



Order No. EA-12-049

RS-15-267

November 30, 2015

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555-0001

Byron Station, Unit 1  
Facility Operating License No. NPF-37  
NRC Docket No. STN 50-454

Subject: Report of Full Compliance with March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)

References:

1. NRC Order Number EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements For Mitigation Strategies For Beyond-Design-Basis External Events," dated March 12, 2012
2. NRC Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Revision 0, dated August 29, 2012
3. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, dated August 2012
4. Exelon Generation Company, LLC's Initial Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated October 25, 2012
5. Exelon Generation Company, LLC Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 28, 2013 (RS-13-018)
6. Exelon Generation Company, LLC First Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 28, 2013 (RS-13-115)
7. Exelon Generation Company, LLC Second Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 28, 2014 (RS-14-008)

8. Exelon Generation Company, LLC Third Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 28, 2014 (RS-14-206)
9. Exelon Generation Company, LLC Fourth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated February 27, 2015 (RS-15-017)
10. Exelon Generation Company, LLC Fifth Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049), dated August 28, 2015 (RS-15-209)
11. NRC letter to Exelon Generation Company, LLC, Byron Station, Units 1 and 2 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049, (Mitigation Strategies) (TAC Nos. MF0893 and MF0894), dated December 17, 2013
12. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 12, 2012
13. Exelon Generation Company, LLC letter to USNRC, Response to March 12, 2012, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, Enclosure 5, Recommendation 9.3, Emergency Preparedness – Staffing, Requested Information Items 1, 2, and 6 - Phase 2 Staffing Assessment, dated May 29, 2014 (RS-14-119)
14. NRC letter to Exelon Generation Company, LLC, Byron Station 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), dated December 17, 2014

On March 12, 2012, the Nuclear Regulatory Commission (“NRC” or “Commission”) issued Order EA-12-049, “Order Modifying Licenses with Regard to Requirements For Mitigation Strategies For Beyond-Design-Basis External Events,” (Reference 1) to Exelon Generation Company, LLC (EGC). Reference 1 was immediately effective and directed EGC to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of an initial status report 60 days following issuance of the final interim staff guidance (Reference 2) and an Overall Integrated Plan (OIP) pursuant to Section IV, Condition C. Reference 2 endorsed industry guidance document NEI 12-06, Revision 0 (Reference 3) with clarifications and exceptions identified in Reference 2. Reference 4 provided the EGC initial status report regarding mitigation strategies. Reference 5 provided the Byron Station, Unit 1 OIP.

Reference 1 required submission of a status report at six-month intervals following submittal of the OIP. References 6, 7, 8, 9, and 10 provided the first, second, third, fourth, and fifth six-month status reports, respectively, pursuant to Section IV, Condition C.2, of Reference 1 for Byron Station, Unit 1.

The purpose of this letter is to provide the report of full compliance with the March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements For Mitigation Strategies For Beyond-Design-Basis External Events (Order Number EA-12-049) (Reference 1) pursuant to Section IV, Condition C.3 of the Order for Byron Station, Unit 1.

Byron Station, Unit 1 has developed, implemented, and will maintain the guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event in response to Order EA-12-049. The information provided herein documents full compliance for Byron Station, Unit 1 with Reference 1.

OIP open items have been addressed and closed as documented in References 6, 7, 8, 9, 10, and below, and are considered complete pending NRC closure. EGC's response to the NRC Interim Staff Evaluation (ISE) open and confirmatory items identified in Reference 11 have been addressed and closed as documented in References 7, 8, 9, 10, and below, and are considered closed as documented in Reference 14. EGC's response to the NRC ISE confirmatory items identified as open in Reference 14 are addressed below, and are considered complete pending NRC closure. EGC's response to the NRC audit questions and additional audit open items have been addressed and closed as documented in References 10, 14, and below, and are considered complete pending NRC closure. The following tables provide completion references for each OIP open item and NRC ISE open or confirmatory item, and NRC Audit Report open item.

**Overall Integrated Plan Open Items**

Key Site assumptions (p.4)	Primary and secondary storage locations have not been selected yet; once locations are finalized implementation strategies and routes will be assessed for hazard impact.	Reference 9
Sequence of events (p.5)	The final timeline will be time validated once detailed designs are completed and procedures are developed.	Reference 9
Identify how strategies will be deployed (p.7)	Identification of storage area and creation of the administrative program.	Reference 9
Programmatic controls (p.8)	Develop an administrative program for FLEX responsibilities, and testing & maintenance.	Reference 10
Regional Response Center plan (p.9)	Development of Byron Station's playbook.	Reference 9
Key Reactor Parameters (p. multiple)	Identify additional parameters that are needed in order to support key actions identified in the plant procedures/guidance or to indicate imminent or actual core damage.	Reference 9

Deployment Conceptual Design (p. multiple)	Develop the storage structure conceptual design.	Reference 9
Maintain RCS Inventory Control, Phase 2 (p.23)	A calculation will be required for the timing of the boration and quantity required.	Reference 10 and updated with this submittal as provided below
Maintain Containment, Phase 1 (p.31)	Additional calculations will be performed to evaluate containment response.	Reference 10
Maintain Spent Fuel Pool Cooling, Phase 1 (p.39)	Procedure development for Initial Spent fuel pool make-up with gravity drain from the RWST.	Reference 9
Maintain Spent Fuel Pool Cooling, Phase 1 (p.39)	Initial calculations were used to determine the fuel pool timelines. Formal calculations will be performed to validate this information during development of the spent fuel pool cooling strategy detailed design.	Reference 9
Maintain Spent Fuel Pool Cooling, Phase 1, (p.39 and p.42)	Evaluation of the spent fuel pool area for steam and condensation will be performed and used to determine if vent path strategy is needed.	Reference 9
Safety Functions Support, Phase 2 (p.51)	Habitability conditions will be evaluated and a strategy will be developed to maintain Main Control Room.	Reference 9
Safety Functions Support, Phase 2 (p.51)	Critical ventilation assets may be required to support DDAF pumps, station battery rooms, miscellaneous electric equipment rooms, and fuel handling building personnel habitability and/or component survivability. Specific analyses of these rooms will be performed.	Reference 9

**Interim Staff Evaluation Open Items**

Item No. 3.2.1.8.A	References 9 and 10
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**Interim Staff Evaluation Confirmatory Items**

Item No. 3.1.1.1.A	Reference 9
Item No. 3.1.1.3.A	Reference 9
Item No. 3.1.1.4.A	Reference 8
Item No. 3.1.5.1.A	Reference 9

Item No. 3.1.5.3.A	Reference 9
Item No. 3.2.1.A	Reference 9
Item No. 3.2.1.1.A	Reference 9
Item No. 3.2.1.1.B	Reference 9
Item No. 3.2.1.1.C	Reference 9
Item No. 3.2.1.1.D	Reference 9
Item No. 3.2.1.2.B	Reference 10 and updated with this submittal as provided below
Item No. 3.2.1.2.E	Reference 8
Item No. 3.2.1.3.A	References 9 and 10
Item No. 3.2.1.4.A	References 9 and 10
Item No. 3.2.1.4.B	Reference 9
Item No. 3.2.1.5.A	Reference 8
Item No. 3.2.1.6.A	Reference 10 and updated with this submittal as provided below
Item No. 3.2.1.6.B	Reference 9
Item No. 3.2.1.9.A	Reference 9
Item No. 3.2.2.A	Reference 9
Item No. 3.2.3.A	References 9 and 10
Item No. 3.2.3.B	Reference 9
Item No. 3.2.4.1.A	Reference 9
Item No. 3.2.4.2.A	Reference 9
Item No. 3.2.4.2.B	Reference 9
Item No. 3.2.4.3.A	Reference 9
Item No. 3.2.4.4.A	Reference 10 and updated with this submittal as provided below
Item No. 3.2.4.6.A	Reference 8
Item No. 3.2.4.7.A	Reference 10 and updated with this submittal as provided below
Item No. 3.2.4.8.A	Reference 9
Item No. 3.2.4.9.A	Reference 9
Item No. 3.2.4.10.A	Reference 9

**NRC Audit Report Open Items**

<b>Audit Open Item</b>	<b>Completion Response Reference</b>
AQ-27	Reference 10
SE # 10	Reference 10
SE # 12	Reference 10
SE # 13	Reference 10

The following table documents completion of the final remaining open items. As previously stated, EGC provides the response for the following items and considers them to be complete for Byron Station, Unit 1.

<u>Item</u>	<u>Description</u>	<u>Reference</u>
<p><b>OIP Open Item</b></p> <p>Maintain RCS Inventory Control, Phase 2 (pg. 23)</p> <p>A calculation will be required for the timing of the boration and quantity required.</p>	<p>Westinghouse Calculation CN-LIS-15-034, Byron and Braidwood Stations Reactor Coolant System ELAP Inventory Control Analysis with SHIELD Reactor Coolant Pump Seal Packages, is complete and provides a minimum time of 58 hours to the end of single-phase natural circulation and 186 hours until Core Uncovery occurs.</p> <p>Westinghouse Calculation CN-LIS-15-039, Byron and Braidwood Stations Reactor Coolant System ELAP Long-Term Subcriticality Analysis with Low-Leakage Reactor Coolant Pump Seal Packages, provides a bounding calculation that determines boration would start by 16 hours into the ELAP with a minimum of 6000 gallons of 2300ppm borated water injected.</p>	<p><u>Complete</u></p>
<p><b>ISE CI 3.2.1.2.B</b></p> <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</p>	<p>Byron Station has installed the Westinghouse Reactor Coolant Pump (RCP) SHIELD Passive Thermal Shutdown Seals (SDS) (Generation III). Byron Station has Westinghouse RCP Model 93A. Credit for the SHIELD seals has been endorsed by NRC for Westinghouse Model 93A RCPs as documented in NRC letter to Westinghouse, dated May 28, 2014 (ML14132A128). The RCP seal leakage assumed in Westinghouse calculation CN-LIS-15-034, Byron and Braidwood Stations Reactor Coolant System ELAP Inventory Control Analysis SHIELD Reactor Coolant Pump Seal Packages, is consistent with NRC limitation and condition Number 4 identified in the above reference NRC letter to Westinghouse.</p> <p>The qualification testing of the shutdown seal was performed at conditions based on a cold leg temperature of 571°F. The maximum shutdown seal temperature remains below the shutdown</p>	<p><u>Complete</u></p>

<p>adequate and acceptable.</p>	<p>seal temperatures experienced during qualification testing.</p> <p>Following a loss of AC power, it is possible for the RCS cold leg temperature to exceed 571°F for short periods of time without the shutdown seal heating up beyond the temperatures experienced during qualification testing. This is due to the significant thermal inertia of the massive reactor coolant pump internals and pressure boundary. The evaluation documented in Westinghouse Letter LTR-CDA-15-11 concludes that even if the cold leg temperature is 581°F for the first 3000 seconds (50 minutes) following ELAP initiation, the maximum fluid temperature at the reactor coolant pump seal inlet remains below the temperatures experienced during shutdown seal qualification testing. Auxiliary Feedwater flow to the steam generators will be initiated at approximately 30 minutes into the ELAP event. Following the restoration of Auxiliary Feedwater flow to the steam generators and prior to initiating plant cooldown, cold leg temperature will be dictated by the Main Steam Safety Valves. Cold leg temperature will remain less than 571°F during this period based on the lowest Main Steam Safety Valve setting of 1175 psig adjusted for setting tolerance and lift setpoint testing uncertainty.</p> <p>Westinghouse LTR-RES-13-153, Documentation of 7228C Compound O-Rings at ELAP Conditions, concludes with a high level of confidence, that the integrity of the RCS O-rings will be maintained at the temperature conditions experienced during the ELAP event.</p>	
<p><b>ISE CI 3.2.1.6.A</b></p> <p>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-</p>	<p>There was one change based on the Westinghouse calculation CN-LIS-15-40, Byron and Braidwood Stations Delayed AFW FLEX Studies, which resulted in less time to SG dry out. The time to isolate the SG PORVs and to start the “B” AF Pump was shortened. Byron Procedures BCA 0.0, Loss of All AC, and BFSG-2, Alternate AFW/EFW Suction Source, steps and directions have been updated. This change was revalidated and updated in the Time</p>	<p><u>Complete</u></p>

month update.	<p>Sensitive Actions Procedure.</p> <p>The timeline was updated using the times documented in the Westinghouse calculations. The revised timeline, previously provided in Attachment A of the 6-month updates, has been validated and the changes required do not impact the time or margins documented for Byron Station Unit 1.</p>	
<p><b>ISE CI 3.2.4.4.A</b></p> <p>Communications – Confirm that upgrades to the site’s communications systems have been completed.</p>	<p>Communications upgrade is complete.</p> <p>Byron Station has completed the NARS Upgrade satellite communications system per NRC RFI 9.3.</p> <p>Byron Station also has 3 Iridium Satellite phones available for the SM/SED in the MCR area. Additional handheld radios for use on talk-around with batteries are staged in the robust FLEX building. The Site has Sound Powered phones and cords in lockers in the plant with cables as well as Bull Horns for help with notifications.</p>	<u>Complete</u>
<p><b>ISE CI 3.2.4.7.A</b></p> <p>Water Sources – Justify the time at which SG dryout will occur.</p>	<p>Westinghouse Calculation CN-LIS-15-40, Byron and Braidwood Stations Delayed AFW FLEX Studies, provided bounding information that the shorest time to SG dry out would be 2702 seconds, or 45 minutes on Unit 2 and 3777 seconds, or 63 minutes on Unit 1.</p>	<u>Complete</u>

**MILESTONE SCHEDULE – ITEMS COMPLETE**

<b>Milestone</b>	<b>Completion Date</b>
Submit 60 Day Status Report	October 25, 2012
Submit Overall Integrated Plan	February 28, 2013
Contract with National SAFER Response Center	October 15, 2014
<b>Submit 6 Month Updates:</b>	
Update 1	August 28, 2013
Update 2	February 28, 2014
Update 3	August 28, 2014
Update 4	February 27, 2015
Update 5	August 28, 2015
<b>Modification Development:</b>	
Phase 1 and 2 modifications	October 2, 2015
National SAFER Response Center Operational	October 15, 2014



<b>Milestone</b>	<b>Completion Date</b>
<b>Procedure Development:</b>	
Strategy procedures	September 24, 2015
Validate Procedures (NEI 12-06, Sect. 11.4.3)	September 24, 2015
Maintenance procedures	September 24, 2015
Staffing analysis	May 29, 2014
<b>Modification Implementation</b>	
Phase 1 and 2 modifications	October 2, 2015
Storage plan and construction	October 20, 2014
FLEX equipment acquisition	October 20, 2014
Training completion	August 21, 2015
Unit 1 implementation date	October 2, 2015

### **ORDER EA-12-049 COMPLIANCE ELEMENTS SUMMARY**

The elements identified below for Byron Station, Unit 1 as well as the site OIP response submittal (Reference 5), the 6-Month Status Reports (References 6, 7, 8, 9, and 10), and any additional docketed correspondence, demonstrate compliance with Order EA-12-049.

#### **Strategies - Complete**

Byron Station, Unit 1 strategies are in compliance with Order EA-12-049. There are no strategy related Open Items, Confirmatory Items, or Audit Questions/Audit Report Open Items. The Byron Station, Units 1 and 2, Final Integrated Plan for mitigating strategies will be provided upon full compliance for Byron Station, Unit 2 (Spring 2016).

#### **Modifications - Complete**

The modifications required to support the FLEX strategies for Byron Station, Unit 1 have been fully implemented in accordance with the station design control process.

#### **Equipment – Procured and Maintenance & Testing – Complete**

The equipment required to implement the FLEX strategies for Byron Station, Unit 1 have been procured in accordance with NEI 12-06, Section 11.1 and 11.2, received at Byron Station, Unit 1, initially tested/performance verified as identified in NEI 12-06, Section 11.5, and is available for use.

Maintenance and testing will be conducted through the use of the Byron Station, Unit 1 Preventative Maintenance program such that equipment reliability is achieved.

### **Protected Storage – Complete**

The storage facilities required to implement the FLEX strategies for Byron Station, Unit 1 have been completed and provide protection from the applicable site hazards. The equipment required to implement the FLEX strategies for Byron Station, Unit 1 is stored in its protected configuration.

### **Procedures – Complete**

FLEX Support Guidelines (FSGs) for Byron Station, Unit 1 have been developed and integrated with existing procedures. The FSGs and affected existing procedures have been verified and are available for use in accordance with the site procedure control program.

### **Training – Complete**

Training for Byron Station, Unit 1 has been completed in accordance with an accepted training process as recommended in NEI 12-06, Section 11.6.

### **Staffing – Complete**

The Phase 2 staffing study for Byron Station has been completed in accordance with 10CFR50.54(f), "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 2.1, 2.3, and 9.3, of the Near-Term Task Force review of Insights from the Fukushima Dai-ichi Accident," Recommendation 9.3, dated March 12, 2012 (Reference 12), as documented in Reference 13.

### **National SAFER Response Center – Complete**

EGC has established a contract with Pooled Equipment Inventory Company (PEICo) and has joined the Strategic Alliance for FLEX Emergency Response (SAFER) Team Equipment Committee for off-site facility coordination. It has been confirmed that PEICo is ready to support Byron Station, Unit 1 with Phase 3 equipment stored in the National SAFER Response Centers in accordance with the site specific SAFER Response Plan.

### **Validation – Complete**

EGC has completed performance of validation in accordance with industry developed guidance to assure required tasks, manual actions and decisions for FLEX strategies are feasible and may be executed within the constraints identified in the Overall Integrated Plan (OIP) for Order EA-12-049.

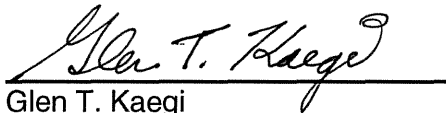
**FLEX Program Document - Established**

The Byron Station, Unit 1 FLEX Program Document has been developed in accordance with the requirements of NEI 12-06.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact David P. Helker at 610-765-5525.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 30<sup>th</sup> day of November 2015.

Respectfully submitted,



Glen T. Kaegi  
Director - Licensing & Regulatory Affairs  
Exelon Generation Company, LLC

cc: Director, Office of Nuclear Reactor Regulation  
NRC Regional Administrator - Region III  
NRC Senior Resident Inspector – Byron Station  
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Illinois Emergency Management Agency - Division of Nuclear Safety