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

October 10, 2014

Mr. Thomas Joyce
President and Chief Nuclear Officer
PSEG Nuclear LLC
P.O. Box 236, N09
Hancocks Bridge, NJ 08038

SUBJECT: SALEM NUCLEAR GENERATING STATION, UNIT NOS. 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. MF0868, MF0869, MF0913, AND MF0914)

Dear Mr. Joyce:

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. ML13059A296), PSEG Nuclear LLC (PSEG, the licensee) submitted its OIP for Salem Nuclear Generating Station, Unit Nos. 1 and 2 (Salem), in response to Order EA-12-049. By letters dated August 25, 2013, February 25, 2014, and August 26, 2014 (ADAMS Accession Nos. ML13239A097, ML14058A230, and ML14240A265, respectively), PSEG submitted its first three 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 Salem interim staff evaluation (ISE) and audit report on January 24, 2014 (ADAMS Accession No. ML13339A667), and continues with in-office and onsite portions of this audit.

By letter dated February 28, 2013 (ADAMS Accession No. ML130640502), the licensee submitted its OIP for Salem in response to Order EA-12-051. By letter dated July 11, 2013 (ADAMS Accession No. ML13186A167), the NRC staff sent a request for additional information (RAI) to the licensee. By letters dated August 12, 2013, August 25, 2013, February 25, 2014, and August 26, 2014 (ADAMS Accession Nos. ML13225A363, ML13239A095, ML14058A232, and ML14240A249, respectively), the licensee submitted its RAI responses and first three six-month updates to the OIP. The NRC staff's review led to the issuance of the Salem ISE and RAI dated October 17, 2013 (ADAMS Accession No. ML13270A414). 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.

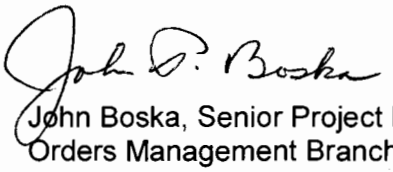
The ongoing audits allow the staff to review open and confirmatory items from the mitigation strategies ISE, RAI responses from the spent fuel pool instrumentation (SFPI) ISE, the licensee's integrated plans, and other audit questions. Additionally, the staff gains a better understanding of submitted 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 Salem from August 5-7, 2014 per the audit plan dated July 11, 2014 (ADAMS Accession No. ML14183A015). 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, review of staging and deployment of offsite equipment, and review of installation details for SFPI equipment. Two representatives from the State of New Jersey's Department of Environmental Protection observed the audit process.

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 301-415-2901 or by e-mail at John.Boska@nrc.gov.

Sincerely,



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

Docket Nos.: 50-272 and 50-311

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

PSEG NUCLEAR LLC

SALEM NUCLEAR GENERATING STATION, UNIT NOS. 1 AND 2

DOCKET NOS. 50-272 and 50-311

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. ML13059A296), PSEG Nuclear LLC (PSEG, the licensee) submitted its OIP for Salem Nuclear Generating Station, Unit Nos. 1 and 2 (Salem), in response to Order EA-12-049. By letters dated August 25, 2013, February 25, 2014, and August 26, 2014 (ADAMS Accession Nos. ML13239A097, ML14058A230, and ML14240A265, respectively), PSEG submitted its first three 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 Salem interim staff evaluation (ISE) and audit report on January 24, 2014 (ADAMS Accession No. ML13339A667), and continues with in-office and onsite portions of this audit.

By letter dated February 28, 2013 (ADAMS Accession No. ML130640502), the licensee submitted its OIP for Salem in response to Order EA-12-051. By letter dated July 11, 2013 (ADAMS Accession No. ML13186A167), the NRC staff sent a request for additional information (RAI) to the licensee. By letters dated August 12, 2013, August 25, 2013, February 25, 2014, and August 26, 2014 (ADAMS Accession Nos. ML13225A363, ML13239A095, ML14058A232, and ML14240A249, respectively), the licensee submitted its RAI responses and first three six-month updates to the OIP. The NRC staff's review led to the issuance of the Salem ISE and RAI dated October 17, 2013 (ADAMS Accession No. ML13270A414). 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 (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 Salem from August 5-7, 2014, per the audit plan dated July 11, 2014 (ADAMS Accession No. ML14183A015). 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 using the Nuclear Energy Institute (NEI) developed 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 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'" (ADAMS Accession No. ML12229A174). For Order EA-12-051, the staff will make a safety determination using the NEI developed guidance document NEI 12-02, Revision 1, "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 for compliance, additional staff review will be required to evaluate the alternative strategy in reference to the applicable order.

AUDIT ACTIVITIES

The onsite audit was conducted at the Salem facility from August 5, 2014, through August 7, 2014. The NRC audit team staff was as follows:

Title	Team Member	Organization
Team Lead	David Allsopp	NRR/DIRS
Branch Chief	Stewart Bailey	NRR/JLD
Branch Chief	Bo Pham	NRR/JLD
Technical Support – Electrical	Prem Sahay	NRR/JLD
Technical Support – Reactor Systems	Diana Woodyatt	NRR/JLD
Technical Support – Balance of Plant	Michael Levine	NRR/JLD
Project Manager	John Boska	NRR/JLD

The NRC staff executed the onsite portion of the audit per the three part approach discussed in the July 11, 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 (August 5, 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 describing the site's strategies to meet the NRC orders. The licensee reviewed 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 reviewed was the design and location of the storage facilities for the FLEX equipment, the interface with the National Strategic Alliance for FLEX Emergency Response (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 and any additional review items needed from the licensee 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

NRC staff met with licensee staff to discuss the amount of leakage from the reactor coolant pump (RCP) seals, the timing of the injection of borated water into the reactor coolant system, and the mixing of that water during natural circulation conditions. NRC staff determined that the amount of leakage from the RCP seals needed to be finalized, and that would affect the other parameters.

3.2 Electrical Technical Discussions and Walk-Downs

a. NRC staff reviewed the calculations on extending battery life based on load shedding, and walked down the battery rooms to evaluate strategies for hydrogen and temperature control. NRC staff also walked down panels used for load shedding to evaluate feasibility and timing.

b. NRC staff walked down connection points and locations for FLEX electrical generators. The staff noted a concern that the phase rotation of the three-phase FLEX generators may not match the phase rotation of the site. The licensee committed to check phase rotation, and ensure that the coded phase wires would match the plant configuration. The staff reviewed the licensee's load and sizing calculations for the FLEX generators, and needs to review the final sizing calculations.

3.3 SFPI Technical Discussions and Walk-Downs

NRC staff walked down the location of the level sensors in the SFP, the connection boxes on the fuel handling building (FHB) inside wall where the coaxial cable connects to the hardline cable leading to the level sensor, and the locations of the readouts and the batteries in the reactor auxiliary building (RAB) relay room. The staff noted that readouts would also be available on two recorders in the main control room (MCR), on panel RP1. NRC staff also reviewed the routing of the cables. No concerns were identified during the walkdown.

3.4 Other Technical Discussion Areas and Walk-Downs

a. NRC staff met with licensee staff to discuss the required robust source of water for the turbine-driven auxiliary feedwater (TDAFW) pumps. The auxiliary feedwater storage tanks (AFSTs) were previously noted to be susceptible to tornado-borne missiles. The licensee is performing analyses to credit using the Hope Creek fire water tank and

diesel-driven fire pump to supply water to the TDAFW pumps. The staff walked down the physical location of the AFSTs and the Hope Creek fire water tank, and will review the final analyses.

b. NRC staff walked down the new FLEX equipment storage locations, Staging Area B, and the Staging Areas A. Staff identified a concern that Staging Area B could be impacted by collapse of the Hope Creek cooling tower. The licensee addressed this concern through separation distances and alternate routes.

c. In the case of a high storm surge from a hurricane, the tanks on the site may fail. In that case, water from the basement of the turbine building (TB) is the credited source of water for the steam generators (SGs). NRC staff walked down this water source. The water from the TB basement is pumped by sump pumps to a FLEX pump which then feeds the SGs. The NRC staff expressed a concern that adequate water level may not be present in the TB basement, and that the TB sump pumps may be unable to provide water flow due to a large check valve in the flow path. The licensee will address this concern.

d. There will be two FLEX generators permanently located in the Unit 2 canyon area (between the Unit 2 fuel handling building (FHB) and the reactor auxiliary building (RAB). In the case of a high storm surge from a hurricane, the licensee plans to move two additional FLEX generators into the canyon, and protect the generators by building a wall across the mouth of the canyon. The wall must protect against a storm surge of about 13 to 15 feet. The licensee plans to demonstrate building a prototype wall, and the NRC staff will review the feasibility of the construction.

e. 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 (primary and alternate). No concerns other than those stated elsewhere in this section were identified.

f. NRC staff walked down the access points to the safety-related fuel oil storage tanks (FOSTs), which will be the source of the diesel fuel used to refuel the FLEX equipment. The access points are accessible considering the current flooding licensing basis. Staff walked down the refueling paths to be used by the refueling trailer.

g. The licensee's cooldown strategy relies on operation of the SG power-operated relief valves (PORVs), which the licensee plans to operate from the MCR. The NRC staff noted that during an extended loss of alternating current power (ELAP) temperatures would be high in the outer penetration rooms where two of the SG PORVs are located. The staff has requested that the licensee evaluate if the PORVs are expected to remain functional considering the elevated temperatures.

4.0 Exit Meeting (August 7, 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

open items were discussed at the exit meeting (see Attachment 3 for additional information):

a. ISE OI 3.2.1.8.A, Core Sub-Criticality
The NRC concern is that boric acid needs to be added to the RCS and allowed to mix thoroughly with the water in the RCS before the cooldown and xenon decay bring the core back to criticality. There is a position paper from the Pressurized-Water Reactor Owners Group (PWROG) which addresses this concern, and an endorsement letter from the NRC dated January 8, 2015 (ADAMS Accession No. ML13276A183) which endorses the position paper with clarifications. The PWROG is still addressing some of the clarifications.

b. ISE OI 3.2.4.7.A, Water Sources
The NRC concern is that in order to have a timely source of water for the TDAFW pump, the licensee needs to demonstrate either 1) a tornado analysis for the Salem area that analyses typical tornado direction and width to support the separation approach, or 2) qualify the AFSTs for partial tank survivability. If Salem chooses the separation approach, the licensee needs to protect the Hope Creek fire water cross-connect valve to survive a tornado and verify all actions can be completed prior to RCS heatup due to SG dryout.

c. ISE CI 3.2.1.A, Applicability of WCAP Analysis
The licensee needs to specify which analysis performed in WCAP-17601-P is applicable to Salem (or produce a site-specific analysis) and justify the use of that analysis by identifying and evaluating the important parameters and assumptions demonstrating that they are representative of Salem and appropriate for simulating the ELAP transient. The licensee is deciding how to address the leakage rate from RCP seals.

d. ISE CI 3.2.1.1.A, Computer Code Used for ELAP Analysis
The licensee is currently relying on the NOTRUMP computer code for the ELAP analyses. The NRC staff has questions about the validity of the NOTRUMP code for the conditions for which it is being used and the PWROG is addressing this concern.

e. ISE CI 3.2.1.2.A, RCP Seal Leakage Rates
Confirm that the RCP seal initial maximum leakage rate used in the analysis is greater than or equal to the upper bound expectation for the ELAP event (21 gpm/seal) discussed in the PWROG white paper addressing the RCP seal leakage for Westinghouse plants.

f. ISE CI 3.2.1.2.B, RCP Seal Leakage Rates
For certain Westinghouse designs, a discussion of the information (including the applicable analysis and relevant seal leakage testing data) should be provided to justify that (1) the integrity of the associated seal O-rings will be maintained at the temperature conditions experienced during the ELAP event, and (2) the seal leakage rate of 21 gpm/seal used in the ELAP is adequate and acceptable.

g. ISE CI 3.2.1.9.A, Use of Portable Pumps
The NRC staff has concerns regarding the ability to maneuver the FLEX auxiliary feedwater and charging pumps on the 84' elevation of the Auxiliary Building given the constrained space. The staff is looking for information on the size of the pumps versus the available space to maneuver the pumps.

After the audit visit, the licensee provided additional information on how the pumps could be maneuvered in the available space. This item is now closed.

h. ISE CI 3.2.4.2.A, Ventilation – Equipment Cooling
The NRC staff is waiting to review the battery low temperature technical evaluation and waiting on the new GOTHIC calculation for the battery charger switchgear room that includes the battery chargers, and the evaluation to demonstrate that the battery chargers are qualified for the analyzed temperature.

i. ISE CI 3.2.4.8.A, Electrical Power Sources/Isolations and Interactions
The NRC staff needs to review the diesel generator sizing calculations, which were not completed.

j. ISE 3.2.4.10.A, Load Reduction to Conserve DC Power
The NRC completed its review of the draft battery load shed analyses, but needs to review the licensee's evaluation of the functions lost by DC load shedding, which was not completed.

k. AQ-29, Decay Heat Curve
The NRC staff needs to review the plant-specific auxiliary feedwater storage tank technical evaluation, for water supplies for decay heat removal, which was not completed.

l. AQ-34, Portable Boron Mixing Tank
The NRC staff is looking for an evaluation showing that one 1000 gallon tank will provide sufficient volume to feed both units. Also, if the batch stream is diluted, there is a concern as to how the licensee can measure the flowrate of the pure water stream if there is no power.

m. SFPI RAI-3, Loading Analysis and Manner of Attaching the Instrumentation
The NRC Headquarters staff needs to review the design change package, DCP 80108861.

n. SFPI RAI-20, Susceptibility to Electromagnetic Interference
The documentation for the spent fuel pool level instruments indicate some susceptibility to electromagnetic interference (EMI), which may result in invalid level indication. The documentation indicates that the level indication returns to normal when the EMI is removed. The NRC staff is looking for either the conduct of a full frequency EMI test or the insertion of a procedural caution that the use of hand held radios or similar devices may affect readings of the level instrumentation.

o. SE #2, RCP Seal Leakage and NSAL 14-1
Westinghouse nuclear safety advisory letter NSAL -14-1 indicates there may be higher leakage from the reactor coolant pump (RCP) seals during an extended loss of ac power (ELAP) than was previously analyzed. The license is working to resolve this issue, and is considering modifications to the plant. The NRC will review the final resolution.

p. SE #5, Accuracy of the NOTRUMP Computer Code
Westinghouse used the NOTRUMP computer code to develop certain timelines for operator actions in an ELAP event (see WCAP-17601-P for example). NRC simulations using the TRACE code indicate some differences, which may be significant enough to affect the timeline for operator actions. The PWROG is working with the NRC on a resolution, which may be applicable to all PWRs.

q. SE #6, Permanent Staging of FLEX Generators in the U2 Canyon
The NRC staff has concerns with the use of the canyon area as a permanent location for the diesel generators. Concerns include the susceptibility to damage caused by hydrogen and other compressed gas tanks which are stored on the roof directly above the alley and the ability to remove debris after a tornado. The staff would like to observe or view a video of the canyon wall being constructed.

r. SE #7, Feeding SGs From the Turbine Building Basement
Regarding sump pump operation after flooding the Turbine Building, provide a basis to show the length of time it will take to fill the demineralized water discharge pipe and if sufficient force can be generated to open the 16" check valve to the SG FLEX pump. Also, the NRC staff would like to see a timeline to fill the Turbine Building during a flood to show sufficient volume of water to allow feeding the SGs.

s. SE #8, Equipment Habitability For SG PORV Operation
Provide a basis (including modelling the louvers in the GOTHIC calculations for the penetration rooms if necessary) to show functionality of the SG power-operated relief valves (MS-10s) for the temperatures expected in the outer penetration rooms during an ELAP.

The following pending items were discussed at the exit meeting (see Attachment 3 for additional information):

a. ISE CI 3.2.1.6.A, Sequence of Events
The NRC staff reviewed changes to your sequence of events and have no concerns, the staff is waiting for you to issue these changes on the docket in an update to the Overall Integrated Plan.

b. ISE CI 3.2.4.8.B, Electrical Power Sources/Isolations and Interactions
The NRC staff needs to complete a review of the FLEX Support Guidelines (FSGs) to confirm that electrical isolation from the FLEX equipment is achieved as described during the audit.

c. ISE CI 3.2.4.8.C, Minimum DC Bus Voltage
NRC staff needs to complete its review of the calculations associated with the minimum required dc bus voltage.

d. SE #1, RCS Venting
NRC staff needs to complete its review of FSG-8, Alternate RCS Boration.

CONCLUSION

The NRC staff completed all three parts of the July 11, 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, Attachment 3 provides 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: MS/SFPI SE Audit Items currently under NRC staff review (licensee input needed as noted)

While this report notes the completion of the onsite portion of the audit per the audit plan dated July 11, 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 Attachment 3 provides a list of currently open items, 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. MS/SFPI Audit Items currently under NRC staff review

Onsite Audit Participants

NRC Staff:

David Allsopp	NRR/DIRS/IPAB
John Boska	NRR/JLD/JOMB
Diana Woodyatt	NRR/JLD/JERB
Prem Sahay	NRR/JLD/JERB
Stewart Bailey	NRR/JLD/JCBB

Michael Levine	NRR/JLD/JCBB
Bo Pham	NRR/JLD/JERB

Salem Staff:

Greg Sosson	Senior PM – Fukushima Response
Bob Henriksen	Fukushima Response Manager - Salem
Fred Priestley	Fukushima Response Team - Operations
Bill Wallace	Fukushima Response Team - Operations
Pat Ayers	Engineering
Jim Higgins	Engineering
Steve Pompper	Fukushima Response Team - Operations
Gary Ruf	Fukushima Response Engineering Manager
Bill McTigue	Licensing
Mike Slobodien	Emergency Services
Bob Swartzwelder	Engineering

Documents Reviewed

- Calculation ES-4.008, Rev 0, 125 VDC Beyond Design Base Event Battery Sizing Calculation (draft)
- Calculation ES-3.005, Rev 0, 28 VDC Beyond Design Base Event Battery Sizing Calculation (draft)
- Calculation 267750A, Seismic Criteria for Nuclear Service Water Connections
- Technical Evaluation 80111831-0020, Room Temperatures
- Technical Evaluation 80111831-0080, Battery Room Temperature
- Drawing, FLEX Overall Integrated Plan, Attachment E-1, FLEX 460V Power
- Drawing, FLEX Overall Integrated Plan, Attachment E-2, FLEX 230V Power
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-1, Service Water Intake Structure Connections
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-2, Turbine Building Submersible Pump Connection
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-3, HCGS Fire Protection Connection
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-4, Connection for FLEX AFW Pump Suction
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-5, Connection for FLEX AFW Pump Discharge
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-6, CVC Connection for FLEX Charging Pump Suction
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-7, SI Connection for FLEX Charging Pump Discharge
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-8, SI Connection for FLEX AFW Pump Suction
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-9, SI Connection for FLEX AFW Pump Discharge
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-10, SW-AFW Cross Tie Connection for FLEX AFW Pump Suction
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-11, CVC Boric Acid Tank Connection
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-12, SFP Riser to Refueling Deck
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-13, SFP Cooling System FLEX Connection
- Drawing, FLEX Overall Integrated Plan, Attachment CM-14, Unit 1 Fuel Oil Connection
- Drawing, FLEX Overall Integrated Plan, Attachment CM-14, Unit 2 Fuel Oil Connection
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-16, Page 1, Salem Unit 1 and 2 FLEX Piping to Supply Water to Secondary Side of all 4 Steam Generators
- Drawing, FLEX Overall Integrated Plan, Attachment 1M-16, Page 2, Salem Unit 1 and 2 FLEX Piping to Supply Water to Primary Side of all 4 Reactor Cold Legs
- Drawing 606366-A, Rev 0, Spent Fuel Probe Mount

- Draft SAFER Response Plan for Salem
- OP-AA-108-111-1001, Rev 9, Severe Weather and Natural Disaster Guidelines
- 1-EOP-LOPA-1, Rev 25, Loss of All AC Power
- S1.OP-FLEX.FSG-0001, Long Term RCS Inventory Control (draft)
- S1.OP-FLEX.FSG-0002, Alternate 13 Aux Feedwater Suction Source (draft)
- S1.OP-FLEX.FSG-0003, Alternate Low Pressure Feedwater (draft)
- S1.OP-FLEX.FSG-0004, ELAP DC Bus Load Shed/Management (draft)
- S1.OP-FLEX.FSG-0005, Initial Assessment and FLEX Equipment Staging (draft)
- S1.OP-FLEX.FSG-0006, Alternate Aux Feed Water Storage Tank Makeup (draft)
- S1.OP-FLEX.FSG-0007, Loss of Vital Instrumentation or Control Power (draft)
- S1.OP-FLEX.FSG-0008, Alternate RCS Boration (draft)
- S1.OP-FLEX.FSG-0009, Low Decay Heat Temperature Control (draft)
- S1.OP-FLEX.FSG-0010, Passive RCS Injection Isolation (draft)
- S1.OP-FLEX.FSG-0011, Alternate Spent Fuel Pool Makeup and Cooling (draft)
- S1.OP-FLEX.FSG-0012, Alternate Containment Cooling (draft)
- S1.OP-FLEX.FSG-0013, Transition From FLEX Equipment (draft)

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

Audit Items Currently Under NRC Staff Review, Requiring Licensee Input As Noted

Audit Item Reference	Item Description	Licensee Input Needed
ISE OI 3.2.1.8.A	Core Sub-Criticality: The NRC concern is that boric acid needs to be added to the RCS and allowed to mix thoroughly with the water in the RCS before the cooldown and xenon decay bring the core back to criticality. There is a position paper from the Pressurized-Water Reactor Owners Group (PWROG) which addresses this concern, and an endorsement letter from the NRC dated January 8, 2015 (ADAMS Accession No. ML13276A183) which endorses the position paper with clarifications. The PWROG is still addressing some of the clarifications.	Complete the EOP setpoint calculations. Determine how much RCP seal leakage must be considered in the ELAP analyses.
ISE OI 3.2.4.7.A	Water Sources: The NRC concern is that in order to have a timely source of water for the TDAFW pump, the licensee needs to demonstrate either 1) a tornado analysis for the Salem area that analyses typical tornado direction and width to support the separation approach, or 2) qualify the auxiliary feedwater storage tank for partial tank survivability. If Salem chooses the separation approach, the licensee needs to protect the Hope Creek fire water cross-connect valve to survive a tornado and verify all actions can be completed prior to RCS heatup due to SG dryout.	Provide a tornado analysis which demonstrates that the Hope Creek fire water tank is sufficiently separated from the AFSTs to preclude damage from a single tornado. Show that actions to switch to an alternate water supply can be completed prior to RCS heatup due to SG dryout.

Audit Item Reference	Item Description	Licensee Input Needed
ISE CI 3.2.1.A	Applicability of WCAP Analysis: The licensee has specified that the analysis of an ELAP event in WCAP-17601, section 5.2, is applicable to Salem.	Demonstrate how the Salem RCP seal leakage rate will meet the rate assumed in Section 5.2. Also, update the ELAP parameters comparison to show the Salem SG PORVs steam flow rate in percent of full power steam flow.
ISE CI 3.2.1.1.A	Computer Code Used for ELAP Analysis: The licensee is currently relying on the NOTRUMP computer code for the ELAP analyses. The NRC staff has questions about the validity of the NOTRUMP code for the conditions for which it is being used and the PWROG is addressing this concern.	Either the PWROG resolves the NRC's concerns, or Salem may be able to demonstrate sufficient margin through early injection of water to the RCS to avoid reflux cooling mode.
ISE CI 3.2.1.2.A	RCP Seal Leakage Rates: Confirm that the RCP seal initial maximum leakage rate used in the analysis is greater than or equal to the upper bound expectation for the ELAP event (21 gpm/seal) discussed in the PWROG white paper addressing the RCP seal leakage for Westinghouse plants.	Address Westinghouse NSAL 14-1, which stated that many RCP seal leakage rates exceed the values assumed in WCAP-17601.
ISE CI 3.2.1.2.B	RCP Seal Leakage Rates: For certain Westinghouse designs, a discussion of the information (including the applicable analysis and relevant seal leakage testing data) should be provided to justify that (1) the integrity of the associated seal O-rings will be maintained at the temperature conditions experienced during the ELAP event, and (2) the seal leakage rate of 21 gpm/seal used in the ELAP is adequate and acceptable.	NRC needs information on the effect of high temperatures on the RCP seals.
ISE CI 3.2.1.6.A	Sequence of Events: The NRC staff reviewed changes to the sequence of events and have no concerns.	The licensee should issue these changes to the NRC on the docket in an update to the Overall Integrated Plan.

Audit Item Reference	Item Description	Licensee Input Needed
ISE CI 3.2.3.A	Containment Cooling: The licensee committed to perform further containment analysis to demonstrate that containment integrity can be maintained up until a point in time when containment cooling can be restored during Phase 3.	Provide the new containment analysis.
ISE CI 3.2.3.B	Containment Functions Strategies: In the ISE review, the licensee stated that SGS plans to use the Modular Accident Analysis Program analysis to complete the FLEX strategies and timelines for containment cooling. Review these analyses when available.	Provide the new containment analyses.
ISE CI 3.2.4.2.A	Ventilation – Equipment Cooling: The NRC staff is waiting to review the battery low temperature technical evaluation and waiting on the new GOTHIC calculation for the battery charger switchgear room that includes the battery chargers, and the evaluation to demonstrate that the battery chargers are qualified for the analyzed temperature.	Provide the approved technical evaluations (80111831-0080) and GOTHIC calculation.
ISE CI 3.2.4.2.C	Ventilation – Equipment Cooling: The licensee stated that GOTHIC modeling and room heat-up calculations are being developed for plant strategic areas including the TDAFW rooms.	Provide the approved technical evaluations (80111831-0020) and GOTHIC calculation.
ISE CI 3.2.4.6.A	Personnel Habitability – Elevated Temperature: Confirm the maximum environmental room temperatures at ELAP coping periods greater than the 4-hours assumed in NUMARC 87-00, and confirm that measures are in place to ensure personnel habitability, as needed.	Provide the approved technical evaluations (80111831-0020) and GOTHIC calculation.

Audit Item Reference	Item Description	Licensee Input Needed
ISE CI 3.2.4.6.B	Personnel Habitability: The licensee stated that formal analyses would be performed to support the initial actions taken to provide cooling for the main control room until Phase 2 actions can be implemented.	Provide the approved technical evaluations (80111831-0020) and GOTHIC calculation.
ISE CI 3.2.4.8.A	Electrical Power Sources/Isolations and Interactions: The NRC staff needs to review the diesel generator sizing calculations, which were not completed.	Provide approved diesel generator sizing calculations.
ISE CI 3.2.4.8.B	Electrical Power Sources/Isolations and Interactions: The NRC staff needs to complete a review of the FLEX Support Guidelines (FSGs) to confirm that electrical isolation from the FLEX equipment is achieved as described during the audit.	Provide a summary of the licensee's evaluation of Action Tracking number 80108711-0330.
ISE CI 3.2.4.8.C	Minimum DC Bus Voltage: NRC staff needs to complete its review of the calculations associated with the minimum required dc bus voltage.	Provide approved calculations associated with the minimum required dc bus voltage.
ISE CI 3.2.4.10.A	Load Reduction to Conserve DC Power: The NRC completed its review of the draft battery load shed analyses, but needs to review the licensee's evaluation of the functions lost by DC load shedding, which was not completed.	Provide the evaluation of the functions lost by DC load shedding

Audit Item Reference	Item Description	Licensee Input Needed
ISE CI 3.3.2.A	Configuration Control: The licensee should address concerns with the single line diagrams of the proposed electrical systems. The NRC staff review of the Sketch E-2 indicated that some of the portable receptacles appear to show orientation of disconnecting blades inside receptacles such that the disconnecting blade would remain energized with the receptacles switch in de-energized position (i.e. blade inside receptacle may remain connected to the electrical power input side through the portable cables.). The NRC staff is concerned that such conditions inside the portable de-energized receptacle boxes with an energized blade may create a potential personnel hazard.	Address concerns on potential personnel hazard.
ISE CI 3.4.A	Offsite Resources: The licensee's Integrated Plan addressed the use of off-site resources per NEI 12-06, Section 12.2, Guideline 1.	The NRC issued an assessment of the National SAFER Response Centers. The licensee should address site specific aspects of implementation guidelines 2 through 10 of NEI 12-06.
AQ-29	Decay Heat Curve: The NRC staff needs to review the plant-specific auxiliary feedwater storage tank (AFST) technical evaluation, for water supplies for decay heat removal, which was not completed.	Provide the technical evaluation for the AFST water usage. Address how AFST volume and other analyses were calculated where decay heat is an input. Was the same ANS model used for these purposes, or were different models used for other applications, and how are they justified?
AQ-34	Portable Boron Mixing Tank: The NRC staff is looking for an evaluation showing that one 1000 gallon tank will provide sufficient volume to feed both units. Also, if the batch stream is diluted, there is a concern as to how the licensee can measure the flowrate of the pure water stream if there is no power.	Provide appropriate evaluations.

Audit Item Reference	Item Description	Licensee Input Needed
SE #1	RCS Venting: NRC staff needs to complete its review of FSG-8, Alternate RCS Boration.	NRC review in progress.
SE #2	RCP Seal Leakage and NSAL 14-1: Westinghouse nuclear safety advisory letter NSAL -14-1 indicates there may be higher leakage from the reactor coolant pump (RCP) seals during an extended loss of ac power (ELAP) than was previously analyzed. The license is working to resolve this issue, and is considering modifications to the plant. The NRC will review the final resolution.	Provide final resolution for this issue.
SE #5	Accuracy of the NOTRUMP Computer Code Westinghouse used the NOTRUMP computer code to develop certain timelines for operator actions in an ELAP event (see WCAP-17601-P for example). NRC simulations using the TRACE code indicate some differences, which may be significant enough to affect the timeline for operator actions. The PWROG is working with the NRC on a resolution, which may be applicable to all PWRs.	Provide PWROG resolution on accuracy of the NOTRUMP code.
SE #6	Permanent Staging of FLEX Generators in the U2 Canyon (an alternate to NEI 12-06): The NRC staff has concerns with the use of the canyon area as a permanent location for the diesel generators. Concerns include the susceptibility to damage caused by hydrogen and other compressed gas tanks which are stored on the roof directly above the alley and the ability to remove debris after a tornado. The staff would like to observe or view a video of the canyon wall being constructed.	Provide an evaluation of the susceptibility to damage for the FLEX generators. Demonstrate that construction of the canyon protective wall is viable.

Audit Item Reference	Item Description	Licensee Input Needed
SE #7	Feeding SGs From the Turbine Building Basement: Regarding sump pump operation after flooding the Turbine Building, provide a basis to show the length of time it will take to fill the demineralized water discharge pipe and if sufficient force can be generated to open the 16" check valve to the SG FLEX pump. Also, the NRC staff would like to see a timeline to fill the Turbine Building during a flood to show sufficient volume of water to allow feeding the SGs.	Provide the evaluation and timeline of the ability to pump water from the TB basement to the SGs.
SE #8	Equipment Habitability For SG PORV Operation Provide a basis (including modelling the louvers in the GOTHIC calculations for the penetration rooms if necessary) to show functionality of the SG power-operated relief valves (MS-10s) for the temperatures expected in the outer penetration rooms during an ELAP.	Provide the evaluation of the functionality of the SG PORVs.
SE #9	Validation and Verification: The licensee was developing procedures for validation and verification of the revised plant procedures and the new FSGs. The NRC will review those procedures.	Validation and verification procedures which also address human factors concerns.
SE #10	Shutdown/Refueling Modes: Salem will enhance shutdown risk processes and procedures using the supplemental guidance provided in the NEI position paper entitled "Shutdown / Refueling Modes," dated September 18, 2013 (Reference 12) and endorsed by the NRC via letter to NEI dated September 30, 2013	Provide the revised shutdown risk processes and procedures.

Audit Item Reference	Item Description	Licensee Input Needed
SE #11	Preventive maintenance: As part of the development of FLEX maintenance and testing programs, Salem will use the EPRI Technical Report entitled "Nuclear Maintenance Applications Center: Preventative Maintenance Basis for FLEX Equipment," transmitted to NRC via NEI letter dated October 3, 2013, and endorsed by NRC letter dated October 7, 2013.	Provide the FLEX maintenance and testing program.

If you have any questions, please contact me at 301-415-2901 or by e-mail at John.Boska@nrc.gov.

Sincerely,

/RA/

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

Docket Nos.: 50-272 and 50-311

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