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 2

February 3, 2014

Wolf Creek Nuclear Operating Corporation
Wolf Creek Generating Station
Docket No. 50-482

Prepared for:

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

Contract NRC-HQ-13-C-03-0039
Task Order No. NRC-HQ-13-T-03-0001
Job Code: J4672
TAC No. MF0788

Prepared by:

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

1.0 BACKGROUND

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

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

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

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

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

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

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

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

2.0 EVALUATION PROCESS

In accordance with the provisions of Contract NRC-HQ-13-C-03-0039, Task Order No. NRC-HQ-13-T-03-0001, Mega-Tech Services, LLC (MTS) performed an evaluation of each licensee's Integrated Plan. As part of the evaluation, MTS, in parallel with the NRC staff, reviewed the original Integrated Plan and the first 6-month status update, and conducted an audit of the licensee documents. The staff and MTS also reviewed the licensee's answers to the NRC staff's and MTS's questions as part of the audit process. The objective of the evaluation was to assess whether the proposed mitigation strategies conformed to the guidance in NEI 12-06, as endorsed by the positions stated in JLD-ISG-2012-01, or an acceptable alternative had been proposed that would satisfy the requirements of Order EA-12-049. The audit plan that describes the audit process was provided to all licensees in a letter dated August 29, 2013 from Jack R. Davis, Director, Mitigation 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 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. ML13070A026), and as supplemented by the first six-month status report in letter dated August 28, 2013 (ADAMS Accession No. ML13247A277), Wolf Creek Nuclear Operating Corporation (the licensee or Wolf Creek) provided the Wolf Creek Integrated Plan for compliance with Order EA-12-049. The Integrated Plan describes the strategies and guidance under development for implementation by Wolf Creek 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 staff notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049. That letter described the process used by the NRC staff in its review, leading to the issuance of an interim staff evaluation and audit report. The purpose of the staff's audit is to determine the extent to which the licensees are proceeding on a path towards successful implementation of the actions needed to achieve full compliance with the Order.

3.1 EVALUATION OF EXTERNAL HAZARDS

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

3.1.1 Seismic Events.

NEI 12-06, Section 5.2 states:

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

On page 2 of the Integrated Plan, in the section regarding determination of applicable extreme external hazards, the licensee stated that per NEI 12-06, seismic hazards must be considered for all nuclear sites. Therefore, seismic hazards are applicable to Wolf Creek. The licensee further stated that with the exception of some portions of the Category I pipelines, all safety related structures are founded on rock, concrete fill, or granular structural fill that is not susceptible to liquefaction. The portions of the Category I pipelines that are not founded on rock, concrete fill, or granular structural fill are located on clayey soil with plasticity greater than 10%. For those areas, analyses indicate that no liquefaction will take place for the postulated safe shutdown earthquake (SSE).

The licensee also stated on page 5 that the seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore were not assumed in their Integrated Plan.

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

3.1.1.1 Protection of FLEX Equipment – Seismic Hazard

NEI 12-06, Section 5.3.1 states:

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

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

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

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

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

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

On pages 16, 45, and 53 of the Integrated Plan, in the sections regarding the strategies for maintaining core cooling and heat removal, SFP cooling, and safety functions support, respectively, the licensee stated that protection of associated portable equipment from seismic hazards would be provided in two locations. Both the primary and the alternate storage locations will be designed or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures.* The licensee further stated that large portable FLEX equipment will be secured to withstand an SSE and will be protected from seismic interactions with other components. No components will be stacked or at a raised elevation that could potentially cause interference with the deployment of any of the FLEX equipment. This plan addresses considerations 1, 2 and 3 above.

On page 31 of the Integrated Plan in the section regarding the strategies for maintaining reactor coolant system (RCS) inventory in the transition phase, the licensee described storage plans similar to those stated above with the exception of some items that would be stored in the Auxiliary Building, which is a Category 1 building protected from the external hazards.

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

3.1.1.2 Deployment of FLEX Equipment - Seismic Hazard

NEI 12-06, Section 5.3.2 states:

> There are five considerations for the deployment of FLEX equipment following a seismic event:
>
> 1. If the equipment needs to be moved from a storage location to a different point for deployment, the route to be traveled should be reviewed for potential soil liquefaction that could impede movement following a severe seismic event.
>
> 2. At least one connection point of 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.

Although the Integrated Plan provided a discussion regarding liquefaction considerations for structures and pipelines at the Wolf Creeks site on page 2 of the submittal, no discussion was provided regarding potential soil liquefaction that could impede transport of FLEX equipment following a severe seismic event. The licensee will need to address this impact, and to take steps if necessary to conform to the NEI 12-06 guidance of consideration 1 above. This is identified as Open Item 3.1.1.2.A in Section 4.1 below.

On page 18 of the Integrated Plan in the section describing the core cooling with steam generators (SGs) available, the licensee described how the strategy connection was to be protected and stated that both the internal connection to the intermediate piping and the primary connection point are located in the Auxiliary Building which is seismically qualified and missile protected. Similar wording and provisions were described in other sections of the Integrated Plan when referring to protection of, and access paths to, connection points. This information is consistent with the guidance provided in consideration 2 above.

With regard to consideration 3 above, the licensee provided the following information. On page 25 of the Integrated Plan, in the section describing the core cooling strategy, the licensee described access to the UHS and stated that the connection to the UHS would be a hose, connected to a strainer basket, which will be dropped into the lake. During the audit process, the licensee stated that the only downstream river control structure is a dam approximately 260 miles from the site and concluded that failure of downstream dams does not pose a threat to the plant. The reviewer found that conclusion reasonable because of the significant distance in river miles between the site and the downstream Pensacola dam. In addition, during the audit process, the licensee stated that since the Wolf Creek Cooling Lake dam was not designed to withstand a SSE, its FLEX strategies only rely on the safety-related portion of the UHS that was designed to withstand a SSE.

The Integrated Plan did not discuss the need for, or if necessary, provisions for, power that might be required to deploy equipment, such as power to open roll up doors at a storage location as described in consideration 4 above. This is identified as Open Item 3.1.1.2.B in Section 4.1 below.

On page 16 of the Integrated Plan, in the section regarding maintaining core cooling and heat removal, the licensee stated that both the primary and alternate storage locations will store deployment vehicles, thereby addressing the guidance of consideration 5 above.

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

3.1.1.3 Procedural Interfaces – Seismic Hazard

NEI 12-06, Section 5.3.3 states:

> There are four procedural interface considerations 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 13 of the Integrated Plan, and in each section where instruments are listed for key parameters for mitigating strategies, the licensee stated Wolf Creek may need to develop procedures to read this instrumentation locally, where applicable, using a portable instrument, in accordance of the guidance of Section 5.3.3 of NEI 12-06. In addition, during the audit process, the licensee stated that Wolf Creek is preparing procedures that will provide guidance after a BDB seismic event, detailing the use of portable instruments to locally obtain necessary instrument readings from qualified electrical equipment. The licensee further stated that these procedures will conform to the guidance of NEI 12-06 Section 5.3.3, consideration 1.

With regard to consideration 2 and 3 above, the licensee stated during the audit process that Wolf Creek does not have large internal flooding sources that are not seismically robust and do not require ac power and; that Wolf Creek does not use ac power to mitigate ground water in critical locations.

And finally, with regard to consideration 4 above, Wolf Creek, as previously stated, is not subject to the consequences of downstream dam failure.

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 if these requirements are implemented as described.

3.1.1.4 Considerations in Using Offsite Resources – Seismic Hazard

NEI 12-06, Section 5.3.4 states:

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

On page 10 of the Integrated Plan, in the section regarding the Regional Response Center (RRC) plan, the licensee stated that the industry will establish two RRCs to support utilities during a BDBEE scenario as outlined in NEI 12-06. Equipment will be moved from an RRC to a local Assembly Area, established by the Strategic Alliance for FLEX Emergency Response (SAFER) team and the utility. During the audit process, the licensee stated that Wolf Creek has multiple diverse paved roads that provide access to the site and that a procedure is being developed to summarize these routes and their accessibility during each type of event. And finally, the licensee also stated that RRC would have airlift capability to overcome or circumvent site access routes that may be impassible.

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 offsite resources if these requirements are implemented as described.

3.1.2 Flooding

NEI 12-06, Section 6.2 states:

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

NEI 12-06, Section 6.2.1 states:

> 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 2 of the Integrated Plan, in the section regarding general Integrated Plan elements, the licensee stated that the Wolf Creek site is considered a "dry" site. The maximum flood level from any cause is below the plant site elevation level and therefore external flooding hazards are not applicable. However, the licensee further stated that Wolf Creek plans to develop FLEX strategies that address the potential for on site dam failures resulting from probable maximum precipitation (PMP) or from seismic events.

The licensee also stated on page 5 that the flooding re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 had not been completed and therefore were not assumed in the Integrated Plan.

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

As previously stated in Section 3.1.2 of this report, the licensee determined that the external flooding hazard is not applicable to the Wolf Creek site. However, the licensee also stated on page 2 of the Integrated Plan that Wolf Creek plans to develop FLEX strategies that address the potential for on site dam failures resulting from probable maximum precipitation (PMP) or from seismic events. Also, on pages 16, 31, 46, and 53 of the Integrated Plan, in the sections regarding the strategies for maintaining core cooling and heat removal, RCS inventory control, SFP cooling, and safety functions support, respectively, the licensee stated that the associated portable equipment would be provided in two locations that will be located above plant grade with a floor level of at least 2,000 ft. and will therefore be above the maximum flood level of 1999.86 ft.

It is not clear from the information presented whether or not the licensee will be developing plans to account for the protection of all FLEX equipment from the potential impact of on site dam failures. The licensee will need to address this potential impact, and to take precautions if necessary to conform to the NEI 12-06, Section 6.2.3.1 guidance of consideration 1 and 2 above. This is identified as Confirmatory Item 3.1.2.1.A in Section 4.2 below.

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

As previously stated in Section 3.1.2 of this report, the licensee has determined that the external flooding hazard is not applicable to the Wolf Creek site. However, the licensee also stated on page 2 of the Integrated Plan that Wolf Creek plans to develop FLEX strategies that address the potential for on site dam failures resulting from probable maximum precipitation (PMP) or from seismic events.

It is not clear from the information presented whether or not the licensee will be developing plans to address deployment of FLEX equipment in view of the potential impact of on site dam failures. The licensee will need to address this potential impact, and to take precautions or provide alternate transport plans if necessary to conform to the NEI 12-06, Section 6.2.3.2 guidance above. This is identified as Confirmatory Item 3.1.2.2.A in Section 4.2 below.

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

As previously stated in Section 3.1.2 of this report, the external flooding hazard is not applicable to the Wolf Creek site. However, as stated in Section 3.1.2 of this report, Wolf Creek plans to develop FLEX strategies that address the potential for on site dam failures resulting from probable maximum precipitation (PMP) or from seismic events.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to procedural interfaces for flood 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 page 10 of the Integrated Plan, in the section regarding regional response center plan, the licensee stated the industry will establish two RRCs to support utilities during a BDBEE scenario as outlined in NEI 12-06. Equipment will be moved from an RRC to a local Assembly Area, established by the SAFER team and the utility. As previously discussed, the licensee stated that Wolf Creek has multiple diverse paved roads that provide access to the site and that a procedure is being developed to summarize these routes and their accessibility during each type of event. And finally, the licensee also stated that RRC would have airlift capability to overcome or circumvent site access routes that may be impassible.

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 offsite resources if these requirements are implemented as described.

3.1.3 High Winds

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

> The screening for high wind hazards associated with hurricanes should be accomplished by comparing the site location to NEI 12-06, Figure 7-1 (Figure 3-1 of U.S. NRC, "Technical Basis for Regulatory Guidance on Design Basis Hurricane Wind Speeds for Nuclear Power Plants," NUREG/CR-7005, December, 2009); if the resulting frequency of recurrence of hurricanes with wind speeds in excess of 130 mph exceeds 10^{-6} per year, the site should address hazards due to extreme high winds associated with hurricanes.
>
> The screening for high wind hazard associated with tornadoes should be accomplished by comparing the site location to NEI 12-06, Figure 7-2, from U.S. NRC, "Tornado Climatology of the Contiguous United States," NUREG/CR-4461, Rev. 2, February 2007; if the recommended tornado design wind speed for a 10^{-6}/year probability exceeds 130 mph, the site should address hazards due to extreme high winds associated with tornadoes.

On page 3 of the Integrated Plan in the section regarding the determination of applicable extreme external hazards, the licensee stated Figures 7-1 and 7-2 from NEI 12-06 were used for this assessment. Based on Figure 7-1 of NEI 12-06, Wolf Creek would not be susceptible to hurricanes so the hazard is screened out. However, based on Figure 7-2 of NEI 12-06, Wolf Creek has the potential to experience damaging winds caused by a tornado exceeding 130 mph. Therefore, high-wind hazards are applicable to the WCGS site.

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

3.1.3.1 Protection of FLEX Equipment - High Wind Hazard

NEI 12-06, Section 7.3.1 states:

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

remain deployable following the high wind event. (This option is not applicable for hurricane conditions).

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

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

On page 16 of the Integrated Plan, the licensee stated two locations have been determined for storage of Wolf Creek's FLEX equipment. The primary storage building will not be protected from high winds and missiles; however, the alternate storage building will be designed and built to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures* or more stringent standards. In addition, the licensee stated that these facilities would be in diverse locations. During the audit process, the licensee provided additional information on the description of "diverse" by stating the buildings are separated by approximately 1900 ft. and are oriented along a northwest to southeast path. The licensee stated that according to the National Oceanic and Atmospheric Administration (NOAA), the vast majority of tornado movement occurs in a southwest to northeast direction. Therefore, the licensee determined that the building locations are not in line with expected tornado travel. The reviewer concluded that the licensee's protection of FLEX equipment for the high wind hazard is reasonable because at least one of the storage locations is robust with respect to high winds and storage locations considered the predominant path of tornados for its geographical location. In addition, the reviewer noted that based on historical tornado data from the NOAA's National Weather Service Storm Prediction Center, the majority of tornado movement is from southwest to northeast direction and the tornado widths in Coffey and surrounding counties in the last 40 years has been less than 1900ft.

On page 31 of the Integrated Plan regarding the strategies for maintaining RCS inventory, the licensee noted that some FLEX equipment to support that safety function would be located in the Auxiliary Building, which is also protected from high winds.

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 protection if these requirements are implemented as described.

3.1.3.2 Deployment of FLEX Equipment – High Wind Hazard

NEI 12-06, Section 7.3.2 states:

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

in considering how the baseline capability is deployed.

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

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

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

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

On page 25 of the Integrated Plan, in the section describing the core cooling strategy, the licensee described access to the UHS and stated that the connection to the UHS would be a hose, which will be connected to a strainer basket, and dropped into the lake. Furthermore, the licensee stated on page 60 of the Integrated Plan, in the list of PWR [Pressurized Water Reactor] Portable Equipment Phase 2, that a "Pettibone All-Terrain Forklift (or similar)" and "FLEX Transportation Equipment" would be available. The licensee also stated, on page 16 of the Integrated Plan, that both the primary and alternate storage locations will store deployment vehicles. The reviewer determined that these plans address the guidance of the considerations above.

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

3.1.3.3 Procedural Interfaces – High Wind Hazard

NEI 12-06, Section 7.3.3, states:

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

On page 6 of the Integrated Plan, the licensee stated that the pre-planned strategies developed will be incorporated into the unit emergency operating procedures (EOPs) in accordance with established EOP change processes. In addition, on page 15 of the Integrated Plan, the licensee stated that procedures and guidance to support deployment and implementation, including interfaces to EOPs, special event procedures, abnormal event procedures, and system operating procedures, will be developed in accordance with NEI 12-06, Section 11.4. The licensee further stated that Wolf Creek will align with the FLEX support guidelines being developed by the Pressurized Water Reactor Owner's Group (PWROG).

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 procedures 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.

As previously discussed in Section 3.1.1.4 of this Technical Evaluation Report, the licensee stated that Wolf Creek has multiple diverse paved roads that provide access to the site and that a procedure is being developed to summarize these routes and their accessibility during each type of event. And finally, the licensee also stated that RRC would have airlift capability to overcome or circumvent site access routes that may be impassible.

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 offsite resources if these requirements are implemented as described.

3.1.4 Snow, Ice and Extreme Cold

As discussed in NEI 12-06, Section 8.2.1:

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

On page 3 of the Integrated Plan, regarding the determination of applicable extreme external hazards, the licensee stated that Wolf Creek is located above the 35th parallel (Latitude 38° 14' 20" North and Longitude 95°41' 20" West) and must consider the challenges of extreme snowfall and extreme cold. In addition, the licensee stated that the Wolf Creek site is not located in a Level 1 or 2 region as defined by Figure 8-2 of NEI 12-06, and therefore, the FLEX strategies must consider the impedances caused by ice storms.

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

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

NEI 12-06, Section 8.3.1 states:

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

On pages 16, 45, and 53 of the Integrated Plan, in the sections regarding the strategies for maintaining core cooling and heat removal, SFP cooling, and safety functions support, respectively, the licensee stated that the primary and the alternate storage locations will be designed or evaluated equivalent to ASCE 7-10, *Minimum Design Loads for Buildings and Other Structures*. This plan meets the guidance of consideration 1 above. In addition, on pages 17, 46, and 53 of the Integrated Plan, the licensee stated that portable equipment required to implement FLEX strategies will be maintained in storage locations that will be climate controlled.

On page 31 of the Integrated Plan regarding the strategies for maintaining RCS inventory control, the licensee noted that some FLEX equipment to support this safety function would be located in the Auxiliary Building, which is a climate controlled building.

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 storage if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.2 states:

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

With regard to consideration 1 above, the licensee stated on page 17 of the Integrated Plan, in the section regarding programmatic controls, that equipment associated with the FLEX strategies will be procured as commercial equipment with design, storage, maintenance, testing, and configuration control in accordance with NEI 12-06, Section 11.0. The reviewer notes that the referenced NEI 12-06 section provides for design guidance that supports equipment operation as intended to support the FLEX strategies.

With regard to consideration 2 above, the licensee stated during the audit process that on-site debris and snow removal equipment stored in Wolf Creek's primary FLEX storage building will be used to clear the site roads in support of transporting equipment

With regard to consideration 3 above, the licensee also stated during the audit process that surface ice on the cooling lake and the UHS is possible. In the event that the lake is unavailable, a hydraulic lift pump will be placed inside the UHS intake structure to provide UHS access. The licensee stated that plant cold weather procedure, SYS EF-205, Rev. 33, ESW/Circulating Water Cold Weather Operations, is used when lake temperatures reach 35°F or below to mitigate the formation of frazil ice.

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

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

NEI 12-06, Section 8.3.3, states:

> The only procedural enhancements that would be expected to apply involve addressing the effects of snow and ice on transporting the FLEX equipment.

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

As discussed previously in Section 3.1.3.3 of this Technical Evaluation Report, the licensee stated that the pre-planned strategies developed will be incorporated into the unit EOPs in accordance with established EOP change processes. In addition, on page 15 of the Integrated Plan, the licensee stated that procedures and guidance to support deployment and implementation, including interfaces to EOPs, special event procedures, abnormal event procedures, and system operating procedures, will be developed in accordance with NEI 12-06, Section 11.4. The licensee further stated that Wolf Creek will align with the FLEX support guidelines being developed by the PWROG.

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 procedures if these requirements are implemented as described.

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

NEI 12-06, Section 8.3.4, states:

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

As previously discussed in Section 3.1.1.4 of this Technical Evaluation Report, the licensee stated that Wolf Creek has multiple diverse paved roads that provide access to the site and that a procedure is being developed to summarize these routes and their accessibility during each type of event. And finally, the licensee also stated that RRC would have airlift capability to overcome or circumvent site access routes that may be impassible.

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 offsite resources if these requirements are implemented as described.

3.1.5 High Temperatures

NEI 12-06, Section 9.2 states:

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

On page 3 of the Integrated Plan, the licensee noted that per NEI 12-06, all sites must address high ambient temperatures, and therefore, extreme heat hazards are applicable to the Wolf Creek site.

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

3.1.5.1 Protection of FLEX Equipment – High Temperature Hazard

NEI 12-06, Section 9.3.1, states:

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

On page 17 of the Integrated Plan regarding the strategies for maintaining core cooling in the transition phase (phase 2), in the section that identifies how equipment is protected from high temperature hazard, the licensee stated that the storage locations will be evaluated for high temperature effects and ventilation will be provided as required to ensure no adverse effects on the FLEX equipment. The storage locations will be climate controlled.

Similar statements are provided for the transition phase for RCS inventory control, SFP cooling, and safety function support.

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 storage if these requirements are implemented as described.

3.1.5.2 Deployment of FLEX Equipment – High Temperature Hazard

NEI 12-06, Section 9.3.2 states:

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

During the audit process, the licensee stated that the design basis temperature range for Wolf Creek is -30°F to 120°F. The Phase 2 FLEX equipment will be stored and staged onsite in two pre-cast concrete buildings. The storage buildings will be heated but will not be air conditioned. The licensee explained that adequate cooling will be available via louvered end panels and if needed, forced ventilation via electric fans. Furthermore, the building design specification used to procure the FLEX storage buildings will include the operating temperature range, -30°F to 120° F, to ensure that extreme temperatures are accounted for.

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

3.1.5.3 Procedural Interfaces - High Temperature Hazard

NEI 12-06, Section 9.3.3 states:

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

On page 15 of the Integrated Plan, the licensee stated that procedures and guidance to support deployment and implementation including interfaces to EOPs, special event procedures, abnormal event procedures, and system operating procedures, will be developed in accordance with NEI 12-06, Section 11.4. The licensee further stated that Wolf Creek will align with the FLEX support guidelines being developed by the PWROG.

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 if these requirements are implemented as described.

3.2 PHASED APPROACH

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

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

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

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

NEI 12-06, Table 3-2 and Appendix D summarize one acceptable approach for the reactor core cooling strategies. This approach uses the installed AFW system to provide 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 RCS inventory control and maintenance of long-term subcriticality through the use of low leakage reactor coolant pump (RCP) 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 BDB 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 re-criticality as discussed in Appendix D, Table D-1.

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.

During the NRC audit process the licensee was requested to specify which analysis performed in WCAP-17601-P is being applied to Wolf Creek. The response provided by the licensee did not clearly identify the analysis used. Additionally, the licensee was requested to justify the use of that analysis by identifying and evaluating the important parameters and assumptions demonstrating that they are representative of Wolf Creek and appropriate for simulating the ELAP transient. Additional information will need to be provided by the licensee to address the items above. This has been identified as Confirmatory Item 3.2.1.1.A in Section 4.2.

The licensee has provided a Sequence of Events (SOE) in their Integrated Plan, which included the time constraints and the technical basis for the site. As noted above, the licensee did not provide a clear statement in the Integrated Plan with regard to what analysis was used as the bases for the development of the SOE. However, the licensee did state, on page 70, in Attachment 1B, NSSS Significant Reference Analysis Deviation Table, that there were "No Deviations from WCAP-17601 -P, January 2013, Revision 1." Based on that statement, and because WCAP-17601 references the use of NOTRUMP, the reviewer assumed that the licensee has decided to use the NOTRUMP computer code for simulating the ELAP event.

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

(1) Reliance on the NOTRUMP code for the ELAP analysis of Westinghouse plants is limited to the flow conditions prior to reflux condensation initiation. This includes specifying an acceptable definition for reflux condensation cooling. This is identified as Confirmatory Item 3.2.1.1.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 the computer codes used to perform ELAP analysis if these requirements are implemented as planned.

3.2.1.2 Reactor Coolant Pump Seal Leakage Rates

NEI 12-06, Section 1.3 states:

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

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

The licensee provided a sequence of events (SOE) in the Integrated Plan, which included the time constraints and their technical basis. The SOE is based on an analysis using specific RCP seal leakage rates. The issue of RCP seal leakage rates was identified as a Generic Concern and was addressed by 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 [Nuclear Steam Supply System] Designs" dated January 2013 (ADAMS Accession No. ML13042A011 and ML13042A013 (Non-Publically Available)).
- A position paper dated August 16, 2013, entitled "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Reactor Coolant Pump (RCP) Seal Leakage in Support of the Pressurized Water Reactor Owners Group (PWROG)" (ADAMS Accession No. ML13235A151 (Non-Publicly Available)).

After review of these submittals, the NRC staff has placed certain limitations for Westinghouse designed plants. Those limitations and their corresponding Confirmatory Item numbers for this

TER are provided as follows:

(1) For the plants using Westinghouse RCPs and seals that are not the SHIELD shutdown seals, the RCP seal initial maximum leakage rate should be greater than or equal to the upper bound expectation for the seal leakage rate for the ELAP event (21 gpm/seal) discussed in the PWROG position paper addressing the RCP seal leakage for Westinghouse plants. If the RCP seal leakage rates used in the plant-specific ELAP analyses are less than the upper bound expectation for the seal leakage rate discussed in the position paper, justification should be provided. If the seals are changed to non-Westinghouse seals, the acceptability of the use of non-Westinghouse seals should be addressed, and the RCP seal leakage rates for use in the ELAP analysis should be provided with acceptable justification. As indicated in the licensee's Integrated Plan and response to the audit process, Wolf Creek will use SHIELD seals. Therefore, this issue is not applicable to Wolf Creek.

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

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

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

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

3.2.1.3 Decay Heat

NEI Section 3.2.1.2 states in part:

The initial plant conditions are assumed to be the following:

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

On pages 11, 12, and 13 of the Integrated Plan describing phase 1 core cooling and heat removal, and on page14 of the plan describing phase 2 core cooling and heat removal, the licensee described the sequence of actions to be taken to provide cooling water to the core following an ELAP event. These actions, and the sequence and the timing of these actions, are dependent on decay heat rate, which is derived from the thermal hydraulic analyses utilized at the Wolf Creek plant. However, no discussion regarding decay heat modeling was provided. During the NRC audit process, the licensee identified references in WCAP-17601-P where the ANS 5.1-1979 + 2 sigma model is stated as the decay heat model used in the ELAP analysis.

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

On pages 3 through 6 of the licensee's Integrated Plan, the licensee listed the initial plant conditions assumed for the Wolf Creek plant. The list conformed to the guidance of NEI 12-06, Section 3.2.1.2. In addition, the list is consistent with the initial conditions listed in WCAP-17601-P. The licensee stated on page 70, in Attachment 1B, NSSS Significant Reference Analysis Reconciliation Table, that there are no deviations from the WCAP-17601-P.

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 initial conditions if these requirements are implemented as described.

3.2.1.5 Monitoring Instrumentation and Controls

NEI 12-06, Section 3.2.1.10 states in part:

> The parameters selected must be able to demonstrate the success of the strategies at maintaining the key safety functions as well as indicate imminent or actual core damage to facilitate a decision to manage the response to the event within the Emergency Operating Procedures and FLEX Support Guidelines or within the severe accident management guidelines (SAMGs). Typically these parameters would include the following:

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

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

On pages 13, and again on pages 15, 16 and 24 of the Integrated Plan, the licensee provided the following list of instrumentation to support phases 1, 2 and 3 coping strategies for maintaining core cooling and heat removal:

1. SG Level - Normal Power Source: Class 1E dc; Long-Term Power Source: Temporary DG
2. AFW Flow indication (downstream of connection points) - Normal Power Source: Class 1E dc; Long-Term Power Source: Temporary DG
3. SG Pressure - Normal Power Source: Class IE Long-Term Power Source: Temporary DG
4. CST [Condensate Storage Tank] Level - Normal Power Source: non-Class IE, a new local level gauge will be installed
5. RCS Hot Leg Temperature (if core exit thermocouples not available)- Normal Power Source: Class 1E dc; Long-Term Power Source: Temporary DG
6. RCS Cold Leg Temperature - Normal Power Source: Class IE dc; Long-Term Power Source: Temporary DG
7. Core Exit Thermocouple - Normal Power Source: Class IE dc; Long-Term Power Source: Temporary DG
8. RCS Pressure - Normal Power Source: Class IE dc; Long-Term Power Source: Temporary DG
9. Pressurizer Level - Normal Power Source: Class 1E dc; Long-Term Power Source: Temporary DG

Similar lists are provided for instrumentation to support RCS inventory control. On page 39 and on page 43 of the Integrated Plan, in the section regarding key parameters for maintaining containment and SFP cooling, respectively, the licensee identified instrumentation for measuring containment pressure and SFP level.

At the end of each list, the licensee stated that Wolf Creek may need to develop procedures to read the instrumentation locally, where applicable, using a portable instrument, in accordance with the guidance of Section 5.3.3 of NEI 12-06. The reviewer noted that there is a licensee identified open item on page 64 of the Integrated Plan related to those instrument lists stating that for non-Class 1E instrumentation that will be repowered using a temporary battery, an analysis will need to be performed to determine battery life and frequency of replacing battery. Completion of the analysis noted above is identified as Confirmatory Item 3.2.1.5.A in Section 4.2 below.

There was no discussion in the Integrated Plan to address instrument accuracies for temporary instrumentation that may be required during the implementation of FLEX strategies. Because instrumentation accuracies may be critical in these applications, the licensee will need to address this issue. This is identified as Confirmatory Item 3.2.1.5.B in Section 4.2 below.

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

3.2.1.6 Sequence of Events

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

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

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

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

The SOE is discussed on pages 7 and 8 of the Integrated Plan and in Attachment 1A on pages 67 through 69. On page 8 of the Integrated Plan, the licensee stated that to confirm the times given in the SOE, Wolf Creek plans to prepare procedures for each task, perform time study walkthroughs for each of the tasks under simulated ELAP conditions, and account for equipment tagging and other administrative procedures required to perform the task. During the audit process, the licensee stated that Wolf Creek intends to update the timing and deployment calculation, DAR-SEE-II-12-21 Rev. 2, "Wolf Creek Generation Station FLEX Timing and Deployment," to be consistent with the final hose routes, connection points, and fueling requirements. Final FLEX support guidelines are scheduled for completion by the end of January 2014. The licensee further reiterated that walkthroughs will be performed after the final guidelines are completed to validate timing, hose and cable lengths, and connections. The licensee indicated that these walkthroughs are scheduled to complete by the end of August 2014.

On page 7 of the Integrated Plan, the licensee stated that a cooldown of the plant would commence as part of the response to the ELAP event. During the audit process, the licensee was asked to discuss whether an analysis had been performed to ensure that injection of nitrogen gas into the RCS from the accumulators would not occur, or would not adversely affect the proposed mitigation strategy In its response, the licensee stated that procedural controls to prevent nitrogen injection into the RCS are being developed. The strategy is to re-energize the 480V bus using the FLEX generators to enable closing the accumulator isolation valves or to enable venting the nitrogen.

The licensee's response did not fully address the methodology that would be used to ensure that nitrogen injection from the accumulators would not occur. In Attachment 1 to the PWROG's interim core cooling position paper, a methodology accounting for containment heatup, instrument uncertainties, and other factors, was specified to ensure the selection of a final steam generator pressure that would prevent nitrogen injection. It was not made clear during the audit whether the licensee plans to follow this approach or is planning to use an alternate approach. The confirmation that the licensee will (1) use the methodology in Attachment 1 to the PWROG's interim core cooling position paper or (2) specify an alternate method for preventing nitrogen injection and demonstrate its acceptability is identified as Confirmatory Item 3.2.1.6.A in Section 4.2 below.

On page 12 of the Integrated Plan, the licensee discussed the use of the atmospheric relief valves (ARVs) during the cooldown process. The licensee stated that these four valves are installed on the outlet piping of each SG to provide for controlled removal of reactor decay heat during normal reactor cooldown. During the audit process, the licensee was asked to address the following factors associated with operating the ARVs:

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

The licensee provided responses to those items as follows:

1) Per section 9.3-1 of the Updated Safety Analysis Report (USAR) the compressed air system contains an 8 hour safety related nitrogen backup for the ARVs and AFW control valves. This 8 hour backup supply will begin to deplete as soon as the offsite power is lost.
2) An analysis of actual nitrogen usage by the ARVs throughout an event has been completed. Draft calculation FD-13-001, determined that total air consumption for the steam generator ARVs and the AFW control valves is 5.464 scfm. The information from this analysis is being used to size a FLEX compressor that can supply air to operate the ARVs for the entire event.
3) The ARVs are operated by dc solenoids powered from the Class 1E batteries. The existing battery analysis accounts for these solenoid loads. Phase 2 FLEX generators will repower chargers to maintain these batteries.
4) Manual actions will not be necessary because the motive force and the control power will be available throughout the event.

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

3.2.1.7 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 Wolf Creek. This generic concern has been resolved generically through the NRC endorsement of NEI position paper entitled “Shutdown/Refueling Modes” (ADAMS Accession No. ML13273A514); and has been endorsed by the NRC in a letter dated September 30, 2013 (ADAMS Accession No. ML13267A382).

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

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

The PWROG submitted a position paper, dated August 15, 2013 (withheld from public disclosure due to proprietary content), which provides test data regarding boric acid mixing under single-phase natural circulation conditions and outlined applicability conditions intended to ensure that boric acid addition and mixing would occur under conditions similar to those for which boric acid mixing data is available. In an endorsement letter dated January 8, 2014 (ADAMS Accession No. ML13276A183), the NRC staff concluded that the August 15, 2013, position paper constitutes an acceptable approach for addressing boric acid mixing under natural circulation during an ELAP event, provided that the following additional conditions are satisfied:

(1) The required timing for providing borated makeup to the primary system should consider conditions with no reactor coolant system leakage and with the highest applicable

leakage rate for the reactor coolant pump seals and unidentified reactor coolant system leakage.

(2) For the condition associated with the highest applicable reactor coolant system leakage rate, two approaches have been identified, either of which is acceptable to the staff:

a) Adequate borated makeup should be provided such that the loop flow rate in two-phase natural circulation does not decrease below the loop flow rate corresponding to single-phase natural circulation.

b) If loop flow during two-phase natural circulation has decreased below the single-phase natural circulation flow rate, then the mixing of any borated primary makeup added to the reactor coolant system is not to be credited until one hour after the flow in all loops has been restored to a flow rate that is greater than or equal to the single-phase natural circulation flow rate.

(3) In all cases, credit for increases in the reactor coolant system boron concentration should be delayed to account for the mixing of the borated primary makeup with the reactor coolant system inventory. Provided that the flow in all loops is greater than or equal to the corresponding single-phase natural circulation flow rate, the staff considers a mixing delay period of one hour following the addition of the targeted quantity of boric acid to the reactor coolant system to be appropriate.

During the audit process, the licensee stated that the Wolf Creek long-term sub-criticality calculations meet the limitations currently documented in the PWROG position paper. However, the licensee had neither (1) committed to abide by the generic approach discussed above, including the additional conditions specified in the NRC's endorsement letter, nor (2) identified an acceptable alternate approach for justifying the boric acid mixing assumptions in the analyses supporting its mitigating strategy. As such, resolution of this concern for Wolf Creek is identified as Open Item 3.2.1.8.A in Section 4.1.

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

3.2.1.9 Use of Portable Pumps

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

> Regardless of installed coping capability, all plants will include the ability to use portable pumps to provide RPV/RCS/SG [reactor pressure vessel/reactor coolant system/steam generator] makeup as a means to provide diverse capability beyond installed equipment. The use of portable pumps to provide RPV/RCS/SG makeup requires a transition and interaction with installed systems. For example, transitioning from reactor core isolation cooling (RCIC) to a portable FLEX pump as the source for RPV makeup requires appropriate controls on the depressurization of the RPV and injection rates to avoid extended core uncovery. Similarly, transition to a portable pump for SG makeup may require cooldown and depressurization of the SGs in advance of using the

> portable pump connections. Guidance should address both the proactive transition from installed equipment to portable and reactive transitions in the event that installed equipment degrades or fails. Preparations for reactive use of portable equipment should not distract site resources from establishing the primary coping strategy. In some cases, in order to meet the time-sensitive required actions of the site-specific strategies, the FLEX equipment may need to be stored in its deployed position.

NEI 12-06 Section 11.2 states in part:

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

On page 14 of the Integrated Plan in the section describing the phase 2 core cooling, the licensee stated that the primary and alternate strategies involve staging a portable FLEX core cooling pump to the east of the Turbine Building and north of the CST. This portable FLEX core cooling pump would draw from the CST through a modified man-way cover on the southeast side of the tank and discharge through a flexible hose to an intermediate hard pipe connection located in the CST valve house. On page 29 of the Integrated Plan, in the section discussing the strategy for maintaining RCS inventory control during the transition phase, the licensee describes the utilization of a portable electric pump for strategy implementation. This portable FLEX RCS inventory control pump would draw suction from the Boric Acid Tanks (BAT) or from the Refueling Water Storage Tank (RWST). It should be noted that the licensee confirmed that the BATs are fully protected from all BDBEE; however, the RWST is only seismically qualified and an evaluation is being finalized to demonstrate that the tank meets current licensing basis for tornado missiles. In addition, a design to protect the RWST valve house against tornado missiles is being finalized. This issue is discussed in detail later in Section 3.2.4.7, of this Technical Evaluation Report. Also, on page 44, the licensee identified the use of a portable SFP pump for phase 2 strategies. It should be noted that the Wolf Creek CST is not protected from seismic events and is not missile protected. However, a licensee evaluation is being finalized to demonstrate that the existing CST meets current licensing basis for seismic events and tornado missiles and the licensee plans to protect the CST valve house against tornado missiles is being finalized. This issue is also discussed in detail later in Section 3.2.4.7 of this Technical Evaluation Report.

On page 58 of the Integrated Plan, the licensee stated that the Wolf Creek Cooling Lake and UHS impoundment are potential cooling water makeup sources. Transfer to the CST would be via a FLEX portable pump taking suction from the west side of the plant from the boat ramp. It was not clear from the information provided whether the discharge of this FLEX pump will be used to refill the CST or some other connection will be made to support phase 2 of maintaining core cooling and heat removal. During the audit process, the licensee stated that if the Wolf Creek Cooling Lake is available, a hydraulically driven submersible pump will be placed into the lake and the discharge will be piped directly to the makeup connection on the CST. If the Wolf Creek cooling lake is not available, the licensee stated that the hydraulically driven submersible pump will be lowered into the essential service water (ESW) intake structure to access the UHS. The discharge will be aligned directly to the makeup connection on the CST, and the flow will be directed through a strainer prior to being injected into the tanks. The licensee further clarified that no intermediate pumps are required for either alignment.

The sections of the Integrated Plan discussed above demonstrate conformance with the guidance of NEI 12-06 Section 3.2.2 Guideline (13) with regard using portable pumps to provide makeup as a means to enable diverse capability beyond installed equipment and the transition and interaction with installed systems. However, it was not clear from the information presented in the Integrated Plan what evaluations or analyses will be used to demonstrate that the pumps and the hose and piping configurations will enable adequate pressure and flow to meet the strategy requirements. During the audit process, the licensee provided the following information. Preliminary analyses have been used to determine the required pump flow rate and corresponding head for each of the portable pumps as per CN-FSE-12-9 Rev. 0, "Wolf Creek FLEX Conceptual Design AFT Fathom Models." Justification showing that the required capacity (flow rate and head) and mission time for each of the portable pumps are adequate to maintain core cooling and sub-criticality during Phases 2 & 3 of ELAP can be found in TR-FSE-13-5 Rev. 0, "Wolf Creek FLEX Integrated Plan," Appendix C. The licensee further stated that updated analysis models (Fathom) will be included in the final design.

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

3.2.2   Spent Fuel Pool Cooling Strategies

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

As described in NEI 12-06, Section 3.2.1.7 and JLD-ISG-2012-01, Section 2.1, strategies that have a time constraint to be successful should be identified and a basis provided that the time can be reasonably met. NEI 12-06, Section 3 provides the performance attributes, general criteria, and baseline assumptions to be used in developing the technical basis for the time constraints. Since the event is a BDB event, the analysis used to provide the technical basis for time constraints for the mitigation strategies may use nominal initial values (without uncertainties) for plant parameters, and best-estimate physics data. All equipment used for consequence mitigation may be assumed to operate at nominal setpoints and capacities. NEI 12-06, Section 3.2.1.2 describes the initial plant conditions for the at-power mode of operation; NEI 12-06, Section 3.2.1.3 describes the initial conditions; and NEI 12-06, 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 42 of the Integrated Plan, in the section discussing the spent fuel cooling for phase 1, the licensee stated that with an initial SFP temperature of 100°F and with a normal decay heat load in the pool, the time to boil is approximately 8.9 hours after the start of the ELAP event. For a normal decay heat load, it has been determined that it will take approximately 34.93 hours until the inventory reaches 15 ft. above the top of the fuel racks at which time makeup to the SFP is required. A similar analysis for the condition when fuel is in transfer or for full core off-load determined that SFP makeup is required at 14.95 hours after the start of the ELAP event. The licensee has identified this time constraint in the SOE action item list for aligning a FLEX pump to provide SFP cooling. As discussed on page 44 of the Integrated Plan, the SFP will be cooled by using the FLEX pump to inject coolant directly into the pool or into existing SFP piping.

On page 49 of the Integrated Plan, in the section describing the phase 3 SFP cooling strategy, the licensee stated that the SFP cooling system would be repowered to provide indefinite coping for the SFP but no method for repowering was provided. In the 6-month update, the licensee stated that the pump would be repowered from a 4160v generator provided by the RRC.

On page 44 of the Integrated Plan, in the section discussing the spent fuel pool cooling for phase 2 using the portable SFP pump, the licensee stated that during phase 2, it is expected that access to the SFP area could be challenged due to environmental conditions local to the pool. The licensee stated that "most" of the actions required for phase 2 occur outside of the Fuel Building. It was not clear what actions are required *inside* the fuel building and, for those actions, how the "challenges" would be addressed. During the audit process, the licensee stated that the only action performed inside the fuel building during a BDBEE is to connect a hose to a connection located on the ground elevation just inside the roll up door that will take place before the SFP begins to boil. The licensee clarified that the hose will be extended outside and placed an adequate distance away from the roll up door such that environmental condition concerns regarding access to the fuel building are eliminated.

Also on page 44 of the Integrated Plan, the licensee described connection points for the SFP makeup strategies but it was not clear whether or not each of the connection points would be protected from hazards such as freezing or wind generated missiles. During the audit process, the licensee clarified the configuration and stated that connection points, primary and alternate, will be located within the fuel building on the ground elevation just inside the roll up door and will be protected from external hazards. In addition, the licensee indicated in its response that the spray connection is also located on the ground elevation just inside the roll up door. On page 45 of the Integrated Plan, the licensee provided a discussion regarding the modifications necessary to support phase 2 of its spent fuel pool strategy. The licensee indicated that for SFP spray, hard piping will be run through the Plant East wall of the Fuel Building on the 2000' elevation and up to the 2047'-6" elevation and the pipe will terminate in a monitor nozzle that will perform the spray function. In response to an audit question, the licensee stated that the spray connection can provide the 250 gpm specified by the guidance in NEI 12-06.

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

On pages 38, 39, and again on page 41 of the Integrated Plan in the sections regarding phase 1, 2, and 3 strategies for maintaining containment, the licensee stated, that containment pressure and temperature are expected to increase during an ELAP due to loss of containment cooling and RCS leakage into containment. However, with the installation of the low leakage RCP shutdown seals, the pressure and temperature are not expected to rise to levels that could challenge the containment structure. During the audit process, the licensee stated that the GOTHIC analysis shows that the containment structure meets its design criteria for peak pressure after an ELAP duration of 7 days. Additionally, the instrumentation inside containment critical to coping with an ELAP event has been shown to remain below the temperature acceptance criteria of 306.1°F. The licensee further stated that this calculation is in final review and will be made available for NRC staff review when complete. Further review of the analysis results to verify that the containment temperature and pressure remain at or below acceptable limits is identified as Confirmatory Item 3.2.3.A in Section 4.2 below.

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

The licensee made no reference in the Integrated Plan regarding the need for, or use of, additional cooling systems necessary to assure that coping strategy equipment functionality can be maintained. On page 11 of the Integrated Plan in the section regarding Phase 1 of maintaining core cooling and heat removal the licensee stated that the TDAFWP is a horizontal centrifugal pump and the pump bearings are cooled by the pumped fluid. Nonetheless, the only portable equipment used for coping strategies identified in the Integrated Plan that would require some form of cooling are portable diesel powered pumps and generators. These self-contained commercially available units would not be expected to require an external cooling system nor would they require AC power or normal access to the UHS.

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 support functions if these requirements are implemented as described.

3.2.4.2 Ventilation – Equipment Cooling

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

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

On page 7 of the Integrated Plan in the section regarding the SOE, the licensee stated that current procedures involve blocking open the doors of the turbine driven auxiliary feedwater (TDAFW) pump room and that Wolf Creek is pursuing an analysis to prove indefinite coping, or to provide actions necessary to maintain environment qualification (EQ) requirements for the TDAFW pump. During the audit process, the licensee was requested to provide a discussion regarding the proposed analysis. The licensee stated that the Wolf Creek TDAFW pump room calculation, GF-415 Rev. 0, "Temperature of Auxiliary Feedwater Turbine Driven Pump Room During 4 Operating Conditions," covers a loss of offsite power that includes loss of ventilation in the room. The calculation assumes the TDAFW pump room door remains closed and still yielded acceptable results with respect to the equipment qualification temperature of 150°F.

No information was provided in the Integrated Plan regarding the potential for high or low temperature in the battery rooms and the effect on the batteries. The licensee provided additional information on this topic during the audit process. The licensee stated that the analysis of battery room temperatures during an accident scenario was performed in the document HV-288 Rev. 0, "Loss of Ventilation." In this analysis, it was conservatively assumed that the rooms were sealed compartments, doors fully closed. The licensee explained that the assumption for the mitigation strategy was that operators would open the battery room doors for ventilation and that, during a FLEX event, portable fans will be added to provide additional ventilation capability. Furthermore, the licensee stated that during an extreme cold event, the battery rooms will start at normal temperatures and as soon as the batteries begin to discharge, the batteries will give off heat. Therefore it is not expected that the battery rooms will see a significant decrease in temperature during an extreme cold event.

In addition to the discussion above for the battery room, on page 50 of the Integrated Plan regarding safety functions support, the licensee stated that strategies are being developed for temporary ventilation of vital areas and that the strategies will include propping open doors and possibly using small generators to power up fans. Further review of these strategies is identified as Confirmatory Item 3.2.4.2.A in Section 4.2 below.

On page 7 of the Integrated Plan, the licensee briefly stated that battery room ventilation must be started when battery charging begins to vent hydrogen. However, it was not clear to the reviewer what method would be used to provide this ventilation. During the audit process, the licensee stated that strategy for battery room ventilation during battery recharging to prevent hydrogen accumulation has not yet been developed. However, the licensee further stated that a FLEX procedure will be developed to provide detailed instructions for this activity. The procedure will ensure initiation of battery room ventilation via portable fans and ductwork to a safe area that would not be impacted by the potential for hydrogen accumulation (e.g., outside the building).

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 ventilation 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.

The licensee screened in for extreme cold, ice and snow and thus, there is a need for the licensee to address loss of heat tracing effects on FLEX strategies. The licensee did not address the loss of heat tracing in the Integrated Plan. During the audit process, the licensee was asked to discuss the potential for boric acid precipitation and to discuss the potential for loss of heat tracing due to an ELAP event. The licensee stated that preliminary strategies have been identified to eliminate boron precipitation issues in the Boric Acid Tanks (BATs) caused by local area cooldown. These strategies include:

1) Providing makeup from the BATs at a time earlier in the event,
2) Deploying local (BAT) room heating,
3) Diluting the BAT contents after RCS criticality requirements have been achieved,
4) Providing heat tracing.

The licensee further stated that for long-term maintenance of RCS inventory after depletion of the BATs or for the case of an ELAP event initiated during shutdown conditions, the Refueling Water Storage Tank (RWST) will be used. The concentration maintained in the RWST is not susceptible to precipitation at temperatures above the freezing temperature for pure water.

The licensee stated that additional strategies will be developed to ensure the RWST or another borated water source is available indefinitely. Further review of these additional strategies is identified as Confirmatory Item 3.2.4.3.A in Section 4.2 below.

During the audit process, the licensee also addressed the subject of the potential for water freezing in important piping and instrumentation systems. The licensee stated that the Wolf Creek strategy for SG makeup relies on the injection using the CST as the initial makeup source. The volume and initial temperature of the tank contents and associated piping contribute to considerable thermal mass that moderates the decrease in temperature such that bulk freezing of this source is precluded. In addition, the licensee stated that strategies will be developed to prevent freezing of instrumentation and associated lines credited for use during the event. For example, portable heaters can be placed in areas to maintain temperatures at acceptable levels, and area doors can be positioned to facilitate area heating. Further review of the strategies developed to mitigate freezing of water in instrument and small piping is identified as Confirmatory Item 3.2.4.3.B in Section 4.2 below.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Items, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to 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 50 of the Integrated Plan, in the section regarding safety functions support, the licensee stated that strategies are being developed for temporary lighting of vital areas. During the audit process, the licensee stated that Wolf Creek operators are required to carry flashlights and that headlamps will be purchased and kept inside the control room cabinet to allow for hands free lighting.

The NRC staff has reviewed the licensee communications assessment (ADAMS Accession Nos. ML12313A009 and ML13072A090) in response to the March 12, 2012 50.54(f) request for information letter for Wolf Creek and, as documented in the staff analysis (ADAMS Accession No. ML13149A171), has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Therefore, there is reasonable assurance that the guidance and strategies developed by the licensee will conform to the guidance of NEI 12-06 Section 3.2.2, Guideline (8) regarding communications capabilities during an ELAP. Verification that any required communication enhancements are implemented is identified as Confirmatory Item 3.2.4.4.A in Section 4.2 below.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to lighting and communication 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’s plans for the development of guidance and strategies did not address access to the protected area and internal locked areas. However, the licensee's response to the audit process explained that on-shift operators carry appropriate keys to locked areas necessary for plant operation and FLEX implementation. In addition, plant security personnel will be utilized during an ELAP event thus providing additional access capability to locked areas.

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 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.

NEI 12-06 Section 9.2 states,

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

On page 7 of the Integrated Plan, and again on page 44, the licensee discussed access with regard to habitability for the main control room and for the SFP area, respectively. For the control room, the licensee stated that doors would be blocked open to maintain acceptable temperatures for accessibility. For the SFP area, the licensee stated that access could be challenged due to environmental conditions. Restricted access to other areas of the plant due to adverse environments was not discussed. On page 50 of the Integrated Plan, the licensee stated that strategies are being developed for temporary ventilation of vital areas. The strategies will include propping open doors and possibly using small generators to power up fans. Because evaluations are not completed to determine if compensatory actions will be required regarding habitability to permit personnel to access and work in areas such as the control room, the TDAFW pump room, and other areas that may be subject to adverse conditions, further review is required to verify habitability is addressed for areas critical for the strategies. This is identified as Confirmatory Item 3.2.4.6.A in Section 4.2 below.

The licensee's approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and subject to the successful closure of issues related to the Confirmatory Item, provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to habitability 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 [net positive suction head] can be demonstrated and, for example, that the water does not gravity drain back to the UHS. Alternate water delivery systems can be considered available on a case-by-case basis. In general, all CSTs should be used first if available. If the normal source of makeup water (e.g., CST) fails or becomes exhausted as a result of the hazard, then robust demineralized, raw, or borated water tanks may be used as appropriate.
>
> Heated torus water [applicable to Boiling Water Reactors only] can be relied upon if sufficient 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.

In the Integrated Plan, the licensee makes references to utilizing the CST and the RWST as sources of water for mitigation strategies. On page 18 of the Integrated Plan, in the description of core cooling with SG available, the licensee stated that the CST is a non-seismic and non-missile protected tank and that the tank will need to be seismically qualified and missile protected to credit it for any plant strategies. In addition, the licensee stated that the CST valve house and pipe chase will need to be seismically qualified and missile protected. On page 21 of the Integrated Plan, the licensee explained that the RWST is seismically qualified but not missile protected. The licensee has listed two self-identified open items on page 64 of the Integrated Plan to resolve the protection issues for the CST and RWST, OI#3 and OI#4, respectively.

During the audit process, the licensee was asked to discuss the plan for resolving the CST protection issue for seismic events and high wind events. The licensee responded by stating that the evaluation is being finalized to show that the existing CST meets current licensing basis for seismic and tornado missile hazards. The evaluation is scheduled for completion by the end of 2013. In addition, a plan to protect the CST valve house against tornado missiles is also being finalized and the design for the valve house will be complete January 2014. Also, during the audit process, the licensee was asked to discuss the plan for resolving the RWST protection issue for the tank and valve house for high wind events and associated missiles. The licensee responded by stating that the evaluation is being finalized to show that the existing RWST meets current licensing basis for tornado missiles. A design to protect the RWST valve house against tornado missiles is being finalized and the design for the valve house is scheduled to be complete by January 2014. The reviewer noted that the licensee's 6-month update stated that the results of an updated Ground Motion Response Spectrum (GMRS) are required for final decisions regarding modifications for both the CST and the RWST. Completion of the final design/evaluations associated with the CST and RWST, and their respective valve house, and identification of any required actions is identified as Confirmatory Item 3.2.4.7.A in Section 4.2 below.

On pages 57, 58, and 59, of the Integrated Plan, the licensee provided a discussion of the various water sources available to support the FLEX mitigation strategies. These sources include the CST, the RWST, the reactor makeup water storage tank, the demineralized water storage tank, the potable water storage tank, the cooling lake, the UHS, and the boric acid tanks. In addition, information on the planned modifications and the protection of connections was provided. As discussed above, the licensee's is planning and evaluating the protection of the CST and RWST, and their respective valve houses, to be a credited source of water for non-borated and borated water sources, respectively. As previously discussed, the BATs are also a credited borated water source and the Wolf Creek Cooling Lake and the UHS impoundment are a credited non-borated water source that will survive a BDBEE. The licensee's reliance on the other tanks, such as the reactor makeup water storage tank, the demineralized water storage tank, the potable water storage tank, is preferred over the Wolf Creek Cooling Lake and the UHS impoundment but is dependent on a damage assessment after the BDBEE to determine if the water source can be utilized.

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

3.2.4.8 Electrical Power Sources/Isolations and Interactions

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

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

On page 51 of the Integrated Plan in the section on safety functions, the licensee stated that the primary electrical need during phase 2 is dc power for critical instrumentation. This will be accomplished in one of two ways. The primary strategy is to feed Class 1E 480v switchgear and selectively power the battery charger circuits. The alternate strategy is to repower the battery chargers directly through a dedicated circuit from a portable 480V FLEX generator. Although the Integrated Plan addressed the use of portable diesel powered generators to provide backup power, the plan did not provide sufficient information regarding isolation and interactions. The licensee provided additional information during the audit process and stated that new breakers, NG00112 and NG00212, and disconnect switches NK410, NK412, NK413, and NK414, will serve as Class 1E isolation devices. These breakers and disconnect switches will be locked open, separating 480V safety-related busses from the non-safety FLEX generator connection infrastructure. The licensee further stated that no permanent FLEX connections will be made to 4160V busses. Short circuit analyses are scheduled to be complete by the end of 2013 to confirm that safety related electrical equipment to be connected to FLEX generators has a greater short circuit rating than the short circuit capability of the FLEX generators. This is identified as Confirmatory Item 3.2.4.8.A in Section 4.2 below.

There was no discussion provided in the Integrated Plan regarding instrumentation that will be used to monitor portable/FLEX electrical power equipment including the associated measurement tolerances/accuracy to ensure that: 1) the electrical equipment remains protected (from an electrical power standpoint – e.g., power fluctuations) and 2) the operator is provided with accurate information to maintain core cooling, containment, and spent fuel cooling strategies. This is identified as Open Item 3.2.4.8.B in Section 4.1 below.

No information or references were provided in the Integrated Plan regarding sizing calculations to demonstrate the FLEX generator will have sufficient capacity to ensure proper operation of all the required electrical equipment. During the audit process the licensee stated that when the generators are procured, the vendor will provide a sizing evaluation demonstrating that the generator size is adequate. However, it is still not clear what process or analysis the licensee has used to develop the procurement specification for FLEX generator sizing. This is identified as Confirmatory Item 3.2.4.8.C in Section 4.2 below.

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

3.2.4.9 Portable Equipment Fuel

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

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

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

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

On page 5 of the Integrated Plan, the licensee stated that it is assumed and will be confirmed by the licensee at a later date, that each FLEX component can store a minimum of 10 hours of fuel at constant operation. This forms the basis for deployment of the refueling strategies and will be confirmed as more detailed design information becomes available. On page 14 of the Integrated Plan, in the section regarding phase 2 core cooling and heat removal, the licensee stated that there is a large amount of diesel fuel available on-site; greater than 170,600 gallons in safety related emergency diesel generator (EDG) fuel oil storage tanks. The licensee further stated that this volume of fuel oil is sufficient for the phase 2 strategies. During the audit process, the licensee was asked to provide a discussion of the strategy/activities to transfer this fuel oil from the EDG fuel oil storage tanks to the FLEX equipment. Also, the licensee was asked if the fuel transfer connections were robust. The licensee responded with the following information. DAR-FSE-12-4, “FLEX Mechanical Conceptual Design Report for the Wolf Creek Generating Station,” Section 5.1.1.8, “Fuel Requirements,” provides the discussion regarding the fuel transfer strategy. In accordance with this strategy, no modifications will need to be made to the fuel tanks themselves. The site has procured four dc fuel transfer pumps that can be used to move fuel from any of their on-site sources and into a fuel truck. Once the fuel truck is filled, this fuel will be transported to the equipment that requires refueling. The licensee further stated that the dc transfer pumps and fuel truck required to transfer the fuel to the FLEX equipment will be housed inside the FLEX storage buildings. Based on consumption rate information from the licensee’s FLEX Mechanical Conceptual Design Report, the reviewer noted that on-site fuel oil from protected sources can support required functions for core cooling and heat removal, RCS inventory makeup/boration, SFP make-up, repowering of safety function support items and required diesels generators until resupply of fuel oil can be provided by off-site resources.

During the audit process, the licensee also addressed the quality of the diesel fuel to be used. The licensee stated that existing site procedures ensure the quality of the fuel in all of the storage tanks on site. When an offsite vendor or the RRC replenishes the fuel oil supply, procedure STS CH-015 Rev. 27, “Emergency Diesel New Fuel,” will be utilized to assure quality.

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 air AOVs and MOVs [air operated valves and motor operated valves]. 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 [auxiliary feedwater/high pressure coolant injection/reactor core isolation

> cooling] 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 50 of the Integrated Plan regarding safety function support, the licensee stated that the Class 1E NK battery system provides dc electrical power to Class 1E loads and vital instrumentation. The system consists of four batteries (NK11, NK12, NK13, and NK14) separated into two load groups. Each battery has sufficient stored energy to operate the necessary emergency loads for 4 hours after loss of ac power or charger failure, without load shedding. Load shedding will begin 45 minutes after the event and will be completed within 15 minutes. The licensee further stated that battery run time can be extended to 8 hours with implementation of load shedding and that calculations have been completed to confirm that the batteries can provide adequate coping during an ELAP (Reference CN-PEUS-12-12, Rev. 0, Wolf Creek FLEX Battery Coping Analysis). The load shedding process is proceduralized in Wolf Creek procedure EMG C-0, “Loss of All AC Power,” Attachment C.

During the audit process, questions were presented to the licensee regarding the dc loading profile, and the minimum dc bus voltage required for successful strategy implementation. With regard to dc load profile, the licensee stated that the information is provided in reference document CN-PEUS-12-12, Wolf Creek FLEX Battery Coping Analysis. With regard to the minimum dc bus voltage, the licensee stated that the voltage on the vital bus must be maintained at or above 105 vdc to ensure ELAP credited equipment will function properly. The licensee added that Wolf Creek calculation NK-E-001, “125 VDC Class 1E Battery System Sizing, Voltage Drop and Short Circuit Studies,” forms the basis for this minimum voltage.

The licensee’s approach described above, as currently understood, is consistent with the guidance found in NEI 12-06, as endorsed by JLD-ISG-2012-01, and provides reasonable assurance that the requirements of Order EA-12-049 will be met with respect to load reduction 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, Guideline (15) states:

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

equipment associated with each strategy does not require N+1. The existing 50.54(hh)(2) pump and supplies can be counted toward the N+1, provided it meets the functional and storage requirements outlined in this guide. The N+1 capability applies to the portable FLEX equipment described in Tables 3-1 and 3-2 (i.e., that equipment that directly supports maintenance of the key safety functions). Other FLEX support equipment only requires an N capability.

NEI 12-06, Section 11.5 states:

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

2. Portable equipment that directly performs a FLEX mitigation strategy for the core, containment, or SFP should be subject to maintenance and testing guidance provided in INPO [Institute of Nuclear Power Operations] 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., Electrical Power Research Institute (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.

Review of the Integrated Plan revealed that the Generic Concern related to maintenance and testing of FLEX equipment is applicable to Wolf Creek. 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.

However, the reviewer was unable to confirm from the information presented that the licensee had either (1) committed to abide by the generic approach discussed above, or (2) identified an acceptable alternate approach for their equipment maintenance in support of its mitigating strategy. As such, resolution of this concern for Wolf Creek is identified as Confirmatory Item 3.3.1.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 maintenance and testing if these requirements are implemented as described.

3.3.2 Configuration Control

NEI 12-06, Section 11.8 states:

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

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

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

On page 6 of the Integrated Plan, in discussing key site assumptions (A30) to implement NEI 12-06 strategies, the licensee stated that these pre-planned mitigation strategies will be incorporated into the unit emergency operating procedures in accordance with established EOP change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59. On page 10 of the Integrated Plan, in the section regarding programmatic controls, the licensee stated unavailability of equipment and applicable connections that directly perform a FLEX mitigation strategy will be managed using plant equipment control guidelines developed in accordance with NEI 12-06 Rev.0 Section 11.5. The licensee further stated that FLEX strategies and their basis will be maintained in an overall program document and that existing plant configuration control procedures will be modified to ensure that changes to the plant design, physical plant layout, roads, buildings, and miscellaneous structures will not adversely impact the approved FLEX strategies in accordance with NEI 12-06, Section 11.8.

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

3.3.3 Training.

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

1. Programs and controls should be established to assure personnel proficiency in the mitigation of beyond-design-basis events is developed and maintained. These programs and controls should be implemented in accordance with an accepted training process.
2. Periodic training should be provided to site emergency response leaders on beyond-design-basis emergency response strategies and implementing guidelines. Operator training for beyond-design-basis event accident mitigation should not be given undue weight in comparison with other training requirements. The testing/evaluation of Operator knowledge and skills in this area should be similarly weighted.
3. Personnel assigned to direct the execution of mitigation strategies for beyond-design-basis events will receive necessary training to ensure familiarity with the associated tasks, considering available job aids, instructions, and mitigating strategy time constraints.

4. “ANSI/ANS 3.5, Nuclear Power Plant Simulators for use in Operator Training” certification of simulator fidelity (if used) is considered to be sufficient for the initial stages of the beyond-design-basis external event scenario until the current capability of the simulator model is exceeded. Full scope simulator models will not be upgraded to accommodate FLEX training or drills.
5. Where appropriate, the integrated FLEX drills should be organized on a team or crew basis and conducted periodically; with all time-sensitive actions to be evaluated over a period of not more than eight years. It is not the intent to connect to or operate permanently installed equipment during these drills and demonstrations.

On page 10 of the Integrated Plan, in the discussion regarding training, the licensee stated that training plans would be developed for plant groups such as the emergency response organization, fire, security, emergency planning, operations, engineering, maintenance, and instrumentation and controls. The license further stated that the training plan development will be done in accordance with Wolf Creek procedures using the Systematic Approach to Training, and will be implemented to ensure that the required Wolf Creek staff is trained prior to implementation of FLEX.

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

3.4 OFFSITE RESOURCES

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

1) A capability to obtain equipment and commodities to sustain and backup the site’s coping strategies.
2) Off-site equipment procurement, maintenance, testing, calibration, storage, and control.
3) A provision to inspect and audit the contractual agreements to reasonably assure the capabilities to deploy the FLEX strategies including unannounced random inspections by the Nuclear Regulatory Commission.
4) Provisions to ensure that no single external event will preclude the capability to supply the needed resources to the plant site.
5) Provisions to ensure that the off-site capability can be maintained for the life of the plant.
6) Provisions to revise the required supplied equipment due to changes in the FLEX strategies or plant equipment or equipment obsolescence.
7) The appropriate standard mechanical and electrical connections need to be specified.
8) Provisions to ensure that the periodic maintenance, periodic maintenance schedule, testing, and calibration of off-site equipment are comparable/consistent with that of similar on-site FLEX equipment.

9) Provisions to ensure that equipment determined to be unavailable/non-operational during maintenance or testing is either restored to operational status or replaced with appropriate alternative equipment within 90 days.
10) Provision to ensure that reasonable supplies of spare parts for the off-site equipment are readily available if needed. The intent of this provision is to reduce the likelihood of extended equipment maintenance (requiring in excess of 90 days for returning the equipment to operational status).

On pages 10 of the Integrated Plan in the section discussing the RRC, the licensee stated that the industry will establish 2 RRCs to support utilities during a BDBEE scenario as outlined in NEI 12-06. Each RRC will hold 5 sets of equipment, 4 of which will be able to be fully deployed when requested, while the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment moved to the site as needed.

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

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

4.0 SUMMARY OF CONFIRMATORY AND OPEN ITEMS

4.1 OPEN ITEMS

Item Number	Description	Notes
3.1.1.2.A	Although the Integrated Plan provided a discussion regarding liquefaction considerations for structures and pipelines at the Wolf Creeks site, no discussion was provided regarding potential soil liquefaction that could impede movement of FLEX equipment following a severe seismic event. The licensee will need to address this impact, and to take precautions if necessary to conform to the NEI 12-06 guidance of consideration 1 above.	
3.1.1.2.B	The Integrated Plan did not discuss the need for, or if necessary, provisions for, power that might be required to deploy equipment, such as power to open roll up doors at a storage location.	

3.2.1.8.A	The PWROG submitted a position paper, dated August 15, 2013 (withheld from public disclosure due to proprietary content), which provides test data regarding boric acid mixing under single-phase natural circulation conditions and outlined applicability conditions intended to ensure that boric acid addition and mixing would occur under conditions similar to those for which boric acid mixing data is available. During the audit process, the licensee stated that the Wolf Creek long-term subcriticality calculations meet the limitations currently documented in PWROG position. The NRC staff has concluded that the August 15, 2013, position paper was not adequately justified and has not endorsed this position paper. As such, resolution of this concern for Wolf Creek is identified as an Open Item.	
3.2.4.8.B	There was no discussion provided in the Integrated Plan regarding instrumentation that will be used to monitor portable/FLEX electrical power equipment including their associated measurement tolerances/accuracy to ensure that: 1) the electrical equipment remains protected (from an electrical power standpoint – e.g., power fluctuations) and 2) the operator is provided with accurate information to maintain core cooling, containment, and spent fuel cooling strategies.	
3.4.A	The licensee's use of off-site resources conforms to the guidance found in NEI 12-06, Section 12.2, with regard to the capability to obtain equipment and commodities to sustain and backup the site's coping strategies (consideration 1). However, insufficient information has been included to provide reasonable assurance that guidance will be established to conform to the remaining items of NEI 12-06, Section 12.2 (considerations 2 through 10	

4.2 CONFIRMATORY ITEMS

Item Number	Description	Notes
3.1.2.1.A	It is not clear from the information presented whether or not the licensee will be developing plans to account for the protection of all FLEX equipment from the potential impact of on site dam failures. The licensee will need to address this potential impact, and to take precautions if necessary to conform to the NEI 12-06, Section 6.2.3.1 guidance of consideration 1 and 2 for protection of equipment.	

3.1.2.2.A	It is not clear from the information presented whether or not the licensee will be developing plans to address deployment of FLEX equipment in view of the potential impact of on site dam failures. The licensee will need to address this potential impact, and to take precautions or provide alternate transport plans if necessary to conform to the NEI 12-06, Section 6.2.3.2 guidance above.	
3.2.1.1.A	During the NRC audit process the licensee was requested to specify which analysis performed in WCAP-17601-P is being applied to Wolf Creek. The response provided by the licensee did not clearly identify the analysis used. Additionally, the licensee was requested to justify the use of that analysis by identifying and evaluating the important parameters and assumptions demonstrating that they are representative of Wolf Creek and appropriate for simulating the ELAP transient. Additional information will need to be provided by the licensee to address the items above.	
3.2.1.1.B	Reliance on the NOTRUMP code for the ELAP analysis of Westinghouse plants is limited to the flow conditions before reflux condensation initiates. This includes specifying an acceptable definition for reflux condensation cooling.	
3.2.1.2.A	In some plant designs, such as those with 1200 to 1300 psia SG design pressures and no accumulator backing of the main steam system power-operated relief valve (PORV) actuators, the cold legs could experience temperatures as high as 580 ^{o}F before cooldown commences. This is beyond the qualification temperature (550 ^{o}F) of the O-rings used in the RCP seals. For those Westinghouse designs, a discussion of the information (including the applicable analysis and relevant seal leakage testing data) should be provided to justify that (1) the integrity of the associated O-rings will be maintained at the temperature conditions experienced during the ELAP event, and (2) the seal leakage rate of 21 gpm/seal used in the ELAP is adequate and acceptable. Further review of the Wolf Creek analysis is necessary verify items (1) and (2) above.	
3.2.1.2.B	Some Westinghouse plants have installed or will install the SHIELD shutdown seals, or other types of low leakage seals, and have credited or will credit a low seal leakage rate (e.g., 1 gpm/seal) in the ELAP analyses for the RCS response. For those plants, NRC review is necessary of the information provided to address the impacts of the Westinghouse 10 CFR Part 21 report, “Notification of the Potential Existence of Defects Pursuant to 10 CFR Part 21,” dated July 26, 2013 (ADAMS No. ML13211A168) on the use of the low seal leakage rate in the ELAP analysis.	

3.2.1.2.C	If the seals are changed to the newly designed SHIELD seals, or non-Westinghouse seals, the acceptability of the use of the newly designed Generation 3 SHIELD seals, or non-Westinghouse seals should be addressed, and the RCP seal leakages rates for use in the ELAP analysis should be provided with acceptable justification	
3.2.1.5.A	The reviewer noted that there is a licensee identified open item on page 64 of the Integrated Plan related to those instrument lists stating that for non-Class 1E instrumentation that will be repowered using a temporary battery, an analysis will need to be performed to determine battery life and frequency of replacing battery	
3.2.1.5.B	There was no discussion in the Integrated Plan to address instrument accuracies for temporary instrumentation that may be required during the implementation of FLEX strategies. Because instrumentation accuracies may be critical in these applications, the licensee will need to address this issue.	
3.2.1.6.A	In Attachment 1 to the PWROG's interim core cooling position paper, a methodology accounting for containment heatup, instrument uncertainties, and other factors, was specified to ensure the selection of a final steam generator pressure that would prevent nitrogen injection. It was not made clear during the audit whether the licensee plans to follow this approach or is planning to use an alternate approach. Therefore, the licensee needs to confirm that it will (1) use the methodology in Attachment 1 to the PWROG's interim core cooling position paper or (2) specify an alternate method for preventing nitrogen injection and demonstrate its acceptability.	
3.2.3.A	During the audit process, the licensee stated that the GOTHIC analysis shows that the containment structure meets its design criteria for peak pressure after and ELAP duration of 7 days. Additionally, the instrumentation inside containment critical to coping with and ELAP event has been shown to remain below the temperature acceptance criteria of 306.1°F. The licensee further stated that this calculation is in final review and will be made available for NRC staff review when complete. Further review of the analysis results is required to verify that the containment temperature and pressure remain at or below acceptable limits.	
3.2.4.2.A	On page 50 of the Integrated Plan regarding safety functions support, the licensee stated that strategies are being developed for temporary ventilation of vital areas and that the strategies will include propping open doors and possibly using small generators to power up fans. Further review of these strategies is required to verify equipment cooling is maintained.	

3.2.4.3.A	The licensee stated that for long-term maintenance of RCS inventory after depletion of the BATs or for the case of an ELAP event initiated during shutdown conditions, the RWST will be used. The licensee stated that additional strategies will be developed to ensure the RWST or another borated water source is available indefinitely. Further review of these additional strategies is required to verify borated water sources are available.	
3.2.4.3.B	The licensee stated that strategies will be developed to prevent freezing of instrumentation and associated lines credited for use during the event. Further review of the strategies developed to mitigate freezing of water in instrument and small piping is required.	
3.2.4.4.A	The NRC staff has reviewed the licensee communications assessment (ML12313A009 and ML13072A090) in response to the March 12, 2012 50.54(f) request for information letter for Wolf Creek and, as documented in the staff analysis (ML13149A171) has determined that the assessment for communications is reasonable, and the analyzed existing systems, proposed enhancements, and interim measures will help to ensure that communications are maintained. Verification that any required communication enhancements are implemented is required.	
3.2.4.6.A	Evaluations are not completed to determine if compensatory actions would be required regarding habitability to permit personnel to access and work in areas such as the control room, the TDAFW pump room, and other areas that may be subject to adverse conditions. Further review is required to verify habitability is addressed for areas critical for the FLEX strategies.	
3.2.4.7.A	The licensee has listed two self identified open items to resolve the protection issues for the CST and RWST, including their associated valve houses, OI#3 and OI#4, respectively. The reviewer noted that the licensee's 6-month update stated that the results of an updated Ground Motion Response Spectrum (GMRS) are required for final decisions regarding modifications for both the CST and the RWST. The CST is being evaluated for seismic and high wind hazards and the RWST is being evaluated for high wind hazards. Completion of the evaluations and any required actions needs to be confirmed.	

3.2.4.8.A	The licensee provided additional information during the audit process and stated that new breakers, NG00112 and NG00212, and disconnect switches NK410, NK412, NK413, and NK414, will serve as Class 1E isolation devices. These breakers and disconnect switches will be locked open, separating 480V safety-related busses from the non-safety FLEX generator connection infrastructure. The licensee further stated that no permanent FLEX connections will be made to 4160V busses. Short circuit analyses are scheduled to be complete by the end of 2013 to confirm that safety related electrical equipment to be connected to FLEX generators has a greater short circuit rating than the short circuit capability of the FLEX generators.	
3.2.4.8.C	During the audit process the licensee stated that when the generators are procured, the vendor will provide a sizing evaluation demonstrating that the generator size is adequate. However, it is still not clear what process or analysis the licensee has used to develop the procurement specification for FLEX generator sizing	
3.3.1.A	The reviewer was unable to confirm from the information presented that the licensee had either (1) committed to abide by the NEI generic approach for maintenance of FLEX equipment or (2) identified an acceptable alternate approach for their equipment maintenance in support of its mitigating strategy. This issue is yet to be resolved.	