

10 CFR 50.90

RS-16-231

November 14, 2016

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

Braidwood Station, Unit 2  
Renewed Facility Operating License No. NPF-77  
NRC Docket No. STN 50-457

Subject: Revised Response to Request for Additional Information for License Amendment Request for a One-Time Extension of the Essential Service Water (SX) Train Completion Time to Support 2A SX Pump Repair

- References:
- 1) Letter from D. M. Gullott (Exelon Generation Company, LLC) to U. S. Nuclear Regulatory Commission, "License Amendment Request for a One-Time Extension of the Essential Service Water (SX) Train Completion Time to Support 2A SX Pump Repair," dated September 30, 2016 (ML16274A474)
  - 2) Email from J. Wiebe (NRC) to J. Bauer (Exelon Generation Company, LLC) Initial RAIs Related to the Braidwood Unit 2 SX Pump allowed Outage time Amendment Request, dated October 20, 2016
  - 3) Letter from D. M. Gullott (Exelon Generation Company, LLC) to U. S. Nuclear Regulatory Commission, "Response to Request for Additional Information License Amendment Request for a One-Time Extension of the Essential Service Water (SX) Train Completion Time to Support 2A SX Pump Repair," dated October 26, 2016

In Reference 1, Exelon Generation Company, LLC (EGC) requested an amendment to Technical Specification (TS) 3.7.8, "Essential Service Water (SX) System," of Renewed Facility Operating License No. NPF-77 for Braidwood Station Unit 2. The proposed amendment would modify TS 3.7.8 by adding a new Required Action A.2 that increases the Completion Time (CT) currently specified in Required Action A.1, "Restore unit-specific SX train to OPERABLE status," from 72 hours to 200 hours. This proposed change is a one-time change to support a planned 2A SX pump repair scheduled to be performed before January 23, 2017. The U. S. Nuclear Regulatory Commission (NRC) requested additional information related to its review of Reference 1 in Reference 2. EGC responded to the NRC Reference 2 request in Reference 3.

As discussed with the NRC on November 14, 2016, EGC is revising the Reference 3 response to RAI 1. The Attachment to this letter provides the revised response to RAI 1 and supersedes the RAI 1 response provided in Reference 3.

EGC has reviewed the information supporting a finding of no significant hazards consideration that was previously provided to the NRC in Attachment 1 of Reference 1. The additional information provided in this submittal does not affect the bases for concluding that the proposed license amendment does not involve a significant hazards consideration.

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," paragraph (b), a copy of this letter and its attachments are being provided to the designated State of Illinois official.

There are no regulatory commitments contained in this letter.

Should you have any questions concerning this letter, please contact J. A. Bauer at (630) 657-2804.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 14th day of November 2016.

Respectfully,

A handwritten signature in black ink, appearing to read 'D. M. Gullott', followed by a horizontal line extending to the right.

David M. Gullott  
Manager – Licensing  
Exelon Generation Company, LLC

Attachment: Revised RAI 1 Response

cc: Regional Administrator – NRC Region III  
NRC Senior Resident Inspector – Braidwood Station  
Illinois Emergency Management Agency – Division of Nuclear Safety

## ATTACHMENT

In Reference 1, Exelon Generation Company, LLC (EGC) requested an amendment to Technical Specification (TS) 3.7.8, "Essential Service Water (SX) System," of Renewed Facility Operating License No. NPF-77 for Braidwood Station Unit 2. The proposed amendment would modify TS 3.7.8 by adding a new Required Action A.2 that increases the Completion Time (CT) currently specified in Required Action A.1, "Restore unit-specific SX train to OPERABLE status," from 72 hours to 200 hours. This proposed change is a one-time change to support a planned 2A SX pump repair scheduled to be performed prior to January 23, 2017. The U. S. Nuclear Regulatory Commission (NRC) requested additional information related to its review of Reference 1 in Reference 2. EGC responded to the NRC Reference 2 request in Reference 3.

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### **NRC RAI**

#### *Regulatory Basis:*

*The guidelines of Regulatory Guide 1.177, "An Approach for Plant-Specific, Risk-Informed Decision making: Technical Specifications," Revision 1, dated May 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML100910008), state that the NRC staff desires to base its decisions on proposed Technical Specification changes from the results of traditional engineering evaluations, supported by insights (derived from the use of PRA methods) about the risk significance of the proposed changes. Decisions are expected to be reached in an integrated fashion, considering traditional engineering and risk information. One of the traditional engineering considerations is evaluating defense in depth. Defense in depth includes a reasonable balance in prevention of core damage, not having an over-reliance on programmatic activities, and having system redundancy and independence commensurate with the expected frequency of challenges to the system.*

*Braidwood was one of the sites with applicability to Generic Issue 130 and the corresponding Generic Letter 91-13 as noted in the September 30, 2016, submittal. The submittal did not address redundancy of the emergency service water system (SX) and prevention of core damage for the risk of an extended Loss of Offsite Power and failure of the 2B Emergency Diesel Generator (EDG). A fire in the Unit 2 Engineered Safety Feature (ESF) switchgear could also affect similar equipment losses. Loss of the 2B EDG with a LOOP would cause the immediate loss of SX to unit 2 and threaten loss of the 2A EDG due to lack of SX.*

### **NRC RAI 1**

*The licensee is requested to supplement the application by addressing the scenario of an extended LOOP with failure of the 2B EDG. Include in your response as a minimum:*

- a) All operator actions and response times needed,*
- b) How primary plant pressure and inventory will be controlled considering available electrical power and cooling to charging pumps and available cooling to letdown and the effect on 2A EDG,*
- c) How feed water is supplied to the steam generators considering available power and cooling to auxiliary feed water pumps,*
- d) RCP seal injection/cooling,*

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- e) *Available clean water inventory for SG feed for an extended LOOP, Discuss SG feed sources for LOOP that extends several days and/or the ability to use RHR for shutdown cooling.*
- f) *How containment cooling is achieved*
- g) *Are there analysis/calculations in place that demonstrate that the required SX flow from the unit crosstie can meet the SX needs of both units for the above scenario? Explain.*
- h) *Are there procedures in place to mitigate the above described scenario? Explain.*

### EGC Response:

Braidwood Station currently has Abnormal Operating Procedures (AOPs) that the plant staff uses to respond to a complete loss of SX on one unit. These AOPs utilize the SX System's redundancy and the cross-tie capability between the two units as described in Section 3.0 of Reference 1. The AOPs use the second (i.e., standby) 100% capacity SX pump from the opposite unit to provide the required SX flow to the unit that lost the capability of both SX pumps. The details of the AOPs are provided below.

Note: there are no additions, deletions, or changes to these AOPs to support response to a loss of Unit 2 SX during the extended 2A SX train CT.

### EGC Response to RAI-1a:

Operators enter 2BwEP-0, "Reactor Trip or Safety Injection Unit 2," to confirm automatic actions have occurred in response to the Unit 2 reactor trip following the Unit 2 LOOP.

Upon completion of 2BwEP-0 immediate actions, operators enter 2BwOA PRI-8, "Essential Service Water Malfunction Unit 2," due to the loss of Unit 2 SX flow, cued by annunciator 2-2-A2, SX PUMP DSCH HDR PRESS LOW. 2BwOA PRI-8 directs starting the standby Unit 1 SX pump and opening the 1SX005 and 2SX005 motor operated valves to supply Unit 2 SX loads from Unit 1 SX pumps. These actions are performed from the Main Control Room. Simulator training and recent simulator demonstrations have shown that SX crosstie between units is performed well within 5 minutes of the loss of SX to one unit. These actions will be pre-briefed to the operating crews during the extended CT.

The Braidwood Station UFSAR states that a lack of SX flow at the time an EDG starts will not prevent accomplishment of its safety function and that the EDGs were specified and designed to operate for 5 minutes without a supply of cooling water. In addition, an Engineering Evaluation has demonstrated the EDGs could operate for up to 22 minutes with a loss of SX flow to the engine cooler. Therefore, a Unit 2 EDG will be available to power its divisional loads during the SX cross-tie to Unit 1.

Under a LOOP scenario without a reactor trip, the operators would be provided guidance in accordance with 2BwOA ELEC-4, "Loss of Offsite Power, Unit 2," 2BwOA ELEC-3, "Loss of 4kV Bus, Unit 2," and 2BwOA PRI-8. These procedures provide the necessary direction to respond to this event and complete the actions to crosstie SX to Unit 1.

### EGC Response to RAI-1b:

Once the 2A EDG automatically starts and energizes ESF bus 241 within 10 seconds of the LOOP, bus 241 remains energized throughout the event. Two sets of pressurizer heaters and

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both pressurizer power operated relief valves (PORVs) and auxiliary spray remain available to control RCS pressure. Non-ESF bus 243 would be cross-tied with ESF bus 241 to provide power to the 2A and 2D pressurizer heaters.

The 2A Chemical and Volume Control System (CV) pump automatically starts following the LOOP and maintains RCS inventory in conjunction with CV letdown. The 2A Component Cooling System (CC) pump automatically starts following the LOOP to provide cooling to letdown flow. An Engineering Evaluation has demonstrated both the CV and CC systems could operate satisfactorily for at least 10 minutes with a loss of SX flow. Unit 2 SX flow can be restored from Unit 1 within this time period as described in the response to RAI-1a above.

### EGC Response to RAI-1c:

The 2B Auxiliary Feedwater System (AF) pump provides feedwater flow to the steam generators. The 2B AF pump is a direct drive diesel engine equipped with an essential service water booster pump to provide cooling water for jacket water, lubrication oil, and room cooling in the event of a loss of both the 2A and 2B SX pumps (i.e., loss of SX on Unit 2). An Engineering Evaluation has shown that the 2B AF pump is capable of operating, with no AC power sources, for 2 hours with only its SX booster pump providing cooling flow (i.e., loss of SX flow). Unit 2 SX flow can be restored from Unit 1 well within this time period as described in the response to RAI-1a above.

### EGC Response to RAI-1d:

The 2A CV pump provides reactor coolant pump (RCP) seal injection flow immediately when automatically started following the LOOP. The 2A CC pump provides RCP thermal barrier cooling immediately upon its automatic start following the LOOP. Therefore, the plant design will restore RCP seal injection and thermal barrier cooling soon after the LOOP event. An Engineering Evaluation has demonstrated both the CV and CC systems could operate satisfactorily for at least 10 minutes with a loss of SX flow. In the event that Unit 2 RCPs experience an extended loss of seal cooling, the pumps are designed with a seal assembly (i.e., shutdown seal (SDS)) with a ring that constricts around the No. 1 seal sleeve. This controls the shaft seal leakage and limits the loss of reactor coolant inventory through the seal package. Note that a normal LOOP is not expected to cause elevated seal temperatures which would actuate the SDS.

### EGC Response to RAI-1e:

The Condensate Storage Tank (CST) provides a clean water inventory to perform RCS cooldown utilizing the AF system and the steam generator (SG) PORVs. The AF system and SG PORVs cool down the RCS to the Residual Heat Removal System (RH) shutdown cooling conditions (i.e., RCS temperature < 350°F, RCS pressure < 360 psig). RCS cooldown is initiated within 2 hours of CST level lowering to 70% during an RCS cooldown using the SG PORVs to ensure sufficient secondary inventory. Once the SX cross-tie to Unit 1 has been established, the RH, CC, and SX systems remain available to support RH operation in the shutdown cooling mode.

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### EGC Response to RAI-1f:

Containment is cooled by the reactor containment fan coolers (RCFCs). One train of RCFCs (i.e., two fan coolers) will be capable of removing containment heat once the Unit 1 SX cross-tie is established in the first few minutes of the event as discussed in the response to RAI-1a. A Byron/Braidwood calculation addressing Station Blackout demonstrated that the containment parameters will remain below the EQ limits with a complete loss of SX cooling to the RCFCs for four hours. Although this analysis was performed pre-Power Uprate and pre-MUR Uprate, a postulated loss of SX event on Unit 2 would be significantly shorter than 4 hours; therefore, by engineering judgment, the results of the pre-Power Uprate analysis bound the loss of SX scenario.

### EGC Response to RAI-1g:

Design analyses exist that demonstrate the SX system capability. The SX system for each unit consists of two separate and independent trains with 100% capacity to satisfy the normal or post-accident requirements associated with the unit. Typically, one 100% capacity SX pump in each unit operates to cool the unit's loads with the unit cross-tie valve closed. The scenario described requires one opposite unit SX train to be cross-tied to Unit 2 while the other Unit 1 SX train simultaneously supports normal Unit 1 operation. As described in UFSAR Section 9.2.1.2, the crosstie flowpath along with the opposite unit SX pump are capable of providing backup cooling in the event of a loss of all SX on one unit. As soon as the crosstie has been completed, the Unit 1 SX system supplies all required SX loads as identified in UFSAR Table 9.2-1 for Unit 1 and Unit 2.

### EGC Response to RAI-1h:

The procedures for operator response to mitigate the loss of SX on Unit 2 are as follows:

- |              |                                                                                                                                                                                     |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2BwEP-0      | "Reactor Trip or Safety Injection Unit 2." Confirms expected automatic actions have occurred following reactor trip. Directs entry to 2BwOA ELEC-3 to restore bus 242 from bus 142. |
| BwAR 2-2-A2  | "SX PUMP DSCH HDR PRESS LOW." Cues 2BwOA PRI-8 entry.                                                                                                                               |
| 2BwOA PRI-8  | "Essential Service Water Malfunction Unit 2." Directs cooling U-2 SX loads using U-1 SX pumps.                                                                                      |
| 2BwOA ELEC-3 | "Loss of 4KV ESF Bus Unit 2." Directs restoring bus 242 from bus 142.                                                                                                               |
| 2BwOA ELEC-4 | "Loss of Offsite Power, Unit 2." Provides actions to stabilize the plant following a loss of offsite power when a Safety Injection has not occurred.                                |
| 2BwEP ES-0.1 | "Reactor Trip Response." Directs initial control of reactivity, RCS inventory and pressure, secondary heat sink, and AC busses. Secures unnecessary plant equipment.                |
| 2BwEP ES-0.2 | "Natural Circulation Cooldown Unit 2." Performs plant cooldown to mode 5 while controlling RCS temperature and pressure and core reactivity.                                        |

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### **REFERENCES**

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