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

January 6, 2011

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

SUBJECT: DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3, AND QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2 – WITHDRAWAL OF LICENSE AMENDMENT REQUEST CONCERNING THE EXTENSION OF THE TECHNICAL SPECIFICATION COMPLETION TIME FOR STANDBY LIQUID CONTROL (TAC NOS. ME2567, ME2568, ME2569 AND ME2670)

Dear Mr. Pacilio:

By letter to the Nuclear Regulatory Commission (NRC) dated November 10, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML093140516), as supplemented by letter dated October 12, 2010 (ADAMS Accession No. ML102861911), Exelon Generation Company, LLC submitted a request to amend the Technical Specifications (TSs) to extend the COMPLETION TIME (CT) for Condition B of TS 3.1.7 for the Standby Liquid Control (SLC) system from 8 to 72 hours for the Dresden Nuclear Power Station, Units 2 and 3, and Quad Cities Nuclear Power Station, Units 1 and 2.

The NRC staff held a conference call with Mr. Jeffrey Hansen of your staff on November 10, 2010, to discuss several issues identified with this submittal. Subsequently by letter dated November 16, 2010 (ADAMS Accession No. ML103200394), Exelon requested that the submittal be withdrawn and requested the NRC staff's technical assessment. As a result of the withdrawal request, the NRC staff issued a Notice of Withdrawal for Amendment to Facility Operating license in the *Federal Register* on December 6, 2010 (75 FR 75706).

The NRC staff had completed its review of the submittal when the request for withdrawal was received. At your staff's request, enclosed is the NRC staff's assessment on the information provided in support of this licensing request.

Condition B of TS 3.1.7 is unique in that it provides a CT when both redundant subsystems of a two train safety system are inoperable. This condition, which is consistent with the standard TS for boiling water reactor designs, is provided to permit testing and minor maintenance activities on components which are common to both subsystems without requiring a plant shutdown.

It should be noted that the information provided in your submittals was not sufficient to demonstrate that adequate defense-in-depth would be maintained during the out of service period, nor was the use of a risk-based approach appropriate given the proposed means for mitigation of an anticipated transient without scram during an extended loss of function of the SLC system.

If you have any questions, please contact Ms. Eva Brown at (301) 415-2315.

Sincerely,

/RA/

Eva A. Brown, Senior Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-237, 50-249, 50-254, and 50-265

Enclosure:
As stated

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UNITED STATES
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ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

EXTENSION OF THE COMPLETION TIME FOR

STANDBY LIQUID CONTROL SUBSYSTEMS

EXELON GENERATION COMPANY, LLC

DRESDEN NUCLEAR POWER STATION UNIT NOS. 2 AND 3

QUAD CITIES NUCLEAR POWER STATION UNIT NOS. 1 AND 2

DOCKET NOS. 50-237, 50-249, 50-254, AND 50-265

1.0 Background

By risk-informed application dated November 10, 2009, as supplemented by letter dated October 12, 2010, Exelon Nuclear, LLC, (the licensee) requested changes to the technical specifications (TS) for the Dresden Nuclear Power Station (DNP) Units 2 and 3, and for Quad Cities Nuclear Power Station (QC) Units 1 and 2, in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.90. The licensee proposed to extend the COMPLETION TIME (CT) associated with the condition where both standby liquid control (SLC) subsystems are inoperable from 8 hours to 72 hours. The proposed change would allow for more significant maintenance or repair activities on both subsystems or on common components while the affected unit remained at power.

2.0 Licensing/Design Bases Description

2.1 Standby Liquid Control System Description

Each unit at both DNP and QC has a SLC system, which consists of two subsystems sharing a common borated solution supply and some common piping headers. The function of the SLC system is to provide the capability of bringing the reactor to a subcritical condition without taking credit for rod movement for mitigation of an anticipated transient without scram (ATWS) and to ensure that offsite and onsite doses remain within the limits of Title 10 of the *Code of Federal Regulations* Section 50.67, *Accident Source Term.* These functions are accomplished by injecting borated water into the reactor core using at least one of the two 100 percent capacity pumps and associated flowpaths from the common storage tank. Although each subsystem includes a separate pump and explosive valves which are on independent electrical safety buses, the subsystems share common piping and the common storage tank.

Enclosure

As approved in a safety evaluation dated September 11, 2006, credit for the SLC system in the radiological analyses is based on operation of one SLC pump, manually initiated, and injection of the required amount of sodium pentaborate in the reactor and its transport to and mixing with the suppression pool water. The SLC system is manually initiated from the main control room. The design bases for both DNP and QC credits SLC systems for maintaining pH balance in the suppression pool at or above 7 following a LOCA to ensure that iodine will be retained in the suppression pool water. The design bases of the SLC systems for QC and DNP are contained in updated final safety analysis – Section 9.3.5, "Standby Liquid Control System."

2.2 Technical Specifications

The current TS (3.1.7) at DNP and QC are consistent with the NUREG-1433, *General Electric Plants, BWR/4, Rev. 3 Standard Technical Specifications*, Volume 1 (STS). Specifically, there are three conditions of inoperability addressed in the STS and both DNP and QC TS 3.1.7: 1) borated solution concentration parameter out of limit which affects both subsystems; 2) inoperability of a single subsystem; and, 3) inoperability of both subsystems due to causes other than borated solution concentration. An 8-hour CT is provided for inoperability of both subsystems, based on the low probability of an ATWS during this short time period. Typically, TS do not address conditions which represent a total loss of function. The 8-hour CT was provided to allow for inoperabilities of common components, piping, and instrumentation in the SLC system to permit routine surveillance and minor maintenance activities without requiring an immediate shutdown.

2.3 Risk-Informed Decision Making

As discussed in Regulatory Guide (RG) 1.177, *An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications,* licensing bases changes which are risk-informed are expected to meet a set of key principles. Some of these principles are written in terms typically used in traditional engineering decisions (e.g., defense in depth). These principles are:

1. The proposed change meets the current regulations unless it is explicitly related to a requested exemption or rule change;

2. The proposed change is consistent with the defense-in-depth (DID) philosophy;

3. The proposed change maintains sufficient safety margins;

4. When proposed changes result in an increase in core damage frequency or risk, the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement; and,

5. The impact of the proposed change should be monitored using performance measurement strategies.

3.0 Technical Assessment

The Nuclear Regulatory Commission (NRC) staff has reviewed the licensee's analysis in support of its proposed license amendment. In its review, the staff has identified two issues

related to the level of DID to mitigate the consequences of an ATWS or a loss-of-coolant accident (LOCA) during the 72-hour period where the SLC system function is unavailable and to the plant-specific safety basis proposed by the licensee to justify the 72-hour CT. Additionally, the criteria for a risk-informed submittal was not met as it relates to the deterministic DID criteria.

3.1 Inadequate Defense-In-Depth for Mitigation of ATWS Events

The SLC system mitigates an ATWS by providing concentrated borated solution to the reactor vessel sufficient to bring the reactor to subcritical under all conditions independent of the control rods. The licensee's submittal provided no credited alternative methods for injecting borated solution into the reactor vessel in a timely manner other than the SLC system. The submittal also provided no other means except control rod insertion to achieve subcritical conditions.

The licensee contends that alternate rod insertion (ARI) and the recirculating pump trip (RPT) functions provide adequate DID to ensure that the reactor can be made subcritical under all conditions. The NRC staff found that the licensee has provided insufficient support for the use of ARI as an alternate to the SLC system. ARI would not be effective if the cause of the ATWS was mechanical binding of control rods. The RPT limits the power of the reactor, but is not capable of achieving subcritical conditions.

As discussed in RG 1.177, the DID philosophy has traditionally been applied in reactor design and operation to provide multiple means to accomplish safety functions and prevent the release of radioactive material. As the submittal did not provide a suitably independent and redundant means for achieving subcritical conditions during the proposed CT extension, the NRC staff is unable to find that the licensee has provided for adequate mitigation of ATWS events during the proposed 72-hour period where both SLC subsystems would be inoperable.

3.2 Inappropriate Plant-Specific Safety Basis for the Proposed 72-Hour CT

As discussed previously, the existing TS CT of 8 hours, applicable when both SLC subsystems are inoperable due to causes other than out of specification boron concentration in the common supply, is consistent with the STS. The basis for the 8-hour CT as stated in both the STS and the plant-specific TS for both DNP and QC, is the low probability of a design-basis accident (DBA) or transient occurring concurrent with the failure of the control rods to shut down the reactor. Typically for a system which has two redundant 100 percent capability subsystems, TS do not address the condition with both subsystems inoperable. The 8-hour CT was intended to allow for inoperabilities of common components, piping, and instrumentation in the SLC system to permit routine surveillance and minor maintenance activities without requiring an immediate shutdown.

The licensee has provided a plant-specific risk evaluation to demonstrate the frequency of core damage due to ATWS events with both SLC subsystems unavailable is very low, and has proposed this as the new plant-specific basis for a 72-hour CT. The licensee contends that the low frequency of core damage is an appropriate basis to permit a 72-hour CT for loss of the SLC system function. The intent of risk-informed changes to the licensing basis, as provided in RG 1.174, *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,* is to demonstrate low risk of severe accidents

(core damage and large early release) together with maintaining traditional deterministic safety considerations, including compliance with regulations, DID, and safety margins. Because there is no demonstrated DID for achieving subcritical conditions in the event of an ATWS, the basis for the proposed change is risk-based.

The NRC staff further notes that when the proposed ATWS rule language was issued (46 FR 57521) the frequency and consequences from a risk perspective for ATWS events was considered. The NRC found that the possible outcome of these events (i.e. core meltdown accompanied in some cases by a failure of containment and a very large release of radioactivity) were unacceptable. Although the ATWS rule has been determined effective in reducing ATWS risk, as discussed in NUREG-1780, *Regulatory Effectiveness of the Anticipated Transient Without Scram Rule*, "... uncertainties in reactor protection system reliability and mitigative capability may warrant future attention to ensure the expected levels of safety are maintained." The DID philosophy has traditionally been applied in reactor design and operation to provide multiple means to accomplish safety functions and prevent the release of radioactive material. It has been and continues to be an effective way to account for uncertainties in equipment and human performance.

Based on the proposed change being risk-based as a result of no demonstrated DID, the NRC staff is unable to find that the licensee has provided an appropriate safety basis for its proposed 72-hour period where both SLC subsystems would be inoperable.

3.3. Inadequate DID and Ability to Meet Regulatory Criterion for the LOCA

The SLC system mitigates the consequences of a design basis LOCA and is required to be operable to ensure that onsite and offsite doses remain within the limits of 10 CFR 50.67, by maintaining pH balance in the suppression pool at or above 7 following a LOCA to ensure that iodine will be retained in the suppression pool water. The proposed change involves a plant condition with no operable SLC subsystem and no method of meeting 10 CFR 50.67 accident dose limits during a 72-hour period. Thus, the licensee has not demonstrated adequate DID during this time period.

The NRC staff used RG 1.177 and RG 1.183, *Alternative Radiological Source Terms for Evaluating Design-Basis Accidents at Nuclear Power Reactors,* to evaluate the proposed change. Regulatory Position 2.2.1 of RG 1.177 states that the licensee should assess whether the proposed change meets the DID principles and provides guidelines for making this assessment. Regulatory Position 2.0 of RG 1.183, Appendix A, states that suppression pool pH is controlled at values of 7 or greater to ensure iodine is retained in the suppression pool. RG 1.183 is supplemented by the NRC staff's White Paper, *Guidance on the Assessment of a BWR SLC System for pH Control,*" dated February 12, 2004 (ADAMS Accession No. ML040640364).

In the licensee's November 10, 2009, evaluation of the proposed amendment, the licensee states:

> This proposed TS CT extension does not change the design function of the SLC system and does not affect the system's ability to perform its design function. As such, the proposed change complies with the defense-in-depth

principles described in RG 1.174, paragraph 2.2.1 and RG 1.177, paragraph 2.2.1 [Regulatory Position 2.2.1 of both RGs].

The licensee contends that the proposed change complies with the DID principles described in Regulatory Position 2.2.1 of RG 1.177. The basis for the licensee's position is that the CT extension does not affect the SLC system's ability to perform the design function. The NRC staff finds that the SLC system's ability to perform its design function, when the SLC system is operable, is not a valid consideration for the SLC system's ability to provide DID when both trains are inoperable during the proposed 72-hour CT. If no SLC system train is operable, the system will not be able to perform its design function to control the suppression pool pH at values greater than 7. For pH values less than 7, the licensee has not demonstrated that 10 CFR 50.67 limits could be met.

The NRC staff also reviewed another DID consideration proposed by the licensee. In the November 10, 2009, amendment request, the licensee stated:

> Additional redundancy for both reactivity control and suppression pool pH control [emphasis added] is established by the DNPS and QCNPS Emergency Operating Procedures (EOPs). The EOPs describe the actions and criteria for manual addition [emphasis added] of boron into the condensate systems, should RPS, the control rods, the control rod drive system, and the SLC be unable to perform the specif[i]ed design functions.

In an October 12, 2010, supplement, the licensee responded to a staff request for additional information. The response provided the following clarification regarding the proposed crediting of EOP actions as an alternative method of boration:

> Exelon does not intend to credit the referenced EOP actions in the Licensing Basis as an alternate boration pathway to meet the requirements of 10 CFR 50.67. The reference to the existing DNPS and QCNPS EOP procedures for alternate SLC injection are provided only to illustrate that additional methods currently exist to enhance and support sodium pentaborate injection in the event of a Design Basis Loss-of-Coolant Accident (LOCA) which occurs in conjunction with an outage of the entire SLC System. It is understood that the alternate injection methods contained in DNPS and QCNPS EOPs do not satisfy all of the requirements in the NRC's "Guidance on the Assessment of a BWR SLC System for pH Control," dated February 12, 2004.

Also, in an October 12, 2010, supplement the licensee stated:

> The alternate injection path is not formally credited in the plant design basis for defense in depth; rather, the method augments EOP actions in the extremely unlikely event that boron injection is required and SLC is not available.

The licensee's alternative injection method does not satisfy the current NRC guidance for crediting pH control systems. The licensee has not provided or demonstrated an acceptable, reliable and quality alternative on which the NRC staff could base a determination that adequate DID is provided.

In addition, the licensee failed to adequately address other RG 1.177 DID considerations potentially impacted by the proposed crediting of the EOPs. These RG 1.177 considerations include an assessment of over-reliance on programmatic activities, common-cause failures, and defenses against human errors.

For example, RG 1.177, Regulatory Position 2.2.1 states that the DID philosophy is maintained, in part, if "defenses against human errors are maintained." TS change requests should consider whether the new method of operation could change the expected operator response or introduce any new human errors not previously considered. The licensee maintained in the November 10, 2009, submittal, that the proposed extended CT does not credit, nor require new operator actions, despite the above proposal to use EOP actions that use manual methods of boration as a DID measure. These manual methods of boration are not currently part of the licensing basis for TS 3.1.7 and are considered by the NRC staff to be new, credited operator actions not adequately addressed by the licensee's assessment of DID.

Based upon the above review of the licensee's proposed change, the NRC staff finds that the consequences of a design basis LOCA resulting in onsite and offsite doses within 10 CFR 50.67 limits cannot be assured during the proposed 72-hour period. In addition, the NRC staff finds the licensee has not provided adequate DID for mitigation of LOCA events when both SLC subsystems are inoperable.

4.0 Assessment Conclusion

The proposed amendment requested the extension of the TS CT for SLC subsystems from 8 hours to 72 hours to allow for more significant maintenance or repair activities on both subsystems or on common components while the affected unit remains at power. Given the above discussion, the safety basis for the proposed TS is not adequate based on the following:

1. The licensee has failed to provide adequate DID for mitigation of ATWS events by assuring the reactor can be made subcritical by a method independent of the control rods.

2. The licensee has proposed solely a plant-specific risk basis for extending the existing CT, which is inconsistent with the NRC staff position of risk-informed changes to TS.

3. The licensee has not provided adequate assurance that the onsite and offsite doses of a design basis LOCA will be within 10 CFR 50.67 limits during the proposed 72-hour period. In addition, the licensee has failed to provide adequate DID for mitigation of a design basis LOCA.

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Date: January 6, 2011

If you have any questions, please contact Ms. Eva Brown at (301) 415-2315.

Sincerely,

/RA/

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Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-249, 50-237, 50-254, and 50-265

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