From: Kuntz, Robert
Sent: Monday, June 13, 2022 10:32 AM
To: Steinman, Rebecca L:(Constellation Nuclear)
Subject: RAI RE: Quad Cities amendment for spent fuel pool storage analysis (EPID L-2021-LLA-0196)

By letter to the U.S. Nuclear Regulatory Commission (NRC) dated October 25, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21298A168, Exelon Generation Company, LLC submitted a request for amendments to Renewed Facility Operating License Nos. DPR-29 and DPR-30 for Quad Cities Nuclear Power Station, (QCNPS), Units 1 and 2, respectively. On February 1, 2022 (ADAMS Accession No. ML22032A333), Exelon Generation Company, LLC was renamed Constellation Energy Generation, LLC (Constellation, or the licensee). Specifically, the amendment request is proposing a new criticality safety analysis (CSA) methodology for performing the criticality safety evaluation for legacy fuel types in addition to the GNF3 reload fuel in the spent fuel pool (SFP). The amendment is also proposing a change to the new fuel vault (NFV) CSA to utilize the GESTAR II methodology for validating the NFV criticality safety for GNF3 fuel in the General Electric (GE) designed NFV racks.

The U.S. Nuclear Regulatory Commission (NRC) staff is currently reviewing your application and has identified areas where additional information is needed to complete its review. The NRC staff expects a response to this RAI within 30 days of this message which is July 13, 2022. If Constellation can not provide a response as requested contact me to discuss.

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REQUEST FOR ADDITIONAL INFORMATION

QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2

LICENSE AMENDMENT RELATED TO SPENT FUEL STORAGE ANALYSIS

Regulatory Requirements

Title 10 of the Code of Federal Regulations (10 CFR), Part 50, Appendix A, Criterion 5 requires, “Structures, systems, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown.”

10 CFR Part 50, Appendix A, Criterion 62 requires, “Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations.”

Paragraph 50.68(a) of 10 CFR requires, “Each holder of a construction permit or operating license for a nuclear power reactor issued under this part or a combined license for a nuclear power reactor issued under Part 52 of this chapter, shall comply with either 10 CFR 70.24 of this

chapter or the requirements in paragraph (b) of this section." The licensee has chosen to comply with Paragraph 50.68(b) of 10 CFR.

Paragraph 50.68(b)(1) of 10 CFR requires, "Plant procedures shall prohibit the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water."

Paragraph 50.68(b)(2) of 10 CFR requires, "The estimated ratio of neutron production to neutron absorption and leakage (k-effective) of the fresh fuel in the fresh fuel storage racks shall be calculated assuming the racks are loaded with fuel of the maximum fuel assembly reactivity and flooded with unborated water and must not exceed 0.95, at a 95 percent probability, 95 percent confidence level. This evaluation need not be performed if administrative controls and/or design features prevent such flooding or if fresh fuel storage racks are not used."

Paragraph 50.68(b)(3) of 10 CFR requires, "If optimum moderation of fresh fuel in the fresh fuel storage racks occurs when the racks are assumed to be loaded with fuel of the maximum fuel assembly reactivity and filled with low-density hydrogenous fluid, the k-effective corresponding to this optimum moderation must not exceed 0.98, at a 95 percent probability, 95 percent confidence level. This evaluation need not be performed if administrative controls and/or design features prevent such moderation or if fresh fuel storage racks are not used."

Paragraph 50.68(b)(4) of 10 CFR requires, in part, "If no credit for soluble boron is taken, the k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95-percent probability, 95-percent confidence level, if flooded with unborated water."

The QCNPS SFP NCS analysis does not contain soluble boron, so the 10 CFR 50.68(b)(4) requirements regarding soluble boron do not apply.

In addition, paragraph 50.36(c)(4) of 10 CFR requires, "Design features. Design features to be included are those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered in categories described in paragraphs (c) (1), (2), and (3) of this section."

RAI-SFNB-1:

In Section 2.2 New Fuel Vault Criticality Safety Analysis of Attachment 1 to the October 25, 2021, letter it states, "The QCNPS NFV racks are GE designed low density racks with an interrack spacing of 11 inches (Reference 6.3, Section 9.1.1.2). The NFV rack CSA coverage for the new GNF3 fuel will be the GESTAR II (Reference 6.4) analysis for GE designed low density NFV racks upon approval of this proposed license amendment. The applicability of GESTAR II to the GNF3 fuel type is documented in the GNF3 GESTAR II validation report (Reference 6.6). The QCNPS NFV interrack pitch is ≥ 10.5 inches (the criteria listed in GESTAR II) and thus the racks may be utilized to store new GNF fuel with in-core SCCG [Standard Cold Core Geometry] kinf ≤ 1.31 (Reference 6.4, Section 3.5). Past NFV CSA will no longer be applicable to QCNPS upon implementation of this license amendment because the only fuel to be delivered to the site for core reloads will be GNF3."

However, neither Reference 6.4, GE Licensing Topical Report NEDE-24011-P-A, General Electric Standard Application for Reactor Fuel (GESTAR II, Main)," Revision 31, dated

November 2020 (ML20330A199) nor Reference 6.6 NEDC-33879P, Revision 4, “GNF3 Generic Compliance with NEDE-24011-P-A (GESTAR II)," dated August 2020 (ML20244A110) contain a nuclear criticality safety methodology or nuclear criticality safety analysis. To evaluate compliance with 10 CFR 50.68(b)(2) submit the following:

- NFV criticality safety analysis methodology used in the analysis.
- Criticality safety analysis that sets the limits for the QCNPS NFV.
- Criticality safety analysis that demonstrates GNF3 meets the limits for the QCNPS NFV.

RAI-SFNB-2:

QCNPS Updated Final Safety Analysis Report (UFSAR) section 9.1.1.2 states, “The minimum center-to-center spacing of bundles in the racks is 6.625 inches longitudinally by 11 inches between rows.” This is not a pitch ≥ 10.5 inches. To evaluate compliance with 10 CFR 50.68(b)(2) explain and clarify this apparent discrepancy.

RAI-SFNB-3:

The QCNPS NFV center to center pitch is critical to maintaining the geometric spacing of fuel assemblies to ensure 10 CFR 50.68(b)(2) is met. Describe the controls QCNPS has in place to ensure the QCNPS NFV center to center spacing is maintained.

RAI-SFNB-4:

In Section 4.1 “Applicable Regulatory Requirements/Criteria” of Attachment 1 to the October 25, 2021, letter states, in part “The regulation also states that for the optimum moderation case the k_{eff} must not exceed 0.98 at a 95 percent probability, 95 percent confidence level. The optimum moderation case is not applicable to the QCNPS NFV as it is a moderation controlled area (see Reference 6.3, Section 9.1.1.3).” 10 CFR 50.68(b)(3) requires optimum moderation be prevented to forgo complying with the k-effective portion of the paragraph. Section 9.1.1.3 of the QCNPS UFSAR does not list any means by which an optimum moderation condition is prevented. To evaluate compliance with 10 CFR 50.68(b)(3) explain/justify how an optimum moderation condition is precluded at all times.

RAI-SFNB-5:

The measures QCNPS has to ensure NFV optimum moderation condition is precluded at all times are essential to forgoing the NFV optimum moderation k-effective analysis otherwise stipulated in 10 CFR 50.68(b)(3). Describe the controls QCNPS has in place to ensure those measures are not compromised.

RAI-SFNB-6:

In Section 1.0 “INTRODUCITON” of NEDC-33932P Revision 1 (Attachment 3 to the October 25, 2021, letter) it states, “A maximum SCCG, uncontrolled peak in-core k_{∞} [eiqenvalue] of 1.29 as defined by the lattice physics code TGBLA06 (Reference 1) is set as the limit for this analysis.” However, NEDC-33932P Revision 1 Reference 1 does not have a clear nexus to how TGBLA06 calculates a SCCG. Additionally, NEDC-33932P Revision 1 Reference 1 is dated November 10, 1999, which predates GNF3 fuel by at least a decade. To evaluate compliance with 10 CFR 50.68(b)(4) provide the methodology or appropriate reference for how

TGBLA06 calculates SCCG and the analysis or appropriate reference for how TGBLA06 is an appropriate code for modeling GNF3.

RAI-SFNB-7:

The description of the analysis in NEDC-33932P Revision 1 Section 5.5.2 “Normal Bias Cases” provides a brief description of the analysis performed to evaluate “No inserts on the rack periphery.” The analysis considers perturbed scenarios referenced to a non-perturbed scenario. NEDC-33932P Revision 1 Section 5.5.3 “Abnormal/Accident Bias Cases” provides a brief description of the analysis performed to evaluate ”Abnormal positioning of fuel assembly outside the fuel storage rack.” This analysis also considers perturbed scenarios referenced to a non-perturbed scenario. The descriptions provided indicates the non-perturbed scenario values in both the “No inserts on the rack periphery” and the “Abnormal positioning of fuel assembly outside the fuel storage rack” evaluations should be identical. However comparison of the information listed in Table 11 to Table 12 indicates they are not identical. To evaluate compliance with 10 CFR 50.68(b)(4) explain the differences between the non-perturbed scenario values in these tables.

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