This is identified as Confirmatory Item 3.2.4.8.A in Section 4.2.

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

3.2.4.9 Portable Equipment Fuel.

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

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

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

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

On page 50 of the Integrated Plan in the section regarding Phase 2 of the Safety Function Support, the licensee stated that fuel oil to FLEX pumps and generators will be supplied by the quantity of fuel in the tanks located on the skids of the portable equipment. This would be supplemented by fuel tanks contained on the back of the FLEX Truck. The fuel could then be pumped from the fuel storage tanks as needed.

A number of questions were generated during the review of the Integrated Plan regarding the fuel oil supply. Specifically:

1) How much fuel oil will be stored on site for FLEX strategies; and how will fuel be provided indefinitely?
2) How will fuel oil be accessed from the storage tanks?
3) What is the plan for refueling the FLEX equipment?
4) How is the quality of fuel oil is assured if stored for long periods of time?

These questions were presented to the licensee during the audit process and they were addressed as follows:

1) Fuel oil is stored in each of the 8 day tanks in the diesel generator buildings, and in each of the 8 main underground storage tanks. Each day tank maintains a minimum of 250 gallons and the main tanks hold 33,500 gallons.
2) The day tank is maintained full by the installed fuel oil transfer pump that will be powered by FLEX power strategies. The strategy to access the fuel in the fuel oil storage day tanks consists of attaching a portable 120 VAC transfer pump to the day tank drain and transferring fuel to the FLEX transfer truck tank.
3) The FLEX equipment will be refueled using the fuel tank truck or directly from the day tanks via the portable pump and through hoses.
4) The fuel in the storage tanks is maintained fresh by routine use and replenishment. Fuel in the equipment tanks will be periodically replaced.

The reviewer noted that part of the Phase 3 commodities listed on page 63 of the Integrated Plan includes fuel oil bladders thus addressing fuel supplies for an indefinite period.

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 fuel oil supplies if these requirements are implemented as described.

3.2.4.10 Load Reduction to Conserve DC Power.

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

> *Plant procedures/guidance should identify loads that need to be stripped from the plant dc buses (both Class 1E and non-Class 1E) for the purpose of conserving dc power.*
>
> DC power is needed in an ELAP for such loads as shutdown system instrumentation, control systems, and dc backed AOVs and MOVs. Emergency lighting may also be powered by safety-related batteries. However, for many plants, this lighting may have been supplemented by Appendix R and security lights, thereby allowing the emergency lighting load to be eliminated. ELAP

procedures/guidance should direct operators to conserve dc power during the event by stripping nonessential loads as soon as practical. Early load stripping can significantly extend the availability of the unit's Class 1E batteries. In certain circumstances, AFW/HPCI /RCIC operation may be extended by throttling flow to a constant rate, rather than by stroking valves in open-shut cycles.

Given the beyond-design-basis nature of these conditions, it is acceptable to strip loads down to the minimum equipment necessary and one set of instrument channels for required indications. Credit for load-shedding actions should consider the other concurrent actions that may be required in such a condition.

On page 46 of the Integrated Plan, in the section regarding Phase 1 safety function support, the licensee stated that dc load shedding will be accomplished in accordance with Station Blackout procedures. Additional load shedding will be performed to extend battery life for the ELAP and this additional dc load shedding will be proceduralized after the detailed design has been completed. The sequence of events timeline indicates that the load shedding process will begin at T=45 minutes and will be completed at T=3 hours. The timeline indicates that portable generators will be providing power to the battery chargers at less than 7 hours. The load shedding process will need further review when the licensee's procedures are available. This is identified as Confirmatory Item 3.2.4.10.A in Section 4.2.

During the audit process, the licensee provided the following information to address questions identified by the NRC staff. With regard to minimum bus voltage, the licensee stated that the battery terminal voltage does not drop below the 105 VDC minimum until T=7.5 hours. The current plan is to initiate battery chargers before T=7 hours. Although the licensee stated that the basis for the 105 VDC minimum was established in "Evaluation #IR 1468452, Battery Coping During ELAP with Extended Load Shedding," it was not clear to the reviewer from the referenced document how the 105 VDC minimum was basis was developed. Specifically, more information is needed to understand if this minimum voltage provides for sufficient operating voltages at the device terminals to ensure proper operation in support of the strategies. This is identified as Confirmatory Item 3.2.4.10.B in Section 4.2.

The NRC staff also requested clarification during the audit process regarding the dc load profile, the list of loads shed, the required operator actions for load shedding, and the timeframe for completion. The NRC staff also requested information regarding any adverse impact to the plant from the loads shed (e.g. loss of main generator hydrogen venting capability). The licensee responded to these concerns by stating that some of the load shedding actions are contained in present station blackout procedures but reiterated that additional procedure guidance will need to be developed. This additional guidance will identify the additional loads shed, and will address the need to vent main generator hydrogen. The need for further review of the load shedding procedures was previously identified above. In addition, although the licensee addressed the adverse impact from load shedding to the main generator hydrogen venting, the licensee did not address the adverse impact issue in general. This is identified as Confirmatory Item 3.2.4.10.C in Section 4.2.

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

## 3.3 PROGRAMMATIC CONTROLS

### 3.3.1 Equipment Maintenance and Testing.

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

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

NEI 12-06, Section 11.5 states:

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

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

On page 12 of the Integrated Plan, in the section regarding programmatic controls, the licensee stated that Limerick will implement an administrative program for FLEX to establish responsibilities, as well as maintenance and testing requirements. This will establish responsibilities, maintenance and testing requirements for all components associated with FLEX. The licensee further stated that equipment associated with these strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control as outlined in NEI 12-06 section 11.

The NRC staff reviewed the Integrated Plan for LGS 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 licensee informed the NRC of their plans to abide by this generic resolution and of the licensee's plans to address potential plant specific issues associated with implementing this resolution. The NRC staff will evaluate the resulting program through the audit and inspection processes.

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

3.3.2 Configuration Control.

NEI 12-06, Section 11.8 provides that:

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

On page 12 of the Integrated Plan, in the section regarding programmatic controls, the licensee stated that LGS will implement a plant system where a designation will be assigned to FLEX equipment which requires configuration controls associated with systems. This will establish responsibilities, maintenance and testing requirements for all components associated with FLEX. Unique identification numbers will be assigned to all components added to the FLEX plant system. Equipment associated with these strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control as outlined in NEI 12-06 section 11.

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 configuration

control if these requirements are implemented as described.

3.3.3 Training.

NEI 12-06, Section 11.6 provides that:

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

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

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

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

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

On page 12 of the Integrated Plan, in the section describing the training plan, the licensee stated that training materials for FLEX will be developed for all station staff involved in implementing FLEX strategies. For accredited training programs, the Systematic Approach to Training will be used to determine training needs. For other station staff, a training overview will be developed per change management 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 training if these requirements are implemented as described.

3.4 <u>OFF SITE RESOURCES</u>

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

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

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

On page 13 of the Integrated Plan, in the section describing the RRC plan, the licensee provided a description of the offsite resources availability. The licensee stated that LGS has contractual agreements in place with the SAFER. Per that agreement, the industry will establish two RRCs to support utilities during beyond design basis events. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from a RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of the nuclear site's playbook, will be delivered to the site within 24 hours from the initial request.

The licensee's use of off-site resources, as described above, conforms to the guidance found in NEI 12-06, Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies (Guideline 1). However, insufficient information has been included to provide reasonable assurance that guidance will be established to conform to the remaining items of NEI 12-06, Section 12.2 (Guidelines 2 through 10). This has been identified as Open Item 3.4.A, in Section 4.1.

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

requirements of Order EA-12-049 will be met with respect to offsite resources if these requirements are implemented as described.

## 4.0 OPEN ITEMS AND CONFIRMATORY ITEMS

### 4.1 OPEN ITEMS

| Item Number | Description | Notes |
|---|---|---|
| 3.1.1.2.A | NEI 12-06 states that if power is required to move or deploy the equipment (e.g., to open the door from a storage location), then power supplies should be provided as part of the deployment. The Integrated Plan did not address whether or not power would be required to move or deploy equipment. | |
| 3.1.1.3.A | The licensee did not address actions to be taken if instruments were lost due to a seismic event. | |
| 3.1.2.2.A | Further review is required regarding how the licensee will address NEI 12-06 Section 6.2.3.2 deployment considerations 2, 4, 5, and 8 with respect to transient floods. This review includes applicable procedure review. | |
| 3.2.3.A | With regard to maintaining containment, the acceptance of EPG/SAG Revision 3, including any associated plant-specific evaluations (or an alternate method) is identified as an open item. | |
| 3.2.4.2.C | With regard to elevated temperatures in general, the licensee is requested to provide a discussion on the impact of elevated temperatures, as a result of loss of ventilation and/or cooling, on electrical equipment being credited as part of the ELAP strategies (e.g., electrical equipment in the RCIC pump rooms). In the response, specify whether the initial temperature condition assumed the worst-case outside temperature with the plant operating at full power. The licensee is also requested to provide the list of electrical components that are located in the pump rooms that are necessary to ensure successful operation of required pumps. Also provide the qualification level for temperature and pressure for these electrical components for the duration that the pumps are assumed to perform its mitigating strategies function. | |
| 3.4.A | Details not provided to demonstrate the minimum capabilities for offsite resources will be met per NEI 12-06 Section 12.2. | |

### 4.2 CONFIRMATORY ITEMS

| Item Number | Description | Notes |
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| 3.1.1.4.A | With regard to offsite resources, the licensee will develop a plan | |

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| | that will address the logistics for equipment transportation, area set up, and other needs for ensuring the equipment and commodities to sustain the site's coping strategies. | |
| 3.1.5.2.A | The licensee stated that the design of the storage facilities will include provisions to ensure the equipment storage facilities are not impacted by high temperatures. Detailed information will be provided in a future 6-month update to the Integrated Plan. | |
| 3.2.1.1.A | From the June 2013 position paper, benchmarks must be identified and discussed which demonstrate that MAAP is an appropriate code for the simulation of an ELAP event at your facility. | |
| 3.2.1.1.B | The collapsed level must remain above Top of Active Fuel (TAF) and the cool down rate must be within technical specifications limits. | |
| 3.2.1.1.C | MAAP must be used in accordance with Sections 4.1, 4.2, 4.3, 4.4, and 4.5 of the June 2013 position paper. | |
| 3.2.1.1.D | In using MAAP, the licensee must identify and justify the subset of key modeling parameters cited from Tables 4-1 through 4-6 of the “MAAP Application Guidance, Desktop Reference for Using MAAP Software, Revision 2” (Electric Power Research Institute Report 1020236). This should include response at a plant-specific level regarding specific modeling options and parameter choices for key models that would be expected to substantially affect the ELAP analysis performed for that licensee’s plant. Although some suggested key phenomena are identified below, other parameters considered important in the simulation of the ELAP event by the vendor / licensee should also be included.<br><br>a. Nodalization<br>b. General two-phase flow modeling<br>c. Modeling of heat transfer and losses<br>d. Choked flow<br>e. Vent line pressure losses<br>Decay heat (fission products / actinides / etc.) | |
| 3.2.1.1.E | The specific MAAP analysis case that was used to validate the timing of mitigating strategies in the Integrated Plan must be identified and should be available on the ePortal for NRC staff to view. Alternately, a comparable level of information may be included in the supplemental response. In either case, the analysis should include a plot of the collapsed vessel level to confirm that TAF is not reached (the elevation of the TAF should be provided) and a plot of the temperature cool down to confirm that the cool down is within technical specifications limits. | |
| 3.2.1.3.A | The licensee stated that the "times to complete actions in the events timeline are based on ... current supporting analyses. The final timeline will be time validated once detailed designs are completed and procedures are developed. The results will be provided in a future 6-month update." | |
| 3.2.1.4.A | The licensee stated that the detailed design will determine | |

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| | containment heatup rate and the subsequent impacts on RCIC operation and the need for any modifications. This will include a review of the BWROG reports. | |
| 3.2.1.4.B | The licensee identified two RCIC room switch set points that were above the predicted maximum temperature but pointed out that the "RCIC Equipment Room Delta Temperature High" setpoint was below that temperature at 109 °F. It was not clear to the reviewer from the added discussion whether or not any of the setpoints would have an adverse impact on the planned use of the RCIC as a mitigation strategy. Further clarification is needed for this issue. | |
| 3.2.1.4.C | Because the Integrated Plan makes reference to use of the Phase 3 equipment as backup, the Integrated Plan should address the guidance of NEI 12-06 regarding site procedures for Phase 3 implementation. The licensee addressed this concern during the audit response and stated that Limerick would ensure connection capabilities of the Phase 3 offsite equipment to site systems and would develop any procedural guidance required for those connections. | |
| 3.2.1.7.A | The licensee stated that the Limerick plant plans to abide by the generic resolution for refueling and cold shutdown. The licensee stated that a review is in progress to develop a plan to address potential plant specific issues associated with implementing the generic approach. The results and conclusions of this review will be provided in a future 6-month update. | |
| 3.2.1.8.A | The licensee stated that the final design of the FLEX pump suction will determine if additional screens are required. Confirmation that entrained debris as a result of extreme external hazards (e.g., suspended solids especially during flood conditions, or from high wind debris) in the cooling water from the spray pond is addressed. | |
| 3.2.1.8.B | Insufficient technical information is presented or referenced in the Integrated Plan to confirm the ability of the portable FLEX pumps to deliver the required flow through the system of flex hoses, couplings, valves, elevation changes, etc. for the configurations described. The licensee stated that once these designs and mitigating strategies have been fully developed, Exelon will update the Integrated Plan for LGS during a scheduled 6-month update. | |
| 3.2.2.A | The licensee stated that formal calculations will be performed to validate the timing required for supplying cooling water to the spent fuel pool. The information will be provided in a future 6-month update. | |
| 3.2.4.2.A | It was not clear from the information presented in the Integrated Plan what analysis or technical basis was used to conclude that the battery room temperature rise is inconsequential. Also, no discussion was presented to address possible low temperature effects. The licensee is requested to provide information on the | |

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| | adequacy of the ventilation provided in the battery room to protect the batteries from the effects of elevated or lowered temperatures. | |
| 3.2.4.2.B | The licensee stated that battery room ventilation will be addressed through procedure changes and that the proposed methods of ventilation, open doors and fans, will be confirmed during the detailed design process. | |
| 3.2.4.4.A | The NRC staff has reviewed the licensee communications assessment (ML12306A199 and ML13056A135) in response to the March 12, 2012 50.54(f) request for information letter for Limerick and, as documented in the staff analysis (ML13114A067) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Verification of required upgrades is identified as a confirmatory item. | |
| 3.2.4.5.A | The licensee stated that keys for access to the plant are available to security, the shift manager and to the radiation protection group. The licensee further stated that plant areas requiring access as part of the FLEX response, will be evaluated to determine if sufficient keys are available or if additional keys will be required | |
| 3.2.4.6.A | Habitability conditions will be evaluated and a strategy will be developed to maintain the main control room habitability. The strategy and associated support analyses will be provided in a future 6-month update. | |
| 3.2.4.6.B | With regard to the fuel building habitability, the licensee acknowledged that the evaluation of the spent fuel pool area for steam and condensation has not yet been performed. The licensee stated that the final resolution of this concern would be documented in a future 6-month update. | |
| 3.2.4.8.A | The Integrated Plan did not provide information regarding the technical basis for the selection and size of the FLEX generators to be used in support of the coping strategies. Supporting information should be provided to address both Phase 2 and 3 power requirements. The licensee addressed the topic of generator sizing during the audit process by stating that the information would be provided in a future 6-month update. | |
| 3.2.4.10.A | The licensee stated that dc load shedding will be accomplished in accordance with Station Blackout procedures and that additional load shedding will be performed to extend battery life for the ELAP. The additional dc load shedding will be proceduralized after the detailed design has been completed. | |
| 3.2.4.10.B | The licensee stated minimum limit for the dc bus voltage 105 VDC. More information is needed to understand if this minimum voltage provides for sufficient operating voltages at the device terminals to ensure proper operation in support of the strategies. | |
| 3.2.4.10.C | Although the licensee addressed the adverse impact from load | |

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| | shedding to the main generator hydrogen venting, the licensee is requested to address the adverse impact to mitigation strategies as a general issue. | |