



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

May 27, 2015

Mr. Bryan C. Hanson  
President and Chief Nuclear Officer  
Exelon Generation Company, LLC  
4300 Winfield Road  
Warrenville, IL 60555

SUBJECT: BRAIDWOOD STATION, 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. MF0895 AND MF0896)

Dear Mr. Hanson:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design-Basis External Events" and Order EA-12-051, "Issuance of 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. ML13060A362), Exelon Generation Company, LLC (Exelon, the licensee) submitted its OIP for Braidwood Station, Units 1 and 2 (Braidwood) in response to Order EA-12-049. By letters dated August 28, 2013, February 28, 2014, August 28, 2014 and February 27, 2015 (ADAMS Accession Nos. ML13241A286, ML14059A353, ML14248A223 and ML15058A420, respectively), the licensee submitted its first four 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 Braidwood interim staff evaluation (ISE) (ADAMS Accession No. ML13225A592) on December 17, 2013, and continues with in-office and onsite portions of this audit.

By letter dated February 28, 2013 (ADAMS Accession No. ML13059A265), the licensee submitted its OIP for Braidwood in response to Order EA-12-051. By letter dated July 11, 2013 (ADAMS Accession No. ML13191B255), the NRC staff sent a request for additional information (RAI) to the licensee. By letters dated July 31, 2013, August 28, 2013, February 28, 2014, August 28, 2014 and February 27, 2015 (ADAMS Accession Nos. ML13212A364, ML13241A240, ML14062A056, ML14248A208 and ML15058A555, respectively), the licensee submitted its RAI responses and first four six-month updates to the OIP. The NRC staff's review to date led to the issuance of the Braidwood ISE and RAI dated November 04, 2013 (ADAMS Accession No. ML13280A566). 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 Braidwood from February 23 - 26, 2015, per the audit plan dated December 30, 2014 (ADAMS Accession No. ML14356A004). 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 discussions, 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.

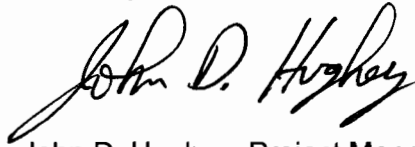
The enclosed audit report provides a summary of the activities for the onsite audit portion. Additionally, this report contains an attachment listing all open audit items currently under NRC staff review.

B. Hanson

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If you have any questions, please contact me at 301-415-3204 or by e-mail at [John.Hughey@nrc.gov](mailto:John.Hughey@nrc.gov).

Sincerely,

A handwritten signature in black ink that reads "John D. Hughey". The signature is written in a cursive style with a large, sweeping initial "J".

John D. Hughey, Project Manager  
Orders Management Branch  
Japan Lessons-Learned Division  
Office of Nuclear Reactor Regulation

Docket Nos.: STN 50-456 and STN 50-457

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  
EXELON GENERATION COMPANY LLC  
BRAIDWOOD STATION, UNITS. 1 AND 2  
DOCKET NOS. STN 50-456 and STN 50-457

BACKGROUND AND AUDIT BASIS

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design-Basis External Events" and Order EA-12-051, "Issuance of 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. ML13060A362), Exelon Generation Company, LLC (Exelon, the licensee) submitted its OIP for Braidwood Station, Units 1 and 2 (Braidwood) in response to Order EA-12-049. By letters dated August 28, 2013, February 28, 2014, August 28, 2014 and February 27, 2015 (ADAMS Accession Nos. ML13241A286, ML14059A353, ML14248A223 and ML15058A420, respectively), the licensee submitted its first four 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

Enclosure

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 Braidwood interim staff evaluation (ISE) (ADAMS Accession No. ML13225A592) on December 17, 2013, 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 Braidwood from February 23 - 26, 2015, per the audit plan dated December 30, 2014 (ADAMS Accession No. ML14356A004). 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.

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 Braidwood facility from February 23, 2015, through February 26, 2015. The NRC audit team staff was as follows:

<b>Title</b>	<b>Team Member</b>	<b>Organization</b>
Team Lead/Project Manager	John Hughey	NRR/JLD
Technical Support – Electrical	Matthew McConnell	NRR/JLD
Technical Support – Reactor Systems	Joshua Miller	NRR/JLD
Technical Support – Balance of Plant	On Yee	NRR/JLD
Technical Support – SFPI	Khoi Nguyen	NRR/JLD
Observer	Julie Boettcher	Region III/DRP
Observer	David Passehl	Region III/SRA

The NRC staff executed the onsite portion of the audit per the three part approach discussed in the December 30, 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 (February 23, 2015)

At the onsite 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 presented a review 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 reviewed were the design and location of the storage facilities for the FLEX equipment, the interface with the National Strategic Alliance for FLEX Emergency Response (SAFER), and the SFPI 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

The NRC staff met with licensee staff to discuss the amount of leakage from the reactor coolant pump (RCP) seals and the timing of the injection of borated water into the reactor coolant system (RCS), and the availability of water sources. The NRC staff reviewed the analyses and flow calculations along with applicable procedures including the plant parameters that will be monitored to indicate the potential for reactor core damage. The NRC staff also walked down the licensee's strategies and reviewed plant procedures for implementing the core cooling and makeup strategies. The NRC staff also reviewed Braidwood's modeling of an extended loss of alternating current 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. The 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

The NRC staff reviewed the calculations regarding battery life, FLEX generating sizing and walked down the procedures for electrical load shedding. The NRC staff also walked down the diesel-driven auxiliary feedwater pump room, battery rooms and control room envelope to evaluate strategies for hydrogen control and temperature control due to heat generating electrical equipment. The NRC staff reviewed the isolation and interactions of electrical power sources regarding the protection of class 1E equipment from faults in portable FLEX equipment and the design elements that ensure multiple electrical sources do not attempt to simultaneously power electrical buses. The NRC staff also walked down panels used for load shedding to evaluate feasibility and timing. Lastly, the NRC staff conducted a walk-through of portable FLEX diesel generator procedures, to include power pathways, areas where manual actions are required, and electrical isolation.

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

The NRC staff walked down instrument, transmitter, electronics, and display locations for the SFP level instrumentation, along with the associated cable runs. In addition, the NRC staff noted that the licensee had completed design calculations and drawings detailing the installation of the SFPI components as well as the associated calibration, maintenance and test procedures. During the onsite audit the NRC staff identified that a previously requested list of SFPI procedures was not complete. In continuing audit

activities, the licensee provided an additional listing of the remaining SFPI procedures and the associated audit item was closed.

### 3.4 FLEX Equipment Storage Configuration Discussion Areas and Walk-Downs

The Braidwood FLEX storage configuration consists of two storage buildings located adjacent to one another and located outside of the site protected area. 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 NRC staff identified that the Braidwood 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, Rev. 0. 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 Revision 0 of NEI 12-06, Section 7.3.1.1.a.

In 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. In addition to lacking N sets of equipment, the +1-building is located directly adjacent to the N-building and, therefore, does not meet the guidance contained in NEI 12-06, Rev. 0, Section 7.3.1.1.b or 7.3.1.1.c.

NEI 12-06, Rev. 0, 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 12-06, Rev. 0, 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 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.



The Braidwood FLEX equipment storage configuration does not protect the +1 set of FLEX equipment from the applicable BDBEE tornado hazard. Therefore, the Braidwood FLEX equipment storage configuration does not meet the guidance contained in NEI 12-06, Rev. 0, 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 Braidwood FLEX storage configuration would not support the maintenance and testing provisions contained in Section 11.5.3 of NEI 12-06, Rev. 0. 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 Braidwood FLEX equipment storage configuration would not meet the condition included in NEI 12-06, Rev. 0, 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 Braidwood FLEX storage configuration is not consistent with guidance contained in NEI 12-06, Rev. 0. Further consideration of the Braidwood 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, Rev. 0, accompanied with appropriate justification. Therefore, the associated FLEX audit item will remain open.

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

- a. The NRC staff reviewed the licensee's plans to ensure adequate communications, lighting, personnel access, and equipment access, to successfully implement the strategies. The staff interviewed plant personnel responsible for these areas, and observed lighting and communication needs during plant walkdowns.
- b. The NRC staff Reviewed Revision 1 of the Braidwood SAFER Response Plan. SAFER equipment staging areas and locations were noted as being documented in Chapter 5 of the plan. The initial fly or drive decision checklist is provided in Appendix 4C of the SAFER Response Plan.
- c. The NRC staff walked down the FLEX strategies for core cooling, RCS inventory, and SFP cooling functions. This included the point of deployment for the portable FLEX pumps, hose routing and deployment connection points (primary and alternate). The licensee will initially remove the core decay heat by adding water to

the steam generators (SGs) and releasing steam from the SGs to the atmosphere. The water will initially be added by the diesel-driven auxiliary feedwater (DDAF) pump, taking suction from the ultimate heat sink via the Essential Service Water (SX) system by gravity feed. Subsequently, a high pressure FLEX makeup pump will be connected to supply borated makeup water to the RCS, supplied from the Refueling Water Storage Tank. The NRC staff also reviewed the licensee's hydraulic analyses to ensure pump sizing and location were sufficient to provide the necessary water flow to perform the associated functions. In addition, the NRC staff reviewed the licensee's procedures to implement actions to address the potential for FLEX hose freezing.

- d. The NRC staff walked down the licensee's strategy for ventilating the control room envelope, battery room and DDAF room to ensure equipment reliability and personnel habitability.
- e. The NRC staff reviewed the strategy that will be implemented by the licensee to refuel the portable diesel-powered FLEX equipment. The NRC staff reviewed the instructions for refueling the equipment as well as the equipment needed to perform the refueling. The staff noted that the licensee's controls for ensuring adequate fuel quality will be addressed in the Braidwood FLEX maintenance and testing program.
- f. The NRC staff identified that the development of the FLEX maintenance and testing program is in progress. The licensee issued corrective action item AR 02459647 in the Braidwood corrective action program to track development and completion of the FLEX maintenance and testing program to include consideration of shelf life and acceptance criteria, manufacture recommendations and plant practices as well as consideration of the Electric Power Research Institute preventative maintenance templates. The associated audit item was closed to Braidwood corrective action item AR 02459647.
- g. The NRC staff confirmed that the deployment path and debris removal evaluations adequately justified the site capability to deploy FLEX equipment to mitigate the applicable BDBEEs.
- h. The NRC staff noted that the licensee completed initial FLEX training in March 2015. FLEX related Emergency Response Organization technical training and FLEX equipment operator training has been drafted and the associated task/Job analysis forms have been developed that include hands-on operation of equipment. FLEX continuing, periodic training for equipment and licensed operators has also been added to the Braidwood Long Range Training Plans.

#### 4.0 Exit Meeting (February 26, 2015)

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 NRC staff also discussed the remaining open items with the licensee and information needed for closure. The open items are listed in Attachment 3 of this report.

## CONCLUSION

The NRC staff completed all three parts of the December 30, 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 (SE) for both the Mitigation Strategies (MS) and SFPI orders. The five sources for the audit items referenced below are as follows:

- a. ISE Open Items (OIs) and Confirmatory Items (CIs)
- b. Audit Questions (AQs)
- c. Licensee-identified OIP OIs
- d. SFPI RAIs
- e. Additional 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 December 30, 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:

John Hughey	NRR/JLD/JOMB
Khoi Nguyen	NRR/JLD/JERB
Matthew McConnell	NRR/JLD/JERB
On Yee	NRR/JLD/JCBB

Joshua Miller	NRR/JLD/JERB
Julie Boettcher	Region III/DRP
David Passehl	Region III/SRA

### Braidwood Staff:

Chris VanDenburgh	Engineering Manager
Mike Hobbs	Project Manager
Jim Kuchenbecker	Operations – Project Manager
James Petty	Operations Shift Supervisor
Javier Sanchez	Operations Procedure Writer
Mike Kuzmuk	Operations Procedure Writer
Steve Pierson	Corporate Senior Operations Procedure Writer
Billy Duffy	Electrical Engineer
John Frauenheim	System Engineer
Joe Zecca	System Engineer
Mark Watson	Operations Training Instructor
Murtaza Abbas	Senior Regulatory Specialist
Gedeon Teame	Electrical Design Engineer
Katie McDonald	FLEX Engineer
Peter Guse	Structural Design Engineer
George Wilhelmsen	Mechanical Design Engineering Manager
Darrel Riedinger	Senior Manager Design Engineering
Frank Piriano	Electrical Design Engineering Manager

## Documents Reviewed

- BRW-14-0255-M, "Braidwood Units 1&2 FLEX Steam Generator Degraded Heat Transfer Analysis Through 72 Hours," Rev. 1.
- BRW-14-0030-M, "Godwin Pump Suction Line Hydraulic Analysis to Support FLEX," Rev. 0.
- BRW-15-0002-S, "Evaluation of FLEX Equipment Haul Paths for Soil Liquefaction Potential," Rev.0 (DRAFT – 2/13/15).
- BRW-97-0340, "Battery Duty Cycle and Sizing for the Braidwood Diesel Driven Auxiliary Feedwater Pumps," Rev. 3.
- BYR13-144/BRW-13-0160-M, "FLEX Pump Sizing and Hydraulic Analysis," Rev. 2.
- BYR13-234/BRW-13-0216-M, "Auxiliary FW Pump Room Temperature Analysis during an ELAP Event," Rev. 0.
- BYR14-130 / BRW-14-0211-M, "Evaluation of Tank and Hose Freezing During an ELAP," Rev. 0.
- BYR13-236/BRW-13-0218-M, "Control Room and Aux. Electrical Equipment Room Heat Up and Ventilation During an ELAP Event," Rev. 0.
- BYR13-237/BRW-13-0219-M, "MEER [Main Electrical Equipment Room] and Battery Room Conditions Following an Extended Loss of AC Power," Rev. 0.
- Engineering Change (EC) 398039, "Braidwood Station Unit 0 Commercial Change – FLEX Storage Robust Building Construction," Rev. 0.
- EC 398040, "Braidwood Station Unit 0 Commercial Change – FLEX Buildings – Commercial Building," Rev. 0.
- EC 394153, "Braidwood Station Unit 1/2 - FUK, Alternate SX Supply to 1/2SX04P Pump Suction Mod 3," Rev. 2.
- EC 399332, "NARS [Nuclear Accident Reporting System] Phone Replacement," Rev. 0.
- 0BwFSG-5, "Initial Assessment and FLEX Equipment Staging, Unit 0," Rev. 0.
- 0BwFSG-6, "Alternate CST Makeup, Unit 0," Rev. 10-21-2014.
- 0BwFSG-11, "Alternate SFP Makeup and Cooling," Rev.0.
- 0BwFSG-50, "FLEX Support Equipment Operation, Unit 0," Rev. 0; (Attachment A, "Filling Portable Diesel Fuel Tanks From DO Storage Tanks," and Attachment E, "Filling a Diesel Driven AUX Feed Pump Day Tank")
- 1BwFSG-2, "Alternate AFW/EFW Suction Source, Unit 1," Rev. 0.
- 1BwFSG-3, "Alternate Low Pressure Feedwater, Unit 1," Rev. 0 (DRAFT).
- 1BwFSG-5, "Initial Assessment and FLEX Equipment Staging, Unit 1," Rev. 0.
- 1BwFSG-8, "Alternate RCS Boration, Unit 1," Rev. 0.
- EP-1-4, "High Pressure Injection Pump," Rev. 2.
- EP-1-8, "Steam Generator – Reactor Make Up Pump," Rev. 2.
- EP-1-10, "Low Pressure – High Flow Pump," Rev. 2.
- Specification No. 151871-DC-C-00001-0, "Exelon FLEX Storage Buildings – Civil/Structural Design Criteria for Exelon Robust and Commercial Buildings," May 01, 2014.

**Braidwood**  
**Mitigation Strategies/Spent Fuel Pool Instrumentation Safety Evaluation Audit Items:**  
**Audit Items Currently Under NRC Staff Review, Requiring Licensee Input As Noted**

<b>Audit Item Reference</b>	<b>Item Description</b>	<b>Licensee Input Needed</b>
ISE CI 3.1.1.1.A	Storage & Protection of FLEX equipment – Confirm final design of FLEX storage structure conforms to NEI 12-06, Rev. 0, Sections 5.3.1, 7.3.1, and 8.3.1 for storage considerations for the hazards applicable to Braidwood.	The Braidwood FLEX storage configuration is not consistent with the guidance contained in NEI 12-06, Rev.0. Further consideration of the Braidwood 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, Rev. 0, accompanied with appropriate justification. (See Section 3.4 of this report for additional information.)
ISE CI 3.2.1.6.A	Sequence of Events – Confirm that the final timeline has been time validated after detailed designs are completed and procedures are developed. The results may be provided in a future 6-month update.	Licensee to provide validation of the timelines required for the electrical load shed as well as the validation for the time sensitive actions in the first two hours after the BDBEE. Validation of the actions associated with the DDAF pump also need to be completed.
ISE CI 3.2.3.A	Containment – Confirm containment reanalysis supports that no Phase 1, 2, and 3 mitigation strategies are required because containment pressure and temperature are maintained within acceptable limits.	Electrical Question: Licensee to provide confirmation that the temperature and pressures within containment will not exceed the equipment qualification (EQ) of electrical equipment that is being relied upon as part of the Braidwood FLEX strategies. The licensee needs to ensure that the EQ profile of the required electrical equipment remains bounding for the entire duration of the event (i.e., indefinitely).

<b>Audit Item Reference</b>	<b>Item Description</b>	<b>Licensee Input Needed</b>
SE #9	<p>Please provide adequate justification for the reactor coolant Pump (RCP) seal leakage rates calculated according to the Westinghouse seal leakage model that was revised following the issuance of NSAL-14-1. The justification should include a discussion of the following factors:</p> <ul style="list-style-type: none"><li>a. benchmarking of the seal leakage model against relevant data from tests or operating events,</li><li>b. discussion of the impact on the seal leakage rate due to fluid temperatures greater than 550°F resulting in increased deflection at the seal interface,</li><li>c. clarification whether the second-stage RCP seal would remain closed under ELAP conditions predicted by the revised seal leakage model and a technical basis to support the determination, and,</li><li>d. justification that the interpolation scheme used to compute the integrated leakage from the RCP seals from a limited number of computer simulations (e.g., three) is realistic or conservative.</li></ul>	Licensee to provide adequate justification of the seal leakage rates used in the Braidwood analysis or other actions to address RCP seal leakage.

Audit Item Reference	Item Description	Licensee Input Needed
SE #10	<p>The NRC staff understands that Westinghouse has recently recalculated RCP seal leakoff line pressures under loss of seal cooling events based on a revised seal leakage model and additional design-specific information for certain plants.</p> <ol style="list-style-type: none"> <li>a. Please clarify whether the piping and all components (e.g., flow elements, flanges, valves, etc.) in your seal leakoff line are capable of withstanding the pressure predicted during an ELAP event according to the revised seal leakage model.</li> <li>b. Please clarify whether operator actions are credited with isolating low-pressure portions of the seal leakoff line, and if so, please explain how these actions will be executed under ELAP conditions.</li> <li>c. If overpressurization of piping or components could occur under ELAP conditions, please discuss any planned modifications to the seal leakoff piping and component design and the associated completion timeline.</li> <li>d. Alternately, please identify the seal leakoff piping or components that would be susceptible to overpressurization under ELAP conditions, clarify their locations, and provide justification that the seal leakage rate would remain in an acceptable range if the affected piping or components were to rupture.</li> </ol>	<p>Licensee to provide justification that the RCP seal leakoff line piping is capable of withstanding the pressures that are predicted to be seen during the ELAP event.</p>



B. Hanson

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If you have any questions, please contact me at 301-415-3204 or by e-mail at John.Hughey@nrc.gov.

Sincerely,

*/RA/*

John D. Hughey, Project Manager  
Orders Management Branch  
Japan Lessons-Learned Division  
Office of Nuclear Reactor Regulation

Docket Nos.: STN 50-456 and STN 50-457

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