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

January 9, 2013

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

SUBJECT: LASALLE COUNTY STATION, UNITS 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION RELATED TO LICENSE AMENDMENT REQUEST TO TECHNICAL SPECIFICATION 3.7.3 ULTIMATE HEAT SINK (TAC NOS. ME9076 AND ME9077)

Dear Mr. Pacilio:

By letter to the U.S. Nuclear Regulatory Commission (NRC) dated July 12, 2012, as supplemented by letter dated September 17, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML12200A330 and ML122690041, respectively), Exelon Generation Company, LLC submitted a license amendment request to allow Technical Specification (TS) 3.7.3 "Ultimate Heat Sink [UHS]" temperature limit of the cooling water supplied to the plant from the UHS to vary with the diurnal cycle. The TS limit will be graphical with the UHS temperature limit varying between 101.25 °F to 104 °F as a function of the time of day. The proposed amendment restricts the initial temperature of the UHS such that the temperature of the cooling water supplied to the plant safety systems from the UHS would not exceed the design limit of 107 °F.

The NRC staff reviewed your submittal and has determined that additional information is required to complete the review. The specific information requested is addressed in the enclosure to this letter. During a discussion with your staff on December 13, 2012, it was agreed that you would provide a response by January 18, 2012.

Please note that if you do not respond to this letter by the agreed-upon date, or provide an acceptable alternate date in writing, the NRC staff may reject your request for approval under the provisions of Title 10 of the *Code of Federal Regulations*, Section 2.108.

The NRC staff considers that timely responses to requests for additional information help ensure sufficient time is available for NRC staff review and contribute toward the NRC's goal of efficient and effective use of staff resources.

If circumstances result in the need to revise the requested response date, please contact me at (301) 415-1115.

Sincerely,

Nicholas J. DiFrancesco, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-373 and 50-374

Enclosure:
Request for Additional Information

cc w/encl: ListServ

REQUEST FOR ADDITIONAL INFORMATION

LICENSE AMENDMENT REQUEST REGARDING

ULTIMATE HEAT SINK

EXELON GENERATION COMPANY, LLC

LASALLE COUNTY STATION, UNITS 1 AND 2

DOCKET NOS. 50-373 AND 50-374

In reviewing Exelon Generation Company, LLC's (EGC, the licensee) submittal dated July 12, 2012, as supplemented by letter dated September 17, 2012, related to Technical Specification (TS) 3.7.3 "Ultimate Heat Sink [UHS]," for the LaSalle County Station (LSCS), Units 1 and 2, the U.S. Nuclear Regulatory Commission (NRC) staff has determined that the following information is needed in order to complete its review:

Information requests 1, 2, 4, and 5, refer to Attachment 3, L-002457, Revision 7, "LaSalle County Station Ultimate Heat Sink Analysis," (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12269A073) of an EGC letter to the NRC dated September 17, 2012.

Review of Inputs

1. Background: Section 4, item (1), "Surface Weather Observations" of Attachment K, pages K2 and K3, states:

> "Raw surface weather observations (Reference 2) from KPIA [weather station in Peoria, Illinois] covered the period of record from January 1, 1995 through December 31, 2004. NCDC [National Climatic Data Center] subjects meteorological data to rigorous quality control checks before archiving it. Nevertheless, meteorological databases still typically include gaps and data values outside of valid ranges. The archived data included most of the weather parameters required by Laket [LakeT-PC computer model] (Table 1), with the following exceptions: freezing precipitation code, solar radiation, atmospheric radiation, and partial pressure of water vapor. S&L [Sargent and Lundy] estimated those parameters using standard methods. To check the thermodynamic consistency of the input data, S&L estimated hourly wet bulb temperature, dew point temperature and humidity to ensure consistency between those parameters and the (on-site) dry-bulb temperature. In instances when the dew point temperature at KPIA exceeded the dry-bulb temperature at the on-site meteorological tower, the dew point temperature at KPIA was set equal to the dry-bulb temperature observed at the on-site tower. This ensured thermodynamic consistency between the relative humidity and the dry-bulb, wet-bulb temperature and dew point temperatures."

Requests: For each of the estimated parameters (particularly for solar radiation and atmospheric radiation), please provide a detailed description of the methodology, inputs, assumptions, and bases used to make the estimates. Additionally, provide an example calculation demonstrating how each type of estimate was generated.

2. Background: The treatment of wind speed is an important consideration for UHS analysis heat transfer. Section M4.2 of Attachment M, states that the meteorological tower measurement height is 33 feet (ft) above ground level (or 752 ft. above mean sea level [MSL]) and the base of the meteorological tower is at 719 ft MSL. The 33-ft (10 meter) measurement height is used in the LakeT-PC model is not discussed. Thus, assuming: (1) the meteorological measurements were made at 752 ft MSL, (2) the Ryan wind function is applicable at 2 meters (6.6 ft) above the water surface (Section 2.3, NUREG-0693, "Analysis of Ultimate Heat Sink Cooling Ponds," November 1980, (ADAMS Accession No. 8012120331)), and (3) the nominal lake surface level is 690 ft MSL during a UHS heatup event, please answer the following:

   Requests:

   a. How does the analysis account for the difference in heights between LSCS's meteorological measurements (752 ft MSL) and the nominal lake surface level (690 ft MSL) during a UHS heatup event?

   b. How were the wind gradients modeled and why are they conservative for LSCS's site characteristics for UHS cooling performance?

   c. Justify the applicability of the Hefner and Ryan wind function to the LSCS's site characteristics. Additionally, discuss the rational and effect of switching between the wind functions when the Ryan predicted lake temperature is within 2.5 °F of the natural lake temperature (as calculated by the Hefner function).

Review of Weather Screening

3. Background: The purpose of the LakeT-PC model analysis is to ensure that the temperature of the UHS during a design basis event will not result in the UHS exceeding the design limit for the cooling water supplied to the plant safety systems. Attachment 1 to the proposed license amendment request (LAR) states that the transit time of the plant accident energy through the UHS is approximately 30 hours. Section 4.0 of the proposed LAR describes the selection of the worst-case meteorological conditions for 1-day and 30-day periods.

   Request: Justify the selection and use of a 24-hour worst-case meteorological period when analyzing a 30-hour transit time.

4. Background: Attachment 3, L-002457 (L-002457), Revision 7, assumes a lake temperature and plant discharge of 100 °F for weather screening purposes. Attachment I, Figure I7.8, page I20, shows that during the first 24 hours, the LSCS UHS pond temperature varies from approximately 140 °F to 101 °F (UHS inlet to UHS outlet).

Section M3.1, "Initial Lake Temperature," of Attachment M states:

> "For the worst-weather evaluation, the initial lake temperature is set at 100 °F. This is an arbitrary reference value for determining the relative
>
> weather severity and does not influence the results of this analysis."
> Section M3.3, "Station Thermal Boundary Condition," of Attachment M states:
>
> "The plant discharge water temperature when determining the worst-weather day and month is assumed to be 100 °F. Since the lake is modeled as open cycle, the lake starts at this temperature at the start of each 3 hour time interval. A constant initial temperature allows for isolation of the meteorological effects on the lake."

Requests:

a. Please justify how the current screening approach of assuming an initial lake temperature of 100 °F, as described in Sections M3.1 and M3.3, is appropriate for application to the LSCS UHS design given that the calculated lake inlet and outlet temperatures range from 101 °F to 140 °F during the first 24 hours after an accident. Also, please justify how the use of an initial lake temperature of 100 °F identifies the worst meteorological conditions for the UHS critical time periods corresponding to minimum water cooling and the applicable conditions for maximum water evaporation.

b. If a different set of meteorological conditions is identified as limiting as a result of revising the screening approach, please confirm that the resultant cooling water temperatures (using the revised meteorological conditions) remain bounded by the proposed TS limits.

Review of UHS Transient Heatup

5. Background: The licensee has stated that the transit time for core standby cooling system (CSCS) flow across the UHS pond during a design-basis accident loss-of-coolant accident (DBA-LOCA) is 30 hours with the UHS sediment level of 1.5 feet. In the DBA-LOCA analysis, the licensee considered the worst 24-hour period of meteorological conditions for controlling parameters in determining peak UHS temperature. By considering the worst 24-hour period, the licensee's analysis showed that the peak temperature of the UHS after a LOCA, which started at 6:00 a.m., would be approximately 12 hours after the LOCA, which occurs 18 hours before any of the UHS water that is affected by accident heat input enters the plant intake.

   Attachments I [Figure I7.7] and L [Appendix L9.4] of Calculation L-002457, "LaSalle County Station Ultimate Heat Sink Analysis," show the effects of the heat added to the UHS by the DBA-LOCA, whose effects do not reach the UHS outlet to the plant until 30 hours after the DBA-LOCA. Figure I7.7 shows temperatures near 140 °F initially entering the UHS immediately after the DBA and shows the UHS inlet temperature to be well above 120 °F for most of the first day after the DBA–LOCA, yet, the UHS outlet to the plant has already peaked at 107 °F at about 3:00 p.m. on the first day. According to Figure 4 of the LAR, the maximum temperature of the UHS outlet temperature on the second day is below the

maximum temperature on the first day, indicating that the heat added by the DBA-LOCA has little effect on the UHS outlet temperature. The seeming lack of influence upon peak UHS temperature by the accident heat and the meteorological conditions of second day after the accident could be attributed to a relatively cool, cloudy, or windy day after the first day following the DBA-LOCA, which is the first day of the 30-day critical period.

Issues: Heat waves where weather extremes have persisted for multiple consecutive days are not uncommon. Considering that a heat wave is in progress and the first critical time period of 24 hours as used by the licensee, the first day of the worst 30-day period may not be representative of the actual second day after an accident. Also, in a letter dated May 6, 2011, the licensee stated that high temperatures and humidity during the daytime, in conjunction with minimal cooling at night and little precipitation during the summer months, results in elevated water temperatures in the LSCS UHS.

The NRC staff is not certain that the licensee has chosen appropriate critical time periods unique to the specific design of the CSCS pond. According to Regulatory Position 1 of Regulatory Guide (RG) 1.27, "the meteorological conditions resulting in minimum water cooling should be the worst combination of controlling parameters, including diurnal variations where appropriate, for the critical time period(s) unique to the specific design of the sink," and "sufficient conservatism should be provided to ensure that a 30-day cooling supply is available and that design basis temperatures of safety related equipment are not exceeded." In RG 1.27 it also states that "meteorological conditions considered in the design of the UHS should be selected with respect to the controlling parameters (i.e., wind speed, humidity, dew point, air temperature, solar radiation, etc.)."

The licensee selected a first critical time period of 24 hours, independent of the time of the accident and the UHS transit time. However, the NRC staff believes that the first critical time period would be 30 hours or greater, dependent upon time of accident initiation and UHS transit time. Using these variables, the first critical time periods would yield more limiting and accurate results. The staff also believes that the first critical time period should be verified by assuming greater first critical time periods and performing the analysis and comparing results. The staff also believes that the analysis for each assumed accident start time, (i.e., 6:00 a.m. - 9 a.m., etc.), would have its own set of a worst-weather data for its particular critical time period.

Requests:

a. The NRC staff requests that the licensee justify their selection of weather data and critical time periods or propose new analysis that would address the NRC staff concerns presented in Issues above.

b. Justify the constant transit time across the UHS pond that is used in your analysis, since reduction in UHS volume over the 30-day recovery period would cause transit time to decrease. If the decrease in transit time is modeled, justify whether the effective UHS volumes, surfaces, and transit times predicted in Attachment J remain applicable.

6. Background: The licensee's LAR submittal dated July 12, 2012, it states that,

> "The current TS temperature limit does not reflect the diurnal effect that weather conditions have upon the allowable UHS temperature. Since the UHS heats up during the day and cools off during the night, the allowable UHS temperature is dependent upon the time of day when the design basis event occurs."

Therefore, the licensee has proposed new TS temperature limits as shown in Figure 3.7.3, based on diurnal variations. Figures 4, 5, and 6, of the LAR show the calculated effects of the diurnal cycle and, particularly, the first 30 hours show the cycle before any heat from the postulated accident has an effect.

Issue: Although the diurnal effects of the weather on the temperature of the cooling water supplied to the plant from the CSCS pond, when the cooling lake is intact, would not be identical to the diurnal effects on the CSCS pond during a DBA, the licensee did not provide actual plant data that shows that diurnal variation would exist at LSCS.

Request: The NRC staff requests the following plant data - recordings of cooling water temperature supplied to the plant from the CSCS pond (from the same source that is used for Surveillance Requirement (SR) 3.7.3.1) every hour on the hour for every day in June, July, and August for 2012. For every recording also include reactor power for both units and ambient temperature. If available, provide a measure of humidity with each recording (i.e., relative humidity, or dew point, or wet bulb temperature).

Review of LaSalle Design Basis Capabilities

7. Background: The actual equipment temperature limit of the UHS was originally 100 °F. By reducing the margin, the licensee subsequently increased the actual equipment temperature limit to 104 °F. The original design fouling factor for the residual heat removal (RHR) heat exchangers is 0.0025. The original design fouling factor for the diesel generators (DGs) coolers is 0.00285. In the proposed LAR, the licensee has proposed new UHS TS limits which are based on an allowable actual equipment temperature limit of 107 °F. Attachment 5 of the LAR shows the licensee's calculated heat transfer capabilities of the heat exchangers cooled by CSCS at 107 °F.

Issues: The licensee used a design fouling factor of 0.00147 in order to qualify RHR heat exchanger (HX) for the design heat removal rate at 107 °F. Attachment 5 shows the required heat transfer rate of 165,564,000 Btu/hr for the DBA-LOCA. The calculated rate using a fouling factor of .00147 and cooling water at 107 °F is 166,468,480 BTU/hr, which provides a small heat transfer margin of 0.55 percent. The licensee stated that Generic Letter (GL) 89-13 testing verifies a lower fouling factor while using a 107 °F UHS temperature.

The licensee used a design fouling factor of 0.0022 in order to qualify DG coolers for the design heat removal rate at 107 °F. Attachment 5 shows a heat transfer margin of 1.5 percent. The licensee stated that the GL 89-13 testing verifies a lower fouling factor while using 107 °F UHS temperature.

Requests:

a. Describe the GL 89-13 testing for the RHR HXs and discuss the accuracy of the testing with respect to design conditions. With a low heat transfer margin for the RHR HXs, please justify your reliance of GL 89-13 testing as a means of assuring that the required heat transfer capability of the RHR heat exchangers is maintained.

b. Describe the GL 89-13 testing for the DG coolers and discuss the accuracy of the testing with respect to design conditions. With a low heat transfer margin for the DG coolers, please justify your reliance of GL 89-13 testing as a means of assuring that the required heat transfer capability of the DG coolers is maintained.

8. Background: The updated safety analysis report (UFSAR), Section 6.5.1.1.1, states that the standby gas treatment system (SGTS) is designed to automatically start in response to any one of the following signals: (1) high pressure in Unit 1 or Unit 2 drywell, (2) low-water level in Unit 1 or Unit 2 reactor, (3) high radiation in exhaust air from over the fuel handling pools in the reactor building for either Unit 1 or Unit 2, (4) high radiation in the ventilation exhaust plenum for reactor building for either Unit 1 or Unit 2, and (5) manual activation from the main control room.

   Issue: The UHS model does not consider heat removal from the spent fuel pool (SFP) during abnormal events. No heat removal is modeled for SFP cooling through the available safety-related RHR system lineup. Safety-related makeup water is provided to maintain pool level during such events. Consider abnormal events listed above when the reactor building ventilation system is isolated with automatic start of SGTS, coincident with no heat removal from the SFP, and, therefore, is allowed to boil, which takes place within a few hours (UFSAR Table 9.1-6).

   Requests:

   a. Please provide the results of evaluation of the capability of the operation SGTS during these events. Discuss whether the SGTS can meet its design basis functions for the entire 30-day period, e.g., draw down and maintain negative pressure of 0.25-inch water gage in the secondary containment, capture of radioactive gases and particles leaking from primary containment after a LOCA, limiting incoming saturated air-steam mixtures to less than 150 °F, and prevention of charcoal desorption.

   b. Please confirm that the safety-related RHR system lineup for SFP cooling is available following a loss of offsite power (LOOP) and/or seismic event. As appropriate, discuss whether the safety-related RHR alignment for SFP cooling can be accomplished for both units under design basis conditions (as LSCS Units 1 and 2 share a common reactor building floor).

Review of Proposed Technical Specifications

9. Background: The current temperature limit for TS SR 3.7.3.1 is 101.25 °F. From the licensee's previous submittal, dated May 6, 2011, the limit was based on an actual equipment limit of 104 °F, reduced by 2 °F for UHS pond heat up during a DBA-LOCA, and reduced by 0.75 °F for instrument uncertainty to yield the TS limit of 101.25 °F. The proposed limit of Figure 3.7.3-1 of the LAR submittal dated July 12, 2012, also has a maximum TS SR limit of 101.25 °F [at 6:00 a.m.], but it is based on an actual equipment limit of 107 °F. According to Table 2 of the LAR submittal, the maximum post-DBA heat up is 4.55 °F.

   Issues: The current TS SR 3.7.3.1 limit, and the proposed TS SR 3.7.3.1 limit at 6:00 a.m., are identical and both are based on the LAKET-PC model. Yet, the current limit is based on an actual UHS temperature of 104 °F, while the proposed TS limit is based on an actual UHS temperature of 107 °F.

   Request: Please explain how 101.25 °F is the maximum TS limit for the actual equipment limits of both 104 °F and 107 °F. In your explanation include what factors in the design inputs, methodology, and assumptions, have changed to make the 101.25 °F appropriate for the 107 °F limit, where 101.25 °F was already stated to be the limit for the actual equipment limit of 104 °F.

10. Background: The proposed TS SR limits proposed in Figure 3.7.3-1, have maximum limits as a function of time of day (i.e., a diurnal cycle). Should the UHS temperature exceed or is projected to exceed Figure 3.7.3-1, Condition B of TS 3.7.3 requires the units be in Mode 3 within 12 hours.

    Issue: In the "Unacceptable Operation" region of Figure 3.7.3-1, the UHS loses its safety function for a DBA-LOCA during the worst-weather conditions. During a heat wave, it is conceivable that the UHS could enter the "Unacceptable Operation" region for consecutive days.

    Request: If temperature of the UHS enters the "Unacceptable Operation" area of Figure 3.7.3-1 for two or more consecutive days, but Mode 3 has not been entered, what actions will the licensee take?

11. Background: If all DGs became inoperable, TS 3.8.1, "AC Sources-Operating," Condition H, requires entry into TS 3.0.3 immediately. In this condition, the units would not be able to mitigate a DBA-LOCA and would be vulnerable to a LOOP and station blackout.

    Issue: If the UHS temperature was above the limits proposed in new Figure 3.7.3-1 of proposed TS 3.7.3, "Ultimate Heat Sink," and UHS temperature was rising at a rate that could cause the DGs to become inoperable before TS 3.7.3 required the units to be in Mode 3, the units could be forced into Condition H of TS 3.8.1.

    Request: What changes to Figure 3.7.3-1 would the licensee propose to ensure the units are placed in a safe shutdown condition in advance of the possible inoperability of the DGs due to high UHS temperature and entry into Condition H of TS 3.8.1.

Review of Operator Actions

12. Request: Describe the required operator actions (other than those in the proposed TSs) that support implementation of the proposed LAR.

13. Request: Are there any additions, deletions, or changes to current operator actions required to support this LAR?

14. Request: What are the changes, deletions, or additions to procedures associated with this LAR?

15. Requests: Describe how operators will read and log the UHS temperatures. Will the required actions be performed by one operator or more than one? Will it require the coordination of an operator at each unit?

16. Request: Are there any impacts to the time available for operators to complete manual actions credited in the UFSAR?

The NRC staff considers that timely responses to requests for additional information help ensure sufficient time is available for NRC staff review and contribute toward the NRC's goal of efficient and effective use of staff resources.

If circumstances result in the need to revise the requested response date, please contact me at (301) 415-1115.

Sincerely,

/ **RA** /

Nicholas J. DiFrancesco, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-373 and 50-374

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