# Ameren Missouri's Sixth Six-Month Status Report for the Implementation of Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events"

## 1 Introduction

Ameren Missouri developed an Overall Integrated Plan (OIP) (Reference 1) for the Callaway Energy Center (CEC), documenting the diverse and flexible strategies (FLEX) for beyond-design-basis external events, in response to NRC Order Number EA-12-049 (Reference 2). This enclosure provides an update of milestone accomplishments since submittal of the last status report (Reference 18), including any changes to the compliance method, schedule, or need for relief/relaxation and the basis, if any. Refer to Section 8 of this enclosure for a list of References.

## 2 Milestone Accomplishments

The following milestones have been completed since the development of the OIP, and have been statused as complete as of January 31, 2016.

- Submittal of the sixth six-month status report (this submittal)
- Perform Staffing Analysis
- Develop Strategies with National SAFER Response Center (NSRC)

## 3 Milestone Schedule Status

The following table provides an update to Attachment 2 of the OIP. The table provides the activity status of each item and indicates whether the expected completion date has changed. The dates are planning dates subject to change as design and implementation details are developed. The milestone target completion dates have been revised based on approval of the relaxation request discussed in Section 5. Italicized text denotes that a Milestone was updated since the last six-month status update (Reference 18).

| Callaway Milestone Schedule | | | |
|---|---|---|---|
| **Activity** | **Original Target Date** | **Activity Status** | **Revised Target Completion Date** |
| **Submit Overall Integrated Implementation Plan** | February-2013 | Complete | |
| **6 Month Status Updates** | | | |
| Update 1 | August-2013 | Complete | |
| Update 2 | February-2014 | Complete | |
| Update 3 | August-2014 | Complete | |
| Update 4 | February-2015 | Complete | |
| Update 5 | August-2015 | Complete | |
| Update 6 | February-2016 | *Complete* | |
| **FLEX Strategy Evaluation** | April-2013 | Complete | |
| **Perform Staffing Analysis** | December-2013 | *Complete* | |
| **Modifications** | | | |
| Modifications Evaluation | April-2013 | Complete | |
| Engineering and Implementation | November-2014 | Started | May-2016 |
| N-1 Walkdown | April-2013 | Complete | |
| Design Engineering | March-2014 | Started | *March-2016* |
| Unit 1 Implementation Outage | November-2014 | Not Started | May-2016 |
| **On-site FLEX Equipment** | | | |
| Purchase | June-2013 | Started | *March-2016* |
| Procure | December-2013 | Started | April-2016 |
| **Off-site FLEX Equipment** | | | |
| *Develop Strategies with National SAFER Response Center (NSRC)* | *November-2013* | *Complete* | |
| Install Off-site Delivery Station (if necessary) | September-2014 | Complete | |
| **Procedures** | | | |
| PWROG issues NSSS-specific guidelines | June-2013 | Complete | |
| Create Callaway FSG (Note 1) | April-2014 | Started | May-2016 |
| Create Maintenance Procedures | June-2014 | *Started* | May-2016 |
| **Training** | | | |
| Develop Training Plan | April-2014 | Complete | |
| Implement Training | May-2014 | Started | May-2016 |
| **Submit Completion Report** | November-2014 | Not Started | July-2016 |

Note 1: The Callaway Energy Center FLEX Support Guidelines (FSG) have been created. The FSG's are awaiting final approval just prior to FLEX implementation.

# 4 Changes to Compliance Method

The following changes have been made to Ameren Missouri's Overall Integrated Plan (OIP) (Reference 1) since submittal of the fifth six-month status report (Reference 18).

## 4.1 Sequence of Events Timeline

The Sequence of Events Timeline has been updated to include changes made to the Overall Integrated Plan since its submittal. The revised Sequence of Events Timeline has been included as Enclosure 2 to this submittal. Significant changes to the Timeline are primarily associated with the addition of the new Hardened Condensate Storage Tank as part of FLEX strategies.

## 4.2 Alternate Approach – Instrument Readings at Containment Penetrations

Ameren Missouri will implement an alternate approach from NEI 12-06, Diverse "And Flexible Coping Strategies (FLEX) Implementation Guide," (Reference 3), Section 5.3.3 for obtaining instrument readings at the containment penetration. The alternate method will be to obtain instrument readings for containment parameters at the closest accessible termination point to the containment penetration or parameter of measurement, as practical. Guidance will be provided on how and where to measure these key instrument readings using a portable instrument (e.g., a Fluke meter) at a location that does not rely on the functioning of intervening electrical equipment (e.g., I/E convertors, analog to digital converters, relays, etc.) that could be adversely affected by BDB (Beyond-Design-Basis) seismic events.

## 4.3 Alternate Approach – Spares for Hoses and Cables

Ameren Missouri will implement the NRC endorsed (ML15125A442, Reference 19) alternate approach from NEI 12-06, "Diverse And Flexible Coping Strategies (FLEX) Implementation Guide," (Reference 3), Section 3.2.2, for spare FLEX hoses and cables per the following:

Method 1: Provide additional hose or cable equivalent to 10% of the total length of each type/size of hose or cable necessary for the "N" capability. For each type/size of hose or cable needed for the "N" capability, at least 1 spare of the longest single section/length must be provided.

Method 2: Provide spare cabling and hose of sufficient length and sizing to replace the single longest run needed to support any single FLEX strategy. If this method is implemented, then Ameren Missouri will ensure that the FLEX pumps and portable generators are confirmed to have sufficient capability to meet flow and electrical requirements when a longer spare hose/cable is substituted for a shorter length.

### 4.4 Alternate Approach – Spent Fuel Pool Make-up and Spray

Ameren Missouri will implement an alternate approach from NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," (Reference 3), Table 3-2, "PWR FLEX Baseline Capability Summary," for Spent Fuel Cooling. Ameren Missouri has installed seismically robust piping to provide make-up and spray to the Spent Fuel Pool (SFP). Ameren Missouri has installed a permanently mounted, seismically robust spray header to provide spray for the SFP. The spent fuel cooling strategy utilizes a portable pump to discharge through hoses that connect to this added installed piping to provide the required makeup and spray flow. These alternate methods meet the requirements for performance attributes of NEI 12-06, Table D-3, "Summary of Performance Attributes for PWR SFP Cooling Functions." Ameren Missouri considers the seismically robust piping to provide make-up and spray to the Spent Fuel Pool (SFP) an upgrade over the minimal requirements of NEI 12-06, Table 3-2, which only require "Make-up via hoses direct to the pool" and "Spray via portable nozzles."

### 4.5 Modes 1 – 4 Core Cooling Connection Point

Ameren Missouri has revised the core cooling connection point for Modes 1 – 4. The original plan was to install the secondary connection for the core cooling pump discharge into the discharge piping of the 'A' Motor Driven Auxiliary Feedwater Pump (MDAFP) downstream of ALFV0042 in Room 1326. The secondary connection now ties into the discharge piping of the 'B' MDAFP just downstream of valve ALV0031 past the tee in room 1325 of the Auxiliary Building.

## 5 Need for Relief/Relaxation and Basis for the Relief/Relaxation

In Reference 5, Ameren Missouri formally requested relief from the requirement of Section IV.A.2 of the Order (EA-12-049) regarding full implementation no later than two (2) refueling cycles after submittal of the Overall Integrated Plan. NRC approval of the requested relief was received in Reference 6, relaxing full Order implementation for Callaway Energy Center until the completion of the spring 2016 refueling outage. The milestone schedule in Section 3 has been updated for consistency with the approved schedule relief. No additional relief is requested herein.

# 6 Open Items from Overall Integrated Plan and Interim Safety Evaluation

The following tables provide a summary of the open items documented in the OIP or the Interim Safety Evaluation (ISE) and the status of each item. Statuses that are bolded and italicized indicate changes in the status from the previous submittal.

| Overall Integrated Plan Open Item | Status |
|---|---|
| OI1 The RWST will need to be missile protected to credit its use in FLEX strategies. | Closed<br>The Refueling Water Storage Tank (RWST) will not be used as a credited source of borated water in our mitigating strategies; therefore, the RWST does not require missile protection to support FLEX mitigation strategies.<br>For MODES 1-4, missile protection of the RWST is not a concern from a FLEX strategy standpoint since the RWST is not required as a Reactor Coolant System (RCS) make-up & boration source. The Boric Acid Tanks (BATs) provide sufficient make-up volume to maintain sub-cooling (natural circulation removing decay heat removal via the Steam Generators) and sub-criticality of the reactor core. Low leakage Reactor Coolant Pump (RCP) seals will limit RCS leakage to less than or equal to 1 gpm/RCP (4 gpm/total). Assuming a maximum unidentified RCS leakage of 1 gpm, the total RCS leakage is 5 gpm.<br>Ameren Missouri has revised its Mode 5 – 6 Shutdown Extended Loss of AC Power (ELAP) Strategy due to concerns that the RWST is not missile protected or does not meet Expedited Seismic Evaluation Process (ESEP) requirements. The revised strategy will utilize the new 500,000-gallon Hardened Condensate Storage Tank (HCST) as a water source and the Boric Acid Batching Tank (BABT) as the boron source for make-up to the BATs. |

| Overall Integrated Plan Open Item | | Status |
|---|---|---|
| OI2 | GOTHIC analysis needs to be performed to demonstrate that Containment pressure and temperature remain at acceptable levels and that instrumentation EQ requirements will be maintained. | ***Closed.***<br>***<u>Modes 1-4:</u>***<br>***The Gothic Analysis of containment demonstrates that the containment design pressure and temperature limits are not exceeded during an ELAP. All instrumentation (except Nuclear Instrumentation (NI)) remains functional in an ELAP in Modes 1 – 4. Ameren Missouri has developed contingency actions in FSGs for the loss of the NIs.***<br>***<u>Modes 5-6:</u>***<br>***The Gothic analysis determined that the containment remains below design pressure for an event in Modes 5, provided the containment is vented early in the event. Ameren Missouri has included this containment venting in FSG-12, "Alternate Containment Cooling." All instrumentation remains functional.*** |
| OI3 | An analysis will need to be performed to demonstrate acceptable SFP cooling pump performance with the SFP in boil-off. | Closed.<br>The Spent Fuel Pool Cooling Pumps will not be repowered. SFP cooling will be maintained by continued makeup and boil-off using the Phase 2 portable equipment. |
| OI4 | 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 | Closed.<br>Ameren Missouri has determined that the non-Class 1E instrument racks will not be re-powered via a temporary battery. The required instrument readings will be obtained via portable instruments. |
| OI5 | The current CST and CST pipe chase are non-seismic. Callaway may pursue the construction of a new seismically qualified and missile protected CST. Current FLEX strategies rely on the existing CST tank. Future evaluation is required to determine the impact on FLEX strategies should the new CST be constructed. | ***Closed.***<br>Ameren Missouri is constructing a new Hardened Condensate Storage Tank (HCST) that is seismically qualified and missile protected. Relaxation of Order requirements regarding the date of full implementation was requested (Reference 5) and has been approved (Reference 6). FLEX Support Guidelines (FSGs) have been developed for use of the new HCST. |

| Overall Integrated Plan Open Item | Status |
|---|---|
| OI6 The method for isolating accumulators during RCS inventory control has not been finalized | Closed.<br>The method for isolating accumulators during RCS inventory control has been finalized. Step 1 of FSG-10, "Passive RCS Injection Isolation (Rev. 0)," determines if isolation of Safety Injection (SI) Accumulators is desired. If the Steam Generators will be depressurized below 220 psig, then the SI accumulators are isolated by closure of their discharge isolation valves (if power is available from FLEX 480 VAC Generator) or vented to the containment atmosphere. Ameren Missouri calculation, BB-180 Rev. 0 Add. 5 "Minimum Steamline Pressure to Prevent Accumulator Nitrogen Injection," establishes the site specific value for the Westinghouse Owners Group Emergency Response Guidelines Setpoint O.07 that is used in the Emergency Operating Procedures (i.e., ECA-0.0, "Loss of All AC Power," Step 17, Rev. 019). The site calculation takes into consideration the potential for nitrogen expansion/SI accumulator pressure increase from heat sources within the containment building (i.e., RCS). |
| OI7 The method for repowering the SFP cooling pumps has not been finalized. | Closed.<br>The SFP Cooling Pumps will not be repowered. SFP cooling will be maintained by continued makeup and boil-off using the Phase 2 portable equipment. |
| OI8 The Westinghouse RCP SHIELD® Seal issue has not been resolved. | Closed.<br>This issue has been resolved. NRC Endorsement of TR-FSE-14-1-P, "Use of Westinghouse SHIELD® Passive Shutdown Seal for FLEX Strategies," is documented in NRC Letter from Mr. Jack Davis, Director, Mitigating Strategies Directorate to Mr. James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, dated May 28, 2014 (ML14132A128). (Reference 15) |

| Interim Safety Evaluation Open Item | Status |
|---|---|
| 3.2.1.2.B – RCP Seal O-Ring Integrity and Leakage Rate<br>Additional review of the licensee's applicable analysis and relevant Reactor Coolant Pump (RCP) seal leakage testing data is needed to justify that (1) the integrity of the associated 0-rings will be maintained at the temperature conditions experienced during the ELAP event, and (2) the seal leakage rate used in the ELAP is adequate and acceptable. | Closed<br>***Ameren Missouri will have installed Westinghouse Generation III SHIELD® Seals on each RCP which contain either compound C or D O-rings. CN-SEE-I-12-32, "Callaway Reactor Coolant System Inventory, Shutdown Margin, and Mode 5/6 Boric Acid Precipitation Control Analysis to Support the Diverse and Flexible Coping Strategy (FLEX)," Revision 1-A dated January 21 2016 utilizes a constant RCP seal leakage rate of 1.25 gpm/RCP. This accounts for the SHIELD® design leak rate of 1.0 gpm/RCP and RCS total unidentified leak rate of 1.0 gpm (additional 0.25 gpm/RCP seal).***<br>NRC Endorsement of TR-FSE-14-1-P, "Use of Westinghouse SHIELD® Passive Shutdown Seal for FLEX Strategies," is documented in NRC Letter from Mr. Jack Davis, Director, Mitigating Strategies Directorate to Mr. James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, dated May 28, 2014 (ML14132A128). |
| 3.2.1.2.D – RCP Seal Leakage Rate<br>The acceptability of the use of the selected seals and the RCP seal leakages rates in the ELAP analysis must be justified. | Closed<br>This issue has been resolved. NRC Endorsement of TR-FSE-14-1-P, "Use of Westinghouse SHIELD® Passive Shutdown Seal for FLEX Strategies," is documented in NRC Letter from Mr. Jack Davis, Director, Mitigating Strategies Directorate to Mr. James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, dated May 28, 2014 (ML14132A128).<br>***The following justification for the acceptability of these seals and the seal leakage rate is provided below.***<br>• ***Ameren Missouri will have installed Westinghouse Generation III SHIELD® Seals on each RCP. CN-SEE-I-12-32, "Callaway Reactor Coolant System Inventory, Shutdown Margin, and Mode 5/6 Boric Acid Precipitation Control Analysis to Support the Diverse and Flexible Coping Strategy (FLEX)," Revision 1-*** |

| Interim Safety Evaluation Open Item | Status |
|---|---|
| | ***A dated January 21 2016 utilizes a constant RCP seal leakage rate of 1.25 gpm/RCP. This accounts for the SHIELD design leak rate of 1.0 gpm/RCP and RCS total unidentified leak rate of 1.0 gpm (additional 0.25 gpm/RCP seal).***<br>• ***During an ELAP event the RCPs trip at event initiation which is prior to RCP seal leakoff exceeding 235°F. Other seal leakage rates discussed in IN 2005-14 are not applicable to Ameren Missouri upon installation of Westinghouse Generation III SHIELD RCP seals which are designed for a maximum RCP seal leakage of 1 gpm/RCP.***<br>• ***Ameren Missouri lowest safety valve lift pressure is 1200 psi which establishes an RCS temperature of 567.2°F. Ameren Missouri will have installed Westinghouse Generation III SHIELD on each RCP which has been qualified to an RCS cold leg temperature of 571°F as documented in TR-FSE-14-1-P, "Use of Westinghouse SHIELD® Passive Shutdown Seal for FLEX Strategies."***<br>• ***TR-FSE-14-1-P, "Use of Westinghouse SHIELD® Passive Shutdown Seal for FLEX Strategies," is applicable for RCP models 93, 93A, and 93A-1. Callaway Energy Center has model 93A-1 RCPs and will install Westinghouse Generation III SHIELD® RCP seals which have been qualified to a maximum leakage rate of 1 gpm/RCP as documented in TR-FSE-14-1-P. A constant leakage rate of 1 gpm/RCP is utilized in CN-SEE-I-12-32, "Callaway Reactor Coolant System Inventory, Shutdown Margin, and Mode 5/6 Boric Acid Precipitation Control Analysis to Support the Diverse and Flexible Coping Strategy (FLEX)," Revision 1-A dated January 21 2016.***<br>• ***Callaway Energy Center has model 93A-1 RCPs and will install Westinghouse Generation III SHIELD RCP seals which have been qualified to a maximum leakage rate of 1 gpm/RCP as documented in TR-FSE-14-1-P. The pump model and seal combination comply*** |

| Interim Safety Evaluation Open Item | Status |
|---|---|
| | *with the seal leakage model described in WCAP-17601 Section 5.7.1, RCS Response with Little or No RCS Leakage – Safe Shutdown Seals /Low Leakage Seals /Alternate Seal Cooling Systems – Westinghouse Generic Case Results*<br>• ***Per the DRAFT FLEX Final Implementation Plan, DRAFT ECA-0.0, "Loss of All AC Power," and DRAFT FSG-4, "ELAP DC Bus Load Shed Management," there is no impact to the Callaway Energy Center ELAP coping strategy due to load shed activities (including isolation of RCS leakage paths).*** |
| 3.2.1.3.A – Specify Key Parameters<br>During the NRC audit process the licensee was requested to provide the following information: If the ANS 5.1-1979 + 2 sigma model is used in the ELAP analysis, specify the values of the following key parameters used to determine the decay heat: (1) initial power level, (2) fuel enrichment, (3) fuel burnup, (4) effective full power operating days per fuel cycle, (5) number of fuel cycles, if hybrid fuels are used in the core, and (6) fuel characteristics based on the beginning of the cycle, middle of the cycle, or end of the cycle. Address the adequacy of the values used. If the different decay heat model is used, describe the specific model and address the acceptability of the model and the analytical results. | ***Closed***<br>***The following assumptions were applied to arrive at the overall normalized decay heat power:***<br>• ***Two standard deviations of uncertainty (+2σ).***<br>• ***Fission product decay heat from three fissile isotopes:***<br>• ***U-235, Pu-239, and U-238. The total recoverable energy associated with one fission for each isotope is assumed to be 201.8 MeV, 210.3 MeV, and 205.0 MeV, respectively.***<br>• ***The power fractions are typical values expected for each of the three fissile isotopes through a three region burn-up for which the feed fuel U-235 enrichment is ~ 5%. This is typical of fuel cycle feeds.***<br>• ***Actinide contributions to the decay heat are from U-239 and Np-239.***<br>• ***A conversion ratio of 0.65 was used to derive the production of the two actinides: U-239 and Np-239.***<br>• ***Fission product neutron capture is treated per the ANS standard.***<br>• ***Finite burnup that utilizes a power history of three 540-day cycles separated by two 20-day outages, which bounds Initial Condition 3.2.1.2 (1) (Reference 3), Section 3.2.1.2. (Minimum assumption of Reference 3 is that the reactor has been operated at 100% power for at least 100 days prior to event initiation.)*** |
| 3.2.1.8.B Boric Acid Mixing<br>The Pressurized-Water Reactor Owners | ***Closed***<br>The NRC has subsequently endorsed the position |

| Interim Safety Evaluation Open Item | Status |
|---|---|
| Group submitted to the NRC a position paper, dated August 15, 2013, 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.<br><br>During the audit process, the licensee informed the NRC staff of its intent to abide by the generic approach discussed above; however, the NRC staff concluded that the August 15, 2013, position paper was not adequately justified and that further information is required. | paper with some clarifications (Reference 10).<br><br>***(a) Discuss whether the uniform boron mixing model was used in the ELAP analysis. If the perfect boron mixing model was used, address the compliance with the recommendations discussed in a PWROG whitepaper related to the boron mixing model. If a different model was used, address the adequacy of the use of the boron mixing model in the ELAP analysis with support of an analysis and/or boron mixing test data applicable to the ELAP conditions, where the RCS flow rate is low and the RCS may involve two-phase flow. If boron mixing test data exists that is applicable to the boron mixing model and the ELAP event, provide a discussion of how the model matches the data.***<br><br>***RESPONSE: The NOTRUMP computer code was used to simulate the RCS responses for generic Westinghouse pressurized water reactors (PWRs) during an ELAP. These responses, documented in WCAP-17601-P, Revision 1, "Reactor Coolant System Response to the Extended Loss of AC Power Event for Westinghouse, Combustion Engineering, and Babcock & Wilcox NSSS Designs," and WCAP-17792-P, Revision 0, "Emergency Procedure Development Strategies for the Extended Loss of AC Power Event for all Domestic Pressurized Water Reactor Designs," demonstrate that mitigation strategies such as the one described in the Ameren Missouri Overall Implementation Plan and plant specific calculation CN-SEE-I-12-32, "Callaway Reactor Coolant System Inventory, Shutdown Margin, and Mode 5/6 Boric Acid Precipitation Control Analysis to Support the Diverse and Flexible Coping Strategy (FLEX)," Revision 1-A are adequate for coping with an ELAP event.***<br><br>***The primary-system transient profile assumed for the plant-specific Mode 1-4 RCS inventory control and long-term subcriticality*** |

| Interim Safety Evaluation Open Item | Status |
|---|---|
| | ***calculation performed for Callaway Energy Center is based on the Westinghouse reference coping cases described in Section 5.7.1 and Section 5.2.1 of WCAP-17601-P, Revision 1, and plant-specific parameters such as RCS nominal temperature(s), pressure(s), and volumes, and accumulator cover gas pressures. This application of plant-specific parameters with the WCAP-17601-P Revision 1 reference coping cases is consistent with the methods and guidance, as well as the restrictions and limitations, specified in PWROG-14064-P, Revision 0, "Application of NOTRUMP Code Results for Westinghouse Designed PWRs in Extended Loss of AC Power Circumstances." Note that Ameren Missouri will implement Westinghouse Generation III SHIELD (safe shutdown/low leakage) reactor coolant pump (RCP) seals, and that the use of low-leakage RCP seals significantly extends the time line relating to reflux condensation initiation. (See, for example, Section 5.7.1 of WCAP-17601-P Revision 1.)***<br><br>***The Mode 1-4 RCS inventory control calculation performed for Callaway Energy Center determined the makeup rate, and time by which makeup is required, necessary to maintain adequate core cooling for the duration of the ELAP event. These calculations account for primary-system specific volume changes resulting from RCS temperature and pressure changes, losses due to RCP seal package leakage, and losses due to primary-system operational leakage. In particular, the RCS inventory control calculations performed for Callaway Energy Center assume the RCS is cooled to approximately 415°F within 12 hours of the loss of all AC power (DRAFT Callaway FLEX Implementation Plan documents that an RCS cooldown/depressurization to a target SG pressure of 290 psig will be initiated no later than 8 hours following the loss of all AC power), a constant Westinghouse safe*** |

| Interim Safety Evaluation Open Item | Status |
| --- | --- |
| | ***shutdown/low-leakage RCP seal package leak rate of 1 gpm per RCP, a constant primary-system Technical Specifications (TS) leak rate of 1 gpm, and that no makeup other than passive accumulator injection is provided during the initial phase of the ELAP. Based on these assumptions, the calculation shows that the RCS liquid inventory would be reduced to the minimum single-phase natural circulation level at approximately 45.1 hours following ELAP initiation, and would be reduced to the minimum two-phase natural circulation level at approximately 66.9 hours following ELAP initiation.***<br><br>***The pumped RCS makeup strategy for Callaway Energy Center (per CN-SEE-I-12-32 Revision 1-A) includes providing RCS injection in excess of the maximum primary-system leak rate of 5 gpm (1 gpm per RCP plus 1 gpm TS unidentified leakage) starting at approximately 12 hours, and no later than 17 hours, following the loss of all AC power. Since this is well before the time when the RCS liquid inventory would be reduced to the minimum single or two-phase natural circulation level, the Callaway Energy Center RCS makeup strategy is sufficient to preclude reflex condensation cooling from occurring during an ELAP.***<br><br>***The plant-specific Mode 1-4 RCS long-term subcriticality calculation performed for Callaway Energy Center is based on the uniform boron mixing model detailed in LTR-FSE-13-46-P, "Westinghouse Response to NRC Generic Request for Additional Information (RAI) on Boron Mixing in Support of the Pressurized Water Reactor Owners Group (PWROG)," which provides justification for, and limitations associated with, using the uniform boron mixing model in ELAP long-term subcriticality calculations. The Callaway Energy Center long-term subcriticality calculation (CN-SEE-I-12-32 Revision 1-A) meets the uniform boron mixing model limitations documented in LTR-FSE-*** |

| Interim Safety Evaluation Open Item | Status |
| --- | --- |
| | ***13-46-P.***<br><br>***(b) Discuss how the boron concentration in the borated water added to the RCS is considered in the cooldown phase of the ELAP analysis, considering that it needs time for the added borated water to mix with water in the RCS.***<br><br>***RESPONSE:***<br>***The RCS boration timeline to maintain subcritical conditions when performing an RCS cooldown to 350°F within 24 hours of event initiation as detailed in CN-SEE-I-12-32, "Callaway Reactor Coolant System Inventory, Shutdown Margin, and Mode 5/6 Boric Acid Precipitation Control Analysis to Support the Diverse and Flexible Coping Strategy (FLEX)," Revision 1-A includes 1 hour of mixing following addition of the borated volume for complete mixing.***<br><br>***(c) Discuss the plant specific boration analysis and results, and show that the core will remain sub-critical throughout the ELAP event.***<br><br>***RESPONSE:***<br>***CN-SEE-I-12-32, "Callaway Reactor Coolant System Inventory, Shutdown Margin, and Mode 5/6 Boric Acid Precipitation Control Analysis to Support the Diverse and Flexible Coping Strategy (FLEX)," Revision 1-A (as discussed above) details how the plant is maintained subcritical during the ELAP event.***<br><br>***The NRC has endorsed the PWROG Generic Response for Boric Acid Mixing during ELAP events, as documented in ML13276A183, with the following clarifications:***<br>***(1) The required timing for providing borated makeup to the primary system should consider conditions with no reactor coolant system*** |

| Interim Safety Evaluation Open Item | Status |
|---|---|
| | ***leakage and with the highest applicable leakage rate for the reactor coolant pump seals and unidentified reactor coolant system leakage.***<br><br>***RESPONSE:***<br>***CN-SEE-I-12-32, "Callaway Reactor Coolant System Inventory, Shutdown Margin, and Mode 5/6 Boric Acid Precipitation Control Analysis to Support the Diverse and Flexible Coping Strategy (FLEX)," Revision 1-A assumes highest RCS leakage for RCS Inventory control and no RCS leakage for RCS Boration requirements.***<br><br>***(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:***<br><br>***1) 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.***<br><br>***RESPONSE***<br>***The pumped RCS makeup/boration strategy for Callaway Energy Center (per CN-SEE-I-12-32 Revision 1-A) includes providing RCS injection in excess of the maximum primary-system leak rate of 5 gpm (1 gpm per RCP plus 1 gpm TS unidentified leakage) starting at approximately 12 hours, and no later than 17 hours, following the loss of all AC power which is well before the time when the RCS liquid inventory would be reduced to the minimum single-phase natural circulation level (45.1 hours).***<br><br>***2) If loop flow during two-phase natural circulation has decreased below the single-phase natural circulation flow rate, then the*** |

| Interim Safety Evaluation Open Item | Status |
| --- | --- |
| | ***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.***<br><br>***RESPONSE***<br>***Not applicable***<br><br>***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.***<br><br>***RESPONSE***<br>***The RCS boration timeline to maintain subcritical conditions when performing an RCS cooldown to 350°F within 24 hours of event initiation as detailed in CN-SEE-I-12-32, "Callaway Reactor Coolant System Inventory, Shutdown Margin, and Mode 5/6 Boric Acid Precipitation Control Analysis to Support the Diverse and Flexible Coping Strategy (FLEX)," Revision 1-A includes 1 hour of mixing following addition of the borated volume for complete mixing.*** |
| 3.2.4.9.A Fuel Oil Quality<br>Information is needed regarding plans for assuring and maintaining fuel oil quality. | Closed<br>All trailer-mounted diesel-driven equipment housed inside the Hardened Storage Building (HSB) will be individually equipped with a trailer-mounted automatic fuel oil purification system that maintains the quality of the fuel oil inside the trailer's tank. After the ELAP, the only "guaranteed" source of fuel-oil (besides what is stored inside the HSB) will |

| Interim Safety Evaluation Open Item | Status |
|---|---|
| | be the Emergency Diesel Fuel Oil Storage Tanks (TJE01A & B). Existing sampling requirements for TEJ01A/B are delineated in Diesel Fuel Oil Testing Program as required by T/S S/R 3.8.3.3. FSG-44, "FLEX Diesel Fuel Strategy," has been developed to provide direction for supplying diesel fuel for FLEX response equipment during an ELAP event. This FSG provides guidance for obtaining diesel fuel oil from the Emergency Diesel Day Tanks (TJE02 A/B), as well as the Emergency Diesel Fuel Oil Storage Tanks (TJE01A & B). Instructions for obtaining fuel from other non-robust diesel fuel tanks are also included in this FSG in the event the tank survives the event.<br>***Note: "Trailer-mounted diesel-driven equipment includes 480-VAC generators, SFP makeup/spray pumps, AFW/RCS makeup pumps, and diesel refuel trailer. Flex equipment with smaller volume tanks will be periodically conditioned by a portable fuel conditioner; periodicity has not yet been defined but will be determined/performed within CEC's PM program.*** |
| 3.4.A Offsite Resource Capabilities<br>Details are needed to demonstrate the minimum capabilities for offsite resources will be met per NEI 12-06 Section 12.2. | Closed<br>The National Safer Response Centers (NSRCs) in Memphis, TN., and Phoenix, AR., are operational. Ameren Missouri has a contract with NSRC to provide Phase 3 FLEX portable equipment. The NRC Staff Assessment of the NSRCs is documented in NRC Letter from Mr. Jack Davis, Director Mitigating Strategies Directorate to Mr. Joseph E. Pollock, Vice President, Nuclear Operations, Nuclear Energy Institute, dated September 26, 2014 (ML14265A107). The Staff Assessment evaluated all the items listed in NEI 12-06, Section 12.2. (Reference 16). |

| Interim Safety Evaluation Confirmatory Item | Status |
| --- | --- |
| 3.1.1.2.A – CST Seismic Hazard<br><br>Because the current CST is unprotected from seismic hazard, the licensee is planning to install a new CST. Verification of installation is necessary. | ***Closed***<br><br>The new Hardened Condensate Storage Tank (HCST) is scheduled to complete by the end of Refuel 21 (RF21)<br><br>***81402-M-001 Rev. 1, HCST Sizing Justification Calculation, confirms that 30 hours of tank inventory is available to support Auxiliary Feedwater heat removal. The calculations also include SFP cooling flows.***<br><br>***The HCST is designed to provide a robust source of water for core cooling during an ELAP event. The HCST and its connection to the Auxiliary Feedwater System are designed to the standards of Seismic Category I as the system is required to remain structurally intact as well as remain functional during and after a safe shutdown earthquake (SSE). However, the system will not be formally categorized as Seismic Category I. All Seismic Category I structures required for safe shutdown are to be designed to withstand effects of a tornado and the most severe wind phenomena encountered at any of the Standardized Nuclear Power Plant System (SNUPPS) sites. Although the new system is not safety-related, it will be subject to the same rigorous design criteria as Seismic Category I structures including tornado-induced wind pressures, internal differential pressures, externally generated missiles and those loads as required by NEI 12-06.***<br><br>***The Project Design Manual, BMN-DOC-006-F01 Rev. 2, has been owner accepted as part of Modification Package 13-0033, and provides the design basis for the project including applicable codes, standards and requirements for the HCST project.*** |
| 3.1.1.2.B – Electrical Power for FLEX Equipment Deployment<br><br>Information is needed regarding whether or not electrical power will be required to move or deploy FLEX equipment from storage. | Closed<br><br>Electrical Power will not be required to move or deploy FLEX equipment from storage.<br><br>***Ingress/egress of the storage building does not require electrical power, nor are there any gates or barriers within the deployment routes requiring*** |

| Interim Safety Evaluation Confirmatory Item | Status |
|---|---|
| | ***electrical power. Therefore, no electrical power is required to deploy Phase 2 equipment from the storage building.*** |
| 3.1.2.A – RWST and UHS Flood Levels<br><br>Licensee stated that UHS and refueling water storage tank (RWST) are below flood levels but the licensee needs to address potential consequences such as debris in the UHS or access to RWST. In addition, the staff noted that the deployment of FLEX equipment and associated procedural interfaces may be impacted by the UHS and RWST being below the design-basis flood level. | ***Closed***<br><br>The RWST is not credited as a water source for any FLEX mitigating strategy. Therefore, the RWST being below the design-basis flood level will have no impact on FLEX equipment deployment and associated procedural interfaces.<br><br>For MODES 1-4, the RWST being located below the maximum plant site flood level of Elevation 840.16 ft. mean sea level (MSL) is not a concern from a FLEX strategy standpoint since the RWST is not required as a Reactor Coolant System (RCS) make-up and boration source. The Boric Acid Tanks (BATs) provide sufficient make-up volume to maintain sub-cooling (natural circulation removing decay heat removal via the Steam Generators) and sub-criticality of the reactor core. Low leakage Reactor Coolant Pump (RCP) seals will limit RCS leakage to less than or equal to 1 gpm/RCP (4 gpm/total). Assuming a maximum unidentified RCS leakage of 1 gpm, the total RCS leakage is 5 gpm.<br><br>Ameren Missouri has revised its Mode 5 – 6 Shutdown ELAP Strategy due to concerns that the RWST is not missile protected or does not meet ESEP requirements. The revised strategy will utilize the new Hardened Condensate Storage Tank (HCST) as a water source and the Boric Acid Batching Tank (BABT) as the boron source for make-up to the Boric Acid Tanks (BATs).<br><br>***The BABT provides makeup to the BATs through performance of FSG-46, "A Mobile Water Purification Unit", and FSG-47, "Batching Boric Acid to the Boric Acid Tanks."***<br><br>***CEC-CS-006-002, "Flooding from Local Intense Precipitation, Callaway Energy Center, Reform, Missouri," concluded in Table 5 that the maximum flooding height at the ESW Pump House is 1999.4 ft. The elevation of the ESW Pump House is 2000 ft per the FSAR. Therefore, the maximum flooding*** |

| Interim Safety Evaluation Confirmatory Item | Status |
|---|---|
| | ***condition does not result in water entering the ESW Pump House and does not potentially hinder utilization of the FLEX connections for ESW injection.***<br><br>***The RWST is not credited as a water source in CEC's coping strategies but if available could be used and considered a defense-in-depth strategy.***<br><br>***The UHS inventory is used as a coping strategy for Phase 3. During Phase 3, submersible pumps provided by SAFER are used to provide water to the ESW system (ref. FSG-48) to support RHR cooling capability. Floating debris will not impact the submersible pumps; however, if submerged debris were to impact pump operation, the affected pump, of which there are 2, would require being secured to facilitate clearing the pump suction.***<br><br>***The UHS is also used as a defense in depth inventory in FSG-46. In this application floating strainers are used on the pump suction.*** |
| 3.1.3.3.A - The licensee did not provide information with regard to procedural interface considerations as they relate to tornados. | Closed<br><br>The following will be included in the Ameren Missouri Final Integrated Plan (FIP):<br><br>Tornados are generally fast moving events and over quickly. OTO-ZZ-00012, "Severe Weather," provides instructions to prepare the plant for severe weather conditions and a potential station blackout ***prior to the severe weather reaching the station***. Ameren Missouri has identified multiple deployment routes for the FLEX portable equipment in the event of damage to the deployment routes. Ameren Missouri has also developed FLEX Support Guideline FSG-5, "Initial Assessment and Flex Equipment Staging," to provide guidelines to establish clear access routes and for the deployment of the portable FLEX Equipment.<br><br>***FSG-5 includes a diagram that indicates the primary and alternate routes to take in order to move FLEX equipment from the HSB to the various locations that FLEX equipment will be utilized.*** |
| 3.2.1.A – Potential Nitrogen Injection from Accumulators into RCS | Closed<br><br>Step 1 of FSG-10, "Passive RCS Injection Isolation |

| Interim Safety Evaluation Confirmatory Item | Status |
|---|---|
| The licensee needs to confirm that adverse quantities of nitrogen from accumulators will not be injected into the RCS during an ELAP event using an acceptable methodology that accounts for the potential for heat transfer from the containment building to the contents of the accumulator. | (Rev. 0)," determines if isolation of Safety Injection (SI) Accumulators is desired. If the Steam Generators will be depressurized below 220 psig, then the SI accumulators are isolated by closure of their discharge isolation valves (if power is available from FLEX 480 VAC Generator) or vented to the containment atmosphere. Callaway Energy Center calculation, BB-180 Rev.0 Add. 5 "Minimum Steamline Pressure to Prevent Accumulator Nitrogen Injection," establishes the site specific value for the Westinghouse Owners Group Emergency Response Guidelines Setpoint O.07 that is used in the Emergency Operating Procedures (i.e., ECA-0.0, "Loss of All AC Power," Step 17, Rev. 019). The site calculation takes into consideration the potential for nitrogen expansion/SI accumulator pressure increase from heat sources within the containment building (i.e., RCS). |
| 3.2.1.B – Effect of failure of NSR portion of TDAFP recirculation line<br><br>The licensee needs to confirm that the potential failure of nonsafety-related portions of the turbine-driven auxiliary feedwater pump recirculation header piping would not (1) adversely affect the quantity of condensate required for secondary makeup or (2) result in adverse accumulation of water in the CST pipe chase or other areas of the plant. | ***Closed***<br><br>CEC strategy is to isolate the turbine-driven auxiliary feedwater pump (TDAFP) recirculation header piping within 3 hours of the HCST being placed in service. This loss of secondary water would have minimal effect on the surrounding area.<br><br>The quantity of secondary water lost from the TDAFP recirculation header piping is accounted for in the calculation determining the minimum HCST volume required for a 30-hour supply of water to the SGs and the SFP. Ameren Missouri has revised the FSGs to provide direction to isolate recirculation flow back to the CST. The construction of the new HCST will minimize the loss of auxiliary feedwater from the turbine-driven AFW pump recirculation header piping.<br><br>A Time Sensitive Action has been added to our Sequence of Events Timeline to realign the turbine-driven auxiliary feedwater pump recirculation from the CST to the HCST within three (3) hours of the depletion of water from the CST. This will ensure an adequate quantity of condensate grade water for secondary makeup.<br><br>***Ameren Missouri strategy is to isolate the turbine-*** |

| Interim Safety Evaluation Confirmatory Item | Status |
|---|---|
| | ***driven auxiliary feedwater pump (TDAFP) recirculation header piping within 3 hours of the HCST being placed in service. This loss of secondary water would have minimal effect on the surrounding area***. |
| 3.2.1.1.A – Use of NOTRUMP Computer Code<br>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. | Closed<br>Ameren Missouri has used generic plant ELAP analyses performed with the NOTRUMP computer code to support the mitigating strategy in its Overall Integrated Plan (OIP). The use of NOTRUMP was limited to the thermal-hydraulic conditions before reflux condensation initiates. The initiation of reflux condensation cooling is defined when the one-hour centered moving average (CMA) of the flow quality at the top of the SG U-tube bend exceeds 0.1 in any one loop. |
| 3.2.1.2.C – RCP SHEILD® SEAL Part 21 Report<br>Further information is required to assess address the impacts of the Westinghouse 10 CFR Part 21 report, "Notification of the Potential Existence of Defects Pursuant to 10CFR Part 21," dated July 26, 2013 (ADAMS Accession No. ML 13211A168) on the use of the low seal leakage rate in the ELAP analysis. | Closed<br>***The Part 21 issue on the Westinghouse low-leakage RCP SHIELD® seals has been resolved. Westinghouse Report TR-FSE-14-1-P documents how the deficiencies in the Generation I and II seals have been addressed. The report also documents the qualification testing performed on the GEN III seals to ensure acceptable performance under ELAP conditions.***<br>***NRC Endorsement of TR-FSE-14-1-P, "Use of Westinghouse SHIELD® Passive Shutdown Seal for FLEX Strategies," is documented in NRC Letter from Mr. Jack Davis, Director, Mitigating Strategies Directorate to Mr. James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, dated May 28, 2014, (ML14132A128) (Reference 15).***<br>***The Westinghouse Gen III SHIELD® seals will be installed in the upcoming refueling outage for the remaining three (3) RCPs without the GEN III SHIELD® Seals installed. At that time, all RCPs will have the GEN III SHIELD® seals installed.*** |
| 3.2.1.5.A – Potential effect of containment harsh conditions of needed instrumentation | ***Closed***<br>***<u>Modes 1-4:</u>***<br>***The Gothic Analysis of containment demonstrates that the containment design pressure and*** |

| Interim Safety Evaluation Confirmatory Item | Status |
| --- | --- |
| The Integrated Plan did not address whether instrumentation credited in the ELAP analysis for automatic actuations and for indications required for the operators to take action are reliable and accurate in the containment harsh conditions. The licensee responded to this question in the audit process by pointing out that the licensee's self-identified open item related to the containment environment (01 2) addresses this issue. The licensee also stated that Westinghouse will be asked to perform a GOTHIC analysis of the containment to demonstrate that acceptable temperature and pressure levels will not be exceeded. | ***temperature limits are not exceeded during an ELAP. All instrumentation (except Nuclear Instrumentation (NI)) remains functional in an ELAP in Modes 1 – 4. Ameren Missouri has developed contingency actions in FSGs for the loss of the NIs.***<br><br>***<u>Modes 5-6:</u>***<br>***The Gothic analysis determined that the containment remains below design pressure for an event in Modes 5 - provided the containment is vented early in the event. Ameren Missouri has included this containment venting in FSG-12, "Alternate Containment Cooling." All instrumentation remains functional.*** |
| 3.2.1.6.A – Validation of FLEX Strategies<br><br>On page 11 of the Integrated Plan, following the sequence of events listed, the licensee stated that to confirm the times given, the licensee will prepare procedures for each task, perform time study walkthroughs for each of the tasks under simulated ELAP conditions, and account for equipment and tagging and other administrative procedures required to perform the task. Further review of the Sequence of Events will be required following this review. | ***Closed***<br><br>FLEX Support Guidelines (FSGs) have been prepared for each task. Validation of the FSG's will be performed per the approved NEI Guidance. The validations will assure that required tasks, manual actions, and decisions for FLEX strategies are feasible and may be executed within the constraints identified in the Overall Integrated Plan (OIP)/Final Integrated Plan (FIP) for Order EA-12-049.<br><br>***The Sequence of Events Timeline has been updated to include changes made to the Overall Integrated Plan since its submittal. The revised Sequence of Events Timeline has been included as Enclosure 2 to this submittal. Significant changes to the Timeline are primarily associated with the addition of the new Hardened Condensate Storage Tank as part of FLEX strategies.*** |
| 3.2.1.8.A – Borated Coolant Basis<br><br>Adequate basis is needed for the timing and quantity of the injection of borated coolant as well as justification that administrative procedures will ensure that subcriticality requirements for future cores are bounded. | ***Closed***<br><br>***Ameren Missouri has drafted a calculation for the "Time after reactor trip when RCS boration is required" (V.08) which will be included in the appropriate FSGs. Future core reloads will be bounded by adding a step to EDP-ZZ-00014, "Reload Design Control and Coordination," to ensure that the results of the calculation remain conservative.*** |

| Interim Safety Evaluation Confirmatory Item | Status |
|---|---|
| 3.2.2.A – SFP Cooling Connection Points<br>The licensee stated the water supply for SFP cooling involves three connections points, all located on the exterior of the fuel building. The connection points on the exterior of the fuel building will need to be protected from high wind missile strikes. If protection is not possible, the connection points will need to be relocated to the inside of the building. The configuration needs to be resolved. | Closed<br>ULNRC-06087, Ameren Missouri's second six-month OIP submittal update (Reference 13), section 4.4, stated that the three connections (primary, secondary, and spray) for the Spent Fuel Pool Cooling strategy had been revised to place these connections just inside the building. An evaluation determined that the connection points would accessible early in the event.<br>***AMN-003-CALC-018 Rev. 2 has been completed to evaluate overspray flow delivery. The calculation concludes that adequate flow is provided by the selected pump, hose and suction source.*** |
| 3.2.2.B – Basis for SFP boil-off time<br>The licensee stated that Westinghouse is being asked to clarify the basis for the 48-hour boil off time for the SFP level and the resulting information will be provided in a future 6-month update to the Integrated Plan. | Closed<br>The boil-off time in the OIP to a level of 15 feet above the fuel racks should have been 35.2 hours. The basis is the time to boil from initial conditions of 140°F and atmospheric pressure is 5.46 hours. An additional time of 29.79 hours was calculated for the boil-off time to a level in the SFP 15 feet above the fuel racks.<br>The time to boil of 5.46 hours plus the boil-off time of 29.79 hours (a total of 35.2 hours) is the basis for a required action time of 33 hours. The 33 hours basis allows for deployment time of SFP Make-Up portable equipment prior to reaching a level of 10 feet above the fuel racks.<br>The reference to 48 hours appears to be an error from previous draft versions of the OIP predicated on a level of 10 feet above the fuel racks.<br>***Westinghouse calculation CN-SEE-II-12-39, "Determination of the Time to Boil in the Callaway Spent Fuel Pool after an Earthquake," provides the basis for maximum & nominal boil-off cases.*** |
| 3.2.3.A – Containment Condition Analysis<br>The licensee will use GOTHIC to analyze containment conditions and based on the results of this evaluation, will develop required actions to ensure maintenance of containment integrity and required instrument | Open<br>***<u>Modes 1-4:</u>***<br>***The Gothic Analysis of containment demonstrates that the containment design pressure and temperature limits are not exceeded during an*** |

| Interim Safety Evaluation Confirmatory Item | Status |
|---|---|
| function. The licensee stated that a detailed discussion of the GOTHIC analysis will be provided in a future 6-month update to address containment cooling during an ELAP event.<br>Open | ***ELAP. All instrumentation (except Nuclear Instrumentation (NI)) remains functional in an ELAP in Modes 1 – 4. Ameren Missouri has developed contingency actions in FSGs for the loss of the NIs.***<br>***<u>Modes 5-6:</u>***<br>***The Gothic analysis determined that the containment pressure remains below design pressure for an event in Mode 5, provided the containment is vented early in the event. Ameren Missouri has included this containment venting in FSG-12, "Alternate Containment Cooling." All instrumentation remains functional.***<br>***<u>Remaining Action:</u>***<br>***Additional evaluation is being performed of the concrete and steel supporting the Rx Vessel. In a BDBEE with no forced ventilation, the temperatures could reach 560°F for a period of time.*** |
| 3.2.4.2.A – Hydrogen Accumulation Prevention<br>The licensee needs to provide details regarding a plan to prevent hydrogen accumulation in the battery room during phases 2 and 3. | ***OPEN - Pending***<br>***From Calculation M-GK-370, "Post-Accident Battery Room H2 Concentration Levels," under conditions where there is no ventilation, H2 concentration may reach 2% in as little as 2.62 days. An exhaust flow of 100 CFM of air by the pressurization system ensures that the concentration will not become critical." FSG-45 "Temporary Ventilation and Lighting," section 4.2 establishes battery room ventilation flow and H2 monitoring. The blowers purchased for H2 removal have a minimum flow rate of 1842 CFM.*** |
| 3.2.4.2.B – Low Temperature Effect on Batteries<br>A discussion is needed specifically on the extreme low temperatures effects of the batteries capability to perform its function for the duration of the ELAP event. | Closed<br>A Gothic Analysis was performed to ensure that the temperature in the battery rooms do not fall below 60°F due to extreme low outside temperatures until such time that the FLEX generators are supplying the battery chargers. The analysis showed with the original minimum room temperature of 60°F the battery rooms will have a slight temperature increase through the ELAP event with no equipment heaters. The DC-powered equipment in the room |

| Interim Safety Evaluation Confirmatory Item | Status |
|---|---|
| | surrounding the battery room will provide sufficient heat to keep the battery room temperatures above 60°F. |
| 3.2.4.2.C – Coping for Beyond 24 Hours<br>The licensee stated that an assessment of room environmental conditions and effects on key equipment was performed and the assessment determined that the near term actions were considered acceptable for 24 hours following a BDBEE scenario as outlined in NEI 12-06. However, the licensee further stated that a future action is required to evaluate coping times beyond 24 hours. This action should also address the capability to vent the SFP area. | ***Closed***<br>For coping times beyond 24 hours, temporary ventilation will be provided. Callaway Energy Center will utilize EOP Addendum 20, "Control Room Cabinet Door List," FSG-45, "Temporary Ventilation and Lighting," and Attachment II of Emergency Coordinator Supplemental Guide, "Fuel Building Ambient Cooling," to address NEI 12-06 Section 3.2.2, Guideline 10.<br>***FSG-45 provides ventilation of areas of concern (e.g., TDAFP Room, Control Room) to ensure equipment will be able to perform as required. In addition, proximity suits and SCBAs will be available for personnel to enter high temperature areas to operate critical components (e.g., TDAFP) if required. The Fuel Building is vented early in the event prior to the environmental conditions preventing venting of the building.*** |
| 3.2.4.3.A – Freeze Protection for FLEX Equipment<br>The potential for (1) freezing of water in FLEX equipment and (2) crystallization of boric acid solution, and therefore the potential need for heat tracing on Chemical and volume control system lines, is still not addressed for long periods of time during the ELAP event scenarios. The licensee stated that additional work is required on these subjects to ensure that the potential for freezing and boron solidification is addressed. | ***Open***<br>Ameren Missouri has developed FSG-50, "Freeze Protection for ELAP Response." FSG-50 is being modified to incorporate ways to keep the Boric Acid Tanks (BATs) from freezing. An analysis is being performed to determine heating requirements for the Boric Acid Tanks and for the batching of boric acid after the BDBEE.<br>***Portable equipment required to implement FLEX strategies will be maintained in the Hardened Storage Building (HSB). The HSB is maintained greater than 50°F. FSG-50, "Freeze Protection for ELAP Response," provides direction for establishing freeze protection for installed plant and temporary equipment.***<br>***Calculation NAI-1901-001, "GOTHIC Analysis of the Boric Acid Tank Rooms for Extended Loss of A/C Power," determines the room temperature in the boric acid tank (BAT) rooms 1116 and 1117 on elevation 1974' and room 1407 on elevation 2026'*** |

| Interim Safety Evaluation Confirmatory Item | Status |
|---|---|
| | ***during an extended loss of A/C power event. Although the temperature initially increases slightly above 60°F in each room, the temperature then drops. In room 1116 the temperature drops below 59°F around 151,200 seconds (42 hours) and lies around 58°F at 72 hours. In room 1117 the temperature drops below 59°F around 133,200 seconds (37 hours) and lies just below 58°F after 72 hours. The temperature in Room 1407 drops below 59°F at approximately 48,600 seconds (13.5 hours) to just above 53°F at 72 hours.***<br><br>***According to the 15th edition of Lange's Handbook of Chemistry (p. 5.11), a single batch of boric acid (7000 ppm) will remain in solution at temperatures as low as 40 F.***<br><br>***FSG-47, "Batching Boric Acid to the Boric Acid Storage Tanks," has a provision to heat makeup water to 90 degrees F. This Boric Acid solution when added to the BAT Tanks will contribute to maintaining the solution above the crystallization temperature. However, no credit is taken for this thermal addition in Calculation NAI-1901-001.***<br><br>***The heat load required to maintain the temperature in the Auxiliary Building 1974' elevation Rooms 1116, 1117 and 1407 to above 59°F over 72 hours is 18,000 BTU/HR.***<br><br>***FSG-50, "Freeze Protection for ELAP Response," has direction to place an electric heater(s) capable of producing greater than 18,000 BTU/HR in the Auxiliary Building 1974' elevation in order to maintain the temperature in Rooms 1116, 1117 and 1407 to above 59°F over 72 hours. Additional direction is given to heat the Boron Injection Header room which, during an ELAP, will contain permanent and temporary piping/hoses used for boron injection. Furthermore, direction is given to establish temporary heating for the permanent and temporary piping/hoses going into the North Piping Penetration Room.*** |

| Interim Safety Evaluation Confirmatory Item | Status |
|---|---|
| | ***<u>Remaining Action:</u>***<br>***Ameren Missouri will provide justification for low temperature operation of the FLEX diesel generators and diesel-powered pumps.*** |
| 3.2.4.4.A – Temporary Lighting<br>The licensee needs to provide information concerning the source of power, storage location and the procedures the operators will use to stage temporary lights. | Closed<br>***The OIP section for Safety Function Support, page 67 of 131 states "Control room lighting will remain powered by the NK (Class 1E) batteries and may be augmented with additional portable lighting equipment." The additional portable lighting equipment will be stored in the Hardened Storage Building. Staging and deployment of temporary lighting is delineated in FSG-45, "Temporary Ventilation, Lighting and Power." This FSG identifies the various sources of electrical power available for temporary lighting in the Control Room and critical plant areas.*** |
| 3.2.4.4.B – Communications Systems Upgrade<br>The NRC staff has reviewed the licensee communications assessment … and has determined that the assessment for communications is reasonable. Confirmation is required to demonstrate that upgrades to the site's communication systems have been completed. | Closed<br>Ameren Missouri has modified the plant radio passive antenna system in the power block to enhance radio communications. The portable radio cart has been procured and is stored in the Hardened Storage Building. External antennas have been installed in the Control Room, TSC, and EOF to support satellite phone communications. Acceptance Testing of the portable radio cart has been completed. ***Plant radios have been upgraded to provide line-of-sight communications.*** |
| 3.2.4.6.A – Temporary Ventilation<br>There were several references in the Integrated Plan regarding the need for analyses and procedures to address ventilation of areas such as equipment rooms and the spent fuel pool area. The licensee responded to questions regarding habitability and stated that the subject of area ventilation will be addressed in a future 6-month update. | ***Open***<br>Ameren Missouri will utilize EOP Addendum 20, "Control Room Cabinet Door List," FSG-45, "Temporary Ventilation and Lighting," and Attachment II of Emergency Coordinator Supplemental Guide, "Fuel Building Ambient Cooling," to address NEI 12-06 Section 3.2.2, Guideline 10.<br>***Callaway has developed FSG-45, "Temporary Ventilation and Lighting." This FSG identifies the various sources of ventilation. Equipment Room ventilation materials will be stored in the Hardened Storage Building.*** |

| Interim Safety Evaluation Confirmatory Item | Status |
| --- | --- |
| | ***<u>Remaining Action:</u>***<br>***Ameren Missouri will provide additional documentation with regard to areas of the plant that must be accessed by the operators in a BDBEE, including their associated temperatures.*** |
| 3.2.4.7.A – RWST Missile Protection<br>The licensee stated the primary strategy for providing adequate cooling during Modes 5 and 6 will take suction from the new RWST connection on the RWST drain line. The licensee further stated that the RWST is seismically qualified but not missile protected. The licensee has noted a self-identified open item stating that the RWST will be missile protected to credit its use in core cooling with SGs not available strategies. | ***Closed***<br>***Ameren Missouri has revised its Mode 5 – 6 Shutdown ELAP Strategy due to concerns that the RWST is not missile protected or does not meet ESEP requirements. Therefore, the RWST is not a credited source of makeup water. The revised strategy will utilize the new 500,000 gallon Hardened Condensate Storage Tank (HCST) as a water source and the Boric Acid Batching Tank (BABT) as the boron source for make-up to the BATs. FSG-14 provides a blended flow strategy from the HCST and the BATs.*** |
| 3.2.4.10.A – Effect of Load Shed Evolution<br>With regard to the battery load shed evolution, the licensee did not address the general question as to whether the potential loss of plant functions and resulting consequences has been addressed. Also, the licensee explained that the main generator seal oil pump is powered from the balance of plant batteries but did not address generator hydrogen hazards when the balance of plant batteries are exhausted. Licensee is requested to address these concerns. | ***Closed***<br>***FSG-4 directs the load shedding of those components that will allow the NK batteries to last 12 hours after the event. Calculation NK-05 Attachment O addresses ELAP conditions. Components shed are those components not needed (status panels) or no longer needed (e.g., steam line and feedwater isolation and reactor trip functions which would have already occurred).***<br>***ECA-0.0 lists steps to vent hydrogen from the main generator. This task is accomplished early in the event so as to not allow hydrogen buildup becoming a hazard and is accounted for in the Phase 2 staffing analysis.*** |

# 7 Potential Interim Safety Evaluation Impacts

There are no potential impacts to the Interim Safety Evaluation identified at this time.

# 8 References

The following references support the updates to the OIP described in this enclosure.

1. ULNRC-05962, “Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,” dated February 28, 2013
2. NRC Order Number EA-12-049, “Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,” dated March 12, 2012
3. NEI 12-06, Revision 0, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"
4. ULNRC-06024, “First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049),” dated August 29, 2013
5. ULNRC-06036, "Request for Relaxation From NRC Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,'" dated October 09, 2013
6. ML13319A668, "Callaway Plant, Unit 1- Relaxation of the Schedular Requirements for Order EA-12-049, 'Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design Basis External Events,'" dated December 11, 2013
7. ML133224A195, "Callaway Plant, Unit 1 - Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC No. MF0772)," dated December 19, 2013
8. ML13273A514, NEI Shutdown/Refueling Modes White Paper, Rev 0 9/18/13
9. ML13267A382, NRC Letter from Mr. Jack Davis, NRC, to Mr. Joseph E. Pollock, NRC Endorsement of FLEX Generic Open Item for Shutdown Refueling Modes, dated September 30, 2013
10. ML13276A183, NRC Letter from Mr. Jack Davis, NRC, to Mr. Jack Stringfellow, PWROG, NRC Endorsement of PWROG Boron Mixing White Paper, dated January 8, 2014
11. ML13241A186, NEI Letter from Mr. Nicholas Pappas, Senior Project Manager, Nuclear Energy Institute, to NRC, Mr. Jack R. Davis, Director Mitigating Strategies Directorate, "EA-12-049 Mitigating Strategies Resolution of Extended Battery Duty Cycles Generic Concern," dated August 27, 2013
12. ML13241A188, NRC Letter from Mr. Jack Davis, Director Mitigating Strategies Directorate to Mr. Joseph E. Pollock, Vice President, Nuclear Operations, Nuclear Energy Institute, Battery Life White Paper Endorsement, dated September 16, 2013
13. ULNRC-06087, "Second Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 26, 2014

14. ULNRC-06135, "Third Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated August 28, 2014

15. ML14132A128, NRC Letter from Mr. Jack Davis, Director, Mitigating Strategies Directorate to Mr. James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, dated May 28, 2014

16. ML14265A107, NRC Letter from Mr. Jack Davis, Director Mitigating Strategies Directorate to Mr. Joseph E. Pollock, Vice President, Nuclear Operations, Nuclear Energy Institute, "Staff Assessment of National SAFER Response Centers Established in Response to Order EA-12-049," dated September 26, 2014

17. ULNRC-06184, "Fourth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated February 26, 2015

18. ULNRC-06240, "Fifth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated August 27, 2015

19. ML15125A442, NRC Letter from Mr. Jack Davis, Director Mitigating Strategies Directorate to Mr. Joseph E. Pollock, Vice President, Nuclear Operations, Nuclear Energy Institute, NRC Endorsement of Alternate Method for Spare FLEX Hose and Cable Capability, dated May 18, 2015