Mega-Tech Services, LLC

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

Revision 1

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Exelon Generation Company, LLC
Three Mile Island Unit 1
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1.0 BACKGROUND

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

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

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

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

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

NEI submitted its document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" in August 2012 (ADAMS Accession No. ML12242A378) to provide specifications for an industry-developed methodology for the development, implementation, and maintenance of guidance and strategies in response to Order EA-12-049. The guidance and strategies described in NEI 12-06 expand on those that industry developed and implemented to address the limited set of 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. ML13059A299), and as supplemented by the first 6-month status report in letter dated August 28, 2013 (ADAMS Accession No. ML13241A035), Exelon Generation Company, LLC (hereinafter referred to as the licensee) provided the Three Mile Island (TMI) 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 Hazard

NEI 12-06, Section 5.2 states that:

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

The licensee's screening for seismic hazards, as presented in their Integrated Plan, has screened this external hazard and identified the hazard levels for reasonable protection of the portable equipment. The licensee confirmed on page 1 of the Integrated Plan that the seismic hazard is defined as a Safe Shutdown Earthquake (SSE) with peak ground acceleration of 0.12g in the horizontal plane and 0.08g in the vertical plan, as shown in UFSAR Figure 2.7-1. The licensee also states on page 3 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 screening for seismic hazards, if these requirements are implemented as described.

3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

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

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

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

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

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

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

On page 5 of the Integrated Plan, the licensee stated that regarding protection of portable equipment, Identification of storage locations and creation of the administrative program are open items. An action tracking Item has been created to track these open items. Closure of these items will be documented in the 6-month update process.

On page 11 of the Integrated Plan, the licensee stated that protection of associated portable equipment from external hazards would be provided in structures that will be constructed to meet the requirements of NEI 12-06 Section 11, however the licensee did not specify the type of configuration, how FLEX equipment such as pumps and power supplies would be secured, or how stored equipment and structures would be protected from seismic interactions. This has been identified as Confirmatory Item 3.1.1.1.A. in Section 4.2.

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

3.1.1.2 Deployment of FLEX Equipment - Seismic Hazard

NEI 12-06, Section 5.3.2 states:

> The baseline capability requirements already address loss of non-seismically robust equipment and tanks as well as loss of all AC. So, these seismic considerations are implicitly addressed.
>
> There are five considerations for the deployment of FLEX equipment following a seismic event:
>
> 1. If the equipment needs to be moved from a storage location to a different point for deployment, the route to be traveled should be reviewed for potential

soil liquefaction that could impede movement following a severe seismic event.

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

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

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

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

On page 3 of the Integrated Plan regarding key site assumptions, the licensee stated that the routes from the storage locations have not yet been assessed for hazard impact. This will be completed and communicated in a future 6-month update following an evaluation.

On page 5 of the Integrated Plan, the licensee stated that, deployment of FLEX is expected for all modes of operation. Transportation routes will be developed from the equipment storage area to the FLEX staging areas. Administrative programs will ensure pathways remain clear, and compensatory actions will be implemented when necessary

The licensee did not specifically address deployment considerations with respect to the deployment of FLEX equipment through areas subject to liquefaction, routing through Class 1 buildings, power required to deploy or move equipment, and protection of the means to move equipment. In the audit process the licensee stated that the failure of the downstream York Haven dam was assumed in the development of the mitigating strategies. This has been identified as Confirmatory Item 3.1.1.2.A. in Section 4.2.

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

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

> There are four procedural interface considerations that should be addressed.

1. Seismic studies have shown that even seismically qualified electrical equipment can be affected by BDB seismic events. In order to address these considerations, each plant should compile a reference source for the plant operators that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (see Section 3.2.1.10). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance should include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power.

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

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

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

On page 8 and 10 of the Integrated Plan, the licensee stated that they will use industry developed guidance from the Owners Groups, Electric Power Research Institute (EPRI) and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06. These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOPs.

The licensee did not address the determination of necessary instrument readings per consideration 1 above, to support the implementation of the mitigating strategies in the event that seismically qualified electrical equipment is affected by beyond-design-basis seismic events. This has been identified as Confirmatory Item 3.1.1.3.A. in Section 4.2.

Additionally the licensee's Integrated Plan did not address large internal flooding sources that are not seismically robust and do not require ac power, the use of ac power to mitigate ground water in critical locations, or the existence of non-seismically robust downstream dams. In the audit process the licensee stated that the failure of the downstream York Haven dam was assumed in the development of the mitigating strategies. The licensee also stated that although the analysis of internal flooding is not yet complete, the strategies do not rely on active means of water removal. The licensee also stated that power for key sump pumps is included in the design of the FLEX power system.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces for seismic hazards, 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 pages 6 and 7 of the Integrated Plan the licensee stated that the industry will establish Regional Response Centers (RRC) to support utilities during beyond design basis events. Communications will be established between the affected nuclear site and the Strategic Alliance for FLEX Emergency Response (SAFER) team and required equipment moved to the site as needed. Equipment arriving first will be delivered to the local assembly area within 24 hours from the initial request. However the licensee did not identify the local assembly area or describe the methods to be used to deliver the equipment to the site. In the audit response the licensee stated that they would utilize off site resources for additional condensate, fuel oil and personnel. The plan will include transportation to the site without used of bridges to the site. The TMI RRC playbook will be made available when approved. This has been identified as Confirmatory Item 3.1.1.4.A. in Section 4.2.

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

3.1.2 Flooding

NEI 12-06, Section 6.2 states:

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

NEI 12-06, Section 6.2.1 states in part:

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

> and those that install temporary barriers or rely on watertight doors to keep the design basis flood from impacting safe shutdown equipment.

On page 1 of the Integrated Plan the licensee stated that, at TMI this event is a precipitation driven event with a minimum of 24 hours warning prior to exceeding the protection of the dike and a peak water level of 313.3 ft. elevation measured at the TMI-1 Intake Pump and Screen House (IPSH). The licensee also specified that the flooding re-evaluations requested by the 50.54(f) letter have not been completed, and therefore are not assumed in the Integrated Plan. Thus, TMI screens in for the external flood hazard.

NEI 12-06 characterizes in Table 6-1 the external flooding hazard in terms of warning time and persistence and having a warning time in days and persistence in months. The licensee did not identify any times for flood persistence. In the response to the audit, the licensee stated based on a re-analysis performed in accordance with NUREG CR-7046, that for the probable maximum flood (PMF) the river level is expected to exceed the level of the dike for approximately 52 hours and that the FLEX strategy assumes that the site is flooded for 72 hours.

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

3.1.2.1 Protection of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.1 states:

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

avoided.

On page 5 of the Integrated Plan, the licensee stated that, Identification of storage and creation of the administrative program are open items. An Action Tracking item has been created to track both open issues. Closure of these items will be documented in the 6-month update process.

On page 11 of the Integrated Plan the licensee stated that, structures to provide protection of FLEX equipment will be constructed to meet the requirements of NEI 12-06 Section 11. The schedule to construct a permanent building is contained in Attachment 2 and will satisfy the site compliance date. Temporary locations will be used until building construction completion. Procedures and programs will be developed to address storage structure requirements, haul path requirements, and FLEX equipment requirements relative to the external hazards applicable to TMI. This has been combined with Confirmatory Item 3.1.1.1.A. in Section 4.2.

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

3.1.2.2 Deployment of FLEX Equipment – Flooding Hazard

NEI 12-06, Section 6.2.3.2 states:

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

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

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

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

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

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

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

On page 3 of 55, of the Integrated Plan, the licensee stated that, routes from the storage locations have not yet been assessed for hazard impact. This will be completed and communicated in a future 6-month update following evaluation.

During the audit process the licensee stated that although the analysis of internal flooding is not yet complete, the strategies do not rely on active means of water removal. The licensee also stated that power for key sump pumps is included in the design of the FLEX power system.

On page 5 of the Integrated Plan, the licensee stated that, deployment of FLEX is expected for all modes of operation. Transportation routes will be developed from the equipment storage area to the FLEX staging areas. Administrative programs will ensure pathways remain clear, and compensatory actions will be implemented when necessary. The licensee did not specifically address the considerations 2, 3. 4. 5, 8, and 9 of NEI 12-06 Section 6.2.3.2 regarding deployment of FLEX equipment. This has been identified as Confirmatory Item 3.1.2.2.A. in Section 4.2.

The licensee specified that in the event of an external flood, the strategy is contingent upon the RCS being cooled down and depressurized, below 300˚F and 250 psig, prior to the ELAP. In the Integrated Plan, the licensee did not provide a detailed explanation of how they will implement such a strategy or a discussion of how the plant shutdown will be properly timed so as to support the assumptions of the ELAP strategy.

In the audit process the licensee stated that the FLEX strategy is built upon the current TMI response to the PMF. The emergency procedure (EP) directs a plant shutdown and cooldown if the river water flow would exceed 900,000 cubic feet per second (CFS) in the next 12 hours. The river level does not exceed the height of the dike until river flow exceeds 1,250,000 CFS. The flood EP shutdown and cooldown criteria ensure that there is approximately 18 hours prior to the point where the river water level would exceed the protection of the dike. The EP describes the goal to be at Decay Heat system conditions before the river water tops the dike. An emergency plant shutdown and cooldown to 300˚F can reasonably be completed in 6 to 8 hours.

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

3.1.2.3 Procedural Interfaces - Flooding Hazard

NEI 12-06, Section 6.2.3.3 states:

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

On page 8 of the Integrated Plan the licensee stated that TMI will use industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06. These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOPs.

In the Integrated Plan the licensee specified that only permanently installed FLEX equipment (FLEX emergency feedwater pumps in the turbine building (TB), FLEX emergency charging pumps in the TB, and FLEX emergency diesel generators in the CB), was required for the flooding event in phases 1, 2, and 3. The licensee's plans for storage and deployment of portable equipment for the flooding event are still being developed. During the audit response the licensee stated that during the flood event, portable equipment is only used to maintain a continuous condensate source after the flood recedes. The portable diesel driven pump will be stored such that it will not be affected by the PMF.

Additionally during the audit process the licensee stated that the current flood protection strategy is described in emergency procedure TM-AOP-002, "Flood". This procedure describes the flood barrier system. For the PMF, no additional protection is required and the site is protected for river flows at 50% above the PMF.

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

3.1.2.4 Considerations in Using Offsite Resources - Flooding Hazard

NEI 12-06, Section 6.2.3.4 states:

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

On pages 6 and 7 of the Integrated Plan the licensee stated that the industry will establish Regional Response Centers (RRC) to support utilities during beyond design basis events. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. Equipment arriving first will be delivered to the local assembly area within 24 hours from the initial request. However the licensee did not identify the local assembly area or describe the methods to be used to deliver the equipment to the site. In the audit response the licensee stated that they would utilize off site resources for additional condensate, fuel oil and personnel. The plan will include transportation to the site without used of bridges to the site. The TMI RRC playbook will be made available when approved. This has been combined with Confirmatory Item 3.1.1.4.A. in Section 4.2.

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

3.1.3 High Winds

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

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

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

On pages 1 and 2 of the Integrated Plan, the licensee stated that NEI 12-06, Figure 7.1 locates TMI between the 130 MPH and 140 MPH curves. NEI 12-06, Figure 7.2, Recommended Tornado Design Wind Speeds, locates TMI in region 2, 170 MPH. The TMI design basis tornado generates 300 mph tangential wind velocity with gust of 130%.

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

3.1.3.1 Protection of FLEX Equipment - High Winds Hazard

NEI 12-06, Section 7.3.1 states:

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

and switchyard such that the path of a single tornado would not impact all locations.

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

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

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

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

On page 5 of the Integrated Plan, the licensee stated that, identification of storage and creation of the administrative program are open items. An Action Tracking Item has been created to track both open items. Closure of these items will be documented in the 6-month update.

On page 11 of the Integrated Plan, the licensee stated that structures to provide protection of FLEX equipment will be constructed to meet the requirements of NEI 12-06 Section 11. The schedule to construct a permanent building is contained in Attachment 2 and will satisfy the site compliance date. Temporary locations will be used until building construction completion. Procedures and programs will be developed to address storage structure requirements relative to the external hazards applicable to TMI. This has been combined with Confirmatory Item 3.1.1.1.A. in Section 4.2.

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

3.1.3.2 Deployment of FLEX Equipment - High Wind Hazard

NEI 12-06, Section 7.3.2 states:

> There are a number of considerations which apply to the deployment of FLEX equipment for high wind hazards:
>
> 1. For hurricane plants, the plant may not be at power prior to the simultaneous ELAP and LUHS condition. In fact, the plant may have been shut down and the plant configuration could be established to optimize FLEX deployment. For example, the portable pumps could be connected, tested, and readied for

use prior to the arrival of the hurricane. Further, protective actions can be taken to reduce the potential for wind impacts. These factors can be credited in considering how the baseline capability is deployed.

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

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

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

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

On page 3 of the integrated plan, the licensee stated that routes from the storage locations have not yet been assessed for hazard impact. This will be completed and communicated in a future 6-month update following evaluation.

On page 5 of the Integrated Plan, the licensee stated that, deployment of FLEX is expected for all modes of operation. Transportation routes will be developed from the equipment storage area to the FLEX staging areas. Administrative programs will ensure pathways remain clear, and compensatory actions will be implemented when necessary. The licensee did not address considerations 2-5 of NEI 12-06 Section 7.3.2. This has been identified as Confirmatory Item 3.1.3.2.A in Section 4.2.

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

3.1.3.3 Procedural Interfaces - High Wind Hazard

NEI 12-06, Section 7.3.3, states:

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

On page 8 and 10 of the Integrated Plan, the licensee stated that, TMI will use industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06. These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOPs.

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

3.1.3.4 Considerations in Using Offsite Resources – High 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 pages 6 and 7 of the Integrated Plan the licensee stated that the industry will establish Regional Response Centers (RRC) to support utilities during beyond design basis events. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. Equipment arriving first will be delivered to the local assembly area within 24 hours from the initial request. However the licensee did not identify the local assembly area or describe the methods to be used to deliver the equipment to the site. In the audit response the licensee stated that they would utilize off site resources for additional condensate, fuel oil and personnel. The plan will include transportation to the site without used of bridges to the site. The TMI RRC playbook will be made available when approved. This has been combined with Confirmatory Item 3.1.1.4.A. in Section 4.2.

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

3.1.4 Snow, Ice and Extreme Cold Hazard

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

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

On page 2 of the Integrated Plan, the licensee stated that NEI 12-06 locates TMI in an area where the record 3-day snowfall is 18" - 25". Figure 8.2 places TMI in a level 4 region for Ice

Storm Severity (Level 4 - Severe damage to power lines and/or existence of large amount of ice). A design temperature of 0°F is applied for the FLEX equipment. In addition, the plan addresses maintaining the availability of the credited water sources with ambient temperature of 0°F (including the river) and deployment of FLEX equipment with severe snow or ice conditions.

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

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

NEI 12-06, Section 8.3.1 states:

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

On page 5 of the Integrated Plan, the licensee stated that regarding protection of portable equipment, Identification of storage locations and creation of the administrative program are open items. An action tracking Item has been created to track these open items. Closure of these items will be documented in the 6-month update process.

On page 11 of the Integrated Plan, the licensee stated that protection of associated portable equipment from external hazards would be provided in structures that will be constructed to meet the requirements of NEI 12-06 Section 11, however the licensee did not specify the type of configuration, how FLEX equipment such as pumps and power supplies would be secured, or how stored equipment and structures would be protected from high winds. This has been combined with Confirmatory Item 3.1.1.1.A. in Section 4.2.

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

3.1.4.2 Deployment of Portable Equipment - Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.2 states:

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

On page 3 of the Integrated Plan regarding key site assumptions, the licensee stated that, routes from the storage locations have not yet been assessed for hazard impact. This will be completed and communicated in a future 6-month update following evaluation.

On page 5 of the Integrated Plan, the licensee stated that, deployment of FLEX is expected for all modes of operation. Transportation routes will be developed from the equipment storage area to the FLEX staging areas. Administrative programs will ensure pathways remain clear, and compensatory actions will be implemented when necessary. In the audit process the license stated in and extreme cold event and snow event, the condensate sources will be maintained through the use of recirculation and temporary tank heating methods. With all three condensate sources available, portable equipment is not required for greater than two days. Plans will be developed which will ensure snow removal, pump staging and access to water with a frozen river within that two day 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 deployment during snow, ice and extreme cold hazards, if these requirements are implemented as described.

3.1.4.3 Procedural Interfaces - Snow, Ice and Extreme Cold Hazard

NEI 12-06, Section 8.3.3 states:

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

On page 8 of the Integrated Plan, the licensee stated that, TMI will use industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06. These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOPs. In the audit process the license stated in and extreme cold event and snow event, the condensate sources will be maintained through the use of recirculation and temporary tank heating methods. With all three condensate sources available, portable equipment is not required for greater than two days. Plans will be developed which will ensure snow removal, pump staging and access to water with a frozen river within that two day 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 procedural interfaces for snow, ice and extreme cold hazards, if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.4, states that:

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

On pages 6 and 7 of the Integrated Plan the licensee stated that the industry will establish Regional Response Centers (RRC) to support utilities during beyond design basis events. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed. Equipment arriving first will be delivered to the local assembly area within 24 hours from the initial request. However the licensee did not identify the local assembly area or describe the methods to be used to deliver the equipment to the site. In the audit response the licensee stated that they would utilize off site resources for additional condensate, fuel oil and personnel. The plan will include transportation to the site without used of bridges to the site. The TMI RRC playbook will be made available when approved. This has been combined with Confirmatory Item 3.1.1.4.A. in Section 4.2.

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

3.1.5 High Temperature Hazard

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 2 of the Integrated Plan the licensee stated that all FLEX equipment is designed for an ambient temperature of at least 120°F. The highest temperature recorded in the area of TMI is 107°F.

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

3.1.5.1 Protection of Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.1, states that:

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

On page 5 of the Integrated Plan, the licensee stated that identification of storage and creation of the administrative program are open items. An Action Tracking Item has been created to track both open items. Closure of these items will be documented in the 6-month update.

On page 11 of the Integrated Plan the licensee stated structures to provide protection of FLEX equipment will be constructed to meet the requirements of NEI 12-06 Section 11. The schedule to construct a permanent building is contained in Attachment 2 and will satisfy the site compliance date. Temporary locations will be used until building construction completion. Procedures and programs will be developed to address storage structure requirements, haul path requirements, and FLEX equipment requirements relative to the external hazards applicable to TMI. This has been combined with Confirmatory Item 3.1.1.1.A. in Section 4.2.

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

3.1.5.2 Deployment of Equipment - High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

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

On page 5 of the Integrated Plan the licensee stated that deployment of FLEX is expected for all modes of operation. Transportation routes will be developed from the equipment storage area to the FLEX staging areas. Administrative programs will ensure pathways remain clear, and compensatory actions will be implemented when necessary. Creation of the administrative programs is an open item. An Action Tracking item has been created to track this issue. Closure of this item will be documented in the 6-month update process.

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

3.1.5.3 Procedural Interfaces - High Temperature Hazard

NEI 12-06, Section 9.3.3 states that:

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

On page 8 and 10 of the Integrated Plan, the licensee stated that, TMI will use industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06. These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOPs.

The licensee provided no information regarding the heat up of a various rooms and enclosures in the Integrated Plan, and no discussion of the potential effects of high temperatures at the location where portable (or permanently installed FLEX) equipment would actually operate in the event of high temperatures in these plant locations. This has been identified as Confirmatory Item 3.1.5.3.A. in Section 4.2.

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

3.2 PHASED APPROACH

Attachment (2) to Order EA-12-049 describes the three-phase approach required for mitigating beyond-design-basis external events in order to maintain or restore core cooling, containment and spent fuel pool cooling capabilities. The phases consist of 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 spent fuel pool and to maintain containment capabilities in the context of a beyond-design-basis external event that results in the loss of all ac power, with the exception of buses supplied by safety-related batteries through inverters, and loss of normal access to the UHS. As described in NEI 12-06, Section 1.3, "[p]lant-specific analyses will determine the duration of each phase." This baseline coping capability is supplemented by the ability to use portable pumps to provide RPV/RCS/SG makeup in order to restore core or spent fuel pool capabilities as described in NEI 12-06, Section 3.2.2, Paragraph (13). This approach is endorsed in NEI 12-06, Section 3, by JLD-ISG-2012-01.

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

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

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

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

The licensee's Integrated Plan did not provide a justification that the reactor coolant system can be adequately cooled down and maintained in natural circulation (NC) under ELAP conditions with seal leakage when local actions are necessary to control the emergency feedwater (EFW) flow and atmospheric dump valve (ADV) position. Specifically, it was not clear that thermal-hydraulic code analysis that models equipment behavior using steady and precise responses with automated controllers would be representative of realistic factors such as imprecision in monitoring and manually controlling EFW flow and ADVs, the lag in response time (e.g., due to communication with control room, equipment response times, etc.), and natural fluctuations due to transient and steady-state flow instability. The licensee did not address issues such as the means of communication between the control room and local equipment operators for the EFW and ADVs, environmental factors such as elevated temperatures or ambient noise of exiting steam, whether thermal-hydraulic sensitivity calculations have been performed to demonstrate that NC and stable primary-to-secondary heat transfer can be reliably maintained, and whether any interruption in makeup flow to the once through steam generators (OTSGs) is anticipated during the transition from the installed turbine-driven EFW pump and FLEX pump.

During the audit process the licensee stated that in the initial response to the ELAP event, EF-P-1 steam pressure, EFW flow and OTSG pressures will be controlled automatically. The desired configuration will be further stabilized using remote manual control. Plant conditions will be stable when EF-P-1 steam pressure, EFW flow and OTSG pressure are transferred to local control. Due to the nature of the control device (i.e. a handwheel requiring many turns to fully stroke the valve) adjustments to flow or pressure will be made gradually.

Additionally the operator stationed in the Intermediate Building, where EF-P-1 steam pressure control, OTSG pressure control and EFW flow control are located, is in close proximity on the 295' elevation. The operator will have the capability to maintain continuous communication with the control room.

Also, passive ventilation (doors opened at upper elevations) and natural circulation (the area where occupancy is required is below grade) will maintain a habitable environment. Communications gear includes an enclosed type ear muff headset. The planned cooldown rate is 10 to 15°F/hr. Small adjustments will be made to maintain control of the cooldown rate.

The licensee also stated during the audit process that the turbine driven EFW pump is capable of continued performance, and that no transition to the backup feed water system is planned. Adequate explanation was not provided for the licensee's change in the time of establishing the backup feedwater capability from 4-6 hours to 20 hours, and whether this timeline applies to all ELAP scenarios. The staff further disagrees with the licensee's conclusion that planning for a transition to backup feedwater system is unnecessary because a transition to portable equipment would be appropriate during the indefinite coping period under ELAP conditions as decay heat, and hence steam to the EFW turbine, diminishes. In light of the reduced decay heat at this juncture and the provision of early makeup to the RCS, the staff expects that the licensee will be capable of transitioning to the backup feedwater system without a significant interruption of feedwater to the steam generators. However, this should be verified by the licensee and has been identified as Confirmatory Item 3.2.1.A in Section 4.2.

In the Integrated Plan, the licensee did not identify whether calculations have been performed consistent with the PWROG-recommended methodology in Attachment 1 to the PWROG Core Cooling Position Paper, Revision 0, PA-PSC-0965 (ADAMS Accession No. ML13042A012, not publicly available) to verify that the intended ELAP mitigation strategy will not result in injection of nitrogen from the core flood tanks (CFTs).

In the audit process the licensee specified that calculation, C-1101-213-5450-002, demonstrates that CFT nitrogen injection will not occur if RCS pressure is maintained above 202 psig. The FLEX strategy will maintain RCS pressure above 400 psig. There appears to be significant margin to account for the effect of heating the contents of CFT; however, the staff notes that the above calculation regarding CFT nitrogen injection was not placed on the electronic portal, nor was the analysis in WCAP-17792-P available to the staff to confirm the applicability of the final RCS pressure. This has been identified as Confirmatory Item 3.2.1.B in Section 4.2.

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

3.2.1.1 Computer Code Used for ELAP Analysis

NEI 12-06, Section 1.3 states:

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

The licensee's submittal stated that the TMI mitigation strategy is not based upon the PWROG WCAP-17601-P ELAP mitigation strategy. However, descriptions and justifications for the computer codes and analysis techniques that were used to analyze the ELAP event to ensure adequate RCS cooling, RCS makeup, and shutdown margin were not provided. In the Integrated Plan, the licensee specified in several locations that they will provide analysis regarding core and containment cooling in future 6-month updates.

In the audit process the licensee specified that the TMI strategy ensures that sufficient RCS makeup capability is placed in service to prevent interruption of single phase natural circulation cooling. This strategy relies upon subcooled natural circulation and OTSG heat removal to maintain core cooling. The ability of subcooled natural circulation to provide core cooling was confirmed by testing at TMI in 1985, operating experience (loss of offsite power (LOOP) in 1997) and prior analysis. The licensee stated that RCS makeup will be restored to maintain subcooled natural circulation in both loops. This strategy prevents two phase conditions from occurring, thereby avoiding non-homogenous boron concentration concerns. Reactivity analysis for the prior fuel cycle (Cycle 19), reference C-1101-202-E620-471, has been completed which shows that the reactor remains shutdown without credit for xenon. Pressurizer level will be restored with borated water at a concentration greater than 2500 ppm boron prior to cooling down the RCS. Analysis (TM-FLEX-001) has been completed using the MAAP4 code to determine a bounding time at which RCS leakage would reduce the RCS inventory to the point of being insufficient to support single phase natural circulation. The licensee stated that the MAAP4 analysis used conservative assumptions for RCS leakage and determined that the RCS inventory would be sufficient for more than 6 hours. Meanwhile, the licensee's mitigation strategy is designed to ensure RCS makeup is restored within 4 hours. The licensee also stated that the MAAP4 analysis discussed above is bounded by the time to loss of primary-to-secondary heat transfer determined in WCAP-17792-P.

The licensee provided a Sequence of Events (SOE) in its Integrated Plan, which included the time constraints and the technical basis for the site. That SOE appears to be based largely on an analysis using the industry-developed MAAP4 computer code. Additional information provided during the audit process appears to indicate that the proposed timing for providing makeup to the reactor coolant system is consistent with analysis documented in WCAP-17792-P. At the time of the present review, this technical report had been neither completed nor provided to the NRC staff for review, although the staff understood that the calculations for B&W NSSS-design plants documented therein were performed using the RELAP5/MOD2-B&W code. Finally, despite having discussed the analyses above, the licensee also stated during the audit that no new analysis for core cooling was performed.

Based upon the statements made during the audit that are summarized above, the NRC staff concluded that further information would be necessary to provide adequate confidence in the proposed Integrated Plan. In particular, the information provided by the licensee during the audit was insufficient to clarify that simulations with the MAAP4 code were not being used as the basis for demonstrating that the proposed mitigation strategy could provide adequate core cooling, RCS makeup, and shutdown margin. Use of the MAAP4 code for the analysis of PWRs is of concern because the MAAP4 code has not been demonstrated to be capable of reliably predicting natural circulation and post-natural-circulation flows in PWRs. The staff's questions with MAAP4 generally arose from the observation that the code uses simplified models, correlations, and user-specified inputs in lieu of detailed mechanistic models. These questions are of particular concern in ELAP scenarios that must consider RCS leakage because the PWR version of the MAAP4 code lacks an explicit momentum balance and relies upon a coarsely nodalized representation of reactor coolant system loops. These simplifications could substantially affect predictions of when the flow in the RCS loops transitions from single-phase natural circulation to two-phase flow and boiler condenser cooling.

Although the RELAP5/MOD2-B&W code has been reviewed and approved for performing LOCA and non-LOCA transient analysis, the NRC staff had not previously examined the technical adequacy of this code for simulating an ELAP event. In particular, the ELAP scenario is differentiated from typical design-basis small-break LOCA scenarios in several key respects, including the absence of normal ECCS injection and the substantially reduced leakage rate, which places significantly greater emphasis on the accurate prediction of primary-to-secondary heat transfer, natural circulation, and two-phase flow within the RCS. As a result of these differences, concern associated with the use of the RELAP5/MOD2-B&W code for ELAP analysis arose regarding the modeling of two-phase flow within the RCS and heat transfer across the steam generator tubes as single-phase natural circulation transitions to two-phase flow and boiler condenser cooling. Furthermore, reliance on the calculations in WCAP-17792-P cannot presently be assessed by the NRC staff because this document has not been provided, nor has the licensee provided sufficient detail concerning the portions of this report that are being relied upon.

Therefore, in summary, the licensee should

(1) Confirm that analysis and conclusions based on simulations with the MAAP4 code are not relied upon for demonstrating adequate core cooling, RCS makeup, or shutdown margin for TMI-1. This has been identified as Confirmatory Item 3.2.1.1.A in Section 4.2.

(2) Provide WCAP-17792-P for NRC staff review, identify the specific calculation(s) in WCAP-17792 considered applicable to demonstrating the feasibility of the proposed mitigation strategy, and justify the applicability of the calculation(s) relied upon in WCAP-17792 to TMI-1. This has been identified as Open Item 3.2.1.1.B in Section 4.1.

(3) As applicable, provide additional analyses for core cooling, RCS makeup, and shutdown margin that are relied upon but not included in WCAP-17792-P. This has been identified as Open Item 3.2.1.1.C in Section 4.1.

(4) Limit use of the RELAP5/MOD2-B&W code in the ELAP analysis for B&W plants to the flow conditions before boiler-condenser cooling initiates. This has been identified as Confirmatory Item 3.2.1.1.D 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 and Open Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to the computer codes used to perform ELAP analysis, if these requirements are implemented as described.

3.2.1.2 RCP Seal Leakage Rates

NEI 12-06, Section 1.3 states:

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

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

On page 16 of the Integrated Plan, the licensee stated that an RCS makeup source greater than the loss rate through RCP seals and controlled bleed off flow will be established before that leakage interrupts natural circulation and OTSG heat removal. The 1A and 1B ES motor control center (MCC) will be energized using the FLEX diesel generator as described in Safety Functions Support section and the FLEX RCS makeup pump will be started within 4 hours. The analysis to confirm the timeline is not yet complete. This has been identified as Confirmatory Item 3.2.1.2.A in Section 4.2.

In the audit process the licensee specified that in support of the FLEX strategy, the RCP seals will be replaced with Flowserve N-9000 seals with the Abeyance seal. After an ELAP, the total RCS loss rate will be less than 11 gpm at 2155 psig, i.e. an RCS leak rate less than 1 gpm and RCP controlled bleed off (CBO) flow of 10 gpm. The RCP's at TMI-1 are Westinghouse Model 93A.

Additionally the licensee specified that to determine the time available to establish RCS makeup after an ELAP, a pressure dependent RCS loss rate of 21 gpm at 2155 psig was assumed. This is at least 10 gpm above the expected loss rate through the controlled bleed off path.

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

- WCAP-17601-P, Revision 1, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering and Babcock & Wilcox

NSSS Designs” dated January 2013 (ADAMS Accession No. ML13042A011 and ML13042A013 (Non-Publicly Available)).

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

After review of these submittals, the NRC staff placed certain limitations for Babcock and Wilcox (B&W) designed plants. Those applicable limitations and their corresponding Confirmatory Item number for this TER are provided as follows:

1. The B&W plants use a variety of RCPs, seals and motors. Some plants rely on procedures to maintain RCS temperatures below the design temperatures of the limiting components (i.e., elastomers), and thus, keep the RCP seal leakage low. For those plants, information should be provided to justify that the procedures are effective to keep the RCS temperatures within the limits of the seal design temperatures, and address the adequacy of the seal leakage rate (2 gpm/seal) used in the ELAP analysis. This has been identified as Confirmatory Item 3.2.1.2.B in Section 4.2.

2. Some plants have low leakage seals to maintain the initial maximum leakage rate of 2 gpm/seal for the ELAP analyses of the RCS response. For those plants, a discussion of the information (including seal leakage testing data) should be provided to justify the use of 2 gpm/seal in the ELAP analysis. This has been identified as Confirmatory Item 3.2.1.2.C in Section 4.2.

3. Address the acceptability of using of the Flowserve N-9000 RCP seals with the Abeyance seal in the Westinghouse RCPs. The RCP seal leakages rates for use in the ELAP analysis should be provided with acceptable justification. This has been identified as Confirmatory Item 3.2.1.2.D in Section 4.2.

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

3.2.1.3 Decay Heat Curve

NEI Section 3.2.1.2 states in part:

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

The licensee’s submittal provided a calculation methodology using decay heat modeling for RCS and SFP heatup and boil off. However, the specific decay heat model used was not documented. In the audit response the licensee stated that the core and spent fuel pool decay heat rates were obtained from plant procedure, EM-TM-TSC-0016, “RCS and SFP Heatup and

Boiloff following loss of Decay Heat Removal”. The curves in this procedure were based on best estimate methodology using ANSI/ANS 5.1-1979 and appropriately accounted for actinide decay and neutron capture in fission products.

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 decay heat curves used in their plant specific analyses, if these requirements are implemented as described.

3.2.1.4 Initial Values for Key Plant Parameters and Assumptions

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

The licensee provided one assumption related to NEI 12-06 section 3.2.1 as noted in its Integrated Plan, on page 3, which states that SSCs which are designed for operation and protected from the external event hazard are assumed to be available. No additional unavailability is assumed.

On page 47 in the Sequence of Events, the licensee provided additional assumptions in Action Items 1-3 regarding plant conditions that included; Item 1 - Plant at 100% power, Item 2 - All control rods inserted and reactor is shutdown and Item 3 - EFW actuated and the Steam Driven Pump EF-P-1 supplies feedwater. The MSSVs and ADVs control pressure.

The licensee did not provide any further description of specific initial key plant parameters specified in NEI 12-06, Sections 3.2.1.2 and 3.2.1.3 except the assumption regarding SSC’s noted above and the items from the SOE Attachment 1A. The licensee did not provide the initial conditions used in the RCS and SFP calculations used in ER-TM-TSC-0016, “RCS and SFP Heatup and Inventory Boiloff Following Loss of Active Decay Heat Removal.” This has been identified as Confirmatory Item 3.2.1.4.A in Section 4.2.

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

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states in part:

> The parameters selected must be able to demonstrate the success of the strategies at maintaining the key safety functions as well as indicate imminent or actual core damage to facilitate a decision to manage the response to the event within the Emergency Operating Procedures and FLEX Support Guidelines or

within the SAMGs. Typically, these parameters would include the following:

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

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

On pages 9, 10, and 14 of the Integrated Plan, the licensee listed the following installed instrumentation as credited for the coping evaluation for maintaining core cooling during ELAP for Phases 1-3: RCS Press, PZR Level, RCS Thot and Tcold, RCS Incore Temperatures, OTSG Pressure, OTSG Level, CST Levels

On pages 17, 18, and 22 of the Integrated Plan, the licensee listed the following installed instrumentation is credited for the coping evaluation for maintaining RCS inventory during ELAP for Phases 1-3: RCS Thot and Tcold, RCS Incore Temperatures, RCS Pressure, RB Pressure, PZR Level, CFT Level, CFT Pressure, and BWST Level. The key reactor parameter for maintaining containment for Phase 3 is the RB Pressure instrument.

On pages 8 and 17 of the Integrated Plan, the licensee stated that TMI's evaluation of the FLEX strategy may identify additional parameters that are needed to support key actions identified in the plant procedures/guidance or to indicate imminent or actual core damage, and any differences will be provided in a future 6-month update following identification. This has been identified as Confirmatory Item 3.2.1.5.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 monitoring instrumentation and controls used for ELAP mitigation, if these requirements are implemented as described.

3.2.1.6 Sequence of Events (SOE)

NEI 12-06, Section 3.2.1.7, Item 6 states:

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

In the Integrated Plan, the licensee provided a sequence of events (SOE) identifying the time constraints and their applicability. On pages 4 and 5 off the Integrated Plan the licensee discussed various time constraint issues as follows:

During the ELAP and LUHS beyond-design-basis external event, TMI has identified the times to complete actions in the Events Timeline are based on operating judgment, the conceptual designs, and the current supporting analyses. The TMI mitigation strategy is not based upon the PWROG WCAP-17601-P ELAP mitigation strategy. In the audit process, the licensee stated that the current SOE is for the seismic event only and that another SOE would be developed for the flood event. Based on the information provided by the licensee, it is not possible to determine the validity of the time constraints provided in the preliminary sequence of events timeline for all hazards. The final timelines will be validated once detailed designs are completed and procedures are developed. The results will be provided in a future 6-month update. This has been identified as Confirmatory Item 3.2.1.6.A in Section 4.2.

Load shedding is required to ensure the station batteries can provide vital instrument power for at least six hours. Preliminary calculation C-1101-734-E420-009 shows the following actions within the specified times achieve that objective:

- Shutdown LO-P-9A & B within 35 minutes
- Vent Main Generator Hydrogen and shutdown GNP-2 within 35 minutes
- Strip instrument systems to reduce vital instrument bus load within one hour
- Break vacuum and shutdown LO-P-6 within one hour.

The licensee will establish FLEX RCS makeup capability within approximately 4 hours to maintain sufficient RCS inventory to support core heat removal. This judgment is based on expected leakage reduction from the installation of low-leakage RCP seals. Conceptual design for low leakage RCP seal design and analysis to confirm the time requirement to establish RCS makeup capability are not yet complete. This has been identified as Confirmatory Item 3.2.1.6.B in Section 4.2.

The licensee will energize 480VAC MCC 1A & 1B using FLEX diesel generator within 6 hours to ensure vital instrument power is maintained.

The licensee will set up a portable diesel driven pump to deliver river water to the FLEX condensate source. A makeup source to replenish the condensate supply may be required within 24 hours after a tornado. This capability is expected to take 4 people approximately 6 hours to accomplish. This action is performed early to provide margin.

In the sequence of events timeline, the licensee identifies a task to attempt to start the SBO diesel generator located in Unit 2 within 5 minutes. The licensee did not explain the extent of operator actions to perform this task to determine the feasibility of accomplishing this task in such a short period of time. This has been identified as Confirmatory Item 3.2.1.6.C in Section 4.2.

In the audit process, the licensee specified that the SOE in Attachment 1A describes the expected operator response. The current license basis response for a station blackout is to start and load the SBO diesel generator within 10 minutes. The controls to start and load the SBO diesel generator are located in the Unit 1 control room. The ability to perform this task within 10 minutes is confirmed by periodic emergency procedure and operator training validation programs. The licensee will revise the SOE Attachment 1A in the February 2014 6-month update and will distinguish the time when action to start SBO is initiated from the time when the decision is made to initiate ELAP actions. This has been identified as Confirmatory Item 3.2.1.6.D 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 the sequence of events, if these requirements are implemented as described.

3.2.1.7 Cold Shutdown and Refueling

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

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

The generic concern related to shutdown and refueling requirements is applicable to TMI. This generic concern has been resolved through the 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'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 core cooling during cold shutdown and refueling, if these requirements are implemented as described.

3.2.1.8 Core Sub-Criticality

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

> All plants provide means to provide borated RCS makeup.

On page 16 of the Integrated Plan, the licensee stated that RCS inventory will be maintained to prevent loss of OTSG heat removal capability. Letdown is automatically isolated after letdown cooling is lost. An RCS cooldown will be employed. An RCS makeup source greater than the loss rate through RCP seals and controlled bleed off flow will be established before that leakage interrupts natural circulation and OTSG heat removal. Makeup will be provided by either of two permanently installed FLEX emergency RCS charging pumps, installed in the Patio area of 322' elevation or the Control Tower, (a seismic Class 1 structure) which will be powered via the 1A and 1B ES MCC using the FLEX diesel. Makeup pump will be started within 4 hours. These pumps will provide makeup to the RCS via manual connections downstream of the "C" and "D" HPI makeup valves (updated to upstream of MU-V-16C and MU-V-16D in the six-month update). These pumps will take suction from either the BWST (preferred) or the Spent Fuel Pool. In the SOE the licensee stated that at 2 hours, operators will locally line up the FLEX RCS charging pumps from the BWST or Spent Fuel Pool to the RCS and at 3 hours operators will start these pumps to restore RCS inventory and initiate boration.

The licensee stated that reactivity analysis demonstrates that makeup for shrinkage from a 2500 ppm Boron source will be provided the necessary boron concentration to maintain the reactor shutdown at 70°F without credit for xenon. The licensee stated that recovering RCS inventory to a level greater than 100 inches in the pressurizer within 24 hours will ensure the reactor remains shutdown. The licensee also stated that in the event that the plant is in a refueling shutdown, the FLEX Emergency Feedwater pumps will also be able to supply the RCS for boil-off makeup. This will be accomplished by additional piping between FLEX emergency feedwater pumps and FLEX emergency RCS charging pumps. The analysis to confirm the timeline is not yet complete as discussed in Section 3.2.1.6 above.

On page 22 of the Integrated Plan the licensee stated that the Phase 1 and 2 strategies will provide sufficient capability such that no additional Phase 3 strategies are required.

The licensee's submittal referenced calculation C-1101-202-E620-471, "TMI-1 Cycle 19 Shutdown Margin Calculation during Emergency Cooldown", but no supporting information based on the document was provided. In particular, the licensee's submittal did not address (1) whether the cycle-specific calculation has applicability beyond the current cycle or would be updated for future operating cycles or, (2) if the FLEX emergency RCS charging pumps can take suction from either the BWST or the SFP which could have different boration levels. The licensee stated that the calculation also did not include the required RCS level when suction is taken from the SFP, and did not specify whether injection of the core flood tanks is anticipated under ELAP conditions or if it would affect the calculation of shutdown margin.

Regarding the above issue, in the audit response the licensee specified that historically a new calculation is performed every cycle to ensure that emergency boration requirements in the EOP (using water at 2500 ppmB) remain valid for the new cycle specific core design. A new calculation is completed each cycle using the same reference document. The SFP boron concentration is normally above 2500 ppmB. New administrative controls will ensure this practice is maintained to satisfy FLEX strategies. There are no conditions where CFT injection is required.

The licensee calculates that RCS makeup should begin within 4 hours of the ELAP event. The licensee has to align a FLEX generator to station buses in order to provide electric power to the FLEX RCS charging pumps. The licensee did not provide justification that the busses that will provide support to the makeup strategy will survive the event causing the ELAP and be available at the time required, or provide a discussion of the strategy that would be employed if the busses cannot be restored within 4 hours.

In the audit process, the licensee specified that the analysis performed using the MAAP4 code in calculation TM-FLEX-001 shows that single phase natural circulation can be maintained without RCS makeup for greater than 6 hours. The licensee stated that this strategy imposes a conservative goal to place makeup in service in 4 hours. The FLEX emergency RCS charging pumps are supplied from independent 480V MCC. This electrical distribution equipment is located above the peak water level of the PMF, in a Class 1 seismic and tornado protected structure. The structure is also hardened for aircraft impact. The buses are designed to function during or after a SSE. The licensee stated that the TMI FLEX design includes a backup such that the failure of an active component will not prevent the function from being performed.

Because TMI plans to maintain the RCS in single-phase natural circulation conditions, a generic concern associated with the mixing of boric acid in the RCS under two-phase conditions was deemed not applicable to the site. However, even under single-phase flow conditions, adequate time for boric acid mixing should be accounted for in the procedures for RCS makeup. Natural circulation tests conducted at other plants have shown that 5-6 RCS turnovers was sufficient to ensure uniform mixing of boric acid within the RCS. Based upon the timing of establishing makeup at 4 hours, the staff expects that the injected boric acid will have sufficient opportunity to mix with the RCS coolant to ensure that subcriticality is maintained.

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 boron injection and maintaining adequate shutdown margin, if these requirements are implemented as described.

3.2.1.9 Use of Portable Pumps

NEI 12-06, Section 3.2.2, Guideline (13), provides the following guidance:

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

NEI 12-06 Section 11.2 states in part:

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

The licensee plans on using permanently installed FLEX pumps for two separate applications: (1) two FLEX emergency feedwater pumps (FX-P-2A & B) submerged in the FLEX emergency condensate storage tank (FX-T-1) for steam generator makeup, and (2) two FLEX emergency RCS charging pumps (FX-P-1A & B) installed in the patio area of 322' elevation or the Control Building (CB) for maintaining RCS inventory control in Phase 2. The permanently installed FLEX emergency feedwater pumps can supply the portable FLEX diesel driven pumps (FX-P-3 and 4) via temporary hoses as noted on the diagram on page 14 of the Integrated Plan 6-month update. According to this diagram the portable FLEX diesel driven pump can only take suction from the submersible FLEX emergency feedwater pumps which are supplied from the CST, the million gallon tank, or the hotwell. An additional FLEX diesel driven pump can take suction from the river to fill these tanks.

Information regarding the power supplies for these permanently installed pumps was not provided in the Integrated Plan, however in the August 28, 2013, 6-month update, the licensee provided additional information regarding pump power supplies. A new MCC1 will be installed and will be powered from the FLEX emergency diesel generators (FX-Y-1A & B). Both the FLEX emergency RCS charging pumps and the FLEX emergency feedwater pumps will be powered from this new FLEX MCC1, which will in turn power the 1P and 1S 480V ES Buses. In the Integrated Plan 6-month update, the licensee provided revised drawing 1E-919-21-002 showing how the power supplies powered by the FLEX emergency generators are connected to these FLEX pumping systems. Since the FLEX RCS charging and emergency feedwater pumps are permanently installed they do not appear to qualify for portable status per NEI 12-06. The rationale for having portable equipment is the it can be stored or located in such a way that it is protected from all external hazards listed in NEI 12-06 (seismic, flooding, high wind, extreme cold and heat). The FLEX emergency feedwater pumps do not appear to be protected from seismic events as are located in the Turbine Building (TB) which is a non-seismic Class 1 building. The pumps are only designed for the flood condition. It is not clear if these pumps will be available in a seismic event due to their location.

In the audit process, the licensee specified that the FLEX feedwater tank and pumps and associated piping will be designed for operation following an SSE or a tornado. There are multiple pathways from the control tower to the FLEX equipment in the TB. Also the licensee specified that the FLEX emergency feedwater pumps will be located in the condenser pit in the TB below grade. This area of the building will be made seismically rugged (i.e. structural integrity after an SSE will be maintained). The pumps & tank will be designed to function after an SSE. The pumps are driven by submersible electric motors for operation during a flood. The location is shielded from high winds and tornado missiles. The TB provides an enclosed space to maintain temperature above freezing in extreme cold. The doors will be open to allow natural circulation in the building during extreme heat. The pumps are designed for operation in ambient above 120°F.

Additionally the FLEX emergency RCS charging pumps will be located in the CB 322' elevation "patio" area. The control building is a seismic class 1 structure. The pumps will be designed to function after an SSE. The pumps are located well above the peak PMF water level. The CB is tornado protected structure, and provides an enclosed space to maintain temperature above freezing in extreme cold. Temporary ventilation will be used to maintain the CB ambient temperature less than 120°F. The pump, motor and controls are designed for operation in ambient above 120°F.

In the audit process the licensee stated that the FLEX diesel generators, fuel storage tank (FX-T-2) and FLEX MCC will be located north of the turbine pedestals on the Turbine Building 322' elevation. The FLEX diesel generators and FLEX MCC will be designed for operation if subjected to twice the SSE, as part of the "augmented approach." Protective barriers will be installed to ensure this equipment remains functional following a tornado. Feasibility analysis has been completed which shows that the Turbine Building should be adequate to support these loads during an SSE. Further analysis is being performed to determine if any structural modifications are necessary to support that conclusion. This has been identified as Confirmatory Item 3.2.1.9.A in Section 4.2.

The Integrated Plan did not provide any information on how existing plant AOP's and EOP's as noted in NEI 12-06 Section 11.4.2, consideration 2, would be affected by the existence of the permanently installed FLEX equipment. In the audit response the licensee stated that the FLEX strategy would be fully incorporated into the pant EOP and AOP structure and that there would not be a new class of procedures.

The table titled, “PWR Portable Equipment Phase 2,” lists two diesel driven pumps. The pumps have flow rates and required head of 240 gpm and 250 psid, and 600 gpm and 245 psid, respectively. The second table titled, “PWR Portable Equipment Phase 3,” lists a positive displacement high pressure pump with the specifications of 1000-3000 psi shutoff head and 60 gpm capacity and three low pressure pumps of 300 psi shutoff head and 2500 gpm max flow, 500 psi shutoff head and 500 gpm max flow, and 150 psi shutoff head and 5000 gpm max flow.

The licensee does not specify the required times for the operator to realign each of the above discussed pumps and confirm that the required times are consistent with the results of the ELAP analysis. Also, the licensee did not discuss how the operator actions are modeled in the ELAP to determine the required flow rates of the portable pumps, or justify that the capacities of each of the above discussed pumps are adequate to maintain core cooling during phases 2 and 3 of ELAP. In the audit process the licensee stated that information regarding this issue will be provided in a 6-month update. This has been identified as Confirmatory item 3.2.1.9.B in Section 4.2.

In the audit process the licensee specified that none of the equipment listed in the “PWR Portable Equipment Phase 3” table is required for the TMI FLEX strategy. This equipment provides defense in depth. Of the equipment described in the question above, the only equipment with a required FLEX function is the portable diesel driven pump, 600 gpm at 245 psid. This pump is used to pump river water to resupply the condensate source and to provide river water flow through a RB emergency cooler when the OTSG is not available. Condensate resupply is needed within 18 hours. RB cooling is required within 3 hours PLUS time to boil. These times are being refined. The RB cooling requirement only applies during outage conditions when additional resources will be made available. Hydraulic analysis is being completed to confirm the pump capacity is adequate for the required FLEX function. This has been identified as Confirmatory Item 3.2.1.9.C in Section 4.2.

The licensee’s Integrated Plan did not specify whether a single FLEX pump would be used to provide cooling flow to multiple destinations (e.g., the reactor core, steam generators, and the spent fuel pool), and if so, whether that FLEX pump could supply adequate flow and clarify whether the pumped flow will be split and simultaneously supplied to all destinations or whether the flow will be alternated between them.

During the audit process, the licensee specified that the FLEX emergency feedwater pumps are used for multiple applications. These include steam generator feedwater (when OTSG is available), makeup to RCS (when OTSG is NOT available), and spent fuel pool makeup (in either case). A single FLEX feedwater pump capacity is sufficient for each combination of requirements, i.e., OTSG & SFP or RCS & SFP. The flow to the OTSG, flow to RCS and flow to SFP will be independently controlled. RCS makeup, OTSG makeup and SF pool makeup are each controlled based on level indication.

On page 14 of the Integrated Plan, the license specified that, for Phase 3, a portable refueling vehicle with a large diesel oil bladder will be available on site to support refilling the portable equipment diesel tanks. An additional means (river makeup is available) of delivering condensate may also be developed, details to be provided in a future 6-month update. This has been identified as Confirmatory Item 3.2.1.9.D in Section 4.2.

On page 40 of the Integrated Plan, the license specified that the FLEX diesel generator fuel supply provides a minimum of 7 days of fuel, and a connection is provided for fuel oil makeup from a portable source.

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 use of portable pumps, if these requirements are implemented as described.

3.2.2 Spent Fuel Pool Cooling Strategies

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

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

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

On page 29 of the Integrated Plan, the licensee stated that, when the core is fully loaded with fuel, SFP makeup is not a time constraint since the maximum SFP heat load is 2.7 MWth. Without any active means of cooling and an initial pool temperature of 100 °F there would be at least 41 hours before boiling would occur and the time until the water level would reach the top of the active fuel is greater than 400 hours. The licensee stated that for maximum heat load the without any active means of cooling and an initial pool temperature of 100 °F, the pool would reach boiling in 12.6 hours. It would take 131.7 hours before the water level would drop to the top of the active fuel. The licensee also stated that the TMI plan provides a means to supply SFP makeup at 12 hours using the FLEX Feedwater capability. With the additional resources available during outage conditions, SFP makeup can be established within 8 hours. The licensee stated that initial SFP cooling calculations were used to determine the fuel pool timelines and that formal calculations will be performed to validate this information during development of the detailed design. The licensee also stated that these strategies utilize a vent path for steam, and that the effects of this steam on other systems and equipment will be evaluated, and the results will be provided in a future 6-month update. This has been 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 requirements of Order EA-12-049 will be met with respect to SFP cooling, if these requirements are implemented as described.

3.2.3 Containment Functions Strategies

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

On pages 24 and 26 of the Integrated Plan, the licensee stated that TMI-FLEX-002, MAAP Containment Pressure Analysis, preliminary results show that Reactor Building pressure will remain below design pressure without any active means of RB cooling for any event where the OTSG is used to remove core heat. Emergency procedures will ensure containment isolation valves are closed.

In the audit process the licensee specified that the containment model for the TMI-1 FLEX analysis (TM-FLEX-002) was developed using MAAP version 4.0.5. The model has four containment nodes (cavity compartment, lower compartment, upper compartment and annular compartment). Heat sinks within the containment model are classified as either distributed or lumped. The walls and floors in containment are modeled as distributed heat sinks. The equipment, piping, piping supports, valves, pumps, ironwork structure (such as grates, stairwells, platforms, etc.) are modeled as lumped heat sinks. The lumped heat sinks are characterized by a single temperature, and can both give and receive heat to the gas, water and debris components of the surrounding containment node. The primary and secondary system heat losses through insulated and non-insulated surfaces are modeled.

Additionally the licensee specified that in support of the FLEX strategy, the RCP seals will be replaced with Flowserve N-9000 seals with the Abeyance seal. After an ELAP, the total RCS loss rate will be less than 11 gpm @ 2155 psig. i.e. RCS Leak rate < 1 gpm and RCP CBO flow of 10 gpm. The licensee stated that within six hours after the ELAP, CBO Flow will be isolated and total RCS leakage into containment will be less than 1 gpm. The TMI MAAP RB Pressure analysis assumed 20 gpm RCS leakage into containment and an outside air ambient temperature of 95°F. The RB Pressure analysis (with OTSG available) showed that RB pressure reached approximately 20 psig but does not approach containment design pressure of 55 psig.

On page 24 of the Integrated Plan, the licensee states that preliminary MAAP analysis results show that Reactor Building pressure will remain below design pressure without any active means of RB cooling for any event where the OTSG is used to remove core heat. The Integrated Plan did not provide information regarding whether containment functions will be restored and maintained in the event of an ELAP occurring when the OTSG is not available to remove core heat, e.g. during Cold Shutdown and Refueling, or if the restoration and maintenance of containment in the event of an ELAP occurring in all Operational Modes.

In the audit process the licensee specified that The TMI FLEX strategy will maintain containment in all modes. MAAP analysis, TM-FLEX-002, has been completed to establish the RB cooling water flow requirement to limit the rise in RB pressure when the OTSG is not available. The licensee stated that this maximum RB pressure is accounted for in the analysis (C-1101-212-5360-020) which demonstrates the BWST and Spent Fuel Pool gravity drain method capabilities and ensures that temporary refueling containment closures remain functional.

The essential instrumentation listed in the Integrated Plan, on pages 24, 26, 28 does not include instrumentation for measuring the temperature of the containment atmosphere. The licensee did not provide the basis for concluding that monitoring the temperature of the containment atmosphere is not required for purposes such as validating the qualification range of measurement instruments located in the containment or establishing the survivability of penetration seals or other equipment.

In the audit process the licensee specified that TMI FLEX strategy does not use containment temperature to control any process. The availability of components within the containment for FLEX is evaluated based on analysis results of bounding conditions within the containment.

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 maintaining containment functions, if these requirements are implemented as described.

3.2.4 Support Functions

3.2.4.1 Equipment Cooling – Cooling Water

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

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

On Page 35 of the Integrated Plan, the licensee stated that the electrical power supply to maintain vital instruments is provided in Phase 1 by the Station batteries and vital instrument bus inverters. With timely load-shedding of large DC motors and stripping loads from non-vital instrument systems, vital instrument power can be ensured for at least 6 hours. The licensee stated that two diesel generators along with fuel tanks will be pre-staged in a protected enclosure on the 322-ft elevation of the Turbine Building. The licensee stated that these generators will be available to supply power to the 1A and 1B ES MCCs via a manual connections through the 1P and 1S 480V ES Buses, and that this equipment will be configured such that the 1A and 1B ES MCC can be energized within four hours of an ELAP event, or sooner based on potential RCS inventory requirements. Each diesel will be capable of providing power for all FLEX needs.

The licensee did not specify if these diesels were of sufficient capacity to supply any additional cooling need such as the system that provides for the TDEFW pump bearing cooling, or any other plant components or cooling systems needed to support the FLEX strategies. Additional formal analysis is required to determine the acceptability of the licensee's plans to provide supplemental cooling to the subject areas (e.g., MCR, EFW/ADV room areas, battery rooms) when normal cooling will not be available during the ELAP. This has been identified as Confirmatory Item 3.2.4.1.A in Section 4.2.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to equipment cooling needs, if these requirements 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 35 of the Integrated Plan, the licensee stated that the electrical power supply to maintain vital instruments is provided in Phase 1 by the Station batteries and vital instrument bus inverters. With timely load-shedding of large dc motors and stripping loads from non-vital instrument systems, vital instrument power can be ensured for at least 6 hours. Additionally the licensee stated that to maintain temperatures the Inverter and battery room area doors are opened to provide ventilation of critical SSC during Phase 1. The licensee stated that this strategy has been used in the past NRC submittals (e.g., ML021910670 or ML011660010). Additionally, the licensee stated that; battery room temperatures and hydrogen levels are not expected to exceed the equipment limitations during Phase 1, hydrogen generation is primarily a concern when batteries are charging, and that hydrogen generation is negligible when batteries are discharging (i.e., Phase 1); and therefore, hydrogen accumulation to the point of combustibility will not occur during Phase 1.

The licensee provide two references regarding this issue; CI101-734-E420-009, R-0, and OP-TM-AOP-034, Loss of Control Building Cooling.

On Page 37 of the Integrated Plan, the licensee stated that, two diesel generators along with Fuel Tanks will be pre-staged in a protected enclosure on the 322' elevation of the Turbine Building. These generators will be available to supply power to the 1A and 1B ES MCCs via manual connections through the 1P and 1S 480V ES Buses. This equipment will be configured such that the 1A and 1B ES MCCs can be energized within four hours of an ELAP event (or sooner based on potential RCS inventory requirements). Each diesel will be capable of providing power for all FLEX needs (i.e., the FLEX equipment, Vital Instrument Buses, and Emergency lighting). The licensee also stated that the Phases 1 and 2 strategies will provide sufficient capability such that no additional Phase 3 strategies are required.

At a steady-state condition of 110 degrees F, the environmental conditions within the MCR would remain at the uppermost habitability temperature limit defined in NUMARC 87-00 for efficient human performance. NUMARC 87-00 provides the technical basis for this habitability standard as MIL-STD-1472C, which concludes that 110 degrees F is tolerable for light work for a 4 hour period while dressed in conventional clothing with a relative humidity of approximately

30%. The licensee did not provide sufficient information to conclude that the habitability limits of the MCR will be maintained in all Phases of an ELAP.

On pages 35 and 37 of the Integrated Plan, the licensee stated that they intend on maintaining the Command and Control function within the MCR. Habitability conditions will be evaluated and a strategy will be developed to maintain MCR habitability. The strategy and associated support analyses will be provided in a future 6-month update. This has been identified as Confirmatory Item 3.2.4.2.A in Section 4.2.

The analysis of battery room conditions was not complete, and the licensee noted that additional formal analysis to determine the acceptability of their actions regarding the battery room's accessibility is needed. This has been identified as Confirmatory Item 3.2.4.2.B in Section 4.2.

The licensee did not provide any information regarding temporary cooling/ventilation for areas such as the TDEFW pump room, ADV rooms or cable spreading rooms. The licensee's current strategies are based on preliminary analysis. The licensee stated that the current strategy for providing cooling or ventilation for these areas is to connect a permanently staged 480V AC diesel generator and fuel tanks to be located in the Turbine Building elevation 322. The strategy is to repower 1A and 1B ES MCCs in four hours and hence supply power for cooling these areas. The licensee did not provide any details regarding what ventilation systems would be repowered for these areas of the plant, or the capacity of the FLEX emergency diesel generators to meet these needs, or how this would be accomplished. This has been identified as Confirmatory Item 3.2.4.2.C in Section 4.2.

The licensee did not provide a discussion in its Integrated Plan regarding effects of extreme high/low temperatures (i.e., temperatures above/below those assumed in the battery sizing calculations) on each battery's capability to perform its function for the duration of the ELAP event. This has been identified as Confirmatory Item 3.2.4.2.D 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 ventilation for equipment cooling if these requirements are implemented as described.

3.2.4.3 Heat Tracing.

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

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

on heat tracing should be identified.

In the Integrated Plan the licensee did not discuss the effects of loss of power to heat tracing. In the audit process the licensee specified that a strategy for extreme cold, snow and ice events is being developed. The licensee stated that preliminary plans include the use of heat tracing for some piping and tanks, e.g. the BWST, and minimum flow paths or steam heating in other situations, e.g. the CST's. Ambient temperature within the Turbine Building, Intermediate Building or Auxiliary Building where FLEX equipment is located will be maintained above critical low freezing temperatures. Review of the licensee's final heat tracing plans is needed. This has been identified as Confirmatory Item 3.2.4.3.A in Section 4.2.

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

3.2.4.4 Accessibility – Lighting and Communications.

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

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

On Page 37 of the Integrated Plan, the licensee stated that two (2) Diesel Generators along with Fuel Tanks will be pre-staged in the Turbine Building. These generators will be available to supply power to the 1A and 1B ES MCCs via manual connections through the 1P and 1S 480V ES Buses. This equipment will be configured such that the 1A and 1B ES MCCs can be energized within four hours of an ELAP Each diesel will be capable of providing power for all FLEX needs such as emergency lighting.

On Page 42 and 43 of the Integrated Plan, the licensee listed ten portable lights with tripods and three (3) Satellite phones that would be available.

In the audit process the licensee specified that local battery supplied emergency lights will provide the lighting for most of the initial FLEX response actions, and that this will be supplemented with portable lighting in some locations. When the FLEX power supply is energized, within 4 hours, the plant AC emergency lighting will be used where needed for FLEX response.

The licensee stated that communications for the initial response rely on face to face direction from the control room, and continuous communications capability between the control room and operators at EFW & ADVs FLEX diesel generator and FLEX RCS makeup pumps. The licensee stated that initial communication for offsite notifications will be made using portable satellite phones, and this capability will be supplemented with a self-sufficient satellite cell phone trailer which would provide a node/base station to allow the use of multiple cell phones from TMI.

The licensee plans and strategies include providing power to installed emergency lighting via the permanently installed FLEX emergency generators. The licensee stated that they had not completed the final analysis for the time constraints noted in the SOE, therefore the timing of the need for use of the emergency generators to supply emergency lighting cannot be determined. This has been identified as Confirmatory Item 3.2.4.4.A in Section 4.2.

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

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 providing adequate lighting and communications, if these requirements are implemented as described.

3.2.4.5 Protected and Internal Locked Area Access

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

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

The licensee provided no information in the Integrated Plan regarding local access to the protected and internal locked areas under ELAP. In the audit process the licensee indicated that they are developing a strategy to address access to security areas. This has been identified as Confirmatory Item 3.2.4.5.A. in Section 4.2.

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

3.2.4.6 Personnel Habitability – Elevated Temperature

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

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

Section 9.2 of NEI 12-06 states,

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

As discussed above under Section 3.2.4.2 Ventilation, the licensee plans for ventilation for areas such as the MCR or battery rooms are either incomplete or not addressed. This will affect considerations for operator accessibility to these areas. The licensee's analysis regarding access to the MCR, and battery rooms, is preliminary and additional formal analysis is required. In the audit process the licensee specified that temporary ventilation (fans and flexible ducts) will be used to maintain control room habitability, to control the ambient temperature in control building areas with credited FLEX electrical equipment and to limit the accumulation of hydrogen during battery charging. This approach uses a "once through" air flow path. The licensee stated that the technical basis to demonstrate that this temporary capability is sufficient and that supporting documentation, ECR 13-00310, will be made available to NRC when it is completed. In external events, other than extreme heat, the MCR ambient temperature will be maintained below 100°F. The licensee stated that for extreme heat events, additional personnel (i.e. rotation to cooler areas) will be used to ensure control room personnel can perform in the environment. This has been identified as Confirmatory Item 3.2.4.6.A. in Section 4.2.

A baseline capability for Spent Fuel Cooling is to provide a vent pathway for steam and condensate from the SFP area. On page 29 of the Integrated Plan, the licensee stated that these strategies utilize a vent path for steam. The effects of this steam on other systems and equipment will be evaluated, and the results will be provided in a future 6-month update. This has been combined with 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 requirements of Order EA-12-049 will be met with respect personnel habitability in areas of the plant that may experience elevated ambient temperatures, if these requirements are implemented as described.

3.2.4.7 Water Sources.

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

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

On page 8 of the Integrated Plan, the licensee stated that a condensate source of at least 200,000 gallons will be available for any Beyond Design Basis External Event (BDBEE).

On page 10 of the Integrated Plan, the licensee stated that the backup feed water supply will be provided by the FLEX feedwater pumps submerged in the FLEX Emergency Condensate Storage Tank. These provide a suction boost for the diesel driven portable pump in tornado or earthquake events, or are used exclusively in an external flood event. These pumps are connected to use water from the Main Condenser Hotwell, the Condensate Storage Tanks or DW-T-2, the "Million Gallon Tank".

On pages 54 and 55 of the Integrated Plan the licensee provided two diagrams; TMI FLEX Flow Diagram Feedwater System and TMI FLEX Flow Diagram Reactor Coolant and Spent Fuel Pool System. These diagrams provided some of the capacities of the water supplies to be used for RCS makeup and RCS inventory Control as follows: BWST – 237,000 gallons available and

Spent Fuel Pool – 220,000 gallons available

In the August 28, 2013 update on page 14 of 15, the licensee provided a revised drawing that provided capacities for the tanks to be used a supply to the emergency submersible FLEX feedwater pumps as follows: Condensate Storage Tanks 1A and 1B (CO-T-1A and CO-T-1B) at 216,000 gallons each, Million Gallon Tank (DW-T-2) at 280.000 gallons, and the hotwell at 20,000 gallons. The drawing also shows that the licensee can use a portable FLEX pump to draw water from the river for makeup to these tanks. The licensee stated that the portable pump can also supply the OTG's but the source of water is the Hotwell, CST's or million gallon tank.

In the audit process the licensee provided an evaluation of how they will mitigate an ELAP if at least one of the non-protected tanks does not survive, and provided justification that the tanks can be credited in accordance with NEI 12-06. The licensee stated that preliminary analysis and evaluations in accordance with NEI 12-06 standards support the conclusion that at least one of the three sources will be available in any of the postulated external events. Regarding seismic events, the licensee stated that the CO-T-1A and CO-T-1B both tanks are Seismic Class 1, per the UFSAR and references SQ-T-CO-T-0001A and SQ-T-CO-T-0001B.

Regarding the flood hazard, the licensee specified that CO-T-1A, CO-T-1B and DW-T-2 will maintain their integrity during or after a licensing basis PMF. Structural evaluations of CO-T-1A & CO-T-1B demonstrate the tank withstand the buoyant force on the tank and provided reference C-1101-122-E410-005. Additionally the DW-T-2 water level remains above the PMF peak water level throughout the event, hence no buoyant force exists for this tank.

The licensee stated that at TMI the tornado wind load exceeds the hurricane wind load. Tank integrity to support FLEX function will be maintained with the tornado wind load. All tornado events in the last 20 years were reviewed, and the maximum size (width) tornado within a 25 mile radius of TMI was 500 feet across. A wider area review, i.e. within 50 miles of TMI, indicates that 90% of all tornados were smaller than 450 feet. The main plant structures which provide a tornado missile shield are design for 300 MPH winds with a 130% wind gust, and beyond that designed for aircraft impact. CO-T-1B is located north and west of the main plant which are aircraft and tornado hardened structures. CO-T-1A is located north and east of the main plant aircraft (and tornado) hardened structures. DW-T-2 is located south and east of the main plant.

Additionally CO-T-1B & CO-T-1A are separated by 392 ft. CO-T-1A and DW-T-2 are separated by 430 feet. CO-T-1B and DW-T-2 are separated by 542 feet. The separation between CO-T-1B and DW-T-2 is perpendicular to the expected travel path of a tornado, i.e. from southwest toward northeast, and greater than any tornado which has historically occurred in the area around TMI. Both tanks east of the plant (CO-T-1A and DW-T-2) would be shielded by the plant structures for a tornado traveling from Southwest to Northeast. DW-T-2 is almost surrounded by robust structures which are taller than the tank to the west and south, and cover the lower sections of the tank from the east. The licensee stated that this shielding by robust structures makes it unlikely that a tornado missile could strike more than one of the three condensate sources. The licensee stated that therefore, based on the ability of all three tanks to handle the tornado wind load, and the separation perpendicular to the likely tornado path between CO-T-1B & DW-T-2 exceeding the width in local historical events, and the significant shielding by nearby robust structures protecting DW-T-2 and CO-T-1A, there is reasonable assurance that at least one of the three sources would not be damaged by a tornado.

The licensee appears to use probability approach to reach a conclusion that at least one of these tanks will survive an ELAP event. This approach does not conform to the NEI 12-06, Section 3.2.1.3, initial condition (3) guidance which allows the assumption that “cooling water and makeup water inventories contained in systems or structures with designs that are robust with respect to … high winds, and associated missiles are available” because the NEI 12-06, Appendix A definition for robust designs relies on consideration of an SSC as a single unit rather than an analysis to demonstrate that redundancy of SSCs in the site design makes protection from missiles unnecessary. Guidance on the acceptability of reliance on separation of redundant portable equipment is provided in NEI 12-06, Section 7.3.1, consideration 1.b. The use of this justification for the availability of the water in the tanks would constitute an alternative approach, but would need to take into account further analysis such as the full scope of the historical data on tornado events in the region surrounding the site rather than the 20 year period examined and discussion of why a limit on tornado width frequency within the historical data would be appropriate (i.e., bounding only 90% of tornado events for the 50 mile radius, if this approach is taken). This has been identified as Open Item 3.2.4.7.A in Section 4.1.

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

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.

The Integrated Plan provided no discussion regarding electrical isolation and interaction considerations. The licensee provided only the following regarding connection of portable generators to plant systems.

The licensee plans on using 480V ac portable diesel generator(s) to power various systems as noted in Section 3.2.4.4 above. The licensee did not provide any supporting information such as calculations or analysis of loading/sizing of portable diesel generator(s) or strategy regarding how portable/FLEX diesel generators and the Class 1E diesel generators are isolated to prevent simultaneously supplying power to the same Class 1E bus. In the audit process the licensee specified that the FLEX electrical power system will be designed to handle the appropriate loads, and that the FLEX MCC will be isolated from the ES 480V system by two normally open Class 1E breakers in series. Operating procedures will control the lineup to FLEX electrical system. Emergency procedures will ensure the normal feeder breakers are open prior to connection the FLEX power supply. Review of the load sizing calculations has been identified as Confirmatory Item 3.2.4.8.A in Section 4.2.

On page 37 of the Integrated Plan, the licensee states that two (2) diesel generators along with Fuel Tanks will be pre-staged in a protected enclosure on the 322 ft. elevation of the TB, and that these generators will be available to supply power to the 1A and 1B ES MCCs via a manual connections through the 1P and 1S 480V ES Buses for Phase 2 mitigating strategies. This is an alternative approach for satisfying the Mitigating Strategies Order. The use of pre-staged generators as an alternate approach is still being reviewed by the NRC staff for acceptability and therefore this has been identified as Open Item 3.2.4.8.B in Section 4.1.

The licensee's approach described above, as currently understood, has raised concerns which must be addressed before confirmation can be provided that Integrated Plan is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, such that there would be reasonable assurance that the requirements of Order EA-12-049 will be met with respect to loading/sizing of FLEX diesel generators. These questions are identified as Confirmatory and Open Items in Sections 4.2 and 4.1 respectively.

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.

Delivery of fuel to the FLEX diesel generators staged in the Turbine Building during Phase 3 was not addressed in the Integrated Plan.

In the August 28, 2013 update, the licensee revised plans for supplying diesel fuel to the portable FLEX diesel generators and stated that one 5000 gallon fuel oil "day" tank (FX-T-2) will replace the two 2600 gallons fuel oil tanks. In the audit response the licensee provided additional details regarding fuel supplies. FLEX tank FX-T-2, will be supplied from underground tank DF-T-1, which has a 25,000 gallons capacity. This 5000 gallon tank will normally contain 100 gallons, enough to start and initially load the generators. Programmatic controls for the ES fuel source maintain fuel quality. Fuel is periodically transferred from the day tank to support testing. Excess fuel is drained back to the FO-T-1 a 50,000 gallon above ground tank to ensure fuel turnover. Following an ELAP two ac powered plant fuel transfer pumps (DF-P-1- C or DF-P-1-D) will refuel FX-T-2 or the portable 200 gallon tanks to refuel the portable FLEX pump. These fuel transfer pumps will be powered by the FLEX portable diesel generator in the turbine building. Fuel consumption for a full load 500 kW generator is 37 gallons per hour and 13 gallons per hour for the FLEX pump. The minimum volume in DF-T-1 of 25,000 gallons will last more than 20 days will be available

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

3.2.4.10 Load Reduction to Conserve DC Power

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

Plant procedures/guidance should identify loads that need to be stripped from the plant dc buses (both Class 1E and non-Class 1E) for the purpose of conserving dc power.

DC power is needed in an ELAP for such loads as shutdown system instrumentation, control systems, and dc backed AOVs and MOVs. Emergency lighting may also be powered by safety-related batteries. However, for many plants, this lighting may have been supplemented by Appendix R and security lights, thereby allowing the emergency lighting load to be eliminated. ELAP procedures/guidance should direct operators to conserve dc power during the event by stripping nonessential loads as soon as practical. Early load stripping can significantly extend the availability of the unit's Class 1E batteries. In certain circumstances, AFW/HPCI /RCIC operation may be extended by throttling flow to a constant rate, rather than by stroking valves in open-shut cycles.

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

On page 4 of the Integrated Plan the licensee stated that load shedding is required to ensure the station batteries can provide vital instrument power for at least six hours. Preliminary calculation C-1101-734-E420-009 shows the following actions within the specified times, achieve that objective: 1) Shutdown LO-P-9A & B within 35 minutes, 2) vent Main Generator Hydrogen and shutdown GNP-2 within 35 minutes, 3) strip instrument systems to reduce vital instrument bus load within one hour, and 4) break vacuum and shutdown LO-P-6 within one hour.

On page 35 of the Integrated Plan the licensee states that with timely load-shedding of large dc motors and stripping loads from non-vital instrument systems, vital instrument power can be ensured for at least 6 hours.

Since the licensee stated that their load shedding analysis was based on the preliminary calculation noted above, the final calculation results could differ from initial assumptions and could therefore provide different outcomes regarding dc load shedding strategies. No supporting information was provided regarding the analysis in calculation C-1101-734-E420-009. This has been identified as Confirmatory Item 3.2.4.10.A in section 4.2.

The licensee plans to secure the main generator seal oil pump when the hydrogen pressure decreases to 15 psig. The licensee did not explain why they stop at 15 psig and not purge the main generator with CO2, or explain the potential consequences of securing the seal oil pump with 15 psi of hydrogen remaining in the generator casing.

During the audit process the licensee specified that when generator pressure is less than 15 psig, if the dc Emergency Turbine Bearing Oil Pump (EBOP) remains operating, DC generator seal oil pump can be shut down and the EBOP is capable of providing generator seal oil and containing the hydrogen within the generator.

The licensee provided updated information as part of the audit process which stated the minimum DC bus voltage of 105 V. However, the licensee did not provide any basis for the minimum DC bus voltage that will be required to ensure proper operation of all required electrical equipment. This has been identified as Confirmatory Item 3.2.4.10.B in Section 4.2.

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

3.3 PROGRAMMATIC CONTROLS

3.3.1 Equipment Maintenance and Testing.

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

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

NEI 12-06, Section 11.5 states:

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

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

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

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

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

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

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

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

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

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

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

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

On page 6 of the Integrated Plan, the licensee stated that TMI will apply administrative programs to establish responsibilities for testing & maintenance requirements. Standard industry PMs will be developed to establish maintenance and testing frequencies based on type of equipment and will be within EPRI guidelines.

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

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

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

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

3.3.2 Configuration Control.

NEI 12-06, Section 11.8 provides that:

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

On page 5 of the Integrated Plan, the licensee stated that the FLEX mitigation strategy will be treated as an independent system which requires configuration controls associated with systems. Unique identification numbers will be assigned to all FLEX components. Equipment associated with these strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control as outlined in JLD-ISG-2012-01 section 6 and NEI 12-06 Section 11.

The licensee provided insufficient information to conclude that configuration control of equipment and connections will be controlled in conformance with the guidance of NEI 12-06, Section 11.8, Items 1, 2 and 3. This has been identified as Confirmatory Item 3.3.2.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 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. Periodic training should be provided to site emergency response leaders on beyond design-basis emergency response strategies and implementing guidelines. Operator training for beyond-design-basis event accident mitigation should not be given undue weight in comparison with other training requirements. The testing/evaluation of Operator knowledge and skills in this area should be similarly weighted.

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

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

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

On page 6 of the Integrated 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 and communicated.

The licensee did provide the operator actions and associated completion times to mitigate the consequences of ELAP, or discuss how the plant specific FLEX mitigation procedures and the associated administrative controls and training program will be developed and implemented to assure that the required operator actions are consistent with that assumed in the analyses and can be reasonably achievable within the required completion times.

In the audit process the licensee specified that the SOE, in Attachment 1A, describes the basic sequence of mitigation actions for earthquake or tornado events which occur with the reactor at power. The specific procedures (new or revised) have not yet been completed. The requirements from analysis will be used to develop and to validate the new and revised procedures. This includes the existing design and licensing basis requirements and the new FLEX requirements. Validation of time response is performed using a composite of field simulation and performance exercises, combined with simulator exercises. This has been identified as Confirmatory Item 3.3.3.A in Section 4.2.

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

3.4 OFF SITE RESOURCES

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

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

On page 6 and 7 of the Integrated Plan, the licensee stated the industry will establish two (2) Regional Response Centers (RRC) to support utilities during beyond design basis events. Each RRC will hold five (5) sets of equipment, four (4) of which will be able to be fully deployed when requested. The fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team. Required equipment will be 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 off-site resources conform to the minimum capabilities specified 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, item 1 above. However, the licensee did not address the remaining items, 2 through 10 of Section 12.2. This has been identified as Confirmatory Item 3.4.A., in Section 4.2.

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

4.0 OPEN AND CONFIRMATORY ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.2.1.1.B	Provide WCAP-17792-P for NRC staff review, identify the specific calculation(s) in WCAP-17792 considered applicable to demonstrating the feasibility of the proposed mitigation strategy, and justify the applicability of the calculation(s) relied upon in WCAP-17792 to TMI-1.	
3.2.1.1.C	As applicable, provide additional analyses for core cooling, RCS makeup, and shutdown margin that are relied upon but not included in WCAP-17792-P.	
3.2.4.7.A	The licensee appears to use probability approach to reach a conclusion that at least one of the three tanks depended on for RCS makeup will survive an ELAP event. NEI 12-06 guidance does not give probability as option. The NRC staff continues to review this as a proposed alternate approach.	Significant
3.2.4.8.B	On page 37 of the Integrated Plan, the licensee states that two (2) diesel generators along with Fuel Tanks will be pre-staged in a protected enclosure on the 322 ft. elevation of the Turbine Building. These generators will be available to supply power to the 1A and 1B ES MCCs via a manual connections through the 1P and 1S 480V ES Buses for Phase 2 mitigating strategies. This is an alternative approach for satisfying the Mitigating Strategies Order and is still under review by the NRC staff.	Significant

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.1.1.A	The licensee stated that protection of associated portable	

	equipment from external hazards would be provided in structures that will be constructed to meet the requirements of NEI 12-06 Section 11, however the licensee did not specify the type of configuration, how FLEX equipment such as pumps and power supplies would be secured, or how stored equipment and structures would be protected from all external hazards.	
3.1.1.2.A	The licensee did not specifically address deployment considerations with respect to the deployment of FLEX equipment through areas subject to liquefaction, routing through Class 1 buildings, power required to deploy or move equipment, and protection of the means to move equipment	
3.1.1.3.A	The licensee did not address the determination of necessary instrument local readings per consideration 1 of NEI 12-06 Section 5.3.2, to support the implementation of the mitigating strategies in the event that seismically qualified electrical equipment is affected by beyond-design-basis events.	
3.1.1.4.A	The licensee did not identify the local assembly area or describe the methods to be used to deliver the equipment to the site for all hazards. In the audit process the licensee stated that the TMI RRC playbook will be made available when approved.	
3.1.2.2.A	The licensee did specifically address considerations 2, 3, 4, 5, 8, and 9 of NEI 12-06 Section 6.2.3.2 regarding deployment of FLEX equipment.	
3.1.3.2.A	The licensee did not address considerations 2-5 of NEI 12-06 Section 7.3.2 regarding loss of access to the ultimate heat sink, the need to remove debris, a means to move equipment that is protected, and the ability to restock supplies.	
3.1.5.3.A	The licensee provided no information regarding the heat up of a various rooms and enclosures in the Integrated Plan, and no discussion of the potential effects of high temperatures at the location where portable (or permanently installed FLEX) equipment would actually operate in the event of high temperatures in these plant locations.	
3.2.1.A	The licensee needs to confirm that the transition to the backup feedwater system will occur without a significant interruption of feedwater to the steam generators.	
3.2.1.B	The licensee needs to provide adequate technical basis for concluding that nitrogen injection will not occur from the core flood tanks.	
3.2.1.1.A	The licensee needs to confirm that analysis and conclusions based on simulations with the MAAP4 code are not relied upon for demonstrating adequate core cooling, RCS makeup, or shutdown margin for TMI-1.	
3.2.1.1.D	The licensee did not provide information confirming that reliance on the RELAP5/MOD2-B&W code in the ELAP analysis for B&W plants is limited to the flow conditions before boiler-condenser cooling initiates.	Generic Issue
3.2.1.2.A	The 1A and 1B ES motor control center (MCC) will be	

	energized using the FLEX diesel generators as described in Safety Functions Support section and the FLEX RCS makeup pump will be started within 4 hours. The analysis to confirm the timeline is not yet complete.	
3.2.1.2.B	Information should be provided to justify that the procedures are effective to keep the RCS temperatures within the limits of the seal design temperatures, and address the adequacy of the seal leakage rate (2 gpm/seal) used in the ELAP analysis.	Generic Issue
3.2.1.2.C	For plants that have low leakage seals to maintain the initial maximum leakage rate of 2 gpm/seal for the ELAP analyses of the RCS response, a discussion of the information (including seal leakage testing data) should be provided to justify the use of 2 gpm/seal in the ELAP analysis.	Generic Issue
3.2.1.2.D	Address the acceptability of using the Flowserve N-9000 RCP seals with the abeyance seal in the Westinghouse RCPs. The RCP seal leakages rates for use in the ELAP analysis should be provided with acceptable justification.	Generic Issue
3.2.1.4.A	The licensee did not provide any further description of specific initial key plant parameters specified in NEI 12-06, Sections 3.2.1.2 and 3.2.1.3 except the assumption regarding SSC's, and the items from the SOE Attachment 1A. The licensee did not provide the initial conditions used in the RCS and SFP calculations used in ER-TM-TSC-0016.	
3.2.1.5.A	TMI's evaluation of the FLEX strategy may identify additional parameters that are needed to support key actions identified in the plant procedures/guidance or to indicate imminent or actual core damage, and any differences will be provided in a future 6-month update.	
3.2.1.6.A	During the ELAP and LUHS beyond-design-basis external event, TMI has identified the times to complete actions in the Events Timeline are based on operating judgment, the conceptual designs, and the current supporting analyses. The TMI mitigation strategy is not based upon the PWROG WCAP-17601-P ELAP mitigation strategy. In the audit process, the licensee stated that the current SOE is for the seismic event only and that another SOE would be developed for the flood event. Based on the information provided by the licensee, it is not possible to determine the validity of the time constraints provided in the preliminary sequence of events timeline for all hazards. The final timelines will be validated once detailed designs are completed and procedures are developed. The results will be provided in a future 6-month update.	
3.2.1.6.B	The licensee will establish FLEX RCS makeup capability within approximately 4 hours to maintain sufficient RCS inventory to support core heat removal. This judgment is based on expected leakage reduction from the installation of low-leakage RCP seals. Conceptual design for low leakage RCP seal design and analysis to confirm the time requirement to establish RCS makeup capability are not yet complete.	

3.2.1.6.C	In the sequence of events timeline, the licensee identifies a task to attempt to start the SBO diesel generator located in Unit 2 within 5 minutes. The licensee did not explain the extent of operator actions to perform this task to determine the feasibility of accomplishing this task in such a short period of time.	
3.2.1.6.D	The licensee will revise the SOE Attachment 1A in the February 2014 6-month update and will distinguish the time when action to start SBO is initiated from the time when the decision is made to initiate ELAP actions.	
3.2.1.9.A	The licensee stated that the FLEX diesel generators (FX-Y-1A & B), fuel storage tank (FX-T-2) and FLEX MCC will be located north of the turbine pedestals on the Turbine Building 322' elevation. The FLEX diesel generators and FLEX MCC will be designed for operation if subjected to twice the SSE, as part of the "augmented approach." Protective barriers will be installed to ensure this equipment remains functional following a tornado. Feasibility analysis has been completed which shows that the Turbine Building should be adequate to support these loads during an SSE. Further analysis is being performed to determine if any structural modifications are necessary to support that conclusion.	
3.2.1.9.B	The Integrated Plan table titled, "PWR Portable Equipment Phase 2," lists two diesel driven pumps. The second table titled, "PWR Portable Equipment Phase 3," lists several pumps to be obtained form the RRC. The licensee did not discuss how the operator actions are modeled in the ELAP to determine the required flow rates of the portable pumps listed in the "PWR Portable Equipment Phase 3", or justify that the capacities of each of the above discussed pumps are adequate to maintain core cooling during phases 2 and 3 of ELAP.	
3.2.1.9.C	The licensee noted the availability of a FLEX portable diesel driven pump, 600 gpm at 245 psid. This pump is used to pump river water to resupply the condensate source and to provide river water flow through a RB emergency cooler when the OTSG is not available. Condensate resupply is needed within 18 hours. RB cooling is required within 3 hours PLUS time to boil. These times are being refined. The RB cooling requirement only applies during outage conditions when additional resources will be made available. Hydraulic analysis is being completed to confirm the pump capacity is adequate for the required FLEX function.	
3.2.1.9.D	The license stated that, for Phase 3, a portable refueling vehicle with a large diesel oil bladder will be available on site to support refilling the portable equipment diesel tanks. An additional means (river makeup is available) of delivering condensate may also be developed.	
3.2.2.A	The licensee stated that initial SFP cooling calculations were used to determine the fuel pool timelines and that formal	

	calculations will be performed to validate this information during development of the detailed design. The licensee also stated that these strategies utilize a vent path for steam, and that the effects of this steam on other systems and equipment will be evaluated, and the results will be provided in a future 6-month update	
3.2.4.1.A	The licensee did not specify if the FLEX diesel generators on the Turbine Building were of sufficient capacity to supply any additional cooling need such as the system that provides for the TDEFW pump bearing cooling, or any other plant components or cooling systems needed to support the FLEX strategies. Additional formal analysis is required to determine the acceptability of the licensee's plans to provide supplemental cooling to the subject areas, e.g., MCR, EFW, ADV room areas, battery rooms.	
3.2.4.2.A	Habitability conditions in the Main Control Room will be evaluated and a strategy will be developed to maintain Main Control Room habitability. The strategy and associated support analyses will be provided in a future 6-month update.	
3.2.4.2.B	The analysis of battery room conditions was not complete, and the licensee noted that additional formal analysis to determine the acceptability of their actions regarding the battery room's accessibility is needed. Also additional discussion on the hydrogen gas exhaust path for each strategy is needed, and a discussion of the accumulation of hydrogen to ensure that the hydrogen gas level is below combustible level when the batteries are being recharged during Phase 2 and 3.	
3.2.4.2.C	The licensee did not provide any information regarding temporary cooling/ventilation for areas such as the TDEFW pump room, ADV rooms or cable spreading rooms. The licensee's current strategies are based on preliminary analysis. The current strategy for providing cooling or ventilation for these areas is to connect a permanently staged 480V AC diesel generator and fuel tanks to be located in the Turbine Building elevation 322. The strategy is to repower 1A and 1B ES MCCs in four hours and hence supply power for cooling these areas. The licensee did not provide any details regarding what ventilation systems would be repowered for these areas of the plant, or the capacity of the FLEX emergency diesel generators to meet these needs, or how this would be accomplished.	
3.2.4.2.D	Provide a discussion on extreme high/low temperature effects on the battery capability to perform its function for the duration of ELAP event.	
3.2.4.3.A	The licensee specified that a strategy for extreme cold, snow and ice events is being developed. Preliminary plans include the use of heat tracing for some piping and tanks, e.g. the BWST, and minimum flow paths or steam heating in other situations, e.g. the CST's. The final plans will be reviewed	

	when complete.	
3.2.4.4.A	The licensee plans and strategies include providing power to installed emergency lighting via the permanently installed FLEX emergency generators. The licensee has not completed the final analysis for the time constraints noted in the SOE, therefore the timing of the need for use of the emergency generators to supply emergency lighting cannot be determined.	
3.2.4.4.B	The NRC staff reviewed the licensee communications assessment and has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2 (8) regarding communications capabilities during an ELAP. Confirmation that upgrades to the site's communications systems have been completed will be accomplished.	
3.2.4.5.A	The licensee provided no information in the Integrated Plan regarding local access to the protected and internal locked areas under ELAP. In the audit process the licensee indicated that they are developing a strategy to address access to security areas.	
3.2.4.6.A	The licensee's analysis regarding access to the MCR, and battery rooms, is preliminary and additional formal analysis is required. In the audit process the licensee specified that temporary ventilation (fans and flexible ducts) will be used to maintain control room habitability, to control the ambient temperature in control building areas with credited FLEX electrical equipment and to limit the accumulation of hydrogen during battery charging. This approach uses a "once through" air flow path. The licensee stated that the technical basis to demonstrate that this temporary capability is sufficient and that supporting documentation, ECR 13-00310, will be made available to NRC when it is completed.	
3.2.4.8.A	In the audit process the licensee specified that the FLEX electrical power system (480V ac diesel generators and new MCC) will be designed to handle the appropriate loads. The load sizing calculations will be reviewed when provided by the licensee.	
3.2.4.10.A	The licensee stated that their load shedding analysis was based on a preliminary calculation, and the final calculation results could differ from initial assumptions and could therefore provide different outcomes regarding DC load shedding strategies. No supporting information was provided regarding the analysis in calculation C-1101-734-E420-009.	
3.2.4.10.B	Provide basis for the minimum DC voltage at the DC bus that will be required to ensure proper operation of all the electrical equipment.	

3.3.2.A	The licensee provided insufficient information to conclude that configuration control of equipment and connections will be controlled in conformance with the guidance of NEI 12-06, Section 11.8, Items 1, 2 and 3.	
3.3.3.A	The specific procedures for training, new or revised, have not yet been completed. The requirements from analysis will be used to develop and to validate the new and revised procedures. This includes the existing design and licensing basis requirements and the new FLEX requirements. Validation of time response is performed using a composite of field simulation and performance/simulator exercises.	
3.4.A	The licensee's plans for the use of off-site resources conform to the minimum capabilities specified 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, item 1. The licensee did not address the remaining items, 2 through 10 of Section 12.2.	