Exelon Generation
4300 Winfield Road
Warrenville, IL 60555

www.exeloncorp.com

Exelon Nuclear

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Braidwood Station, Units 1 and 2
Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Byron Station, Units 1 and 2
Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Subject: Request for Additional Information Regarding a License Amendment for a One-Time Extension of the Essential Service Water Train Completion Time

References:
(1) Letter from Keith R. Jury (Exelon Generation Company, LLC) to U.S. NRC, "Request for a License Amendment for a One-Time Extension of the Essential Service Water Train Completion Time," dated June 11, 2003

(2) Letter from George F. Dick (NRC) to John L. Skolds (Exelon Generation Company, LLC), "Request for Additional Information Regarding a One-Time Extension of the Essential Service Water Completion Time – Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2"

In Reference 1, Exelon Generation Company, LLC (EGC) requested NRC approval of a proposed change to Appendix C, "Additional Conditions," of Facility Operating License Nos. NPF-72, NPF-77, NPF-37 and NPF-66, for the Braidwood Station, Units 1 and 2, and the Byron Station, Units 1 and 2, respectively. The proposed change would add a license condition that increases the Completion Time (CT) for Required Action A.1, "Restore unit-specific SX train to OPERABLE status," associated with Technical Specifications (TS) Section 3.7.8, "Essential Service Water (SX) System," from 72 hours to 144 hours. This proposed change would only be used one time on each unit at Byron Station and on Unit 1 only at Braidwood Station.

During the NRC's review of the proposed change, a number of questions were raised and subsequently, in Reference 2, the NRC requested that we provide additional information to support justification of the proposed change. Our response to the NRC's request is provided in Attachment 1.

Should you have any questions related to this matter, please contact J. A. Bauer at (630) 657-2801.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 12-5-03

Kenneth A. Ainger
Manager, Licensing

Attachment 1: Response to a Request for Additional Information Regarding a License Amendment for a One-Time Extension of the Essential Service Water Train Completion Time

Attachment 1

Response to a Request for Additional Information Regarding a License Amendment for a One-Time Extension of the Essential Service Water Train Completion Time

In a letter from George F. Dick (NRC) to John L. Skolds (Exelon Generation Company, LLC), "Request for Additional Information Regarding a One-Time Extension of the Essential Service Water Completion Time – Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2," the NRC requested that the following additional information be provided to support justification of the proposed license condition addressed in a letter from Keith R. Jury (Exelon Generation Company, LLC) to the U.S. NRC, "Request for a License Amendment for a One-Time Extension of the Essential Service Water Train Completion Time," dated June 11, 2003 (i.e., Reference 1). The information requests and the associated responses are presented below.

1. *In Attachment 1, Section 4.1 (1st paragraph) of the June 11, 2003, submittal, the licensee states that, ".....However, the actual plant design and supporting analyses demonstrate that the plant has additional capability to prevent and mitigate a loss of SX to a unit than credited in the current plant licensing basis, (e.g., the backup fire protection system the cooling to the Chemical and Volume Control (CV) centrifugal charging pumps which is not credited in the licensing basis)." Discuss fully the additional capabilities that exist, and to what extent these capabilities satisfy licensing basis requirements for safety-related applications (e.g., Seismic Category I, QA-1, EQ). Also, discuss the compensatory measures that will be taken to assure that these additional capabilities will be available.*

   Response to Question 1

   There are two capabilities with respect to the essential service water (SX) system that are credited in the risk analysis but are not credited in the licensing basis.

   - The first is the capability of a single SX pump to provide cooling to loads of both units. A best estimate flow analysis has shown that a single pump can provide cooling to all loads on both units with the exception of the Reactor Containment Fan Coolers (RCFC) and Emergency Diesel Generators (EDGs) on the unit without an SX pump and one train of RCFCs on the unit with an available SX pump. This analysis was performed assuming that the available SX pump is being crosstied to the other unit to either maintain cooling to that unit while it is shutting down or responding to an accident condition. This crosstie is accomplished by opening the 1/2SX005 valves (a remote action from the control room). These valves are Seismic Category I and Safety Related.

   - The second capability credited in the risk analysis is the ability to provide cooling from the Fire Protection (FP) system to the Chemical and Volume Control (CV) centrifugal charging pumps. This capability is used to ensure that Reactor Coolant Pump (RCP) seal injection remains available in the event of an extended loss of SX. With the exception of the valves and fittings on the CV pump oil cooler, this connection is neither Seismic Category 1 nor Safety Related; however, its use is not credited for either seismic events or to mitigate a Loss of Coolant Accident (LOCA). In order to assure that these capabilities will be available during the planned evolution, the equipment associated with both the SX crosstie and the FP connection to the CV pumps will be considered "Protected Equipment" while the plant invokes the one-time extension to the CT of TS 3.7.8, Condition A. In addition, while invoking the one-time extension to the CT of Condition A, the "dedicated" control room operator and shiftly briefings will supplement routine training on these actions performed as part of Licensed Operator

Requalification Training. This increases the likelihood of performing the necessary actions successfully, if they are required.

2. *In Attachment 1, Table -2, the licensee indicated that the defenses against human errors are preserved. However, the staff notes that the licensee's compensatory measures credit additional operator actions. This would suggest that the potential for human error has increased. Please explain.*

   Response to Question 2

   The defenses against human errors are preserved, as there are no new operator errors introduced when operating with an SX pump on each unit inoperable. The likelihood of requiring operator actions to respond to a loss of SX on a unit is increased. The risk assessment recognizes this and establishes compensatory measures designed to decrease the potential for human error if these actions are required.

3. *Describe the compensatory measures that will be taken to preserve the SX function against the adverse affects of inclement weather conditions that might arise, and to preserve on-site and off-site electrical sources during the period of allowed outage time (AOT) extension.*

   Response to Question 3

   The SX pumps and all support equipment are located in structures that are designed to withstand the effects of severe weather including tornados and high winds. The major impact of such events is, therefore, the initiation of a Loss of Offsite Power (LOOP) event. As identified in Table 7 of our June 11, 2003 submittal (i.e., Reference 1), maintenance on all four EDGs and associated electrical buses will be restricted while the CT is in effect. This assures that the electrical power will be available should a LOOP occur.

4. *In its application the licensee has stated, "Credit for the dedicated operator to maintain and respond to SX-related problems is recognized as a key compensatory measure." In the six bullets that follow this statement the term "dedicated" operator occurs three times and "designated" operator appears twice. The staff position on "dedicated" does not necessarily mean that operator has no other duties as long as the other duties do not interfere with performing the required tasks. A "dedicated" operator is located in the immediate vicinity of where the task is to be performed and is capable of performing the task on demand. Therefore, no decision time, preparation time, or travel time is involved. A "designated" operator is available to perform the specific task when required, but may have other responsibilities that require him/her to be away from the immediate vicinity of where the required task is to be performed. Implied in both "dedicated" and "designated" is that the individual is "qualified" to do the task. Please clarify whether the operators are "dedicated" or "designated" in each of the five instances in this case. If these are "designated" operators, what tasks take precedence and how does the operator know when and what tasks to perform?*

Attachment 1

**Response to a Request for Additional Information
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Response to Question 4

The senior reactor operator (SRO) and reactor operator (RO) are considered "dedicated" operators. The equipment operator (i.e., non-license operator) is considered a "designated" operator. The designated equipment operator will only be assigned tasks that can be immediately deferred if the operator is required to implement the designated actions. These three operators are in addition to the minimum staffing levels required by Technical Specifications and 10 CFR 50.54, "Conditions of licenses," paragraph (m)(2)(i). Additional clarification of the six bullets on pages 16 and 17 of our June 11, 2003 submittal, describing "implementation of the dedicated operator," is provided below.

- *training emphasis on establishing the SX unit crosstie and alternate cooling for the CV pumps for control room operators and equipment operators;*

  Control room operators and equipment operators will receive refresher training on the procedures for establishing the SX unit crosstie and alternate cooling for the CV pumps prior to entering the SX Completion Time.

- *assignment of dedicated operators inside and outside the control room to back up the nominal staff for these actions. These personnel represent additional operators (i.e., one senior reactor operator (SRO) in the control room, one reactor operator (RO), and one equipment operator) assigned to monitor SX performance and take these actions as a back up to the nominal shift staff;*

  As noted above, the SRO and RO are considered dedicated, and the equipment operators is considered designated. These three operators are in addition to the minimum required Technical Specification staffing levels.

- *conducting training to walk through the alignment actions with designated operators prior to entering the SX LCO;*

  A briefing will be provided to SROs, ROs and equipment operators to ensure that any operator, either dedicated or designated, will be familiar with the appropriate compensatory actions and the location of staged equipment and necessary tools (e.g., keys for locked valves and ladders needed to access equipment) to execute the associated tasks.

- *briefings on the SX alignment and the conditions that could require performance of these operator actions at each shift change;*

  Shiftly briefings will be provided to both the dedicated SRO and RO as well as the designated equipment operator to ensure understanding of the entry conditions for the compensatory actions.

- *providing copies of the procedures for the action to align fire protection cooling to the designated equipment operators prior to each shift change to minimize the need to locate the procedures during loss of SX conditions; and*

  Copies of the procedures will be provided to the designated equipment operator.

- *placing ladders/stepping stools in locations where the fire protection hose hookup is above the height that an operator can reach it without assistance (such as the B charging pump rooms at Byron Station).*

  Staging of ladders/stepping stools will be done to minimize the time required for the designated equipment operator to take the specified action.

5. *The submittal further indicates, "These personnel represent additional operators (i.e., one senior reactor operator in the control room, one reactor operator, and one equipment operator) assigned to monitor SX performance and take these actions as a back up to the normal shift staff;(.)"*

   a. *Please describe the command, control, and communication arrangement and protocol these additional operators have with the normal control room crew.*

   Response to Question 5.a

   The dedicated SRO and RO will specifically monitor SX performance; however, will report directly to the operating unit Unit Supervisor who reports to the Shift Manager. The designated equipment operator will report to the dedicated SRO. Standard three-way communication protocol will be used throughout the evolution.

   The dedicated SRO and RO will identify the entry conditions for implementation of the appropriate abnormal operating procedures. They will inform the Unit Supervisor that the entry conditions have been reached and are implementing abnormal operating procedure BwOA Pri-8, "Essential Service Water Malfunction," (Braidwood) or BOA PRI-7, "Essential Service Water Malfunction," (Byron), and will subsequently report the results of the actions to the Unit Supervisor.

b. *What are the tasks anticipated to be required in this case and what is the level of complexity/difficulty of each? What are the consequences of not successfully accomplishing the tasks?*

Response to Question 5.b

The tasks anticipated to be required are provided in Table 1 below.

**Table 1
Task Identification**

Task	Location	Complexity/Difficulty	Consequences if Not Performed
Establish SX unit crosstie	Main Control Room	SIMPLE – Isolate flow to one RCFC train, open crosstie valve	Loss of SX, requires additional action to establish alternate cooling to CV pumps to maintain RCP seal injection and prevent potential for RCP Seal LOCA
Establish alternate cooling (i.e., FP) to CV pump oil cooler	CV Pump Room	SIMPLE – Locally connect fire hose to CV pump oil cooler connection (pre-staged), isolate normal flow path from SX, open FP valve	Loss of CV pump for RCP seal injection. Potential for RCP Seal LOCA
Establish cool suction source for CV pumps	Main Control Room	MODERATE – Align seal return to pressurizer relief tank, monitor seal water heat exchanger outlet temperature (if greater than 160°F, align CV pumps suction to refueling water storage tank)	Loss of CV pump for RCP seal injection. Potential for RCP Seal LOCA

c. *How much time is available to accomplish the above tasks and how much time have the tasks been demonstrated to take? If these are "designated" operators how has travel time been accounted for? Please describe the demonstration.*

Response to Question 5.c

Table 2 below provides a summary of the time available as well as the time required to take these actions. The "Time Required" includes travel time associated with the designated operators. This time was obtained from a review of operations simulator training records, including job performance measures. The travel time associated with the designated operators is an estimate based on engineering judgment.

**Table 2
Operator Action Times**

Task	Time Available	Time Required
Establish SX unit crosstie	90 minutes	6 minutes
Establish alternate cooling (i.e., FP) to CV pump oil cooler	90 minutes	15-20 minutes
Establish cool suction source for CV pumps	30 minutes	7 minutes

d. *What are the communication requirements and how have they been demonstrated acceptable?*

Response to Question 5.d

Communications from the control room to the "designated" equipment operator will be accomplished using the normal radio system, telephone or plant page. These systems are verified operational through normal frequent use and have proven to be adequate for all plant evolutions based on years of operating experience.

e. *Please describe the environmental conditions at each task location. Please describe the access to required equipment.*

Response to Question 5.e

Other than the FP connection to the CV pumps, all actions can be taken from the control room. The FP connection to the CV pump is performed in the CV pump rooms in the auxiliary building. The CV pump rooms are not environmental adverse areas and there are no special access requirements necessary to perform the prescribed actions other than normal radiation work permit compliance.

6. *Section 9.2.1.2.2 of the Byron and Braidwood (B/B) updated final safety analysis report (UFSAR) states that the essential service water pumps are located at the lowest level of the auxiliary building to ensure net positive suction head. Section 9.2.1.2.7 of the B/B-UFSAR*

states that Pumps 1A and 2A are located in one compartment, and that Pumps 1B and 2B are located in a separate adjacent compartment. Each compartment has a watertight door. During replacement of the SX pump suction isolation valves, a postulated flood originating in one of the SX pump rooms (caused, for example, by spurious opening of the common upstream suction isolation valve) could propagate to other areas of the auxiliary building since the watertight door would be opened to allow personnel and equipment access.

Please describe how internal floods that may originate in one of the SX pump rooms during replacement of the SX pump suction isolation valves have been addressed in the risk evaluation. Provide relevant flood initiating event frequencies, sequence descriptions, core damage frequency estimates, and large early release frequency estimates.

Response to Question 6

The SX pump suction isolation valves are located in separate valve pits outside of the SX pump rooms. During the valve replacement, the suction line will be isolated using the common upstream suction isolation valves as well as having balloons installed in the suction line. As the common upstream suction isolation valves are remote (i.e., located in the lake screen house at Braidwood Station and the SX basin at Byron Station) from the suction isolation valves, this effectively eliminates the risk from a spurious valve opening.

7. *Section 4.3.1.2 (Page 16 of 52) in Attachment 1 of Exelon's request states that "The risk evaluation of internal events incorporates a number of compensatory measures that the plant will take to assure the risk impacts are acceptably low." In order to: (a) ensure that the proposed compensatory measures are not being relied upon to compensate for weaknesses in plant design, and (b) clearly understand which compensatory measures should be referenced in the staff's safety evaluation supporting the license amendment, please provide the results of a sensitivity study that shows how the incremental conditional core damage probability and the incremental conditional large early release probability change if none of the compensatory measures are implemented.*

Response to Question 7

Table 3 below provides the incremental conditional core damage probability (ICCDP) and incremental conditional large early release probability (ICLERP) for internal events if the compensatory measures are not implemented.

**Table 3
Results of Risk Metrics with No Compensatory Measures**

Risk Metric	Risk Metric Results		
	Braidwood	Byron	
	Unit 1	Unit 1	Unit 2
ICCDP	6E-6	6E-6	6E-6
ICLERP	2E-7	2E-7	3E-7

Attachment 1

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8. *Provide the details of any significant findings and observations from the probabilistic risk assessment (PRA) peer review certification conducted for the Byron Station. Include in the discussion any improvements or corrections that were made in the plant as a result of the findings. Note that it is not necessary to provide this information for the Braidwood Station since it was previously sent to the NRC staff on July 7, 2000 as a response to a request for additional information issued in conjunction with Exelon's request to extend allowable completion times and change surveillance requirements for emergency diesel generators.*

Response to Question 8

The significant Byron Station PRA peer review comments and resolutions are provided in Table 4.

**Table 4
Peer Review Findings**

Observation	Resolution
The fault tree logic for automatic start of the motor-driven AF pump assumes that a safety injection (SI) signal is always initiated. This is probably not true.	The fault tree logic was corrected.
The Class IE AC power dependency for the AF system is incorrect as described and modeled. The air operated flow control valves are assumed to fail open in the AF models if Class 1E 120V AC power is lost. The Class 1E 120V AC system description states that the valves will fail closed. Further checking verified the Class 1E 120V AC power description (i.e., fail closed).	The fault tree logic was corrected to appropriately model the dependency of the A train AF valves on Instrument Bus 111 (or 211) and the B train AF valves on Instrument Bus 114 (or 214).
Actuation logic for reactor protection system (RPS) and SI considers full range of possible signals. The RPS/engineered safety features actuation system (ESFAS) analysis file clearly identifies which signals will be generated for each individual initiating event. However, while the RPS fault tree is correctly structured so that only the appropriate trip signal(s) are credited for a given initiating event, the SI fault tree logic is not. Consequently, the SI analysis credits all possible SI signals for those initiators which will generate an SI signal. The analysis is, therefore, non-conservative particularly for those initiators which do not generate diverse SI actuation signals.	The fault tree logic was corrected to appropriately model the SI signal.

9. *Attachment 4, Table 2-1 of Exelon's request summarizes the major changes made to the Braidwood and Byron PRA models since Exelon's request to exten(d) allowable completion times and change surveillance requirements for emergency diesel generators was submitted (January 20, 2000). Please provide the following information:*

   a. *Describe the quality process used to control how the PRA model changes were reviewed and approved. Discuss internal, external, and peer reviews as applicable.*

      Response to Question 9.a

      The Byron/Braidwood PRA model received two peer reviews (Braidwood Station in 1999; Byron Station in 2000) as they share a single PRA model (i.e., with appropriate flags and databases to differentiate between units/sites). Model revisions since the Byron Station peer review have been developed by the corporate Risk Management staff and independently reviewed by the Byron and Braidwood Site Risk Management staff. To ensure that the model remains an accurate reflection of the as-built, as-operated plants, the following activities are routinely performed.

      - Design changes and procedure changes are reviewed for their impact on the PRA model.
      - New engineering calculations and revisions to existing calculations are reviewed for their impact on the PRA model.
      - Maintenance unavailabilities are captured and their impact on CDF is trended.

      In addition, prior to using the PRA model for an application, the PRA model is reviewed using the EPRI PSA Applications Guide Technical Adequacy Checklist to ensure that the model is adequate for that application. Based on this review, additional model changes or updates are performed (if required) prior to using the model in support of that application.

   b. *What is the current "freeze date" of the Braidwood and Byron PRA models? List all PRA model changes that have been identified/planned but not yet implemented, indicating their anticipated impacts (if any) on the risk results and conclusions concerning the extension of the SX train completion time request that is currently under consideration.*

      Response to Question 9.b

      The current Byron/Braidwood PRA model was approved on May 16, 2003. This model reflected the as-built, as-operated plant as of December 31, 2002. Prior to completion of the current model, all open PRA model and documentation issues were reviewed to ensure that they had no impact on the SX CT analysis. Thus, the open items do not impact the results, insights, or conclusions presented in Reference 1.

As part of the review described above, five open issues were identified that are related to loss of SX scenarios. These items were addressed using qualitative assessment or sensitivity analysis and their disposition is described below.

- Use of WOG 2000 RCP Seal LOCA Model.

  The Byron and Braidwood PRA models use an RCP Seal LOCA model based on NUREG/CR-4550, "Analysis of Core Damage Frequency From Internal Events: Expert Judgment Elicitation," Volume 2, April 1989, for modeling RCP seal failures during station blackout conditions. A recent study by the Westinghouse Owners Group (i.e., the "WOG Model") provides different failure probabilities and flow rates for the RCP seals, as well as new timing. A sensitivity study was performed to evaluate the impact of the WOG model on the calculations used to evaluate the risk associated with extending the SX CT. This sensitivity study concluded that use of the WOG 2000 Seal LOCA model would increase ICCDP/ICLERP by less than 4%. Therefore, the selection of RCP Seal LOCA model does not significantly impact the conclusions of the analysis.

  It should be emphasized that these RCP Seal LOCA models are only applied to station blackout scenarios. For scenarios where RCP seal cooling is lost with offsite power available, seal integrity is assumed to be lost leading to a small LOCA. This conservatism in non-station blackout scenarios overshadows the difference in station blackout seal failure models and overstates the ICCDP and ILERP.

- Since the time Reference 1 was submitted, the success criteria for auxiliary building ventilation (VA) fans was found to incorrectly allow use of two fans per plenum while operating procedures restrict use to one fan per plenum.

  This modeling error was recently identified and qualitatively determined to have an insignificant impact on the ability to use the VA system to provide cooling to the CV pump rooms following a loss of SX. The Human Error Probability for establishing the connection remains higher than the probability of failing two or more fans. Changes have been made to the on-line risk assessment tools at Byron Station and Braidwood Station to compensate for this error.

- The PRA model assumes that neither SX pump cubicle cooler nor oil cooling are required for continued operation of the SX pumps. Existing analyses indicate that either the lube oil cooler or the cubicle cooler are required for long term operation.

  As the running SX pump cools both the oil cooler and cubicle cooler, the multiple failures required to fail cooling to the pump are insignificant as compared to direct failures of the pump. Therefore, lack of modeling this combined dependency has a negligible impact on the risk assessment. In addition, room temperature in the SX pump rooms is monitored and alarmed. Corrective action will be taken if a cubicle cooler is unable to provide adequate ventilation.

- Modeling of inter-train SX crosstie valves (1/2SX033, 1/2SX034) needs enhancements for on-line risk assessments.

  This modeling issue only applies to maintenance evolutions that result in one of the SX train crosstie valves being closed and unable to open. As identified in Reference 1, this configuration will not be allowed during the CT.

- Time allowed for power recovery in Station Blackout Analysis does not adequately account for the time to restart and align systems.

  A sensitivity analysis was performed to determine the impact of decreasing the amount of time available for off-site power recovery. As Loss of Offsite Power (LOOP) is not a dominant contributor to risk in the configuration with two SX pumps unavailable, increasing the non-recovery probability results in less than a 2% increase in ICCDP/ICLERP.

In addition to the five open issues described above that were determined not to affect the conclusions of the PRA analysis of the proposed extended SX completion time, all other pending changes to the PRA model (e.g., more conservative modeling assumptions, minor data and model enhancements, and documentation enhancements) that were not related to loss of SX scenarios were reviewed and determined to have no impact on the PRA analysis of the proposed extended SX completion time.