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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION FOR AMENDMENT NO. 261 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-39 AMENDMENT NO. 223 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-85 CONSTELLATION ENERGY GENERATION, LLC LIMERICK GENERATING STATION, UNITS 1 AND 2 DOCKET NOS. 50-352 AND 50-353

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1.0 INTRODUCTION

1.1 Background

By license amendment request (LAR) dated March 11, 2021 [1], as supplemented by letters dated May 5, 2021 [2], December 15, 2021 [3], February 14, 2022 [4], and June 30, 2022 [5], Exelon Generation Company, LLC (the licensee)¹ requested amendments to Renewed Facility Operating License Nos. NPF-39 and NPF-85 for Limerick Generating Station (Limerick), Units 1 and 2, respectively. The licensee requested to revise the license condition in each license pertaining to the licensee's approval to use Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.69, "Risk-informed categorization and treatment of structures, systems and components [SSCs] for nuclear power reactors," to allow the use of an alternative defense-in-depth, pressure boundary, and seismic processes (or approaches) for categorizing SSCs in the licensee's application of 10 CFR 50.69.

This safety evaluation addresses only the licensee's request to allow use of a proposed alternative seismic approach in the licensee's application of 10 CFR 50.69. As discussed in enclosure 4 to the U.S. Nuclear Regulatory Commission's (NRC's or the Commission's) letter dated May 17, 2023 [6], the NRC staff partially denied the licensee's request. Specifically, the NRC staff denied the proposed alternative defense-in-depth and pressure boundary categorization approaches.

The NRC staff performed an audit in November 2021 to support its review of the LAR. The NRC staff's audit plan is dated October 1, 2021 [7], and was supplemented by emails dated October 20, 2021 [8], January 24, 2022 [9], and February 2, 2022 [10]. The NRC staff's audit summary report is dated March 24, 2023 [11]. By emails dated April 20, 2021 [12], and May 13, 2022 [13], the NRC staff requested additional information from the licensee. The NRC staff held public meetings with the licensee on May 3, 2022 [14], June 24, 2022 [15], and February 23, 2023 [16], to discuss its review of the LAR. The licensee responded to NRC staff's requests and audit discussions by letters dated May 5, 2021 [2], December 15, 2021 [3], February 14, 2022 [4], and June 30, 2022 [5].

On August 10, 2021, the NRC staff published a proposed no significant hazards consideration (NSHC) determination in the *Federal Register* [17] for the proposed amendments. Subsequently, by letter dated December 15, 2021 [3], as supplemented by letter dated February 14, 2022 [4], the licensee provided additional information that expanded the scope of the amendment request as originally noticed in the *Federal Register*. Accordingly, the NRC published a second proposed NSHC determination in the *Federal Register* on February 22, 2022 [18], as corrected by notice dated March 18, 2022 [19]. The supplement dated June 30, 2022 [5], provided additional information that clarified the LAR, did not expand the scope of the LAR, and did not change the NRC staff's revised proposed NSHC determination as published in the *Federal Register* on February 22, 2022 [18], as corrected by notice dated March 18, 2022 [19].

1.2 Description of 10 CFR 50.69 Licensing Basis

On July 31, 2018, the NRC issued Amendment Nos. 230 and 193 [20] for Limerick, Units 1 and 2, respectively, which added a new license condition in appendix C of the operating

¹ On February 1, 2022, Exelon Generation Company, LLC was renamed Constellation Energy Generation, LLC.

licenses that allowed the licensee to implement 10 CFR 50.69. The provisions of 10 CFR 50.69 allow adjustment of the scope of SSCs subject to special treatment requirements (e.g., quality assurance, testing, inspection, condition monitoring, assessment, and evaluation) based on a method of categorizing SSCs into one of four risk-informed safety class (RISC) categories according to their safety significance. For SSCs categorized as "low safety-significant" (LSS), alternative treatment requirements may be implemented in accordance with the regulation. The licensee determines safety significance using an integrated decision-making process that uses both risk insights and traditional engineering insights. The licensee conducts periodic assessment activities to adjust the categorization or treatment processes, as needed, so that SSCs continue to meet all applicable functional requirements.

Under 10 CFR 50.69, a licensee classifies SSCs as having either safety-significant functions (RISC–1 and RISC–2 categories)² or LSS functions (RISC–3 and RISC–4 categories). For high safety-significant (HSS) SSCs, 10 CFR 50.69 maintains current regulatory requirements (i.e., it does not change requirements for these SSCs) for special treatment. For LSS SSCs, licensees can implement alternative treatment requirements in accordance with 10 CFR 50.69(b)(1) and 10 CFR 50.69(d)(2). For RISC–3 SSCs, licensees can replace special treatment with an alternative treatment. For RISC–4 SSCs, 10 CFR 50.69 does not impose new treatment requirements, and RISC–4 SSCs are removed from the scope of any applicable special treatment requirements identified in 10 CFR 50.69(b)(1).

Section 1.5, "Categorization Process Summary," of Nuclear Energy Institute (NEI) 00-04, Revision 0, "10 CFR 50.69 SSC Categorization Guideline" [21], indicates that a licensee can use a seismic risk analysis (either a plant-specific seismic probabilistic risk assessment (SPRA) or a seismic margin analysis (SMA)) to identify SSCs that are safety-significant because of seismic risks. The licensee currently uses an SMA to assess seismic risk at Limerick [20]. NEI 00-04 [21] indicates that using an SMA is more conservative than using an SPRA because it identifies all system functions and associated SSCs involved in the seismic margin success paths as safety significant, regardless of their capacity, frequency of challenge, or level of functional diversity. In its supplement [3], the licensee stated that all SSCs included in its SMA safe shutdown equipment list (i.e., the success path component list) conservatively default to HSS.

1.3 Proposed Changes

In its LAR [1], as supplemented [2],³ the licensee stated that several 10 CFR 50.69 categorization processes are overly conservative and resource intensive and do not provide a commensurate benefit to the health and safety of the public. To address this, the licensee proposed to revise the 10 CFR 50.69 license condition in each license to allow the use, in part,

² Nuclear Energy Institute (NEI) 00-04, Revision 0, "10 CFR 50.69 SSC Categorization Guideline" [21], uses the term "high-safety-significant (HSS)" to refer to SSCs that perform safety-significant functions. The NRC staff understands HSS, as used in NEI 00-04, to have the same meaning as "safety-significant" (i.e., SSCs that are categorized as RISC–1 or RISC–2), as used in 10 CFR 50.69.

³ In its supplemented dated December 15, 2021 [3], the licensee proposed a different alternative seismic approach than that proposed in its LAR [1] and supplement dated May 5, 2021 [2]. The licensee stated that the information in the supplement dated December 15, 2021 [3], supersedes the corresponding information in the LAR [1] in its entirety, and that the information in the supplement dated May 5, 2021 [2], was no longer relevant or necessary. In its supplement dated February 14, 2022 [4], the licensee confirmed that it requested the Tier 2 approach for use and corrected two sections of the supplement dated December 15, 2021 [3].

of an alternative approach to the currently approved seismic categorization process. The proposed alternative seismic approach is different from those endorsed by the NRC staff in sections 1.5 and 5.3 in NEI 00-04 [21]. In its supplement [3], the licensee stated that the alternative seismic approach is consistent with the "Tier 2" approach described in the Electric Power Research Institute (EPRI) technical report 3002017583 (EPRI-3002017583), "Alternative Approaches for Addressing Seismic Risk in 10 CFR 50.69 Risk-Informed Categorization" [22], including the EPRI markups provided in attachment 2 of the LaSalle County Station (LaSalle) documents dated October 16, 2020 [23], and January 22, 2021 [24].

In its supplement [4], the licensee stated that it would use a single approach (i.e., either the SMA or the proposed alternative seismic approach) for the categorization of an entire system. The licensee proposed that it could implement the alternate seismic approach for any system that was previously categorized, or for systems that will be categorized, and that it would not be required to re-categorize (with the alternative seismic approach) any system that it previously categorized. The licensee proposed that it may continue to use the processes identified in the current applicable license conditions.

To capture the potential impact of seismic risk in the categorization process, the proposed alternative seismic approach would include both quantitative and qualitative assessments of plant SSC-specific seismic insights and their presentation to the integrated decision-making panel (IDP) as part of the IDP's decision-making process. The proposed alternative seismic approach would include focused walkdowns and quantification of probabilistic risk assessment (PRA) importance measures, which are based on a sensitivity study, for selected SSCs using the licensee's internal events PRA (IEPRA). The proposed approach would also include consideration of seismic risk through insights from plant-specific seismic information. In its supplement [3], the licensee explained that the reason for using the proposed alternative seismic approach is that the special seismic risk evaluation process for the proposed approach can identify the appropriate seismic insights to be considered with the other categorization insights from the IDP for the final HSS determinations.

In its LAR [1], as supplemented [2] [3] [4] [5], the licensee stated that it completed the implementation items required by the license conditions prior to the implementation of the 10 CFR 50.69 categorization process, which began in October 2018. Therefore, the licensee proposed to delete the current paragraph specific to the implementation items that states, in part, "Exelon will complete the implementation items . . . prior to implementation of the 10 CFR 50.69 categorization process," and replace it with a new insert paragraph that states:

In addition, Constellation Energy Generation, LLC (CEG) is approved to implement 10 CFR 50.69 using any of the following alternative processes for categorization of RISC–1, RISC–2, RISC–3, and RISC–4 SSCs as specified in Unit [1(2)] License Amendment No. [261(223)] dated [May 17, 2023]:

- the alternative defense-in-depth approach as described in the licensee's letters dated March 11, 2021, May 5, 2021, and June 30, 2022.
- the alternative passive pressure boundary categorization approach as described in the licensee's letters dated March 11, 2021, and June 30, 2022
- the alternative seismic approach as described in the licensee's letters dated December 15, 2021, and February 14, 2022.

The licensee also proposed to update each unit's license condition to reflect the applicable amendment numbers.

Because of the NRC staff's denial of the proposed alternative defense-in-depth and pressure boundary categorization approaches, the NRC staff informed [25] the licensee that the NRC staff would modify the proposed license condition, assuming the staff approves the proposed alternative seismic approach, to state:

In addition, Constellation Energy Generation, LLC (CEG) is approved to implement 10 CFR 50.69 using the alternative seismic approach, as described in the licensee's letters dated December 15, 2021, and February 14, 2022, for categorization of RISC–1, RISC–2, RISC–3, and RISC–4 SSCs as specified in Unit [1(2)] License Amendment No. [261(223)] dated [May 17, 2023].

2.0 REGULATORY EVALUATION

The NRC staff considered the following regulations, licensing basis, and guidance during its review of the proposed changes.

2.1 <u>Regulations</u>

Section 50.69 of 10 CFR provides an alternative approach for establishing requirements for treatment of SSCs for nuclear power reactors using a risk-informed method of categorizing SSCs according to their safety significance. Specifically, for SSCs categorized as LSS, alternative treatment requirements may be implemented in accordance with the regulation. For SSCs determined to be of HSS, requirements may not be changed. The corresponding statement of considerations (SoC) for the rulemaking are in the *Federal Register* notice published on November 22, 2004 [26].⁴

- Paragraph 50.69(b)(2)(ii) of 10 CFR requires an application to implement 10 CFR 50.69 to contain a description of the measures taken to assure that the quality and level of detail of the systematic processes that evaluate the plant for internal and external events during normal operation, low power, and shutdown are adequate for the categorization of SSCs. Paragraph 50.69(b)(2)(iv) requires a description of, and basis for acceptability of, the evaluations to be conducted to satisfy 10 CFR 50.69(c)(1)(iv). The evaluations must include the effects of common cause interaction susceptibility, and the potential impacts from known degradation mechanisms for both active and passive functions, and address internally and externally initiated events and plant operating modes (e.g., full power and shutdown conditions).
- Paragraph 50.69(b)(3) of 10 CFR states that the Commission will approve a licensee's implementation of this section by issuance of a license amendment if the Commission determines that the categorization process satisfies the requirements of 10 CFR 50.69(c).

⁴ Section III.4.10.2, "Section 50.36 Technical Specifications," of the SoC for the 10 CFR 50.69 rulemaking states, "Given the ongoing regulatory efforts to risk-inform the [technical specifications], it was not considered necessary to scope § 50.36 into § 50.69 as a special treatment requirement." Therefore, the NRC staff does not consider the technical specifications to be part of the risk-informed treatment processes of 10 CFR 50.69.

- Paragraph 50.69(c)(1) of 10 CFR states that SSCs must be categorized as RISC–1, RISC–2, RISC–3, or RISC–4 SSCs using a categorization process that determines if an SSC performs one or more safety-significant functions and identifies those functions.
- Paragraph 50.69(c)(1)(ii) of 10 CFR requires that the categorization process must determine SSC functional importance using an integrated, systematic process for addressing initiating events (internal and external), SSCs, and plant operating modes, including those not modeled in the plant-specific PRA.
- Paragraph 50.69(c)(1)(iv) of 10 CFR requires the categorization process to include evaluations that provide reasonable confidence that for SSCs categorized as RISC–3, sufficient safety margins are maintained and that any potential increases in core damage frequency and large early release frequency resulting from changes in treatment permitted by implementation of 10 CFR 50.69(b)(1) and (d)(2) are small.

2.2 Licensing Basis

The NRC issued Amendment Nos. 230 and 193 [20] for Limerick Generating Station, Units 1 and 2 regarding adoption of 10 CFR 50.69.

2.3 <u>Guidance</u>

- NRC Regulatory Guide (RG) 1.200, Revision 2, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities" [27], describes an acceptable approach for determining whether the quality of the PRA, in total or the parts that are used to support an application, is sufficient to provide confidence in the results, such that the PRA can be used in regulatory decision making for light-water reactors.
- RG 1.201 (For Trial Use), Revision 1, "Guidelines for Categorizing Structures, Systems, and Components in Nuclear Power Plants according to Their Safety Significance" [28], endorses the categorization method described in NEI 00-04 [21], with clarifications, limitations, and conditions. RG 1.201 [28] states that as part of the NRC's review and approval of a licensee's application requesting to implement 10 CFR 50.69, the NRC staff intends to impose a license condition that will explicitly address the scope of the PRA and non-PRA methods used in the licensee's categorization approach.
- NEI 00-04, Revision 0 [21] describes a process for determining the safety significance of SSCs and categorizing them into the four RISC categories defined in 10 CFR 50.69.
- EPRI-3002017583 [22] is a technical report that describes a three-tiered, graded evaluation process for considering seismic risk insights in the 10 CFR 50.69 categorization process. Tier 2 sites (moderate seismic hazard or moderate seismic margin sites) are expected to have limited unique seismic categorization insights. This approach recommends a special sensitivity study using a common cause approach in the full power internal events PRA to account for similar categorization insights. These seismic insights would be considered with the other categorization insights by the IDP for the final HSS determinations. Key seismic insights come from considering seismic correlation effects on plant risk, unique seismic interactions, and focused seismic walkdowns that indicate the importance of SSCs for mitigating seismic events. The NRC

staff takes no position on the completeness or accuracy of the list in section 2.1 of EPRI-3002017583 identifying the plants that submitted seismic PRAs in response to the NRC's post-Fukushima 10 CFR 50.54(f) letter. The completeness or accuracy of the list in section 2.1 of EPRI-3002017583 does not impact the NRC staff's evaluation and conclusion on this application because the staff's review is specific to Limerick.

2.4 <u>Precedents</u>

• In its supplement [3], the licensee stated that its application follows the same Tier 2 seismic categorization approach that the NRC staff approved for LaSalle, Units 1 and 2 [29], with no deviations.

3.0 TECHNICAL EVALUATION

3.1 <u>Method of Review</u>

In determining whether an amendment to a license will be issued, the NRC is guided by the considerations that govern the issuance of initial licenses to the extent applicable and appropriate. The NRC staff evaluated the licensee's LAR to determine whether the proposed changes are consistent with the regulations, licensing basis information, guidance, and precedents, as applicable, discussed in section 2.0 of this safety evaluation. Paragraph 50.69(b)(3) of 10 CFR states that the Commission will approve a licensee's implementation of 10 CFR 50.69 by issuing a license amendment if it determines that the licensee's process for categorizing SSCs satisfies the requirements to 10 CFR 50.69(c). The NRC staff reviewed the proposed alternative seismic approach against the categorization process described in NEI 00-04 [21], as endorsed by RG 1.201 [28], and against the requirements in 10 CFR 50.69(c) to determine whether it supports the proposed license condition changes and provides reasonable assurance of continued compliance with 10 CFR 50.69.

The NRC staff reviewed the alternative seismic approach proposed in the licensee's supplement dated December 15, 2021 [3], as supplemented by letter dated February 14, 2022 [4].⁵ The staff reviewed the proposed alternative seismic approach's two main inputs: (1) the conclusions from the case studies in EPRI-3002017583 [22] and (2) the impact of the seismic risk in categorization from the high relative contribution of seismic risk to the overall plant risk.

The NRC staff reviewed the application to determine whether it has sufficient supporting information for the proposed alternative seismic approach, including the quantitative and qualitative assessments of plant SSC-specific seismic insights and how the IDP would consider them. The staff reviewed the application to verify whether the proposed alternative seismic approach adequately includes focused walkdowns and quantification of PRA importance measures for selected SSCs using the licensee's IEPRA. The NRC staff also reviewed the application to verify whether the proposed alternative seismic approach includes proper consideration of seismic risk through insights from plant-specific seismic information.

⁵ This safety evaluation does not address the information in the LAR [1] and the supplement dated May 5, 2021 [2], because, per the licensee's supplement dated December 15, 2021 [3], that information was withdrawn and no longer relevant or necessary to the Tier 2 approach proposed in the supplement dated December 15, 2021 [3].

3.2 Evaluation of Supporting Information for the Alternative Seismic Approach

3.2.1 Description of Measures for Assuring Quality and Detail

Section 50.69(b)(2)(ii) of 10 CFR requires a LAR to implement 10 CFR 50.69 contain, in part, a description of the measures taken to assure that the quality and level of detail of the systematic processes that evaluate the plant for internal and external events during normal operation, low power, and shutdown (including the plant-specific PRA, margins-type approaches, or other systematic evaluation techniques used to evaluate severe accident vulnerabilities) are adequate for the categorization of SSCs.

In section 3.1.4 of attachment 1 to its supplement [3], the licensee provided a description of its proposed alternative seismic approach for considering seismic risk in the categorization process and how the proposed alternative seismic approach would be used in the categorization process. The licensee also stated that its application follows the same Tier 2 seismic categorization approach that the NRC approved for LaSalle [29] with no deviations. In addition, the licensee based the acceptability of its proposed alternative seismic approach on the conclusions gained from case studies performed in EPRI-3002017583 [22]. Therefore, the NRC staff notes that the licensee's justification is indirectly based on the acceptability of the PRAs used for the case studies.

The NRC staff reviewed the supplements dated December 15, 2021 [3], and February 14, 2022 [4], and determined that the information therein and in EPRI-3002017583 [22] provides sufficient details describing the proposed alternative seismic approach, how the licensee would use the proposed alternative seismic approach in the categorization process, and the measures for assuring that the quality and level of detail for the licensee's proposed alternative seismic approach are adequate for the categorization of SSCs. Therefore, the NRC staff finds that the supplements [3] [4] meet the requirements in 10 CFR 50.69(b)(2)(ii) for the proposed alternative seismic approach.

3.2.2 Evaluations to Satisfy 10 CFR 50.69(c)(1)(iv)

Paragraph 50.69(b)(2)(iv) of 10 CFR requires a description of, and basis for acceptability of, the evaluations to be conducted to satisfy 10 CFR 50.69(c)(1)(iv). The evaluations must include the effects of common cause interaction susceptibility, and the potential impacts from known degradation mechanisms for both active and passive functions, and address internally and externally initiated events and plant operating modes (e.g., full power and shutdown conditions).

The licensee's supplement [3] provides information on how the proposed alternative seismic approach meets the requirements of 10 CFR 50.69(c)(1)(iv). The NRC staff finds that the information presented in the supplement [3] and the documents that the licensee incorporated by reference therein provide sufficient description and basis for acceptability of the evaluations to be conducted to satisfy 10 CFR 50.69(c)(1)(iv) for the proposed alternative seismic approach. Therefore, the NRC staff finds that the licensee's supplements [3] [4] meet the requirements in 10 CFR 50.69(b)(2)(iv).

3.3 Evaluation of EPRI-3002017583 Case Studies

3.3.1 Precedent

EPRI-3002017583 [22] includes the results from case studies performed to determine the extent and type of unique HSS SSCs from SPRAs. The case studies were performed for four plants, designated as Plants A through D. In its supplement [3], the licensee stated that EPRI-3002017583 [22] is an update to EPRI-3002012988, "Alternative Approaches for Addressing Seismic Risk in 10 CFR 50.69 Risk-Informed Categorization" [30]. The NRC staff confirmed that the case studies in EPRI-3002017583 are the same as those in EPRI-3002012988, which the staff's safety evaluation for LaSalle's 10 CFR 50.69 license amendments [29] described and evaluated. Based on its review of the licensee's supplement [3] and the documents incorporated by reference therein, the NRC staff determined that it can apply the staff's previous evaluation documented in the safety evaluation for the LaSalle 10 CFR 50.69 amendments [29] to Limerick. Therefore, the staff considers the NRC staff's safety evaluation of the Tier 2 seismic categorization approach for the LaSalle 10 CFR 50.69 amendments [29] to be an applicable precedent for this LAR.

3.3.2 Technical Acceptability of the PRAs Used for Case Studies

In its supplement [3], the licensee provided information concerning the case studies, mapping approach, and conclusions on the determination of unique HSS SSCs from the case studies in EPRI-3002017583 [22], which were used by the licensee to support its proposed alternative seismic approach. EPRI-3002017583's [22] categorization conclusion from the Plants A, C, and D case studies is that the only SSCs identified as HSS in the SPRA that were not also HSS from IEPRA, fire PRA (FPRA), or both, were from unique seismically-induced failure modes. The remainder of HSS SSCs from the SPRA are captured by the corresponding IEPRA, FPRA, or other aspects of the NEI 00-04 [21] categorization process.

The licensee stated that it was using the case study (termed "test case" by the licensee) information in EPRI-3002017583 [22]. In its supplement [3], for case study Plants A, C, and D, the licensee also incorporated by reference (references 13 - 21 and 36 - 38 in the supplement [3]), information related to technical acceptability of the PRAs used and the technical adequacy of certain technical details of the conduct of the case studies. The NRC staff reviewed and evaluated the technical acceptability of the PRAs, the peer review process, resolution of peer review findings, and key assumptions and sources of uncertainty used in the case studies for Plants A, C, and D in EPRI-3002017583 [22] against the guidance in RG 1.200, Revision 2 to verify applicability for this LAR.

Based on its review, the NRC staff finds that the technical acceptability of PRAs used for the Plant A, C, and D case studies in EPRI-3002017583 [22], the mapping approach used in those case studies, and the conclusions on the determination of unique HSS SSCs from the case studies in the precedent [29] are applicable to the licensee's proposed Tier 2 alternative seismic approach for Limerick. Therefore, the NRC staff concludes that the Plant A, C, and D PRAs are technically acceptable for this application [3] [4], and applicable for use in the corresponding case studies supporting the licensee's proposed alternative seismic approach and in the mapping of SSCs between the SPRA, the full-power IEPRA and, as applicable, the FPRA for the Plant A, C, and D case studies. In addition, the NRC staff's review determined that the licensee's plant-specific evaluation supports applying Plant A, C, and D case studies and mapping of SSCs to Limerick's proposed alternative seismic approach. Therefore, the

NRC staff finds that the licensee's plant-specific evaluation is technically justifiable to support conclusions about the determination of unique HSS SSCs from SPRAs in the Plant A, C, and D case studies in EPRI-3002017583 and applicable to the licensee's proposed Tier 2 alternative seismic approach.

3.4 <u>Evaluation of the Implementation of the Alternative Seismic Approach</u>

The NRC staff evaluated the proposed implementation of the alternative seismic approach against 10 CFR 50.69(c)(1)(ii) and (iv). The categorization conclusions from the case studies in EPRI-3002017583 [22] indicated that seismic-specific failure modes resulted in HSS categorization uniquely from SPRAs. Therefore, such seismic-specific failure modes, such as correlated failures, interaction failures, relay-chatter, and passive component structural failure modes, can influence the categorization process. The licensee discussed the implementation of its proposed Tier 2 alternative seismic approach in its supplement [3]. The NRC staff reviewed this information to evaluate whether the licensee appropriately included and implemented the categorization-related conclusions from the EPRI-3002017583 [22].

The proposed alternative seismic approach includes a combination of qualitative and quantitative considerations of the mitigation capabilities and seismic failure modes of SSCs in the categorization process. These considerations are based on plant-specific walkdowns for the SSCs undergoing categorization, quantification of the impact of seismic failure of SSCs subject to correlated or interaction failures, and insights obtained from prior seismic evaluations performed for Limerick. The NRC staff's review and findings on the qualitative and quantitative aspects of the proposed alternative seismic approach are provided below.

3.4.1 <u>Qualitative Evaluation for the Alternative Seismic Approach</u>

In its supplement [3], the licensee indicated that the categorization team's preparation of the system categorization document (SCD) presented to the IDP would include a summary of the identified plant-specific seismic insights pertinent to the SSC being categorized. The licensee further explained that at several steps of the categorization process, the categorization team would consider the available seismic insights relative to the system being categorized and document its conclusions in the SCD. In addition, the licensee would provide the IDP with the basis for the proposed alternative seismic approach, including the seismic hazard for the plant and the criteria for using the proposed alternative seismic approach.

Table 1, "Categorization Evaluation Summary," in the supplement [3] states that the categorization using the proposed alternative seismic approach (termed the "EPRI Tier 2 Seismic" approach in Table 1 of the supplement [3]) would be performed at either the functional or component level. In another supplement [4], the licensee clarified that a separate entry titled, "Fire, Seismic, and Other External Hazards," in Table 1 is for the previously approved SMA approach.

In its supplement [3], the licensee explained that the categorization team would review available Limerick-specific seismic information and other resources to identify Limerick-specific seismic insights relevant to the SSCs being categorized, such as:

- impact of relay-chatter
- implications related to potential seismic interactions such as with block walls
- seismic failures of passive SSCs such as tanks and heat exchangers
- any known structural or anchorage issues with a particular SSC
- components that are implicitly part of PRA-modeled functions (including relays)

In its supplement [3], the licensee stated that, for each system categorized, the categorization team would evaluate correlated seismic failures and seismic interactions between SSCs. The licensee further explained that these insights would provide the IDP a means to consider potential impacts of seismic events in the categorization process. The licensee stated that the IDP could challenge, from a seismic perspective, any candidate LSS recommendation for any SSC if it believed there was basis for doing so. The licensee also stated that any decision by the IDP to downgrade preliminary HSS components to LSS would also consider the applicable seismic insights.

In its supplement [3], the licensee explained that sources of the insights related to seismic events would be prior plant-specific seismic evaluations, such as the seismic hazard screening process, the seismic high frequency evaluation performed for near-term task force (NTTF) recommendation 2.1, seismic walkdowns performed for NTTF recommendation 2.3, and seismic mitigation strategy assessment performed for NTTF recommendation 4.2 (References 26 – 34 in Attachment 1 to the licensee's supplement [3]).

In its supplement [3], the licensee stated that for SSCs that were uniquely HSS from the FPRA but not HSS from IEPRA, the categorization team would review design-basis functions of the SSCs during seismic events or functions credited for mitigation and prevention of severe accidents caused by seismic events. The categorization team would present the results of the review to the IDP as additional qualitative inputs and would describe them in the SCD. The licensee further clarified that the discussion with the IDP would focus on SSCs that are uniquely HSS from FPRA because such SSCs may not be categorized as HSS following the integrated importance measure determination.

Based on its review of the qualitative evaluations for seismic risk in the licensee's proposed alternative seismic approach, the NRC staff finds the following:

- 1. The evaluations would include potentially important seismically-induced failure modes and mitigation capabilities of SSCs during seismically-induced design basis and severe accident events, consistent with the conclusions on the determination of unique HSS SSCs from SPRAs in EPRI-3002017583 [22].
- 2. The licensee would provide system-specific qualitative seismic insights to the IDP for consideration as part of the IDP review process as each system is categorized.
- 3. The insights would use plant-specific prior seismic evaluations, which, in conjunction with the performance monitoring for the proposed alternative seismic approach, reasonably reflect the current plant configuration.

- 4. The qualitative evaluation will complement focused walkdowns and quantitative evaluations identified for the SSCs.
- 5. The recommendation for categorizing civil structures in the proposed alternative seismic approach provides proper consideration of such failures from a seismic event.

3.4.2 Focused Walkdowns for the Alternative Seismic Approach

In its supplement [3], the licensee stated that the proposed alternative seismic approach includes focused walkdowns of SSCs undergoing categorization. The purpose of the walkdowns is to identify, for the SSCs being categorized, the conditions for occurrence of correlated failures, failure of more than one SSC caused by interactions with other SSCs, and single-component failures.

The NRC staff evaluated the focused walkdowns for the proposed alternative seismic approach, as described in the licensee's supplement [3] and in EPRI-3002017583 [22], including the revision markups in the LaSalle documents [23] [24]. In its supplement [3], the licensee stated that its application follows the same Tier 2 seismic categorization approach that the NRC approved for LaSalle [29] with no deviations. Based on its review of the licensee's supplement [3] and the documents incorporated by reference therein, the NRC staff determined that it can apply the staff's previous evaluation documented in the safety evaluation for the LaSalle 10 CFR 50.69 amendments [29] to Limerick.

Based on its review of the focused walkdowns in the proposed alternative seismic approach described in the licensee's supplement [3] and in EPRI-3002017583 [22], including the revision markups in the LaSalle documents [23] [24], the NRC staff finds the following:

- The licensee's focused walkdown in the proposed alternative seismic approach:

 includes consideration of seismically-induced correlated and interaction failures, which fail more than one SSC, and single component failures, and (ii) includes evaluations of the direct and indirect impacts of seismically induced correlated and interaction failure of an SSC. These failure modes reflect the insights from the case studies in EPRI-3002017583 [22]. The modifications to the proposed alternative seismic approach through changes to EPRI-3002017583 [22] appropriately reflect the evaluation of such direct and indirect impacts.
- 2. The qualification of personnel performing the walkdowns and the documentation and retention of the walkdown results are acceptable for the proposed alternative seismic approach. The qualification of personnel performing the walkdowns for the proposed alternative seismic approach is consistent with the state-of-practice for development and peer review of contemporary SPRAs, and the documentation and retention of walkdown information for the proposed alternative seismic approach are consistent with state-of-practice SPRAs and the guidance in NEI 00-04 [21]. Therefore, the staff determined that these activities would result in appropriate information being presented to the IDP for categorization decisions.
- 3. The licensee's approach for selecting the capacity-based screening criterion for the proposed alternative seismic approach is consistent with that for state-of-practice SPRAs. The NRC staff does not expect SSCs screened out based on the criterion to result in HSS components within the 10 CFR 50.69 categorization process.

- 4. The fragility approaches proposed for development of fragility values in Step 5b of the proposed alternative seismic approach are acceptable for the proposed alternative seismic approach because (i) they represent state-of-practice approaches consistent with those used in contemporary SPRAs reviewed by the NRC staff, and (ii) the licensee would not use unreviewed methods for fragility calculations.
- 5. The personnel performing fragility evaluations for the proposed alternative seismic approach is acceptable because the personnel would have experience or background consistent with that used for state-of-practice SPRAs and the guidance in NEI 00-04 on personnel qualifications. In addition, the NRC staff review determined that the documentation of the fragility evaluations would be consistent with documentation used for other categorization processes and, therefore, is acceptable for the proposed alternative seismic approach.
- 6. The proposed alternative seismic approach would result in consideration of relays as implicitly modeled components and of insights related to the impact of seismically induced relay-chatter for the function achieved by the SSC during the categorization.
- 7. The focused walkdowns of SSCs undergoing categorization would identify seismic interaction and correlated failures (including those resulting from potential failures of passive components and structural and anchorage issues). Further, the NRC staff concludes that insights from available plant-specific seismic reviews will also provide categorization related insights from a seismic failure modes perspective.

3.4.3 Quantitative Evaluation for the Alternative Seismic Approach

In its supplement [3], the licensee explained that SSCs identified as being vulnerable to correlated or interaction failure modes based on the focused walkdowns would be subjected to a quantitative evaluation using the licensee's IEPRA to determine the impact of seismic events on the categorization. The licensee would perform a quantitative evaluation through a sensitivity study using the licensee's IEPRA. In its supplement [3], the licensee provided information for the sensitivity study with Limerick-specific information. Section 2.3.1 of EPRI-3002017583 [22] provides further details on this sensitivity study, including the revision markups in the LaSalle documents [23] [24] that the licensee incorporated by reference in its supplement [3]. The sensitivity study would be performed by introducing PRA basic events (termed surrogate events) at appropriate locations in the licensee's IEPRA at appropriate locations to reflect seismically induced correlated failure or interaction failure of single or multiple SSCs. Subsequently, the licensee would quantify the modified IEPRA with the surrogate events for the loss-of-offsite power (LOOP) and small break loss-of-coolant accident (hereafter referred to as small LOCA) initiators, and the licensee would derive importance measures. The licensee would use the importance measures for the surrogate events derived from this sensitivity study to identify the SSCs that should be HSS because of seismically correlated failures or seismic interaction related failures. The licensee further stated that section 2.3.1 of EPRI-3002017583 [22] details the quantitative evaluation to determine the importance of SSCs on a system basis in the proposed alternative seismic approach.

The NRC staff reviewed the quantitative evaluation for the alternative seismic approach described in the licensee's supplement [3] and in EPRI-3002017583 [22], including the revision markups in the LaSalle documents [23] [24]. The NRC staff's review of the licensee's supplement [3] and the documents incorporated by reference therein determined that the NRC's evaluation documented in the LaSalle safety evaluation [29] applies to Limerick because both

are Tier 2 plants and the quantitative evaluation in the licensee's proposed alternative seismic approach is the same as that reviewed by the NRC staff for LaSalle.

The NRC staff determined that seismically induced LOOP and small LOCA occurrence frequencies are representative for Limerick based on the three SPRAs in the case studies in EPRI-3002017583 [22] and the fact that the seismic hazard at Limerick is lower than the hazard for those SPRAs. Therefore, the NRC staff concludes that the proposed occurrence frequency for the seismically induced LOOP event of 1.0 per year, the proposed occurrence frequency for the seismically induced small LOCA event of 1.0E-2 per year, and the proposed surrogate event failure probability of 1.0E-4 are acceptable for use in the licensee's alternative seismic approach. Further, the NRC staff determined that the occurrence frequency and failure probability switch in the sensitivity study is acceptable for the licensee's alternative seismic approach because: (1) it is necessary for developing the importance measures for comparison against the corresponding thresholds in NEI 00-04 [21], and (2) it does not alter the basis for the proposed values. Based on its review, the NRC staff finds reasonable confidence that the categorization outcome from the licensee's proposed alternative seismic approach will be comparable to those from SPRAs.

3.4.4 <u>Conclusions on the Implementation of the Alternative Seismic Approach</u>

Based on its review of Limerick's proposed alternative seismic approach against the requirements in 10 CFR 50.69 and in consideration of the corresponding SoC [26], the NRC staff finds that the proposed alternative seismic approach provides reasonable confidence in the evaluations required by 10 CFR 50.69(c)(1)(ii) and (iv) and consistent with the intent of the SoC for the following reasons:

- 1. It includes qualitative consideration of seismic events at several steps of the categorization process (including documentation of the information for presentation to the IDP) as part of the integrated, systematic process for categorization.
- 2. It includes focused walkdowns that evaluate the direct and indirect impacts of seismically induced correlated failures, interaction failures, and single component failures in a system under categorization.
- 3. It includes a quantitative evaluation (with justified failure probability and initiating event frequencies) that provides reasonable confidence that the categorization results from the licensee's proposed alternative seismic approach would be similar to those from SPRAs.
- 4. Personnel performing necessary walkdowns and analyses would have qualifications consistent with the state-of-practice SPRAs and the guidance in NEI 00-04 [21]. The documentation of these walkdowns and analyses would be consistent with state-of-practice SPRAs and the guidance in NEI 00-04 [21].
- 5. The quantitative and qualitative insights presented to the IDP include (i) potentially important seismically induced failure modes and (ii) mitigation capabilities of SSCs during seismically induced design basis and severe accident events, consistent with the conclusions on the determination of unique HSS SSCs from SPRAs in EPRI 3002017583 [22] with the markups provided in the LaSalle documents [23] [24]. The quantification would use the licensee's IEPRA, and the insights would use prior plant specific seismic evaluations. Therefore, in conjunction with performance monitoring for

the proposed alternative seismic approach, the proposed alternative seismic approach would reasonably reflect the current plant configuration.

- 6. It presents system-specific insights and categorization results from a seismic risk perspective to the IDP for consideration as part of the IDP review process, thereby providing the IDP with a means to consider potential impacts of seismic events in the categorization process.
- 7. It presents the IDP with the basis for the proposed alternative seismic approach (including the moderate seismic hazard for the plant) and the criteria for using the proposed alternative seismic approach.
- 8. As stated in its supplement [4], the licensee would use either the alternative seismic approach or the previously approved SMA [20], but not a combination of both, during categorization of a system, thereby avoiding an inappropriate combination of the two approaches.

3.5 <u>Evaluation for Performance Monitoring for the Alternative Seismic Approach</u>

The NRC staff evaluated the licensee's discussion of its performance monitoring program for the proposed alternative seismic approach to provide reasonable confidence that: (1) the continued validity of the plant-specific information that would be developed for each SSC that is categorized, (2) that any changes to the plant, including the seismic hazard, would be captured and appropriately addressed as part of the 10 CFR 50.69 program, and (3) that the requirements in 10 CFR 50.69(e) would be met for the proposed alternative seismic approach.

In its supplement [3], the licensee stated that its configuration control process would ensure that the licensee would evaluate changes to the plant, including physical changes and changes to documents, to determine the impact on design bases, licensing documents, programs, procedures, and training. The licensee also stated that its performance monitoring process would require periodic review to assess changes that could impact the categorization results and to provide the IDP with an opportunity to recommend categorization and treatment adjustments because of such changes. The licensee explained that it updated its configuration control program to have a checklist related to the impact of seismic events on categorization. The licensee identified some of the items in the checklist in its supplement [3]. The licensee stated that its performance monitoring program would require that the IDP could not approve SCDs until the licensee resolved the IDP's comments on issues, including system-specific seismic insights, to the satisfaction of the IDP. The licensee explained that its scheduled periodic reviews would occur no longer than once every two refueling outages and would evaluate new insights resulting from available risk information (i.e., PRA model or other analysis used in the categorization) changes, design changes, operational changes, and SSC performance. If the licensee determines that these changes affect the risk information or other elements of the categorization process such that the categorization results are more than minimally affected, then the licensee would update the risk information and the categorization process. The licensee explained that if it updates a PRA model or other risk information, it would perform a review of the SSC categorization in addition to the periodic review.

The NRC staff recognizes that the seismic hazard at any site could potentially increase such that the categorization process may be impacted from a seismic risk perspective, either solely from the seismic risk or via the integrated importance measure determination. In its supplement [3], the licensee stated that if the Limerick seismic hazard changed at some future

time and if its feedback process determines that a process different from the proposed alternative seismic approach is warranted for seismic risk consideration under 10 CFR 50.69, then it would seek prior NRC approval for use of such an approach. The NRC staff notes that seeking prior NRC approval for use of a process different from the proposed alternative seismic approach and the previously approved SMA is consistent with the license condition proposed by the licensee in section 2.2. of its supplement [3], as modified by the NRC staff. The licensee further stated that after receiving NRC approval, it would follow its categorization review and adjustment process procedures and would update, as appropriate, the SSC categorization in accordance with 10 CFR 50.69(e).

Based on its review, the NRC staff finds that the licensee's configuration control program includes consideration of seismic issues, failure modes (such as interaction between components), and reviews of seismic loading and seismic dynamic qualification. Further, the licensee's performance monitoring program assesses changes that impact the categorization results and provides the IDP with an opportunity to recommend categorization and treatment adjustments because of such changes. Therefore, the NRC staff finds that the licensee's performance monitoring and configuration control process addresses plant-specific seismic evaluations, thereby ensuring that the corresponding impacts on SSC categorization would continue to remain valid and, if necessary, would be presented to the IDP for consideration of categorization changes.

During its review, the NRC staff noted that the licensee's performance monitoring program for 10 CFR 50.69 has the capability to identify significant changes to the plant risk profile and instances in which a RISC–3 or RISC–4 SSC may fail to perform a safety significant function, resulting in an immediate evaluation and review for such instances. Based on its review, the NRC staff finds that the proposed alternative seismic approach meets the requirements in 10 CFR 50.69(e).

3.6 <u>Conclusion for Proposed Alternative Seismic Approach</u>

Based on its review, the NRC staff concludes that the licensee's proposed alternative seismic approach described in the licensee's supplements [3] [4] is acceptable for considering seismic risk in the licensee's categorization process under 10 CFR 50.69.

3.7 Proposed Changes to License Conditions

In its supplement [3], the licensee proposed a license condition that would allow the use of either the SMA or the alternative seismic approach proposed in that supplement as part of its categorization process. In another supplement [4], the licensee stated that only one of the two methods would be used to categorize an entire system. Based on its review, the NRC staff finds that the proposed license condition, as modified by the staff, described in section 1.3 of this safety evaluation is acceptable for the use of the alternative seismic approach because the approach described in the licensee's supplements [3] [4] is acceptable for this application, as described in sections 3.1 through 3.6 of this safety evaluation. Accordingly, the NRC staff approves the licensee's proposed license condition.

The licensee also proposed to delete the current paragraph in the license conditions specific to the implementation items that states, in part, "Exelon will complete the implementation items . . . prior to implementation of the 10 CFR 50.69 categorization process." In its submittal [1], the licensee stated under oath and affirmation that it completed the implementation items required by the license conditions prior to the implementation of the 10 CFR 50.69 categorization

process, which began in October 2018. Therefore, the NRC staff has reasonable assurance that the licensee completed the license conditions and finds that the proposed deletion is acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the NRC staff notified the Commonwealth of Pennsylvania official on March 30, 2023 [31], of the proposed issuance of the amendments. The Commonwealth official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to installation or use of facility components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve NSHC, and there has been no public comment on such finding published in the *Federal Register* [17] [18] [19]. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 <u>CONCLUSION</u>

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

7.0 <u>REFERENCES</u>

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CEG	Constellation Energy Generation, LLC
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FPRA	fire probabilistic risk assessment
HSS	high safety-significant (or high safety significance)
IDP	integrated decision-making panel
IEPRA	internal events probabilistic risk assessment
LAR	license amendment request
LOCA	loss-of-coolant accident
LOOP	loss of offsite power

8.0 ABBREVIATIONS

LSS	low safety-significant (or low safety significance)
NEI	Nuclear Energy Institute
NRC	U.S. Nuclear Regulatory Commission
NSHC	no significant hazards consideration
NTTF	near term task force
PRA	probabilistic risk assessment
RISC	risk-informed safety class
SCD	system categorization document
SMA	seismic margin analysis
SoC	statement of considerations
SPRA	seismic probabilistic risk assessment
SSC	structure, system, and component

9.0 PRINCIPAL CONTRIBUTORS

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