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10CFR50.90

October 25, 2021

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

Calvert Cliffs Nuclear Power Plant, Units 1 and 2
Renewed Facility Operating License Nos. DPR-53 and DPR-69
Docket Nos. 50-317 and 50-318

Subject: Response to Request for Additional Information Regarding the Spent Fuel Pool Cooling - Shutdown Cooling Systems Licensing Design Basis License Amendment Request

References:

1. Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, “Spent Fuel Pool Cooling - Shutdown Cooling Systems Licensing Design Basis License Amendment Request,” dated June 14, 2021 (ADAMS Accession No. ML21165A406)

2. Letter from Michael Marshall, U.S. Nuclear Regulatory Commission to David P. Rhoades, Exelon Generation Company, LLC, “Calvert Cliffs Nuclear Power Plant, Units 1 and 2 – Audit Plan in Support of Review of License Amendment Request Regarding Change Spent Fuel Pool Cooling Design Basis (EPID L-2021-LLA-0112),” dated July 20,2021 (ADAMS Accession No. ML21200A074)

3. Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, " Spent Fuel Pool Cooling - Shutdown Cooling Systems Licensing Design Basis License Amendment Request Supplement,” dated August 13, 2021 (ADAMS Accession No. ML21225A353)

4. Email from Andrea Mayer, U.S. Nuclear Regulatory Commission, to Francis J Mascitelli, Exelon Generation Company, LLC, " Request for Additional Information: Calvert Cliffs 1 & 2 LAR to Revise Spent Fuel Pool Cooling - Shutdown Cooling Systems Licensing Basis (L-2021-LLA-0112)," dated October 5, 2021 (ADAMS Accession No. ML21287A093)

In accordance with 10 CFR 50.90, “Application for amendment of license, construction permit, or early site permit,” Exelon Generation Company, LLC (Exelon) requested changes to the Spent Fuel Pool and Shutdown Cooling Licensing Design Basis of the Calvert Cliffs Nuclear Power Plant, Units 1 and 2 (CCNPP) (Reference 1).

The original proposed changes would revise the Updated Final Safety Analysis Report (UFSAR) Section 9.4, “Spent Fuel Pool Cooling System,” design basis to allow for partial and full core offloads without being supplemented with one train of the Shutdown Cooling (SDC) system. In addition, the Spent Fuel Pool temperature would be allowed to increase from a

maximum of 120 °F and 130 °F for partial and full core offloads, respectively, to a maximum of 150°F under certain conditions.

On July 20, 2021 NRC announced an Audit Plan to review License Amendment Request (LAR) referenced supporting calculations (Reference 2).

On August 13, 2021 Exelon supplemented the Reference 1 License Amendment Request (LAR) to reduce the LAR scope (Reference 3). The scope of the request was revised to include only full core offloads during refueling outages conducted when the spent fuel pool cooling system (SFPC) service water temperature can be maintained below 50 °F and the SDC system is unavailable to assist the SFPC system, if required.

On October 5, 2021 NRC issued a Request for Additional Information regarding spent fuel pool wall stresses (Reference 4) in order to complete their Audit Review of the LAR supporting calculations.

The attachment to this letter contains the NRC's Request for Additional Information (RAI) followed by Exelon's response.

Exelon has reviewed the information supporting a finding of no significant hazards consideration, and the environmental consideration, that were previously provided to the NRC in References 1 and 3. Exelon has concluded that the information provided in this response does not affect the bases for concluding that the proposed license amendments do not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92. In addition, Exelon has concluded that the information in this response does not affect the bases for concluding that neither an environmental impact statement nor an environmental assessment needs to be prepared in connection with the proposed amendments.

There are no regulatory commitments contained in this response.

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," paragraph (b), Exelon is notifying the State of Maryland of this response to a request for additional information by transmitting a copy of this letter and its attachment to the designated State Official.

Should you have any questions concerning this submittal, please contact Frank Mascitelli at (610) 765-5512.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 25th day of October 2021.

Respectfully,

David P. Helker
Sr. Manager - Licensing and Regulatory Affairs
Exelon Generation Company, LLC

Attachment: Response to Request for Additional Information

cc: Regional Administrator, Region I, USNRC
USNRC Senior Resident Inspector, CCNPP
Project Manager [CCNPP] USNRC
S. Seaman, State of Maryland

ATTACHMENT

Calvert Cliffs Nuclear Power Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-53 and DPR-69
Docket Nos. 50-317 and 50-318

Spent Fuel Pool Cooling - Shutdown Cooling Systems Licensing Design Basis License Amendment Request

Response to NRC Request for Additional Information

References:

1. Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, “Spent Fuel Pool Cooling - Shutdown Cooling Systems Licensing Design Basis License Amendment Request,” dated June 14, 2021 (ADAMS Accession No. ML21165A406)

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By letter dated June 14, 2021, Reference 1, as supplemented by letter dated August 13, 2021, Reference 3, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21165A406 and ML21225A353, respectively), Exelon Generation Company, LLC (Exelon) submitted a license amendment request (LAR) to revise the Updated Final Safety Analysis Report (UFSAR) and the Technical Requirements Manual for Calvert Cliffs Nuclear Power Plant, Units 1 and 2 (CCNPP), to allow for a full core offload in the spent fuel pool (SFP) without being supplemented with one train of the Shutdown Cooling (SDC) system. The proposed amendment also includes a change in the calculational methodology used in the SFP heat-up analysis.

From July 6 to August 29, 2021, the NRC staff conducted a regulatory audit to review licensee calculations supporting the LAR to determine if additional information contained in the analyses performed in support of the requested change is needed to support or develop conclusions for the staff’s safety evaluation. An audit plan was issued by the NRC staff by letter dated July 20, 2021, Reference 2 (ADAMS Accession No. ML21200A074).

The Nuclear Regulatory Commission (NRC) staff has determined, during the regulatory audit, that additional information is needed to complete its review of the request (Reference 4). The NRC Request for Additional Information (RAI) is shown in italic text followed by Exelon’s response.

REQUEST FOR ADDITIONAL INFORMATION

RAI 3.3-1

Regulatory Basis:

Calvert Cliffs UFSAR Appendix 1C states, in part, "Calvert Cliffs was designed and constructed to meet the intent of the draft (proposed) Generic Design Criteria (GDC) for Nuclear Power Plants, which were published by the Atomic Energy Commission in July 1967."

Draft GDC 1 requires that seismic Category 1 structures, systems, and components (SSCs) (e.g., SFP) shall be identified and then designed, fabricated, and erected to quality standards that reflect the importance of the safety function to be performed.

Draft GDC 2 requires, in part, that seismic Category 1 SSCs be designed to withstand, without loss of the capability to protect the public, the additional forces that might be imposed by natural phenomena such as earthquakes, tornadoes, flooding conditions, winds, ice, and other local site effects.

Background:

The proposed LAR, as supplemented, requests to revise the UFSAR Section 9.4, "Spent Fuel Pool Cooling System," design basis to raise the maximum allowable SFP water temperature from 130°F to 150°F for full core offloads in certain refueling outages, and 212°F in the case of total loss of the SFP cooling with 1830 fuel assemblies in the pool. LAR Section 3.3, "Structural Integrity of SFP," states that the current licensing basis for the SFP structural analysis accommodates the increased SFP allowable maximum temperature of 150°F and 212°F based on Reference 11 of the LAR (i.e., engineering calculation CA09085, Rev 0000, "Spent Fuel Pool").

The NRC staff reviewed the UFSAR Sections 5.6.1, 6.3.5.1, and 9.4.4, and Appendix 5A, and found that the SFP was designed for the loads and conditions as shown in UFSAR Table 5-6 in accordance with American Concrete Institute (ACI) 318-63, "Building Code Requirements for Reinforced Concrete," as well as the most severe of the load combination equations in UFSAR Appendix 5A.3.1.8. UFSAR Section 5.6.1.6 also states that the maximum thermal stresses developed in the spent fuel pool walls under the most adverse conditions will be in the range of 950 psi, compressive, and in the range of 7,500 psi, tension, in the reinforcing steel.

During the regulatory audit, the staff found in engineering calculation CA09085 that: a) The SFP walls were analyzed for thermal loads in accordance with methods presented in ACI 505; b) Under normal conditions, the interior wall temperature was 150°F and the maximum calculated thermal stress was 996 psi for concrete and 11,410 psi for reinforcing steel; c) After prolonged outage of the cooling system, the

interior wall temperature could reach 212°F and the maximum calculated thermal stress was 1,681 psi for concrete and 25,600 psi for reinforcing steel.

It appears that the maximum calculated thermal stresses for concrete and reinforcing steel in the CA09085 are higher than the maximum thermal stresses presented in Section 5.6.1.6 of the UFSAR. Accordingly, it is not clear how the code acceptance criteria were met for these load combinations including thermal load used for the SFP walls and liner.

Request:

1. *Clarify and correct the discrepancy between thermal stresses reported in the UFSAR and those in the CA09085.*
2. *Describe, with quantitative results, how the structural acceptance criteria were met for the SFP walls and its liner for the controlling load combinations including thermal loads.*

Exelon Response:

CA09085 was performed using several differing methodologies that were appropriate for the timeframe associated with CCNPP design (1970 to 1977). These methods were performed using two different bounding temperature differentials of 100°F and 60°F. The results for the two methods, at the two differential temperatures, were similar and showed that the concrete and reinforcing steel stresses were within the working stress design allowables of 1,350 psi for 3,000 psi concrete and 20,000 psi for the reinforcing steel (ACI 318-63).

The first method is described in the Reinforced Concrete Design Handbook (Reynolds) that is shown on page 107. Pages 107 and 108 are reproduced and included in the analysis, CA09085, as pages 48 and 49. This method was used to encompass the 150°F SFP water temperature that has been listed as far back as the Preliminary Safety Analysis Report (PSAR) for CCNPP.

The second stress methodology begins on page 53 in the analysis, CA09085, and lists data for the materials, including concrete and steel. This methodology assumes the concrete slab is a “plate” and the stresses are based on Timoshenko, Chapter 2, Section 14 “Thermal Stresses in Plates with Clamped Edges.” This was an alternate method that was used to encompass the 120°F SFP water temperature that has been listed as far back as the PSAR for CCNPP.

The results for the two different methods range from 825 psi to 918 psi for the concrete and 7,400 to 7,830 for the reinforcing steel (pages 51 and 58 of CA09085). These values form the basis for the current UFSAR Section 5.6.1.6 statement: “The maximum thermal stresses developed in the spent fuel pool walls under the most

adverse conditions will be in the range of 950 psi, compressive, and in the range of 7500 psi, tension, in the reinforcing steel."

The stresses noted in the background of the RAI are an excerpt from page 50 of CA09085. Further research into the history of CA09085 has determined that the statements on page 50 of this calculation do not appear to apply to the design basis for CCNPP as originally thought. The reason for their inclusion in the calculation could not be ascertained and would be merely speculation at this point.
The differential temperature range in the current CA09085 methodology, namely 60°F to 100°F, would cover the anticipated normal operating range of the SFP up to the maximum assumed value of 150°F assuming a conservatively low Auxiliary Building temperature of 60°F. The 212°F maximum SFP temperature that would result in the unlikely event of losing both trains of SFP cooling with 1830 bundles in the pool, remains below the allowable stresses using method 1. Note however, that this scenario is considered a short-term temperature transient event that has been historically treated as acceptable for steel reinforced concrete structures. Using the method 1 of analysis as described above, the stresses seen at the SFP at 212°F are 1,254 psi for the concrete and 11,902 psi for the reinforced steel. These stresses are acceptable when compared to the allowables outlined in ACI 318-63.

Below are the results of the different methods compared to the allowables of 1,350 psi for 3,000 psi concrete and 20,000 psi for the reinforcing steel (ACI 318-63):

Method 1 (ΔT = 100F) (Reinforced Concrete Design Handbook – Reynolds)

Concrete - 825 psi (compressive)
Reinforcing steel - 7,830 psi (tensile)

Method 2 (ΔT = 60F) (Timoshenko / Advance Reinforced Concrete (Dunham))

Concrete - 918 psi (compressive)
Reinforcing steel - 7,400 psi (tensile)
Reinforcing steel - 14,200 psi (Compressive)