



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

March 31, 2016

Mr. Fadi Diya  
Senior Vice President and  
Chief Nuclear Officer  
Union Electric Company  
P.O. Box 620  
Fulton, MO 65251

SUBJECT: CALLAWAY PLANT, UNIT 1 - REPORT FOR THE AUDIT REGARDING  
IMPLEMENTATION OF MITIGATING STRATEGIES AND RELIABLE SPENT  
FUEL POOL INSTRUMENTATION RELATED TO ORDERS EA-12-049 AND  
EA-12-051 (CAC NOS. MF0772 AND MF0773)

Dear Mr. Diya:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design-Basis External Events" and Order EA-12-051, "Order to Modify Licenses With Regard To Reliable Spent Fuel Pool Instrumentation," (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML12054A736 and ML12054A679, respectively). The orders require holders of operating reactor licenses and construction permits issued under Title 10 of the *Code of Federal Regulations* Part 50 to submit for review, Overall Integrated Plans (OIPs) including descriptions of how compliance with the requirements of Attachment 2 of each order will be achieved.

By letter dated February 28, 2013 (ADAMS Accession No. ML13063A459), Union Electric Company (the licensee), doing business as Ameren Missouri, submitted its OIP for Callaway Plant, Unit 1 (Callaway) in response to Order EA-12-049. By letters dated August 29, 2013, February 26, 2014, August 28, 2014, February 26, 2015, August 27, 2015, and February 23, 2016 (ADAMS Accession Nos. ML13242A239, ML14057A770, ML14241A666, ML15057A301, ML15239B402 and ML16054A836, respectively), the licensee submitted its first six six-month updates to the OIP. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049 in accordance with NRC Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, "Regulatory Audits" (ADAMS Accession No. ML082900195). This audit process led to the issuance of the Callaway interim staff evaluation (ISE) dated December 19, 2013 (ADAMS Accession No. ML13224A195), and continues with in-office and onsite portions of this audit.

By letter dated February 28, 2013 (ADAMS Accession No. ML13063A449), the licensee submitted its OIP for Callaway, in response to Order EA-12-051. By letter dated June 7, 2013 (ADAMS Accession No. ML13121A187), the NRC staff sent a request for additional information (RAI) to the licensee. By letters dated July 3, 2013, August 29, 2013, February 26, 2014, August 28, 2014, February 26, 2015, August 27, 2015, and February 23, 2016 (ADAMS Accession Nos. ML13190A048, ML13242A240, ML14057A773, ML14241A669, ML15057A303, ML15239B352, and ML16054A841, respectively), the licensee submitted its RAI responses and

first six six-month updates to the OIP. The NRC staff's review to date led to the issuance of the Callaway ISE and RAI dated November 25, 2013 (ADAMS Accession No. ML13323A111). By letter dated March 26, 2014 (ADAMS Accession No. ML14083A620), the NRC notified all licensees and construction permit holders that the staff is conducting in-office and onsite audits of their responses to Order EA-12-051 in accordance with NRC NRR Office Instruction LIC-111, as discussed above.

The ongoing audits allow the staff to review open and confirmatory items from the mitigation strategies ISE, RAI responses from the spent fuel pool instrumentation (SFPI) ISE, the licensee's integrated plans, and other audit questions. Additionally, the staff gains a better understanding of submitted and updated information, audit information provided on e-portals, and preliminary Overall Program Documents/Final Integrated Plans while identifying additional information necessary for the licensee to supplement its plan and staff potential concerns.

In support of the ongoing audit of the licensee's OIPs, as supplemented, the NRC staff conducted an onsite audit at Callaway from January 25 - 28, 2016, per the audit plan dated November 9, 2015 (ADAMS Accession No. ML15309A326). The purpose of the onsite portion of the audit was to provide the NRC staff the opportunity to continue the audit review and gain key insights most easily obtained at the plant as to whether the licensee is on the correct path for compliance with the Mitigation Strategies and SFPI orders. The onsite activities included detailed analysis and calculation discussion, walk-throughs of strategies and equipment laydown, visualization of portable equipment storage and deployment, staging and deployment of offsite equipment, and physical sizing and placement of SFPI equipment.

The enclosed audit report provides a summary of the activities for the onsite audit portion. Additionally, this report contains an attachment listing all open audit items currently under NRC staff review.

If you have any questions, please contact me at 301-415-2833 or by e-mail at Peter.Bamford@nrc.gov.

Sincerely,



Peter Bamford, Senior Project Manager  
Orders Management Branch  
Japan Lessons-Learned Division  
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure:  
Audit report

cc w/encl: Distribution via Listserv



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

AUDIT REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO ORDERS EA-12-049 AND EA-12-051 MODIFYING LICENSES  
WITH REGARD TO REQUIREMENTS FOR  
MITIGATION STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS  
AND RELIABLE SPENT FUEL POOL INSTRUMENTATION  
UNION ELECTRIC COMPANY  
CALLAWAY PLANT, UNIT 1  
DOCKET NO. 50-483

BACKGROUND AND AUDIT BASIS

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design-Basis External Events" and Order EA-12-051, "Order to Modify Licenses With Regard To Reliable Spent Fuel Pool Instrumentation," (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML12054A736 and ML12054A679, respectively). Order EA-12-049 directs licensees to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities in the event of a beyond-design-basis external event (BDBEE). Order EA-12-051 requires, in part, that all operating reactor sites have a reliable means of remotely monitoring wide-range SFP levels to support effective prioritization of event mitigation and recovery actions in the event of a BDBEE. The orders require holders of operating reactor licenses and construction permits issued under Title 10 of the *Code of Federal Regulations* Part 50 to submit for review, Overall Integrated Plans (OIPs) including descriptions of how compliance with the requirements of Attachment 2 of each order will be achieved.

By letter dated February 28, 2013 (ADAMS Accession No. ML13063A459), Union Electric Company (the licensee), doing business as Ameren Missouri, submitted its OIP for Callaway Plant, Unit 1 (Callaway) in response to Order EA-12-049. By letters dated August 29, 2013, February 26, 2014, August 28, 2014, February 26, 2015, August 27, 2015, and February 23, 2016 (ADAMS Accession Nos. ML13242A239, ML14057A770, ML14241A666, ML15057A301, ML15239B402 and ML16054A836, respectively), the licensee submitted its first six six-month updates to the OIP. By letter dated August 28, 2013 (ADAMS Accession No. ML13234A503), the NRC notified all licensees and construction permit holders that the staff is conducting audits of their responses to Order EA-12-049 in accordance with NRC Office of

Enclosure

Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, "Regulatory Audits" (ADAMS Accession No. ML082900195). This audit process led to the issuance of the Callaway interim staff evaluation (ISE) dated December 19, 2013 (ADAMS Accession No. ML13224A195), and continues with in-office and onsite portions of this audit.

By letter dated February 28, 2013 (ADAMS Accession No. ML13063A449), the licensee submitted its OIP for Callaway, in response to Order EA-12-051. By letter dated June 7, 2013 (ADAMS Accession No. ML13121A187), the NRC staff sent a request for additional information (RAI) to the licensee. By letters dated July 3, 2013, August 29, 2013, February 26, 2014, August 28, 2014, February 26, 2015, August 27, 2015, and February 23, 2016 (ADAMS Accession Nos. ML13190A048, ML13242A240, ML14057A773, ML14241A669, ML15057A303, ML15239B352, and ML16054A841, respectively), the licensee submitted its RAI responses and first six six-month updates to the OIP. The NRC staff's review to date led to the issuance of the Callaway ISE and RAI dated November 25, 2013 (ADAMS Accession No. ML13323A111). By letter dated March 26, 2014 (ADAMS Accession No. ML14083A620), the NRC notified all licensees and construction permit holders that the staff is conducting in-office and onsite audits of their responses to Order EA-12-051 in accordance with NRC NRR Office Instruction LIC-111, as discussed above.

The ongoing audits allow the staff to review open and confirmatory items from the mitigation strategies ISE, RAI responses from the spent fuel pool instrumentation (SFPI) ISE, the licensee's integrated plans, and other audit questions. Additionally, the staff gains a better understanding of submitted and updated information, audit information provided on e-portals, and preliminary Overall Program Documents (OPDs) /Final Integrated Plans (FIPs) while identifying additional information necessary for the licensee to supplement its plan and staff potential concerns.

In support of the ongoing audit of the licensee's OIPs, as supplemented, the NRC staff conducted an onsite audit at Callaway from January 25 - 28, 2016, per the audit plan dated November 9, 2015 (ADAMS Accession No. ML15309A326). The purpose of the onsite portion of the audit was to provide the NRC staff the opportunity to continue the audit review and gain key insights most easily obtained at the plant as to whether the licensee is on the correct path for compliance with the Mitigation Strategies and SFPI orders. The onsite activities included detailed analysis and calculation discussion, walk-throughs of strategies and equipment laydown, visualization of portable equipment storage and deployment, staging and deployment of offsite equipment, and physical sizing and placement of SFPI equipment.

Following the licensee's declarations of order compliance, the NRC staff will evaluate the OIPs, as supplemented, the resulting site-specific OPDs/FIPs, and, as appropriate, other licensee submittals based on the requirements in the orders. For Order EA-12-049, the staff will make a safety determination regarding order compliance using the Nuclear Energy Institute (NEI) guidance document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" Revision 0, issued in August 2012 (ADAMS Accession No. ML12242A378), or Revision 2, issued in December 2015 (ADAMS Accession No. ML16005A625). These guidance documents are endorsed by NRC Japan Lessons-Learned Directorate (JLD) 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'" Revision 0 (ADAMS Accession No. ML12229A174), and Revision 1 (ADAMS

Accession No. ML15357A163), with certain clarifications, as providing an acceptable means of meeting the order requirements. For Order EA-12-051, the staff will make a safety determination regarding order compliance using the NEI guidance document NEI 12-02, "Industry Guidance for Compliance with NRC Order EA-12-051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation'" (ADAMS Accession No. ML12240A307), as endorsed, with exceptions and clarifications, by NRC ISG JLD-ISG-2012-03 "Compliance with Order EA-12-051, 'Reliable Spent Fuel Pool Instrumentation'" (ADAMS Accession No. ML12221A339), as providing one acceptable means of meeting the order requirements. Should the licensee propose an alternative strategy or other method deviating from the guidance, additional staff review will be required to evaluate if the alternative strategy complies with the applicable order.

### AUDIT ACTIVITIES

The onsite audit was conducted at the Callaway facility from January 25 - 28, 2016. The NRC audit team staff was as follows:

| <b>Title</b>              | <b>Team Member</b> |
|---------------------------|--------------------|
| Team Lead/Project Manager | Peter Bamford      |
| Technical Support         | Joshua Miller      |
| Technical Support         | Khoi Nguyen        |
| Technical Support         | Prem Sahay         |
| Technical Support         | Kevin Roche        |

The NRC staff executed the onsite portion of the audit per the three part approach discussed in the November 9, 2015, plan, to include conducting a tabletop discussion of the site's integrated mitigating strategies compliance program, a review of specific technical review items, and discussion of specific program topics. Activities that were planned to support the above included detailed analysis and calculation discussions; walk-throughs of strategies and equipment laydown; visualization of portable equipment storage and deployment; staging and deployment of offsite equipment; and physical sizing and placement of SFPI equipment.

### AUDIT SUMMARY

#### 1.0 Entrance Meeting (January 26, 2016)

At the audit entrance meeting, the NRC staff audit team introduced itself followed by introductions from the licensee's staff. The NRC audit team provided a brief overview of the audit's objectives and anticipated schedule.

#### 2.0 Integrated Mitigating Strategies Compliance Program Overview

Per the audit plan and as an introduction to the site's program, the licensee provided a presentation to the NRC audit team titled "Callaway Energy Center FLEX Strategies." The licensee provided an overview of its strategy to maintain core cooling, containment, and SFP cooling in the event of a BDBEE, and the plant modifications being done in order to implement the strategies. The licensee also presented the location of the FLEX

equipment storage facility (hardened storage building), the FLEX equipment that would be stored there, the interface with the National SAFER Response Center (NSRC), and information regarding communications, procedures, and training. The presentation included an overview of the spent fuel pool level indication modification.

### 3.0 Onsite Audit Technical Discussion Topics

Based on the audit plan, and with a particular emphasis on the Part 2 “Specific Technical Review Items,” the NRC staff technical reviewers conducted interviews with licensee technical staff, site walk-downs, and detailed document reviews for the items listed in the plan. Results of these technical reviews that require additional information from the licensee or are still under NRC review are documented in the audit item status table in Attachment 3, as discussed in the Conclusion section below.

#### 3.1 Reactor Systems Technical Discussions and Walk-Downs

The NRC staff met with licensee staff to discuss the amount of leakage from the reactor coolant pump (RCP) seals, reactor coolant system (RCS) makeup strategy, the availability of water sources, and the ability to remove heat from the reactor coolant system via the steam generators. The NRC staff reviewed the analysis and flow calculations along with applicable procedures. The NRC staff also walked down the licensee’s strategies and reviewed plant procedures for implementing the core cooling and makeup strategies.

#### 3.2 Electrical Technical Discussions and Walk-Downs

- a. The NRC staff reviewed the calculations and strategy regarding extending battery life based on load shedding, and walked down the battery rooms to evaluate strategies for hydrogen and temperature control. The NRC staff also walked down panels used for load shedding to evaluate feasibility and timing.
- b. The NRC staff walked down connection points and locations for the FLEX electrical generators. In order to support the licensee’s Phase 2 strategy, one 480V electrical generator will be deployed. The licensee will have a second backup (N+1) generator available. The two generators will be stored in the hardened storage building. The licensee also plans to utilize larger electrical generators from the NSRC in the Phase 3 strategy. The staff reviewed the licensee’s load and sizing calculations associated with the FLEX generators.

#### 3.3 SFPI Technical Discussions and Walk-Downs

The NRC staff walked down the instrument, transmitter, electronics, and display locations for the SFP level instrumentation, along with the associated cable runs. No concerns were identified during the walkdown. The NRC staff also reviewed the associated calibration, maintenance and test procedures for the SFP level instrumentation.

### 3.4 Other Technical Discussion Areas and Walk-Downs

- a. The NRC staff toured the hardened storage building, located at the site. The hardened storage building is designed to survive all applicable site external hazards. The NRC staff walked down equipment haul routes from the hardened storage building to the designated deployment sites, and walked down haul routes from designated staging area for equipment that will be delivered from the NSRC.
- b. The NRC staff walked down the FLEX strategies for core cooling, RCS inventory, and SFP inventory functions. This included the point of deployment for the portable FLEX pumps, hose routing and deployment connection points. The walkdown also included the hardened condensate storage tank which was under construction at the time of the onsite audit.
- c. The NRC staff reviewed the strategy that will be implemented by the licensee to refuel the portable diesel-powered FLEX equipment. The NRC staff reviewed the instructions for refueling the equipment, as well as the equipment needed to perform the refueling. Additionally, the staff reviewed the licensee's procedures for ensuring adequate fuel quality.
- d. The licensee's cooldown strategy relies on operation of the steam generator atmospheric steam dumps (ASDs). The NRC staff reviewed the capability to operate the ASDs during an extended loss of alternating current power (ELAP).
- e. The NRC staff reviewed the licensee's plans to ensure adequate communications, lighting, personnel access, and equipment access, to successfully implement the strategies. The NRC staff interviewed plant personnel responsible for these areas, and observed lighting and communication features during plant walkdowns.

### 4.0 Exit Meeting (January 28, 2016)

The NRC staff audit team conducted pre-exit and exit meetings with licensee staff following the completion of the onsite review activities. The NRC staff highlighted items still under review and noted that the results of the onsite audit trip will be documented in this report. Items that require additional information from the licensee or are still under NRC review are detailed in Attachment 3 of this report.

### CONCLUSION

The NRC staff completed all three parts of the November 9, 2015, onsite audit plan. Each audit item listed in Part 2 of the plan was reviewed by NRC staff members while on site. In addition to the list of NRC and licensee onsite audit staff participants in Attachment 1, Attachment 2 provides a list of documents reviewed during the onsite audit portion.

In support of the continuing audit process, as the licensee proceeds towards orders compliance for this site, Attachment 3 provides the status of all open audit review items that the NRC staff is evaluating in anticipation of issuance of a combined SE for both the mitigation strategies (MS) and SFPI orders. This attachment includes items remaining from the onsite audit, as well as

any items that are being reviewed exclusively in the NRC offices, or have been added since the onsite audit. The five sources for the audit items referenced below are as follows:

- a. MS ISE open Items (OIs) and confirmatory items (CIs)
- b. MS audit questions (AQs)
- c. Licensee-identified Overall Integrated Plan (OIP) Open Items
- d. SFPI RAIs
- e. Additional safety evaluation (SE) needed information

While this report notes the completion of the onsite portion of the audit per the audit plan dated November 9, 2015, the ongoing audit process continues, as per letters dated August 28, 2013, and March 26, 2014, to all licensees and construction permit holders for both orders.

Additionally, while Attachment 3 provides a progress snapshot of the NRC staff's review of the licensee's OIPs, as supplemented, and as augmented in the audit process, the status and progress of the NRC staff's review may change based on licensee plan changes, resolution of generic issues, and other NRC staff concerns not previously documented. Changes in the NRC staff review will be communicated in the ongoing audit process.

Attachments:

1. NRC and Licensee Staff Onsite Audit Participants
2. Onsite Audit Documents Reviewed
3. Callaway MS/SFPI SE Audit Items currently under NRC staff review and requiring licensee input

## Onsite Audit Participants

### NRC Staff:

|               |              |
|---------------|--------------|
| Peter Bamford | NRR/JLD/JOMB |
| Joshua Miller | NRR/JLD/JERB |
| Prem Sahay    | NRR/JLD/JERB |
| Khoi Nguyen   | NRR/JLD/JERB |
| Kevin Roche   | NRR/JLD/JCBB |

### Callaway Staff:

|                          |   |
|--------------------------|---|
| John Patterson           | Director, Engineering Projects              |
| Bruce Huhmann            | Project Manager                             |
| Dan Stepanovic           | Project Manager, Construction               |
| Brian Bax                | Site Engineer, Mechanical                   |
| Austin Alley             | Site Engineer, Civil / Mechanical           |
| Nagasmitha Akkinapragada | Site Engineer, Electrical                   |
| Josh Bollinger           | Site Engineer, Electrical                   |
| Mark Haag                | Site Engineer, Electrical                   |
| Chris Fessler            | Site Engineer, Electrical                   |
| Corey Jutting            | Site Engineer, Civil                        |
| Chris Cash               | Site Engineer, Civil                        |
| Stephen Meyer            | Site Engineer, Licensing/Regulatory Affairs |
| Kurt Linsenhardt         | Site Engineer, Safety Analysis              |
| Jonathan Cordz           | Site Engineer, Safety Analysis              |
| Jim Little               | Site Engineer, Safety Analysis              |
| Casey Poindexter         | Operations                                  |
| Larry Winkelman          | Operations                                  |
| Alvin Robertson          | Westinghouse                                |
| Dave Heinlein            | Consultant                                  |
| Stan Putthoff            | Consultant                                  |
| Paul Miller              | Consultant                                  |
| Steve Sampson            | Consultant                                  |
| George Belchik           | Consultant                                  |
| Jim Cunningham           | Consultant                                  |
| Dave Hollabaugh          | Consultant                                  |

## **Documents Reviewed**

### FLEX Support Guidelines (FSGs)

- FSG-4, "ELAP DC Bus Load Shed Management," Rev. 0 Draft
- FSG-5, "Initial Assessment and FLEX Equipment Staging," Rev. 0 Draft
- FSG-6, "Alternate HCST Makeup," Rev. 0 Draft
- FSG-7, "Loss of Vital Instrument or Control Power," Rev. 0 Draft
- FSG-10, "Passive RCS Injection Isolation," Rev. 0 Draft
- FSG-11, "Alternate SFP Makeup and Cooling," Rev. 0 Draft
- FSG-14, "Shutdown RCS Makeup," Rev. 0 Draft
- FSG-41, "Emergency Communications," Rev. 0 Draft
- FSG-42, "Deployment of NSRC FLEX Generators," Rev. 0 Draft
- FSG-43, "Nitrogen and Instrument Air Strategy," Rev. 0 Draft
- FSG-44, "FLEX Diesel Fuel Strategy," Rev. 0 Draft
- FSG-45, "Temporary Ventilation, Lighting and Power," Rev. 0 Draft
- FSG-46, "Mobile Water Purification Unit," Rev. 0 Draft
- FSG-47, "Batching Boric Acid to the Boric Acid Storage Tanks," Rev. 0 Draft
- FSG-48, "FLEX ESW Pump," Rev. 0 Draft
- FSG-50, "Freeze Protection for ELAP Response," Rev. 0 Draft
- FSG-51, "Temporary Sump Pump Operation," Rev. 0 Draft
- FSG ECA-0.0, "Loss of AC Power," Rev. 0 Draft

### Procedures

- OTO-ZZ-00012, "Severe Weather," Rev. 32
- ECA 0.0, "Loss of All AC Power," Rev. 23

EIP-ZZ-00102, "Emergency Implementing Actions," Rev. 59

ITL-EC-00L59, "Loop-Lvl; Spent Fuel Pool Primary Level," Rev. 1

ITL-EC-00L60, "Loop-Lvl; Spent Fuel Pool Backup Level," Rev. 1

OTA-RK-00022 Add 76D – Spent Fuel Pool Level High/Low Annunciator response procedure which utilizes ECLI0059A/60A

OOA-EC-00002, "Operator Aid for Spent Fuel Pool Level Indications," Rev. 2

ITL-EC-00L59, "Primary Loop Calibration/two-point check functional verification and boron build-up removal," Rev. 1

ITL-EC-00L60, "Backup Loop Calibration/two-point check functional verification and boron build-up removal," Rev. 1

EC-LIT-0059, "Level Indicating Transmitter Calibration and Setup Instructions," Rev. Draft

EC-LY-0059, "SFPIS Calibration I/I Loop Isolator Module," Rev. Draft

EC-LI-0059A, "Digital Display Point Calibration and Setup Instructions," Rev. Draft

EC-LQ-0059A, "Power Supply Replacement and Setup," Rev. Draft

EC-LQY-0059, "Uninterruptible Power Supply Replacement Instructions," Rev. Draft

EC-LQ-0059B, "UPS Battery Replacement Instructions," Rev. Draft

EC-LIT-0060, "Level Indicating Transmitter Calibration and Setup Instructions," Rev. Draft

EC-LY-0060, "SFPIS Calibration I/I Loop Isolator Module," Rev. Draft

EC-LI-0060A, "Digital Display Point Calibration and Setup Instructions," Rev. Draft

EC-LQ-0060A, "Power Supply Replacement and Setup," Rev. Draft

EC-LQY-0060, "Uninterruptible Power Supply Replacement Instructions," Rev. Draft

EC-LQ-0060B, "UPS Battery Replacement Instructions," Rev. Draft

WNA-TP-04709-GEN (J-2048-00030), "Spent Fuel Pool Instrumentation System Calibration Procedure," (Westinghouse proprietary), Rev. 2

KDP-ZZ-00013, Appendix 1, "Equipment Important To Emergency Response Matrix," Rev. 3

Calculations/Analyses

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

81402-M-001, "HCST Sizing Justification Calculation," Rev. 1

CN-SCC-13-001, "Callaway ELAP Containment Environmental Analysis," Rev. 2

AMN-003-CALC-018, "SFP Hydraulic Calculation for FLEX Piping Configuration," Rev. 2

CN-SEE-II-12-39, "Determination of the Time to Boil in the Callaway Spent Fuel Pool after an Earthquake," Rev. 0

M-GK-370, "Post-Accident Battery Room H<sub>2</sub> Concentration Levels," Rev. 1

GK-19, "Calculation of DC & ESF Switchgear Room Heatup," Addendums 1 and 2, Rev. 0

AMN-003-CALC-046, "Fuel Handling Building Habitability Analysis," Rev. 0

NAI-1901-001, "GOTHIC Analysis of the Boric Acid Tank Rooms for Extended Loss of A/C Power," Rev. 0

KA-37, "Backup Nitrogen Supply System Design Pressure Losses," Rev. 0

AMN-003-CALC-016, "FLEX RCS Inventory Control and Core Cooling Hydraulic Calculation for Callaway Energy Center Unit 1," Rev. 4

AMN-003-CALC-017, "AFW Hydraulic Calculation for FLEX Piping Configuration," Rev. 2

AMN-003-CALC-020, "Hydraulic Analysis of ESW Tie-in for FLEX Operation," Rev. 1

NK-05, Attachment O, "Class 1E Battery Capacity," Rev. 10

BB-180, Add. 5, "Minimum Steamline Pressure to Prevent Accumulator Nitrogen Injection," Rev. 0

M-EC-48, "Minimum Safety Limit for LSL 57 & 58," Rev. 0

CN-PEUS-13-31, "Seismic Analysis of the SFP Mounting Bracket for Callaway Plant Unit 1," Rev. 0

CN-PEUS-14-15, "Seismic Qualification of the SFPIS Transmitter Enclosure for Callaway Nuclear Plant Unit 1," Rev. 0

Calculation EC-39, "GOTHIC ELAP Analysis of Electrical Penetration Room #1409 and MG Set Room #1403," Rev. 0

WNA-CN-00300-GEN (Westinghouse, proprietary), "Spent Fuel Pool Instrumentation System Power Consumption Calculation," Rev. 1

EQ-EV-200-SCP, ADD 1, "Comparison of ELAP Environmental Conditions to the Qualified Environmental Conditions for In-Containment Equipment and Cabling at Callaway Plant," Rev. 0

CEC-CS 005-00, "Liquefaction Resistance and Post-Earthquake Settlement for ISFSI at Callaway Energy Center," Rev. 0

#### Drawings

Drawing C-2605 (Q), Sheet 5, "Typical Details Conduit Supports," Rev. 1

#### Other Documents

LTR-SEE-15-150, "Response to a United States Nuclear Regulatory Commission Question from Mitigating Strategies Interim Staff Evaluation (ML13224A195) for the Callaway Nuclear Power Plant," Rev. 0

"SAFER Response Plan for Callaway Energy Center", Rev. 1, dated 8/27/15

BMN-DOC-006-F01, "Hardened Condensate Storage Tank," Rev. 2

Specification Z-1052, "Technical Specification for the FLEX Equipment Storage Unit," Rev. 1

SCP-14-81, "Transmittal of Revision 1 of Westinghouse Clarification on the Basis for the Boiloff Time of the Callaway Energy Center Spent Fuel Pool," Rev. 1

Modification Package (MP) 13-0024, "AFW Makeup for Core Cooling during BDBEE," Rev. 0

MP13-0031, "Hardened Storage for Portable FLEX Equipment," Rev. 0

DAR-PEUS-12-3, "FLEX Electrical Conceptual Design for the Callaway Energy Center and CEC Engineering Disposition," Rev. 1

MP-12-0020, "20110449 - Electrical Tie-ins for FLEX BDBEE," Rev. 3

APA-ZZ-00391, "Beyond Design Basis (BDB) Program Document", Rev. 1 Draft

Post Change Test Plan MP-13-0027, "SFP Instrumentation for NRC Order EA-12-051," Rev.1

LTR-SFPIS-14-164, "Subject: Spent Fuel Pool Instrumentation System – 90<sup>0</sup> Connector Cap's Epoxy," Rev. 0 (Westinghouse, proprietary)

Corrective Action Program Documents

CAR 201306512, Action #2.4.4

CAR 201309599, Action 2

CAR 201309599, Action12

CAR 201309599, Action 24

CAR 201600601, Action 10

CAR 201600710, Action 6

CAR 201600710, Action 7

**Callaway**  
**Mitigation Strategies/Spent Fuel Pool Instrumentation Safety Evaluation Audit Items:**  
**Audit Items Currently Under NRC Staff Review and Requiring Licensee Input**

| <b>Audit Item Reference</b> | <b>Item Summary Description</b>   | <b>Licensee Input Needed</b>   |
|-----------------------------|---|--|
| CI 3.2.3.A                  | Containment environment evaluation for ELAP/loss of access to ultimate heat sink (LUHS) event.  | The area below the reactor vessel is postulated to reach ~560 degrees Fahrenheit during the ELAP/LUHS event. The licensee has indicated that the nuclear instruments will be adversely impacted by this temperature condition. Please confirm that there are no other electrical components or instruments needed for the strategy that will be subject to this temperature level. If there are any electrical components or instruments subject to this temperature provide a basis for their qualification.<br>Note: The NRC staff is reviewing licensee's structural evaluation for this area that has been provided on the ePortal after the onsite audit. |
| CI 3.2.4.3.A                | Evaluate susceptibility for freezing and boron solidification during the ELAP event scenarios.  | Make available for NRC staff review on the ePortal the operating temperature ratings for FLEX equipment that will be operated in low temperature conditions.<br>Note: The NRC staff is reviewing licensee's updated information for this item that has been provided on the ePortal after the onsite audit.  |
| CI 3.2.4.6.A                | Provide analyses and procedures to address ventilation of areas such as equipment rooms and the spent fuel pool area.   | Make available for NRC staff review on the ePortal a list of areas that need access to implement the FLEX strategy. Also provide the associated temperature analyses for those areas during the ELAP/LUHS event as well as the procedures/guidelines for any operator actions credited in the analyses.  |
| AQ.2                        | Internal flooding   | Perform an evaluation of internal flooding sources and how they affect the FLEX strategy. Specifically, evaluate non-robust piping in Auxiliary Building rooms 1206/1207 where the primary and alternate core cooling connections are located.   |
| SE.6                        | Provide a summary of the assessment of temperature effects on the Phase 2 and Phase 3 FLEX generators as a result of extreme temperature hazards.   | Provide an assessment of the low temperature capability for the Phase 2 generator down to the site low temperature of -26 degrees Fahrenheit and make the assessment available for NRC staff review on the ePortal.<br>Note: The NRC staff is reviewing licensee's updated information for this item that has been provided on the ePortal after the onsite audit.   |
| SE.17                       | NEI 12-06 tables 3-1 and D-3 both specify the baseline capability of make to the SFP via hoses on the refuel floor direct to the pool and spray capability via portable monitor nozzles. The licensee's primary makeup method for the SFP uses installed piping and an installed spray nozzle. Also, the license uses separate, installed spray nozzles for the overspray capability. | Provide justification for the alternate approach to NEI 12-06, Rev 0, involving the use of installed piping and components as the primary SFP cooling method as well as installed spray nozzles.<br>Note: The NRC staff is reviewing licensee's justification for this item that has been provided in the 6-month update dated February 23, 2016.  |

| <b>Audit Item Reference</b> | <b>Item Summary Description</b>  | <b>Licensee Input Needed</b>  |
|-----------------------------|--|---|
| SE.18                       | Confirm the seismic protection of connection points and the access to those points through seismically robust structures in accordance with NEI 12-06 consideration 5.3.2.2. | Make available for NRC staff review on the ePortal the plan and associated procedures for a robust steam generator makeup pathway |

first six six-month updates to the OIP. The NRC staff's review to date led to the issuance of the Callaway ISE and RAI dated November 25, 2013 (ADAMS Accession No. ML13323A111). By letter dated March 26, 2014 (ADAMS Accession No. ML14083A620), the NRC notified all licensees and construction permit holders that the staff is conducting in-office and onsite audits of their responses to Order EA-12-051 in accordance with NRC NRR Office Instruction LIC-111, as discussed above.

The ongoing audits allow the staff to review open and confirmatory items from the mitigation strategies ISE, RAI responses from the spent fuel pool instrumentation (SFPI) ISE, the licensee's integrated plans, and other audit questions. Additionally, the staff gains a better understanding of submitted and updated information, audit information provided on e-portals, and preliminary Overall Program Documents/Final Integrated Plans while identifying additional information necessary for the licensee to supplement its plan and staff potential concerns.

In support of the ongoing audit of the licensee's OIPs, as supplemented, the NRC staff conducted an onsite audit at Callaway from January 25 - 28, 2016, per the audit plan dated November 9, 2015 (ADAMS Accession No. ML15309A326). The purpose of the onsite portion of the audit was to provide the NRC staff the opportunity to continue the audit review and gain key insights most easily obtained at the plant as to whether the licensee is on the correct path for compliance with the Mitigation Strategies and SFPI orders. The onsite activities included detailed analysis and calculation discussion, walk-throughs of strategies and equipment laydown, visualization of portable equipment storage and deployment, staging and deployment of offsite equipment, and physical sizing and placement of SFPI equipment.

The enclosed audit report provides a summary of the activities for the onsite audit portion. Additionally, this report contains an attachment listing all open audit items currently under NRC staff review.

If you have any questions, please contact me at 301-415-2833 or by e-mail at Peter.Bamford@nrc.gov.

Sincerely,

/RA/

Peter Bamford, Senior Project Manager  
Orders Management Branch  
Japan Lessons-Learned Division  
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure:

Audit report

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| DATE   | 03/17/16        | 03/18/16           | 03/22/16        |
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