



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

February 20, 2015

Ms. Mary G. Korsnick  
Chief Nuclear Officer  
Exelon Generation  
100 Constellation Way, Suite 500P  
Baltimore, MD 21202

SUBJECT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2 - 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 (TAC NOS. MF1142, MF1143, MF1140, AND MF1141)

Dear Ms. Korsnick:

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. ML13066A171), Exelon Generation, LLC, previously as Constellation Energy Nuclear Group, LLC (Exelon, the licensee) submitted its OIP for Calvert Cliffs Nuclear Power Plant, Units 1 and 2 (Calvert Cliffs), in response to Order EA-12-049. By letter dated March 8, 2013 (ADAMS Accession No. ML13074A056), Exelon submitted a complete revision of the OIP for Calvert Cliffs. By letters dated August 27, 2013, and February 27, 2014 (ADAMS Accession Nos. ML13254A278 and ML14069A318, respectively), the licensee submitted its first two 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 Calvert Cliffs' interim staff evaluation (ISE) and audit report (ADAMS Accession No. ML13225A566) and continues with in-office and onsite portions of this audit.

By letter dated February 28, 2013 (ADAMS Accession No. ML13066A172), the licensee submitted its OIP for Calvert Cliffs in response to Order EA-12-051. By letter dated June 19, 2013 (ADAMS Accession No. ML13164A393), the NRC staff sent a request for additional information (RAI) to the licensee. By letters dated July 3, 2013, August 27, 2013, and February 24, 2014 (ADAMS Accession Nos. ML13190A017, ML13254A279, and ML14069A180, respectively), the licensee submitted its RAI responses and first two six-month updates to the OIP.

The NRC staff's review to date led to the issuance of the Calvert Cliffs ISE and RAI dated November 15, 2013 (ADAMS Accession No. ML13281A205). 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 ePortals, 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 Calvert Cliffs from September 8-12, 2014, per the audit plan dated August 5, 2014 (ADAMS Accession No. ML14210A449), as supplemented by letter dated August 15, 2014 (ADAMS Accession No. ML14224A477). 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.

M. Korsnick

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If you have any questions, please contact me at 301-415-5888 or by e-mail at Jason.Paige@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read 'Jason Paige', with a long horizontal line extending to the right.

Jason Paige, Project Manager  
Orders Management Branch  
Japan Lessons-Learned Division  
Office of Nuclear Reactor Regulation

Docket Nos.: 50-317 and 50-318

Enclosure:  
Audit report

cc w/encl: Distribution via Listserv

Mr. George H. Gellrich, Vice President  
Calvert Cliffs Nuclear Power Plant, LLC  
Calvert Cliffs Nuclear Power Plant  
1650 Calvert Cliffs Parkway  
Lusby, MD 20657-4702

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  
EXELON GENERATION, LLC  
CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2  
DOCKET NOS. 50-317 AND 50-318

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.

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Enclosure

Instruction LIC-111, "Regulatory Audits" (ADAMS Accession No. ML082900195). This audit process led to the issuance of the Calvert Cliffs' interim staff evaluation (ISE) and audit report (ADAMS Accession No. ML13225A566) and continues with in-office and onsite portions of this audit.

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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 ePortals, and preliminary Overall Program Documents (OPDs)/Final Integrated Plans (FIPs) while identifying additional information necessary for the licensee to supplement its plan and address staff potential concerns.

In support of the ongoing audit of the licensee's OIPs, as supplemented, the NRC staff conducted an onsite audit at Calvert Cliffs from September 8-12, 2014, per the audit plan dated August 5, 2014 (ADAMS Accession No. ML14210A449), as supplemented by letter dated August 15, 2014 (ADAMS Accession No. ML14224A477). 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" issued in August, 2012 (ADAMS Accession No. ML12242A378), as endorsed by NRC 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'" (ADAMS Accession No. ML12229A174) as providing one 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 Calvert Cliffs facility from September 8, 2014, through September 12, 2014. The NRC audit team staff was as follows:

<b>Title</b>	<b>Team Member</b>
Team Lead/Project Manager	Jason Paige
Technical Support	Joshua Miller
Technical Support	Michael Levine
Technical Support	Kerby Scales
Technical Support	Carla Roque-Cruz
Associate Director	John McHale
Project Manager	Steve Monarque
Project Manager	Chuck Norton

The NRC staff executed the onsite portion of the audit per the three part approach discussed in the August 5, 2014, 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 (September 8, 2014)

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 "Calvert Cliffs Nuclear Power Plant Mitigating Strategies for Beyond-Design-Basis External Events." 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. Also presented was the design and location of the FLEX equipment storage facility, the FLEX equipment that would be stored there, the interface with the National SAFER Response Center, and 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 review for the items listed in the plan. Results of these technical reviews that require additional information from the licensee or still under NRC review are documented in the audit item status tables in Attachments 3 and 4, as discussed in the Conclusion section below.

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

The NRC staff reviewed Calvert Cliffs’ modeling of an extended loss of alternating current (ac) power (ELAP) event and its ability to mitigate the event, including the computer code used for the ELAP analysis and input parameters assumed to generate the results of the analysis (i.e., the reactor coolant pump seal leakage, reactor coolant system (RCS) venting, etc.). Specifically, while discussing ISE OI 3.2.1.1.A, the licensee confirmed that they are using the CENTS code to perform its analysis of RCS cooling and inventory control during an ELAP. The licensee indicated that they followed the Pressurized-Water Reactor Owners Group (PWROGs) recommendations to use the Reactor vessel level monitoring system as indication and to inject into the RCS before transition from two phase natural circulation to reflux cooling. The licensee’s predicted time to reach reflux cooling is 24.7 hours and they plan to have the ability to inject by 10 hours. Currently, the staff does not need any additional information from the licensee and considers ISE OI 3.2.1.1.A closed.

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

The NRC staff reviewed the calculations on extending battery life based on load shedding, and walked down the turbine-driven auxiliary feedwater (TDAFW) pump, Switchgear, Battery, and Control rooms to evaluate strategies for hydrogen and temperature control. Specifically, in review of ISE CI 3.2.4.2.C, the staff reviewed calculation CA08253 ECP-14-000105-MU-01, Rev 0, “Room Heatup for FLEX Evaluation” and E-85-11, “Hydrogen Generation for 125 Volt DC Batteries for Baltimore Gas and Electric Calvert Cliffs Nuclear Plant,” to verify the hydrogen peaks in the battery rooms during charging. The calculations determined that hydrogen peaks at 0.15 percent, which is below the 2 percent limit, when the doors are opened at 4 hours to provide ventilation. The staff also walked down panels used for load shedding to evaluate feasibility and timing. Lastly, the NRC staff walked down FLEX electrical equipment which was already on site.

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

The NRC staff walked down the SFP area, SFP instrumentation locations, and related equipment mounting areas. No concerns were identified during the walk-downs.

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

- a. In review of ISE CI 3.1.1.1.A and ISE CI 3.1.1.1.B, FLEX equipment storage, the staff noted that Calvert Cliffs FLEX storage configuration consists of two storage

buildings. One building will store N sets of FLEX equipment (N-building) and the second building (+1-building) will contain the additional +1, set of FLEX equipment. The N-building is hardened against all BDBEES and the +1-building is hardened against all BDBEES except for tornado winds/missiles. The buildings are separated by a distance that precludes both buildings being affected by a tornado hazard BDBEE.

NRC staff identified that the Calvert Cliffs N-building / +1-building FLEX equipment storage configuration is not consistent with the tornado wind/missile hazard reasonable protection configurations described in the NEI guidance contained in Section 7.3.1 of NEI 12-06. Section 7.3.1.1.a describes a configuration where FLEX equipment is reasonably protected in a structure designed to withstand the tornado wind/missile hazard. The +1 building is not hardened against tornado hazards and, therefore, does not meet the guidance contained in NEI 12-06, Section 7.3.1.1.a.

NEI 12-06, Sections 7.3.1.1.b and 7.3.1.1.c describe configurations where FLEX equipment is reasonably protected against tornado hazards by an adequate separation distance and orientation. The NRC position is that configuration 7.3.1.1.b and 7.3.1.1.c require N sets of equipment to be stored in each diverse location for a FLEX storage configuration that consists of only 2 locations. While the N-building and +1-building are adequately separated, only one of the locations contains the full N set of FLEX equipment and, therefore, does not meet the guidance contained in NEI 12-06, Section 7.3.1.1.b or 7.3.1.1.c.

NEI 12-06, Section 11.3.3 states the following:

FLEX mitigation equipment should be stored in a location or locations informed by evaluations performed per Sections 5 through 9 such that no one external event can reasonably fail the site FLEX capability (N).

NEI Section 10.1, "Aggregation of FLEX Strategies," includes the following:

Provision of at least N+1 sets of portable on-site equipment stored in diverse locations or in structures designed to reasonably protect from applicable BDBEES is essential to provide reasonable assurance that N sets of FLEX equipment will remain deployable to assure success of the FLEX strategies.

Per the guidance above, it is essential to reasonably protect at least N+1 sets of FLEX equipment from all applicable BDBEES to reasonably assure that N sets (FLEX capability, per section 11.3.3) will remain deployable after the BDBEE. When the reasonable protection scheme of either Section 7.3.1.1.b or 7.3.1.1.c is utilized, 2 sets of N FLEX equipment must be located in the separate locations. The Calvert Cliffs FLEX equipment storage configuration does not meet the reasonable protection schemes of Section 7.3.1.1.b or 7.3.1.1.c since N sets of FLEX equipment are not contained in both locations. Also, as noted above, the Calvert Cliffs FLEX equipment storage configuration does not meet the reasonable protection scheme of Section 7.3.1.1.a since only N sets of FLEX equipment are stored in a robust



structure that protects against all BDBEEs. Therefore, the Calvert Cliffs FLEX equipment storage configuration does not meet the guidance contained in NEI 12-06, Section 10.1, in that it only affords reasonable protection from all applicable BDBEEs for N sets of FLEX equipment, not N+1 sets, as stipulated in the NEI guidance as described above.

The NRC staff further identified that the Calvert Cliffs FLEX storage configuration would not support the maintenance and testing provisions contained in Section 11.5.3 of NEI 12-06. Specifically, section 11.5.3.b states:

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

Should an item of FLEX equipment be made unavailable in the N-building, the site FLEX capability (N) would no longer be available to mitigate a tornado related BDBEE. The corresponding +1 item of FLEX equipment is not considered to be reasonably protected against the tornado hazard, and therefore, is not reasonably assured to be available or remain deployable to assure success of the FLEX strategies. The remaining available and deployable FLEX equipment, reasonably protected in the N-building, would be less than the site FLEX capability (N). Therefore, the Calvert Cliffs FLEX equipment storage configuration would not meet the condition included in NEI 12-06, Section 11.5.3.b (site Flex capability (N) is available) stipulated for the allowance of the 90-day portable equipment unavailability.

The NRC staff communicated to the licensee that the Calvert Cliffs FLEX storage configuration is not consistent with guidance contained in NEI 12-06. Further consideration of the Calvert Cliffs FLEX storage configuration by the NRC staff would require that the licensee propose the configuration as an alternative to the guidance of NEI 12-06, accompanied with appropriate justification.

- b. In review of ISE CI 3.1.2.2.B, connection points for portable equipment, the staff walked down the external FLEX connections for the condensate storage tanks (CSTs). The licensee stated that based on the flood hazard report submitted in March 2013, the flood path from a local intense precipitation (LIP) event does not affect the CSTs. The staff walked down the proposed FLEX connections to verify the predicted flood level during a LIP event. The staff has no further questions regarding flood protection of the CST FLEX connections.
- c. In review of ISE CI 3.1.2.2.C, the staff walked down the primary and alternate drafting locations for the ultimate heat sink (UHS). The licensee stated that there are two locations where water will be taken from the Chesapeake Bay. The first location is from the plant discharge outfall and the second location is in the intake canal downstream of the intake trash racks. The licensee stated that the FLEX hoses will have strainers attached on the ends to preclude large debris from entering the hoses. In addition, the alternate location is located downstream of the trash racks which will preclude large amounts of debris from entering the drafting location. The staff has no further questions regarding drafting locations from the UHS.

- d. In review of ISE CI 3.2.4.6.C, the staff reviewed the possible effects of a BDBEE on the turbine building structure and the potential effect on the access to the TDAFW pump room. The staff reviewed the licensee's response that the turbine building is a Seismic Class II building and would maintain its integrity during a seismic event. In addition, the licensee indicated that should the normal access path through the turbine building to the TDAFW pump room is blocked or rendered unsafe following a seismic event, an alternate route to reach the pump room has been selected. The alternate pathway will be through the seismic Auxiliary Building through an access man way leading to the pump room. The licensee noted that step ladders will be permanently staged in both the Auxiliary Room and the TDAFW pump room to aid in the safe access into the man way.
- e. In review of AQ 3 (AQ 4), large internal flooding sources that are not seismically robust and the use of ac power to mitigate ground water in critical locations, the staff reviewed the licensee's seismic analysis that was conducted as part of the Internal Plant Examination of External Events (IPEEE), which analyzed the susceptibility of seismic induced internal flooding. In the analysis, the licensee noted that the service water piping in the turbine building could be a potential flood source if the piping breaks during a seismic event; however, the IPEEE flooding analysis concluded that the flooding from the service water in the turbine building presents no plant risk to plant safety. Regarding ac power to mitigate ground water, the staff confirmed that Calvert Cliffs utilizes a gravity drainage system, Subsurface Drainage System (SSD), and does not require ac power to mitigate groundwater. The licensee stated that the SSD was installed to lower the original plant ground water elevation. Currently, the staff does not need any additional information from the licensee.
- f. In review of AQ 16 (AQ 18), RCP seal leakage rates, the licensee stated that the Calvert Cliffs ELAP analysis regarding RCP leakage assumes that once RCP seal failure occurs, the leakage flow path characteristics remain constant for the rest of the event. The configuration of the controlled bleedoff line with the check valve maintains the flow through the line constant and the vapor seal maintains the shaft seal integrity. The analysis assumes a catastrophic failure of the RCP seals resulting in the maximum leak rate of 15 gpm per RCP. Currently, the staff does not need any additional information from the licensee.
- g. In review of AQ 37 (AQ 47), cooling and makeup water inventories, the staff walked down the proposed water sources to be used during an ELAP. The licensee stated that the 12 CST is protected from all design-basis external hazards and is therefore considered robust as defined in NEI 12-06. The CST can supply water to both units steam generators (SG) for approximately 10 hours. The licensee's strategy is to use any available water to make-up to 12 CST in order of water quality. The licensee's last resort would be the Chesapeake Bay (their UHS). Due to the 12 CST's ability to supply the SGs for 10 hours, the licensee should have sufficient time to initiate their Phase 2 strategy to provide makeup water to the 12 CST from the UHS before depletion of the tank. The staff has no further questions regarding water sources for SG make-up.
- h. In review of SE Review Item 1, RCS venting, the NRC staff verified that Calvert Cliffs does not need to vent the RCS in order to inject a sufficient quantity of borated

coolant to assure adequate shutdown margin. The licensee determined that boration would not be needed until 32 hours after the ELAP event initiation. Although not required for boration, if venting the RCS were desired under ELAP conditions, the licensee has available reactor head vents that are qualified for liquid, vapor, and two-phase mixtures of water, as well as non-condensables. The licensee also has pressurizer vents with the same qualifications as the reactor head vents. The pressurizer PORVs could further be used as a last option, since the PORV block valves will be reenergized at about 6 hours when the 500kw diesel generators (DGs) are connected. The staff has no further questions regarding RCS venting.

#### 4.0 Exit Meeting (September 12, 2014)

The NRC staff audit team conducted an exit meeting with licensee staff following the closure of onsite audit activities. The NRC staff highlighted items reviewed and noted that the results of the onsite audit trip will be documented in this report. The following items that require additional information from the licensee or are still under NRC review were discussed at the exit meeting (see Attachments 3 and 4 for additional information):

- a. ISE CIs 3.1.1.4.A, 3.1.2.2.A, 3.1.2.2.B, and 3.2.4.5.A, Staging Areas  
The NRC staff reviewed the staging areas and deployment routes to deliver equipment to the site for all hazards. The licensee indicated that the FLEX deployment strategy and route plan are currently being drafted. In addition, the playbook, which will provide details of the staging areas and how to deliver the portable FLEX equipment from the National SAFER Response Centers to the local staging areas and from the local staging areas to the site, is being finalized. The NRC staff requested that the licensee provide a copy of the playbook once it's finalized.
- b. ISE CI 3.1.3.2.A, Debris Removal  
The NRC staff discussed with the licensee their plan to remove debris with their varied array of wheeled vehicles, e.g., forklifts, small tractors, and a backhoe. However, the licensee did not specify which equipment is credited in their strategy and how they plan to protect the equipment. The staff requested that the licensee provide a list of the credited debris removal equipment and how they plan on protecting the equipment from high winds and other hazards.
- c. ISE CI 3.1.4.2.A, Impact of Extreme Temperature Environments  
The NRC staff discussed with the licensee procurement requirements to ensure that FLEX equipment can be operated in extreme hot or cold temperature environments and how hot or cold temperatures will affect manual actions. The licensee indicated that FLEX equipment is being procured to the extreme hot and cold temperature environments specified in Calvert Cliffs Design Criteria Document, "Implementation of Diverse and Flexible Coping Strategies." However, evaluations are being performed for equipment for which specifications did not include extreme temperature ranges. In addition, the licensee plans on performing an evaluation to show how extreme temperatures will affect manual actions. The NRC staff requested that the licensee provide the referenced evaluations.

- d. ISE CIs 3.2.1.6.A and 3.2.1.6.B and AQ 23 (AQ 27), Sequence of Events  
The NRC staff discussed with the licensee its basis for the sequence of events action time constraints. The licensee indicated that the sequence of events action times were revised due to ongoing calculations and are awaiting validation. For example, the completion of the battery coping calculations for the load shed strategy has identified the need to re-sequence the action items in the procedures. The NRC staff requested that the licensee provide the finalized calculations and the basis for the revised sequence of events action items.
- e. ISE CI 3.2.1.7.A and AQ 38 (AQ 48), Shutdown and Refueling Modes  
The NRC staff discussed with the licensee its strategy for responding to an ELAP event while Calvert Cliffs is either in Shutdown or Refueling mode. The licensee indicated that it will follow the generic resolution that is being generated by the PWROG, which is the development of high level strategies for maintaining key safety functions when a unit is in a shutdown condition with residual heat removal systems in service at the onset of an ELAP event. At the time, the NRC staff was reviewing the PWROG generic resolution document. In addition, after the conclusion of the onsite audit, the licensee provided its justification for using the refueling water tank. The staff is currently reviewing the licensee's justification.

In addition, the NRC staff walked down the refueling water storage tank (RWST) and the licensee confirmed that the RWST does not have the requisite tornado driven missile protection. The NRC staff requested that the licensee provide justification for assuming the RWST is available for use during Modes 5 and 6, provide a strategy to flood the refueling cavity using a protected water source, or provide a discussion of compensatory measures to ensure that the licensee will not enter in to any vulnerable evolutions (e.g. mid-loop operations, removal of vessel head, etc.) during severe weather events with the possibility of tornado activity.

- f. ISE CI 3.2.1.9.C, Engineering Evaluations of Phase 3 Equipment  
The NRC staff requested that the licensee provide the revised analyses as detailed engineering evaluations for each of the Phase 3 FLEX component and modification strategy.
- g. ISE CI 3.2.4.9.A and AQ 43 (AQ 54), Fuel Oil Consumption  
The NRC staff discussed with the licensee the fuel consumption rate for all of the FLEX equipment that could be in operation during an ELAP. The licensee indicated that all equipment tanks will be full of fuel at the start of an ELAP, which prevents the need to fuel in Phase 1. However, the licensee did not identify all of the necessary FLEX equipment; therefore, the fuel consumption evaluation was not complete. The NRC staff requested that the licensee provide their fuel consumption evaluation once completed. After the conclusion of the onsite audit, the licensee provided its fuel consumption strategy. The staff is currently reviewing the strategy.
- h. ISE CI 3.2.4.10.A and AQ 34 (AQ 39), DC Load Shedding  
The NRC reviewed and performed a walkdown of the load shed procedure, ERPIP-0653, ELAP DC Bus Load Shed and Management. The licensee indicated that the load shed procedure is being finalized and a time-motion study will be performed to validate that the dc load shed can be completed within 1 hour. The NRC staff

requested that the licensee provide ERIP-0653 and the time-motion study once completed. In addition, the NRC staff requested that the licensee provide calculation CA08257, Battery 12 Load Shed Coping Time for ELAP Event and study CCN0012-17-Study-001, Analysis of Calvert Cliffs DC System in Support of INPO Event Report 11-4.

i. ISE CI 3.4.A, Off-Site Resources

The NRC staff discussed with the licensee its plan to address minimum capabilities of off-site resources, outlined in the 10 guidelines in NEI 12-06. The licensee indicated that the National SAFER Response Center generated a generic response to address the guidelines, and coordination of Calvert Cliffs' strategies with the National SAFER Response Center is ongoing. The NRC staff has a copy of the generic response and is currently reviewing the document.

j. AQ 1 (AQ 2), Power Supply

The NRC staff discussed with the licensee the need for power to move, deploy, or gain access to FLEX equipment (e.g., to open the door from a storage location). The licensee indicated that they are currently evaluating two options for the FLEX building doors. The first option is doors that could slide or roll up electronically, hydraulically, and manually. In addition, the doors would have a backup disconnect and plug for a small portable generator to open the doors. The second option is to erect a passive concrete missile barrier wall in front of the doors. The passive walls would be offset enough to allow trucks and trailers to negotiate around them, but provide a torturous path to prevent tornado/hurricane driven missiles from directly hitting any door. The NRC staff requested that the licensee provide the final design of the FLEX building doors.

k. AQ 21 (AQ 25), DG Sizing Calculations

The NRC staff performed a walkdown of the FLEX DG staging locations. In addition, the staff reviewed the FLEX DG calculation including the DG loads, the effects of starting the largest load, line loss/voltage drop, and the FLEX cable ampacity and impedance values. The NRC staff requested that the licensee provide information regarding the FLEX DG automatic shutdown features for environmental reasons (i.e. fuel quality), provide verification of the phase rotation of the DGs, and provide calculations of the final Phase 3 loads for the National SAFER Response DGs. After the conclusion of the onsite audit, the licensee provided information on the ePortal. The staff is currently reviewing the information.

l. AQ 32 (AQ 37), Electrical Isolation

The NRC staff discussed with the licensee its plan to maintain electrical isolation such that Class 1E equipment is protected from faults in portable/FLEX equipment. The NRC staff requested that the licensee provide drawings showing the connection points for the Phase 2 and 3 FLEX DGs.

m. SE Review Item 4, Safety Injection Tanks (SITs)

The NRC staff discussed with the licensee isolation of the SITs to ensure that nitrogen injection into the RCS is prevented. The licensee stated that SIT isolation will be based on indicated level reaching a procedure specified value (10 inches). The level will be provided by the wide range SIT level indicator, which will be

available throughout the event powered from the 120v vital instrument bus. However, the staff requested the following information: 1) provide a calculation that shows the time that SIT isolation will occur during the prescribed ELAP event; 2) clarify whether the method for determining this time is based on the generic method for determining the SIT nitrogen injection pressure in Attachment 1 to the PWROG's interim core cooling position paper. If a different method is used, provide justification for its adequacy; 3) clarify whether plant procedures include directions for the contingency that the SIT levels are less than ten inches and the motor-operated valves (MOVs) have not yet been repowered (e.g., would operators be directed to halt or reverse the depressurization and cooldown to prevent nitrogen gas intrusion to RCS or would depressurization continue?).

n. SE Review Items 5 and 6, RCS Pump Hydraulic Analysis

While onsite, the staff reviewed the licensee's FLEX pump hydraulic analysis and noted that the analysis assumed that a centrifugal pump would be used for RCS injection. However, the licensee changed that assumption and plans to use a positive displacement pump. The NRC staff requested that the licensee reevaluate the hydraulic analysis to take into consideration the positive displacement pump and provide the revised analysis once completed.

Also, while reviewing the hydraulic analysis, the staff noted that the analysis recommends using flexible hoses with a higher service pressure commensurate with the shutoff head of the pump to which the hoses will be connected. However, the hoses the licensee plans to use in their FLEX strategies do not have the requisite service pressure rating. The NRC staff requested that the licensee provide justification for using lower rated hoses than the hydraulic analysis recommends.

## CONCLUSION

The NRC staff completed all three parts of the August 5, 2014, 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, Attachments 3 and 4 provide the status of all open audit review items that the NRC staff is evaluating in anticipation of issuance of a combined safety evaluation for both the Mitigation Strategies and Spent Fuel Pool Level Instrumentation orders. The five sources for the audit items referenced below are as follows:

- a. Interim Staff Evaluation (ISE) Open Items (OIs) and Confirmatory Items (CIs)
- b. Audit Questions (AQs)
- c. Licensee-identified Overall Integrated Plan (OIP) Open Items (OIs)
- d. Spent Fuel Pool Level Instrumentation (SFPLI) Requests for Additional Information (RAIs)

- e. Additional Safety Evaluation (SE) needed information

The attachments provide audit information as follows:

- a. Attachment 1: List of NRC staff and licensee staff audit participants
- b. Attachment 2: List of documents reviewed during the onsite audit
- c. Attachment 3: Calvert Cliffs MS/SFPI SE Audit Items currently under NRC staff review and requiring licensee input as delineated
- d. Attachment 4: Calvert Cliffs MS/SFPI SE Audit Items currently under NRC staff review but not requiring further licensee input

While this report notes the completion of the onsite portion of the audit per the audit plan dated August 5, 2014, the ongoing audit process continues as per the letters dated August 28, 2013 and March 26, 2014, to all licensees and construction permit holders for both orders.

Additionally, while Attachments 3 and 4 provide 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.

Lastly, the licensee has identified open items that need to be completed to implement Orders EA-12-049 and EA-12-051, and the staff expects that the licensee continue to provide updates on the status of the licensee identified open items in their 6-month updates or on the ePortal.

Attachments:

1. NRC and Licensee Staff Onsite Audit Participants
2. Onsite Audit Documents Reviewed
3. Calvert Cliffs MS/SFPI SE Audit Items currently under NRC staff review and requiring licensee input
4. Calvert Cliffs MS/SFPI SE Audit Items currently under NRC staff review but not requiring further licensee input

## Onsite Audit Participants

### NRC Staff:

Jason Paige	NRR/JLD/JOMB
Kevin Roche	NRR/JLD/JCBB
Joshua Miller	NRR/JLD/JERB
Kerby Scales	NRR/JLD/JERB
John McHale	NRR/JLD

Stephen Wyman	NRR/JLD/JERB
Michael Levine	NRR/JLD/JCBB
Stephen Monarque	NRR/JLD/JOMB
Charles Norton	NRR/JLD/JOMB

### Calvert Cliffs' Staff:

Kelly Root	FLEX Emergency Preparedness Lead
Beth Nolan	Projects Fukushima
David Schupp	Corporate FLEX, Operations
Steven Pierson	Corporate PWR FLEX, Operations
Todd Tierney	Calvert Cliffs Operations, Director
Chuck Benrend	Corporate Fukushima Lead
Chuck Merritt	Calvert Cliffs Fukushima Project
Ken Robinson	Engineering Director
David Lynch	Calvert Cliffs SOS Operations
Mitch Beckman	Calvert Cliffs Maintenance
Tuane Young	Security, Manager
Curtis Hehl	Project Management, Manager
Brian Fuke	Emergency Preparedness Manager
Jim Comeaux	Fukushima Procedure
Jim Adams	Fukushima Project Manager
Bob Pace	Fukushima, Operations
Frank Higgins	Fukushima Seismic and Flooding
Mark Campagna	FLEX Modifications
Emron Hussan	Design
Jim Remeniuk	Structures
Michael Fick	Regulatory Assurance
Sheldon Waiters	FLEX
D. Dvordic	Design



## Documents Reviewed

- CCNPP TDAFW Pump Analysis
- Procedure ERPIP-0651, ELAP DC Bus Load Shed and Management
- Plant specific neutronics analysis CA08023
- Procedure ERPIP-650
- PWROG-14014-NP
- Calculation CA08253 ECP-14-000105-MU-01, Rev 0, Room Heatup for FLEX Evaluation
- Calculation E-85-11, Hydrogen Generation for 125 Volt DC Batteries For Baltimore Gas and Electric Calvert Cliffs Nuclear Plant
- Procedure FSG-16: ERPIP, Alignment for Area Cooling
- Calculation CA08801, Fukushima 480VAC FLEX 100KW Diesel Generator Sizing
- Calculation CA08800, Fukushima 480VAC FLEX 500KW Diesel Generator Sizing
- Exelon Fukushima FLEX 500kW Portable Diesel Generator Calvert Cliffs Engineering Submittal
- Procedure EOP-7, Draft Station Blackout, Rev. 18
- Calculation CA08256, Battery 11 Load Shed Coping Time For Elap Event (min. bus voltage 106.79V)
- Calculation CA08257, Battery 12 Load Shed Coping Time For Elap Event (min. bus voltage 106.40V)
- Calculation CA08258, Battery 21 Load Shed Coping Time For Elap Event (min. bus voltage 105.14V)
- Calculation CA08259, Battery 22 Load Shed Coping Time For Elap Event (min. bus voltage 106.79V)
- Study No: CCN0012-17-Study-001 (Analysis of Calvert Cliffs DC System in Support of INPO Event Report 11-4)

**Calvert Cliffs  
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 Description</b>	<b>Licensee Input Needed</b>
ISE CI 3.1.1.4.A ISE CI 3.1.2.2.A ISE CI 3.1.2.2.B ISE CI 3.2.4.5.A	Staging Areas, Deployment Routes, and Offsite Resources	The NRC staff requests that the licensee provide a copy of the playbook once it's finalized.
ISE CI 3.1.3.2.A	Debris Removal	The NRC staff requests that the licensee provide a list of the credited debris removal equipment and how they plan on protecting the equipment from high winds and other hazards.
ISE CI 3.1.4.2.A,	Impact of Extreme Temperature Environments	The licensee indicated that evaluations are being performed for equipment for which specifications did not include extreme temperature ranges. In addition, the licensee plans on performing an evaluation to show how extreme temperatures will affect manual actions. The NRC staff requests that the licensee provide the referenced evaluations.
ISE CI 3.2.1.6.A ISE CI 3.2.1.6.B AQ 23 (AQ 27)	Sequence of Events	The licensee indicated that the sequence of events action times were revised due to ongoing calculations and are awaiting validation. The NRC staff requested that the licensee provide the finalized calculations and the basis for the revised sequence of events action items
ISE CI 3.2.1.9.C	Engineering Evaluations of Phase 3 Equipment	The NRC staff requests that the licensee provide the revised analyses as detailed engineering evaluations for each of the Phase 3 FLEX component and modification strategy.

Audit Item Reference	Item Description	Licensee Input Needed
ISE CI 3.2.3.A AQ 10 (AQ 12)	Containment Response	In the Calvert Cliffs August 2013 6-month update, the licensee concludes that no active containment cooling would be required for more than 72 hours. The NRC staff requests that the licensee provide a calculation or a detailed summary of the analysis and results, in which supports the above conclusion.
ISE CI 3.2.4.2.E	Ventilation	The ventilation and heat-up calculation did not include a calculation for the West Electrical Penetration Room. The NRC staff requests that the licensee provide a heat-up calculation for the West Electrical Penetration Room.
ISE CI 3.2.4.6.A ISE CI 3.2.4.6.B	Temperature Profiles	The NRC staff requests that the licensee provide an analysis to determine the temperature profiles over 72 hours in the area around the Atmospheric Dump Valve enclosures and the Cable Spreading Room.
ISE CI 3.2.4.10.A AQ 34 (AQ 39)	DC Load Shedding	The NRC staff requests that the licensee provide ERIP-0653 and the time-motion study once completed. In addition, the NRC staff requests that the licensee provide calculation CA08257, Battery 12 Load Shed Coping Time For Elap Event and study CCN0012-17-Study-001, Analysis of Calvert Cliffs DC System in Support of INPO Event Report 11-4.
AQ 1 (AQ 2)	Power Supply	The NRC staff requests that the licensee provide the final design of the FLEX building doors.
AQ 32 (AQ 37)	Electrical Isolation	The NRC staff requests that the licensee provide drawings showing the connection points for the Phase 2 and 3 FLEX DGs.

<b>Audit Item Reference</b>	<b>Item Description</b>	<b>Licensee Input Needed</b>
AQ 38 (AQ 48)	Shutdown and Refueling Modes	The NRC staff requests that the licensee provide justification for assuming that the RWST is available for use during Modes 5 and 6, provide a strategy to flood the refueling cavity using a protected water source, or provide a discussion of compensatory measures to ensure that the licensee will not enter in to any vulnerable evolutions (e.g. mid-loop operations, removal of vessel head, etc.) during severe weather events with the possibility of tornado activity.
SE Review Item 4	Safety Injection Tanks (SITs)	The NRC staff requests the following information: 1) provide a calculation that shows the time that SIT isolation will occur during the prescribed ELAP event; 2) clarify whether the method for determining this time is based on the generic method for determining the SIT nitrogen injection pressure in Attachment 1 to the PWROG's interim core cooling position paper. If a different method is used, provide justification for its adequacy; 3) clarify whether plant procedures include directions for the contingency that the SIT levels are less than ten inches and the MOVs have not yet been repowered (e.g., would operators be directed to halt or reverse the depressurization and cooldown to prevent nitrogen gas intrusion to RCS or would depressurization continue?).

<b>Audit Item Reference</b>	<b>Item Description</b>	<b>Licensee Input Needed</b>
SE Review Items 5 and 6	RCS Pump Hydraulic Analysis	<p>While onsite, the staff was reviewing the licensee's FLEX pump hydraulic analysis and noted that the analysis assumed that a centrifugal pump would be used for RCS injection. However, the licensee changed that assumption and plans to use a positive displacement pump. The NRC staff requests that the licensee reevaluate the hydraulic analysis to take into consideration the positive displacement pump and provide the revised analysis once completed.</p> <p>Also, while reviewing the hydraulic analysis, the staff noted that the analysis recommends using flexible hoses with a higher service pressure commensurate with the shutoff head of the pump to which the hoses will be connected. However, the hoses the licensee plans to use in their FLEX strategies do not have the requisite service pressure rating. The NRC staff requests that the licensee provide justification for using lower rated hoses than the hydraulic analysis recommends.</p>

**Calvert Cliffs**

**Mitigation Strategies/Spent Fuel Pool Instrumentation Safety Evaluation Audit Items:**

**Audit Items Currently Under NRC Staff Review But Not Requiring Further Licensee Input**

<b>Audit Item Reference</b>	<b>Item Description</b>	<b>Action</b>
ISE CI 3.2.1.7.A AQ 38 (AQ 48)	Shutdown and Refueling Modes	The NRC staff discussed with the licensee its strategy for responding to an ELAP event while Calvert Cliffs is either in Shutdown or Refueling mode. The licensee indicated that it will follow the generic resolution that is being generated by the PWROG, which is the development of high level strategies for maintaining key safety functions when a unit is in a shutdown condition with residual heat removal systems in service at the onset of an ELAP event. The NRC staff is currently reviewing the PWROG generic resolution document. In addition, after the conclusion of the onsite audit, the licensee provided its justification for using the refueling water tank. The staff is currently reviewing the licensee's justification.
ISE CI 3.2.2.B ISE CI 3.2.4.1.A ISE CI 3.2.4.2.A ISE CI 3.2.4.2.B ISE CI 3.2.4.2.D	Ventilation	The NRC is currently reviewing the ventilation and heat-up calculation.

<b>Audit Item Reference</b>	<b>Item Description</b>	<b>Action</b>
ISE CI 3.2.4.9.A AQ 43 (AQ 54)	Fuel Oil Consumption	The NRC staff discussed with the licensee the fuel consumption rate for all of the FLEX equipment that could be in operation during an ELAP. The licensee indicated that all equipment tanks will be full of fuel at the start of an ELAP, which prevents the need to fuel in Phase 1. However, the licensee did not identify all of the necessary FLEX equipment; therefore, the fuel consumption evaluation was not complete. The NRC staff requested that the licensee provide their fuel consumption evaluation once completed. After the conclusion of the onsite audit, the licensee provided its fuel consumption strategy. The staff is currently reviewing the strategy.
AQ 21 (AQ 25)	DG Sizing Calculations	The NRC staff is currently reviewing the recently uploaded information on the ePortal.
SE Review Item 3	Human Factors	The NRC staff reviewed human factors associated with implementing Calvert Cliffs' plan. The staff reviewed procedure ERPIP-650, in which has procedural steps to declare 10 CFR 50.54(x) as well as 10 CFR 73.55(p). The licensee provided PWROG-14014-NP as its justification to proceduralize the above regulations. The NRC staff is currently reviewing the PWROG document.

M. Korsnick

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If you have any questions, please contact me at 301-415-5888 or by e-mail at Jason.Paige@nrc.gov.

Sincerely,

*/RA/*

Jason Paige, Project Manager  
Orders Management Branch  
Japan Lessons-Learned Division  
Office of Nuclear Reactor Regulation

Docket Nos.: 50-317 and 50-318

Enclosure:  
Audit report

cc w/encl: Distribution via Listserv

Mr. George H. Gellrich, Vice President  
Calvert Cliffs Nuclear Power Plant, LLC  
Calvert Cliffs Nuclear Power Plant  
1650 Calvert Cliffs Parkway  
Lusby, MD 20657-4702

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DATE	10/30/14	10/30/14	01/30/15	02/18/15
OFFICE	NRR/JLD/JCBB/BC	NRR/JLD/JOMB/BC(A)	NRR/JLD/JOMB/PM	
NAME	SBailey	MHalter	JPaige	
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