



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

December 17, 2014

Mr. Michael J. Pacilio  
President and Chief Nuclear Officer  
Exelon Generation Company, LLC  
4300 Winfield Road  
Warrenville, IL 60555

SUBJECT: BYRON 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. , MF0893, MF0894, MF0872 AND MF0873)

Dear Mr. Pacilio:

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. ML13060A364), Exelon Generation Company, LLC ( Exelon, the licensee) submitted its OIP for Byron Station, Units 1 and 2 (Byron) in response to Order EA-12-049. By letters dated August 28, 2013, and February 28, 2014 (ADAMS Accession Nos. ML13241A279 and ML14059A425, 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 Byron interim staff evaluation (ISE) and audit report (ADAMS Accession No. ML13225A595) on December 17, 2013, and continues with in-office and onsite portions of this audit.

By letter dated March 5, 2013 (ADAMS Accession No. ML13063A265), the licensee submitted its OIP for Byron in response to Order EA-12-051. By letter dated June 07, 2013 (ADAMS Accession No. ML13134A093), the NRC staff sent a request for additional information (RAI) to the licensee. By letters dated July 03, 2013, August 28, 2013, and February 28, 2014 (ADAMS Accession Nos. ML13186A006, ML13241A239, and ML14062A057, 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 Byron ISE and RAI dated November 04, 2013 (ADAMS Accession No. ML13275A305). 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 Byron from August 18-21, 2014, per the audit plan dated July 24, 2014 (ADAMS Accession No. ML14198A559). 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.

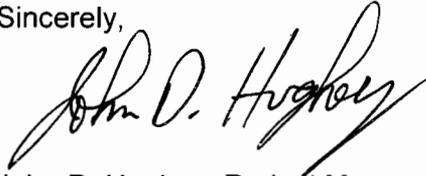
The enclosed audit report provides a summary of the activities for the onsite audit portion. Additionally, this report contains an attachment listing all open audit items currently under NRC staff review.

M. Pacilio

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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,

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.: 50-454 and 50-455

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  
BYRON STATION, UNIT NOS. 1 AND 2  
DOCKET NOS. 50-454 and 50-455

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. ML13060A364), Exelon Generation Company, LLC ( Exelon, the licensee) submitted its OIP for Byron Station, Units 1 and 2 (Byron) in response to Order EA-12-049. By letters dated August 28, 2013, and February 28, 2014 (ADAMS Accession Nos. ML13241A279 and ML14059A425, 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

Enclosure

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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 Byron from August 18-21, 2014, per the audit plan dated July 24, 2014 (ADAMS Accession No. ML14198A559). 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 Byron facility from August 18, 2014, through August 21, 2014. 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
Project Manager	James Polickoski	NRR/JLD

The NRC staff executed the onsite portion of the audit per the three part approach discussed in the July 24, 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 18, 2014)

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

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 also confirmed the cross-connection ability of the steam generator (SG) headers to verify that a symmetric cooldown would be performed in all circumstances. 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. The staff identified that additional information and evaluation is required to confirm that ventilation actions for the Auxiliary Electrical Equipment Room are adequate to maintain acceptable temperatures.

b. NRC staff walked down connection points and locations for FLEX electrical generators and confirmed that class 1E equipment is protected from faults in portable/FLEX equipment and that multiple sources do not attempt to power electrical buses. The staff also reviewed the licensee's load and sizing calculations for the FLEX generators. NRC staff identified that additional information was needed regarding the strategy and procedures addressing transition from Phase 2 to Phase 3 equipment such as portable diesel generators (DGs) and portable pumps.

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

a. NRC staff walked down the location of the primary and backup level sensors in the SFP, and the electrical boxes located on opposite sides of the inside fuel building walls where the coaxial cable connects to the hardline cable leading to the level sensors. NRC staff also walked down the primary channel electrical enclosure located in the auxiliary building (AB) Unit 1 electrical penetration area and the backup channel electrical enclosure located in the in the AB Unit 2 electrical penetration area and the batteries installed in the enclosures. In addition, the staff walked down the primary and backup channel analog SFP level indicators located in the main control room (MCR), on panels 1PM06J (primary) and 2PM06J (backup). The staff also reviewed the routing of the cables.

b. NRC staff identified a concern regarding Electro Magnetic Compatibility compliance associated with future purchase and use of portable EP Communication equipment manufactured by Comm Labs. The licensee has addressed this concern by initiating Action Request item 01694997 in the Byron corrective action program to ensure that SFPI system operation will be tested while the Comm Labs equipment is purchased and placed in service.

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

The Byron FLEX storage configuration consists of two storage buildings located adjacent to one another and located outside of the site protected area (PA). 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.

NRC staff identified that the Byron 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. 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, 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 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 Byron FLEX equipment storage configuration does not protect the +1 set of FLEX equipment from the applicable BDBEE tornado hazard. Therefore, the Byron 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 Byron 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 Byron 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.

NRC staff communicated to the licensee that the Byron FLEX storage configuration is not consistent with guidance contained in NEI 12-06. Further consideration of the Byron 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.

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

a. NRC staff identified a concern that the communications plan did not adequately address the site security access strategy. In response, the licensee implemented additional actions to resolve the staff's concerns.

b. NRC staff confirmed that transportation methods (ground/air) and the various driving routes to each of the National SAFER Response Center staging areas are contained in chapter 4 of the Byron SAFER response plan.

c. NRC staff reviewed the hydraulic analysis for portable FLEX pumps and confirmed that licensee's evaluation considered multiple scenarios that assume conservative hose lengths with margin to account uncertainties for hose runs.

d. 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). NRC staff identified various information needs as noted in Attachment 3 of this report.

e. NRC staff reviewed calculations and FLEX Support Guidelines (FSGs) to validate battery and fuel oil availability to support the Diesel Driven Auxiliary Feedpump (DDAFP) run time requirement. NRC staff also confirmed DDAFP room temperature suitability for pump operation and human occupancy.

f. NRC staff reviewed the evaluations regarding fuel usage requirements for FLEX equipment and confirmed that sufficient, protected sources of fuel are provided on site. In addition, the licensee confirmed that it has existing contracts/agreements for obtaining fuel oil from off site and that these existing contracts/agreements contain contingencies for hurricane/pandemic/new or elevated threats.

g. NRC staff confirmed that the draft FLEX program document contains initial acceptance testing and subsequent preventative maintenance (PM) and testing for FLEX equipment. FLEX equipment is to be maintained under the site's PM program and testing and maintenance procedures will be based on the Energy Power Research Institute FLEX equipment templates.

h. 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.

i. NRC staff reviewed FLEX training tasks for Equipment Operators (EO) and Licensed Operators and the currently approved Long Range Training Plan which documented planned, periodic FLEX training. EO tasks included hands-on operation of equipment, however, FLEX portable equipment was not yet on site. B.5.b equipment was determined to be sufficiently similar to the FLEX equipment such that previous B.5.b training could be appropriately substituted for the initial FLEX training. FLEX integrated drills, including simulator training, are included in Byron emergency plan drill and exercise evaluation criteria.

#### 4.0 Exit Meeting (August 21, 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 CI 3.1.1.1.A, Storage and Protection of FLEX Equipment  
NRC staff communicated to the licensee that the Byron FLEX storage configuration is not consistent with guidance contained in NEI 12-06. As described in section 3.4 of this report, the configuration does not reasonably protect N+1 sets of FLEX equipment from all applicable BDBEEs. Therefore,

further consideration of the Byron 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. ISE CI 3.2.1.2.B, RCP Seal Leakage  
NRC staff discussed that the Byron mitigation strategies are based on generic Westinghouse RCP seal leakage rates. Recent Westinghouse evaluations of RCP seal leakage in response to Westinghouse Nuclear Safety Advisory Letter (NSAL) 14-1 indicate that the generic leak rates previously used by the licensee for its mitigation strategy do not envelope calculated leakage rates applicable to the Byron design. The Pressurized-Water Reactor Owners Group (PWROG) is in the process of performing additional evaluations to refine RCP seal leakage rate projections, which are part of the technical bases for demonstrating Byron compliance with the requirements of NRC Order EA-12-049. Exelon requested relaxation for Byron Unit 2 compliance with Order EA-12-049 based on the ongoing PWROG efforts. The NRC staff approved the requested relaxation on October 7, 2014 (ADAMS Accession No. ML14260A294).
- c. The NRC staff noted that several of the items remained open due to the pending completion of associated calculations and evaluations.

## CONCLUSION

The NRC staff completed all three parts of the July 24, 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 (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 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 24, 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
James Polickoski	NRR/JLD/JOMB
Matthew McConnell	NRR/JLD/JERB

On Yee	NRR/JLD/JCBB
Joshua Miller	NRR/JLD/JERB

Byron Staff:

Blaine Peters	Senior Manager Operations Support and Services
Jim Lynde	Operations FLEX Lead / Procedure Writer
Jon Cunzeman	Mechanical / Structural Design Manger
Brian Kleinfeldt	Reactor Engineer
Davood Karimi	Design Engineer
Steve Pierson	Corporate Senior Operations Procedure Writer
Billy Duffy	Electrical Engineer
Dave Schupp	Severe Accident Management Guidelines (SMAG) Staff Operations Support
Bill Perchiazzi	URS Mechanical Design Engineering
Dave Baran	URS Mechanical Design Engineering
Ron Edwards	Operations Procedure Writer
Barry Thurston	Senior Project Manager
Jim Kuchenbecker	Braidwood Project Manager
Howard James	URS Mechanical Design Engineering
Chris Staum	Engineer
Phil Young	Director Strategy & Asset Management
Phil Amway	SAMG Senior Staff Engineer
Dave Cook	Byron Project Manager
Jim Printz	Byron Procedure Writer, Contractor
Lisa Zurawski	NRC Coordinator

## Documents Reviewed

- Calculation BYR13-239, Rev 0, RCS Boration Analysis During an ELAP Event
- Calculation 151871-C-C-00021, Robust FLEX Storage Building
- Calculation BYR13-144/BRW-13-0160-M, FLEX Pump Sizing and Hydraulic Analysis
- Calculation BYR13-234/BRW-13-0216-M, Auxiliary FW Pump Room Temperature Analysis During an ELAP Event
- Calculation BYR13-238/BRW-13-220-E, Diesel Driven Auxiliary Feedwater Pump Battery Duty Cycle and Sizing for a Beyond Design Basis External Event
- Calculation BYR13-240/BRW-13-0222-M, Spent Fuel Pool Boil Off Analysis during an ELAP Event
- Calculation BYR14-060/BRW-14-0080-E, Unit 1(2), 125 VCD Battery FLEX Coping Calculation
- Calculation BYR14-130/BRW-14-0211-M, REV. 0, Evaluation of Tank and Hose Freezing During an ELAP
- Calculation BYR96-2481, Rev 0, Steam Generator Storage Building and Heavy Haul Path
- Drawing No. 151871-01000-M-GA-001-1, FLEX Storage Building General Arrangement
- Drawing No. 151871-00000-C-CON-03-2, Foundation Mat Plan Tie Down Layout
- Drawing No. 151871-00000-C-ARC-001-2, FLEX Storage Building Architectural General Notes and Roof Details
- Drawing No. 151871-00000-C-CON-006-2, FLEX Storage Building Concrete Outline Wall Elevations
- SAFER Response Plan for Byron Generating Station, revision dated 8/14/2014
- Technical Evaluation EC 399165, Rev. 0, FLEX Haul Path Liquefaction Evaluation
- Technical Evaluation EC 367118, Rev 0, Independent Spent Fuel Storage Installation
- Technical Evaluation EC 394153, FUK: Alternate SX Supply to 1/2 SX04P Pump Suction FLEX Mod 3
- Technical Evaluation BYR99-010/BRW-99-0017-I, Documentation of the Basis of the Emergency Operating Procedure Setpoints
- EP-AA-122-300-F-01, Drill and Exercise Evaluation Criteria
- 0BFSG-5, Initial Assessment and FLEX Equipment Staging
- 0BFSG-6, Alternate CST Makeup
- 0BFSG-11, Alternate SFP Makeup and Cooling
- 0BFSG-50, FLEX Support Equipment Operation
- 0BFSG-51(Draft), Alternate MCR [main control room] Ventilation
- 2BFSG-2, Alternate AFW [auxiliary feedwater]/EFW [emergency feedwater] Suction Source
- 2BFSG-5, Initial Assessment and FLEX Equipment Staging Unit 2" (Attachment B - Aligning Medium Head FLEX Pump) (Attachment C - Aligning High Head FLEX Pump)
- BRW-10-0146-M/BYR10-103, AF Diesel Driven Pump Fuel Consumption and Day Tank Requirements

**Byron**  
**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 CI 3.1.1.1.A	Storage & Protection of FLEX equipment – Confirm final design of FLEX storage structure conforms to NEI 12-06, Sections 5.3.1, 7.3.1, and 8.3.1 for storage considerations for the hazards applicable to Byron.	<p>NRC staff has determined that the Byron FLEX storage configuration is not consistent with guidance contained in NEI 12-06. Therefore, further consideration of the Byron 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. (See Section 3.4 of this audit report for additional information.)</p> <p><u>Electrical Question:</u>  Licensee is requested to provide a discussion on protection of pre-staged FLEX equipment.</p>
ISE CI 3.2.1.1.C	Confirm analysis for secondary side [steam Generator] (SG) fouling due to the use of abnormal water sources ([Refueling Water Storage Tank] (RWST), well water, [service water] (SX) water)	The NRC staff is reviewing the water quality analysis provided by licensee subsequent to the onsite audit.
ISE CI 3.2.1.1.D	Complete analysis for length of time prior to depletion of the RWST and determine whether additional boration equipment is needed for Phase 3 coping strategy.	The NRC staff is reviewing the draft RWST depletion calculation provided by licensee subsequent to the onsite audit.

Audit Item Reference	Item Description	Licensee Input Needed
ISE CI 3.2.1.2.B	<p>Reactor Coolant Pump (RCP) Seal Leakage - In some plant designs, the cold legs could experience temperatures as high as 580 °F before cooldown commences. This is beyond the qualification temperature (550 °F) of the O-rings used in the RCP seals. For those Westinghouse designs, a discussion should be provided to justify that (1) the integrity of the associated 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.</p>	<p>The NRC staff is reviewing additional information regarding item (1) provided by licensee subsequent to the onsite audit.</p> <p>With regard to item (2), the Byron mitigation strategies are based on generic Westinghouse RCP seal leakage rates. Recent Westinghouse evaluations of RCP seal leakage in response to Westinghouse Nuclear Safety Advisory Letter (NSAL) 14-1 indicate that the generic leak rates previously used by the licensee for its mitigation strategy do not envelope calculated leakage rates applicable to the Byron design. The Pressurized-Water Reactor Owners Group (PWROG) is in the process of performing additional evaluations to refine RCP seal leakage rate projections, which are part of the technical bases for demonstrating Byron compliance with the requirements of NRC Order EA-12-049. Exelon requested relaxation for Byron Unit 2 compliance with Order EA-12-049 based on the ongoing PWROG efforts. The NRC staff approved the requested relaxation on October 7, 2014 (ADAMS Accession No. ML14260A294).</p>
ISE CI 3.2.1.3.A	<p>Decay Heat - Verify that the Integrated Plan update provides the details of the WCAP 17601-P methodology to include the values of certain key parameters used to determine the decay heat levels. Address the adequacy of the values used.</p>	<p>The NRC staff is reviewing cooldown (decay heat) calculations provided by licensee subsequent to the onsite audit.</p>

Audit Item Reference	Item Description	Licensee Input Needed
ISE CI 3.2.1.6.A	Sequence of Events (SOE) – 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.	<p>The NRC staff is reviewing additional information provided by licensee subsequent to the onsite audit.</p> <p>The new SOE needs to include an updated critical time for the FLEX diesel generators.</p>
AQ - 27	Ventilation: Provide a discussion on the impact of elevated temperatures, as a result of loss of ventilation and/or cooling, on support equipment being credited as part of the ELAP strategies (e.g., support equipment in the turbine driven auxiliary feedwater pump rooms). In your response, specify whether the initial temperature condition assumed the worst-case outside temperature with the plant operating at full power. Provide the list of support components that are located in the pump rooms that are necessary to ensure successful operation of required pumps. Also provide the qualification level for temperature and pressure for these support components for the duration that the pumps are assumed to perform its mitigating strategies function.	<p>The licensee needs to explain why the proposed ventilation actions for the auxiliary electric equipment room are acceptable to reduce temperature bellow allowable levels.</p> <p>The NRC staff is reviewing additional information provided by licensee subsequent to the onsite audit.</p>
SE #10 (new item from onsite audit)	Transition from Phase 2 to 3.	Licensee needs to provide the strategy / FSG regarding transition from Phase 2 to Phase 3 equipment (e.g. diesel generators, pumps, etc)

<b>Audit Item Reference</b>	<b>Item Description</b>	<b>Licensee Input Needed</b>
SE #12 (new item from onsite audit)	The NRC staff understands that Westinghouse has recently recalculated 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. Please clarify whether the piping in your seal leakoff line is capable of withstanding the pressure predicted during an ELAP event according to the revised seal leakage model. If not, please discuss any planned modifications to the seal leakoff piping design and the associated completion timeline. Alternately, please clarify that the seal leakage rate would remain in an acceptable range if the affected seal leakoff piping were to rupture.	The NRC staff is reviewing additional information provided by licensee subsequent to the onsite audit.
SE #13 (new item from onsite audit)	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.	The NRC staff is reviewing additional information provided by licensee subsequent to the onsite audit.

M. Pacilio

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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  
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Japan Lessons-Learned Division  
Office of Nuclear Reactor Regulation

Docket Nos.: 50-454 and 50-455

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