ENCLOSURE 1

DESCRIPTION AND ASSESSMENT OF THE PROPOSED CHANGE

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1.0 SUMMARY DESCRIPTION

Ameren Missouri (Union Electric Company) proposes to amend Operating License NPF-30 for Callaway Plant Unit 1 (Callaway). The proposed amendment would revise the Technical Specifications (TSs), the TS Bases, and the Final Safety Analysis Report (FSAR) to reflect the results of an updated criticality safety analysis (CSA) for the storage of spent fuel. The updated CSA (1) revises the current CSA based on the latest methodologies consistent with current NRC guidance and acceptance criteria, (2) simplifies the storage configuration by establishing two regions within the spent fuel racks (SFRs) located within the spent fuel pool (SFP), and (3) provides an evaluation that encompasses a future fuel design. The scope of this change does not include the new fuel storage facility.

The updated CSA provides a complete, up-to-date criticality safety evaluation for the Callaway SFP based on the methodology described in NEI 12-16, "Guidance for Performing Criticality Analyses of Fuel storage at Light Water Reactor Power Plants," Revision 4 (Reference 2), which is compliant with Regulatory Guide (RG) 1.240, "Fresh and Spent Fuel Pool Criticality Analyses," Revision 0 (Reference 1), and acceptance criteria defined in 10 CFR 50.68, "Criticality accident requirements" (Reference 6).

The simplified storage configuration within the SFRs involves designation of two storage regions vice three regions specified in the current TSs. The two-region storage model is summarized below and shown in Figure 1 in Section 3.3.3 below. Refer to Attachment 6 for figures depicting the storage configuration, along with details and limitations associated with this summary description.

- Region 1 will have a 2x2 checkerboard pattern that can accommodate two fuel assemblies and two empty storage cells in which fuel assemblies do not reside in a side-by-side configuration.
- Region 2 will have a uniform loading pattern where all available SFR cells are available for the storage of spent fuel assemblies provided certain limitations are met.

Regarding this updated CSA's applicability to a future fuel design, this license amendment request is required to support use of Framatome GAIA fuel being procured under the Vendor Qualification Program (VQP). A separate license amendment request to support Callaway's use of Framatome's GAIA fuel is under development.

The CSA description, results of the CSA, and the description of how the CSA conforms to methodologies consistent with the current NRC guidance and acceptance criteria are presented in Attachment 6 to this enclosure. Attachment 6 contains proprietary information, and Ameren Missouri requests that it be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390. Attachment 5 presents the public (non-proprietary) version of Attachment 6. Attachment 4 contains the affidavit provided by HOLTEC International (HI) that sets forth the basis on which the proprietary information in Attachment 6 may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in 10 CFR 2.390(b)(4).

As a result of the updated CSA, changes are requested to the following Technical Specifications (TSs): TS 3.7.16, "Fuel Storage Pool Boron Concentration"; TS 3.7.17, "Spent Fuel Assembly Storage"; including Figure 3.7.17-1, "Minimum Required Fuel Assembly Burnup as a Function of Initial Enrichment to Permit Storage in Regions 2 and 3"; and TS 4.3.1, "Criticality." A marked-up version of the current TSs depicting the proposed changes is provided Attachment 1. A clean, re-typed version of the proposed TS changes is provided in Attachment 2.

The proposed changes to the TS Bases are depicted in Attachment 3 and are provided for information only. The TS Bases will be updated following approval of the requested license amendment in accordance with TS 5.5.14, "Technical Specification (TS) Bases Control Program."

The Final Safety Analysis Report (FSAR) will be updated to reflect the updated CSA in accordance with 10 CFR 50.59 and 10 CFR 50.71 following NRC approval of the requested license amendment.

As introduced above, this license amendment request is required to support use of Framatome GAIA fuel being procured under the VQP. A separate license amendment request to support Callaway's use of Framatome's GAIA fuel is under development. That amendment is needed prior to operating cycle 27 (beginning around October 2023) to support the use of fuel assemblies acquired under the VQP in the core. Unlike the four GAIA lead fuel assemblies inserted into the core during operating cycle 25, the four VQP assemblies to be used in operating cycle 27 will likely have enrichment values above the limits that would allow their placement in the spent fuel storage racks while complying with the requirements of TS 4.3.1.1. Specifically, GAIA fuel contains gadolinia as a burnable absorber which does not conform to the integral fuel burnable absorbers (IFBAs) referenced in the TS and included in the current CSA. Based on these considerations, the license amendment requested per this LAR is needed by June 23, 2023 in order to support receipt and storage of the four GAIA VQP fuel assemblies prior to use in operating cycle 27.

The subject of this license amendment request was presented to the NRC staff during a pre-submittal telephone call held on June 29, 2022 (References 9 and 17). Feedback, recommendations and discussion points from that discussion are reflected in this LAR.

2.0 DETAILED DESCRIPTION

Ameren Missouri proposes to amend Operating License NPF-30 by incorporating the following changes to the Technical Specifications for Callaway Plant Unit 1. The proposed TS changes are consistent with the format, level of detail, and structure of NUREG-1431, Standard Technical Specifications Westinghouse Plants, Volume 1 Specifications, Revision 5.0 (Reference 16).

TS 3.7.16, "Fuel Storage Pool Boron Concentration"

The CSA will establish a two-region storage configuration within the SFRs, which will be discussed in detail in the TS 4.3.1 change discussion. To support the criticality analyses performed for this two-region storage model, the revised CSA takes credit for soluble boron under normal conditions within Region 2 as described in Section 3.3.7.3 of Attachment 6. Because soluble boron is to be credited in the analyses, a minimum soluble boron concentration will be required whenever fuel assemblies are stored in the spent fuel storage pool. Thus, the Applicability for TS 3.7.16 is being revised to remove wording that makes the LCO non-applicable when an administrative verification has been performed for ensuring that all assemblies are properly located in their designated locations (i.e., by removing wording that makes the LCO applicable when "a fuel storage pool verification has not been performed since the last movement of fuel assemblies in the fuel storage pool"). The change to the Applicability is depicted below:

APPLICABILITY: When fuel assemblies are stored in the fuel storage pool~~ and a fuel storage pool verification has not been performed since the last movement of fuel assemblies in the fuel storage pool~~.

Because of the Applicability change, Required Action A.2.2 is no longer germane to compliance with the LCO and no longer serves to either establish compliance with the LCO or remove the unit from the Applicability consistent with the LCO 3.0 rules of usage for the TS. Thus, the Required Actions for Condition A are modified as depicted below:

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Fuel storage pool boron concentration not within limit.	--------------------NOTE------------------ LCO 3.0.3 is not applicable ---	
	A.1 Suspend movement of fuel assemblies in the fuel storage pool.	Immediately
	<u>AND</u>	
	A.2~~.1~~ Initiate action to restore fuel storage pool boron concentration to within limit.	Immediately
	~~<u>OR</u>~~	
	~~A.2.2 Verify by administrative means that a non-Region 1 fuel storage pool verification has been performed since the last movement of fuel assemblies in the fuel storage pool.~~	~~Immediately~~

The proposed changes to the TS Bases for TS 3.7.16 are depicted in Attachment 3 and are provided for information only. The TS Bases will be updated following approval and issuance of the requested license amendment, in accordance with TS 5.5.14, "Technical Specification (TS) Bases Control Program."

TS 3.7.17, "Spent Fuel Assembly Storage"

As a consequence of the adoption of a two-region storage model (described later in regard to the changes proposed for TS 4.3.1, "Criticality") conforming changes to TS 3.7.17 are necessary. As shown below, the changes proposed for TS 3.7.17 would remove reference to a third region (i.e., Region 3) in the SFP and would remove the wording "or in accordance with Specification 4.3.1.1." The wording "or in accordance with Specification 4.3.1.1" refers to an allowance in TS 4.3.1.1.e which is being deleted. The two-region storage model is described in Attachment 6.

LCO 3.7.17 The combination of initial enrichment and burnup of each spent fuel assembly stored in Region 2 ~~or 3~~ shall be within the Acceptable Domain of Figure 3.7.17-1~~ or in accordance with Specification 4.3.1.1~~.

The Actions for TS 3.7.17 are unchanged. A conforming change is required to the Surveillance description and the Frequency for SR 3.7.17.1 as depicted below.

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.17.1	Verify by administrative means the initial enrichment and burnup of the fuel assembly is in accordance with Figure 3.7.17-1~~ or Specification 4.3.1.1~~.	Prior to storing the fuel assembly in Region 2~~ or 3~~

Current TS Figure 3.7.17-1, "Minimum Required Fuel Assembly Burnup as a Function of Initial Enrichment to Permit Storage in Regions 2 and 3," is revised as shown in Attachment 2. An illustrative figure is provided in Section 3.3.3, below, as Figure 2. Because Region 3 is being eliminated, the title of Figure 3.7.17-1 is revised to "Minimum Required Fuel Assembly Burnup as a Function of Initial Enrichment to Permit Storage in Region 2." The revised figure continues to define the spent fuel assembly storage location requirements as a function of Fuel Assembly Cumulative Exposure (in GWd/mtU) versus Fuel Assembly Initial Enrichment (in wt% U-235). The revised figure defines the required fuel assembly cumulative burnup as a function of initial enrichment and cooling time (i.e., decay time following removal from the core). There are five curves differentiating the Acceptable Domain from the Unacceptable Domain for storage in Region 2. The curves are based on analyses performed with fuel assembly cooling times ranging from zero years (i.e., freshly discharged fuel) to twenty years.

The proposed changes to the TS Bases for TS 3.7.17 are depicted in Attachment 3 and are provided for information only. The TS Bases will be updated following approval of this requested license amendment in accordance with TS 5.5.14, "Technical Specification (TS) Bases Control Program."

TS 4.3.1, "Criticality"

As discussed in Attachment 6, the revised CSA allows storage of fuel assemblies within two regions. Region 1 will utilize a checkerboard loading pattern and is designed to accommodate new fuel assemblies with up to a maximum nominal enrichment of 5.0 weight percent (wt%) U-235 with no credit for burnable absorbers. Region 1 will also be used to store fuel assemblies with up to a maximum nominal enrichment of 5 wt% U-235 with no credit for burnable absorbers that do not have sufficient burnup to allow placement in Region 2. Spent fuel storage is designated for Region 2. Region 2 is designed to accommodate fuel assemblies of up to 5.0 wt% U-235 initial enrichments and which have accumulated minimum burnups within the acceptable domain according to revised TS Figure 3.7.17-1 (provided in Attachments 2 and 3). An illustrative figure is provided in Section 3.3.3, below, as Figure 2.

Inherent in the above discussion is the adoption of analysis methodologies consistent with those described in References 1 and 2 and use of the acceptance criteria given in 10 CFR 50.58(b)(4) as detailed in Attachment 6.

As a result of the adoption of a two-region configuration and change in the CSA assumptions, the following changes are proposed for TS 4.3.1.1:

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies having a maximum nominal U-235 enrichment of 5.0 weight percent;~~ For fuel with enrichments greater than 4.6 nominal weight percent of U-235, the combination of enrichment and integral fuel burnable absorbers shall be sufficient so that the requirements of 4.3.1.1.b are met.~~

b. k_{eff} ~~≤ 0.95~~ < 1.0 if fully flooded with unborated water and $k_{eff} \leq 0.95$ if flooded with borated water, which includes an allowance for uncertainties as described in Section 9.1 of the FSAR;

c. A nominal 8.99 inch center to center distance between fuel assemblies placed in the fuel storage racks;

d. Partially spent fuel assemblies with a discharge burnup in the "Acceptable ~~Burnup~~ Domain" for Region 2 ~~and 3~~ storage~~"~~ of Figure 3.7.17-1 may be allowed unrestricted storage in the fuel storage racks, except for the empty cells in the checkerboarding configuration (Region 1);

e. Deleted ~~Partially spent fuel assemblies with a discharge burnup in the "Acceptable Burnup Domain for Region 3 Storage" of Figure 3.7.17-1 may be allowed unrestricted storage, except for the empty cells in the checkerboarding configuration, and except in Region 2 locations in a Mixed Zone Three Region configuration in the fuel storage racks; and~~

f. New or partially spent fuel assemblies with a discharging burnup in the "Unacceptable ~~Burnup~~ Domain" for Region 2 ~~or 3~~ Storage~~"~~ of Figure 3.7.17-1 will be stored in Region 1.

Since this change does not involve the storage of fuel assemblies in the new fuel storage racks, no changes are proposed to TS 4.3.1.2.

3.0 TECHNICAL EVALUATION

3.1 Background and SFP Description

As described in Reference 10, a spent fuel storage facility (SFSF) is located within the Callaway fuel building and provides onsite storage for spent fuel elements. Spent fuel storage racks (SFRs) are located in the fuel storage pool, which is constructed of reinforced concrete with a stainless steel lining and is an integral part of the fuel building. The fuel storage pool consists of the spent fuel pool and the cask loading pool. The fuel storage pool provides a cooling and shielding medium for the spent fuel. The facility provides protection for spent fuel assemblies under conditions such as tornadoes, earthquakes, and flooding and provides an efficient method for safe and reliable fuel handling operations within the fuel storage pool. The SFSF is safety related and is required to ensure a subcritical array during all normal, abnormal, and accident conditions.

The spent fuel pool has a normal water volume of approximately 55,260 cubic feet (413,400 gallons). Borated water is used for filling the spent fuel pool. FSAR[1] Figures 1.2-20 through 1.2-22 depict the

[1] Callaway's FSAR contains two sets of volumes. The FSAR Standard Plant (SP) set describes the Westinghouse Standard Nuclear Unit Power Plant (SNUPPs) design and the FSAR Site Addendum (SA) describes site-specific features not addressed in the SP volumes. All references in this document are to the FSAR SP volumes.

storage facility. FSAR Figure 9.1-2 sheets 1 through 3 depict the fuel storage rack configuration. FSAR Table 9.1-2 provides the design data for the fuel storage pool.

When Callaway received its low power operating license in June 1984, the spent fuel pool was authorized to store no more than 1344 fuel assemblies located in 12 spent fuel storage racks in the spent fuel pool. With NRC approval of the Callaway fuel storage pool rerack amendment in 1999 (Reference 11), and with the completion of the rerack modification to the spent fuel pool, Callaway's expanded total fuel storage space was increased to a capability to store 2642 fuel assemblies. The modification replaced the original 12 fuel storage racks with 15 high density storage racks in the spent fuel pool and created an additional capability to add three high density storage racks within the cask loading pool at a future time. The three high density racks within the cask loading pool would be capable of storing 279 fuel assemblies. These racks within the cask loading pool are currently not installed.

The rack modules are designed as cellular structures such that each fuel assembly has a square opening with conforming lateral support and a flat horizontal bearing surface. The design maximizes structural integrity while minimizing inertial mass. Each rack module is supported by four legs which are remotely adjustable. Therefore, the racks can be made vertical, and the top of the racks can easily be made co-planar with each other. The composite box subassembly, baseplate, and support legs constitute the principal components of the rack module.

The rack modules are free-standing and self-supporting. They are primarily made from Type 304L austenitic stainless steel in a prismatic array. They are separated by a gap of approximately 1.5 inches from one another. Along the pool walls, a nominal gap is provided which varies for each wall. The racks contain BORAL[2] as an active neutron absorber. The BORAL provides fixed neutron absorption for primary reactivity control. The BORAL absorbers in the racks have been sized to sufficiently shadow the active fuel height of all fuel assembly designs stored in the pool.

The fifteen high-density storage installed racks in the spent fuel pool are of a common design, thus allowing a uniform application of the CSA evaluation results. While unused, the three additional high-density storage racks for use within the cask loading pool are also of the same design.

The Safety Design Bases for the SFSF, as described in FSAR Section 9.1.2.1.1, are provided below. Note that this license amendment request is seeking approval for a CSA that changes Safety Design Basis Four as depicted below.

> SAFETY DESIGN BASIS ONE - The SFSF is capable of withstanding the effects of natural phenomena, such as earthquakes, tornadoes, floods, and external missiles (GDC-2).

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[2] BORAL is a registered trademark.

SAFETY DESIGN BASIS TWO - The SFSF is designed to maintain structural integrity after an SSE to perform its intended function following a postulated hazard, such as fire, internal missiles, or pipe break. The SFSF uses the design and fabrication codes commensurate with Category I structures and the seismic category assigned by Regulatory Guide 1.29 (GDC-3 and 4).

SAFETY DESIGN BASIS THREE - Components of this system are not shared with other units (GDC-5).

SAFETY DESIGN BASIS FOUR - The fuel storage pool is designed to maintain fuel assemblies in a subcritical array with $k_{eff} < 1.0$ for the pool flooded with unborated water and $k_{eff} \leq 0.95$ for the pool flooded with borated water, all for 95% probability at a 95% confidence level, when fuel assemblies are inserted into prescribed locations (GDC-62 and 10 CFR 50.68(b)(4)).

SAFETY DESIGN BASIS FIVE - The fuel handling area and equipment are designed to prevent a drop of an unacceptable object into the fuel storage pool. The SFSF is designed to prevent the loss of cooling water within the pool that could uncover the stored fuel or prevent cooling capability. A redundant seismic Category I emergency makeup water supply is provided. The fuel building is a controlled air leakage facility.

SAFETY DESIGN BASIS SIX - The spent fuel storage racks are designed for the following loads and combinations thereof:

a. Dead loads
b. Live loads (fuel assemblies)
c. Crane uplift load (the spent fuel pool bridge crane - 2 tons)
d. Safe shutdown earthquake loads
e. Operational basis earthquake loads
f. Thermal loads
g. Fuel assembly drop load

SAFETY DESIGN BASIS SEVEN - The SFSF is designed to meet the requirements of 10 CFR 73.55 and 10 CFR 73.60, which require physical protection of special nuclear material while in storage.

SAFETY DESIGN BASIS EIGHT - The spent fuel racks are constructed so as to preclude insertion of spent fuel assemblies into other than prescribed storage locations. If a fuel assembly is accidentally lowered or dropped onto the top of the racks or into the annular space between the spent fuel racks and the pool wall, subcriticality is maintained in all cases with a shutdown margin of at least 0.05 ($k_{eff} \leq 0.95$).

SAFETY DESIGN BASIS NINE - The SFSF is monitored for evidence of criticality in compliance with GDC-63 and 10 CFR 70.24.

SAFETY DESIGN BASIS TEN - The capability to inspect the SFSF is provided (GDC-61).

The SFP and SFR details are presented in FSAR Sections 9.1.2, "Spent Fuel Storage," and Appendix 9.1A, "Fuel Storage Pool Rack Analysis." Following approval of the requested license amendment, these FSAR sections will be updated to reflect the results of the new CSA.

3.2 Description of the Current License Requirements

Callaway's Technical Specifications, supported by the TS Bases and the FSAR, reflect standards used to develop the current license basis (CLB) requirements. These standards correlate to those accepted by the NRC before 1999 as described in Reference 11. The essential licensing requirement is that the SFP design maintains fuel assemblies in a subcritical array with $k_{eff} \leq 0.95$ when fuel assemblies are inserted into prescribed locations, consistent with GDC-62 and staff guidance in effect at that time. The CLB criticality analysis (including the associated assumptions and input parameters) given in FSAR Appendix 9.1A shows that the spacing between fuel assemblies in the storage racks is sufficient to maintain the array, when fully loaded and flooded with nonborated water, in a subcritical condition, i.e., k_{eff} of less than or equal to 0.95. This is based upon fuel with a maximum nominal enrichment of 5.0 wt% U-235.

To allow the storage of fresh fuel and fuel assemblies not meeting burnup assumptions, a Mixed Zone Three Region (MZTR) storage configuration was developed. Using the MZTR configuration, fuel storage configuration patterns are established under administrative controls to define storage areas specifically designated for low burnup fuel, including fresh (unburned) fuel. Cells reserved for storage of fresh fuel with a maximum nominal enrichment of 4.6 wt% U-235, and spent fuel without any burnup limitations, is designated as Region 1. Region 2 and 3 cells may accommodate fuel assemblies with up to 5 wt% U-235 initial enrichment that have accumulated the minimum burnup requirements given in TS Figure 3.7.17-1. Additional description of the MZTR storage configurations is described in Reference 13. As an alternative to MZTR storage, Region 1 fuel storage may be accomplished in a checkerboard pattern without any enrichment or burnup restrictions.

In the MZTR configuration, Region 1 cells are only located along the outside periphery of the rack modules and must be separated by one or more Region 2 storage cells. Region 1 storage cells may be located directly across from one another when separated by a water gap. The outer rows of alternating Region 1 and 2 storage cells must be further separated from the internal Region 3 storage cells by one or more Region 2 cells. In the checkerboard configuration, assemblies are placed in an alternating checkerboard-style pattern with empty cells (i.e., assemblies are surrounded on all four sides by empty cells except at the checkerboard boundary).

The fuel storage rack configuration does not preclude the accidental lowering or dropping of a fuel assembly across the top of the racks or into the space between the racks and the pool wall. For these occurrences, the current CSA (also referred to as the analysis of record or AOR) takes credit for the presence of soluble boron in the pool water because the analysis is not required to assume two unlikely, independent, concurrent events in order to ensure protection against a criticality accident (double contingency principle) as described in Reference 12. The analysis shows that the reduction in k_{eff} caused by the soluble boron more than offsets the reactivity addition caused by credible accidents. The current CSA confirmed that a SFP fully loaded with fresh fuel in all cells, a very conservative assumption, the TS LCO 3.7.16 LCO required value of 2165 ppm would assure that the limiting k_{eff} of

0.95 is not exceeded. For the revised CSA, a minimum boron concentration of only 550 ppm would be adequate to assure that the limiting k_{eff} of 0.95 is not exceeded. The CSA assumed boron concentration is significantly lower than the TS 3.7.16 LCO required value of 2165 ppm resulting in significant conservatism.

These CSA assumptions and limits are the basis for the current requirements given in TS 3.7.16, TS 3.7.17, Figure 3.7.17-1, and TS 4.3.1.1.

3.3 Description of the Proposed Changes

The analysis and results in this section are summarized from the criticality safety evaluation report provided in Attachment 6. That report provides the evaluation that demonstrates compliance with the regulatory requirements of 10 CFR 50 Appendix A, General Design Criteria 62, "Prevention of criticality in fuel storage and handling," (Reference 4) as they relate to the prevention of criticality by physical systems or processes using geometrically safe configurations, and 10 CFR 50.68, "Criticality accident requirements," (Reference 6) as they relate to preventing a criticality accident and to mitigating the radiological consequences of a criticality accident. The evaluation documented in Attachment 6 was developed using the guidance of NEI 12-16, "Guidance for Performing Criticality Analyses of Fuel storage at Light Water Reactor Power Plants," Revision 4, (Reference 2) as endorsed by Regulatory Guide (RG) 1.240, "Fresh and Spent Fuel Pool Criticality Analyses," Revision 0 (Reference 1) consistent with the clarification and exceptions contained therein.

The following sections discuss the changes associated with the updated CSA, the rationale for those changes, and the basis for their acceptability.

3.3.1 *Alignment with current standards and guidance*

While many aspects of the current CSA approved by the NRC in January 1999 align with current methods and guidance given in References 1 and 2, other aspects do not, and these differences have created unnecessary confusion when discussing requirements with inspectors and industry peers, have imposed cumbersome limitations on the storage of fuel assemblies in the SFP, and would preclude storage of Framatome GAIA assemblies acquired under the VQP. Thus, Callaway contracted HOLTEC International to develop an updated CSA that uses current computer codes, is compliant with currently accepted assumptions, meets current industry guidance (Reference 2) and adopts the acceptance criteria given in 10 CFR 50.68(b)(4). The description of the computer codes, their limitations, assumptions, and compliance with acceptance criteria is provided in Attachment 6.

3.3.2 *Removal of restrictions tied to integral fuel burnable absorbers*

As described in FSAR Section 9.1.2, the current CSA used assumptions regarding the presence of integral fuel burnable absorbers (IFBAs) to define acceptable and unacceptable regions for storage of fuel assemblies including storage of any fuel assembly with an enrichment greater than 4.6 wt% U-235. This was a valid criterion when applied to the current and legacy Westinghouse fuel used at Callaway; however, it will not be valid for the storage of Framatome GAIA fuel acquired under the VQP in the future. The fuel design under adoption at Callaway, Framatome's GAIA fuel, contains the burnable absorber gadolinia uniformly dispersed within the fuel, which is not in a form consistent with current analyses. Therefore, credit cannot be given to its presence, resulting in the inability to place

GAIA fuel (with a greater than 4.6 wt% U-235 enrichment) in the spent fuel storage racks. For this reason, the updated CSA in Attachment 6 and the proposed revisions to TS 3.7.17 and TS 4.3.1.1 remove the storage limitations tied to IFBA presence. The updated CSA demonstrates the acceptability of placing both the current and the future fuel vendors' assemblies with enrichments up to 5 wt% U-235 within the designated Region 1 SFRs. This proposed change is driven by multiple factors including simplification of the CSA model and computations, simplification of storage patterns within the SFP, elimination of the potential personnel error mode associated with determining the storage region, and the ability to store future Framatome GAIA fuel assemblies in the SFP.

3.3.3 *Adoption of a two-region storage model*

This proposed amendment simplifies the three-region MZTR model by changing it to a two-region model as described below and depicted in Figure 1.

- Region 1 – A 2x2 checkerboard pattern with two fresh fuel assemblies and two empty storage cells. For this application, the term "fresh fuel assembly" also includes assemblies not meeting the criteria for storage in Region 2.
- Region 2 – A uniform loading of spent fuel assemblies in all available loading cells. For this application, the term "spent fuel assembly" includes assemblies meeting the criteria for storage in Region 2.

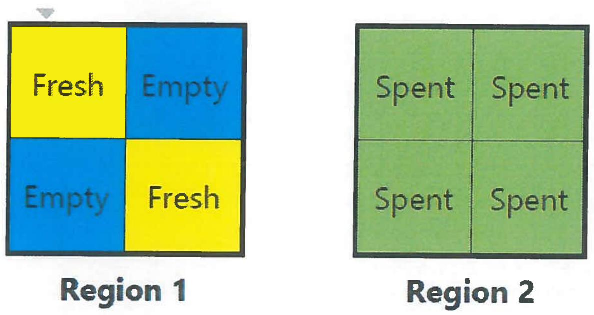

Figure 1 – Permissible Loading Configurations

The existing three-region burnup curve, i.e., TS Figure 3.7.17-1, is being revised to define the criteria for the two-region storage configuration. The new TS figure continues to define the spent fuel assembly storage location requirements as a function of Fuel Assembly Cumulative Exposure (in GWd/mtU) versus Fuel Assembly Initial Enrichment (in wt% U-235). Additionally, the new figure specifies the acceptable domain for storage in Region 2 as a function of fuel assembly cooling time. There are five curves differentiating the Acceptable Domain from the Unacceptable Domain for storage in Region 2. The curves are based on analyses performed with fuel assembly cooling times ranging from zero years (freshly discharged fuel) to twenty years as described in sections 3.3.6.2 and 7.6.2 of Attachment 6. There are no changes proposed that pertain to the new fuel storage area. An example of new TS Figure 3.7.17-1 is shown in Figure 2.

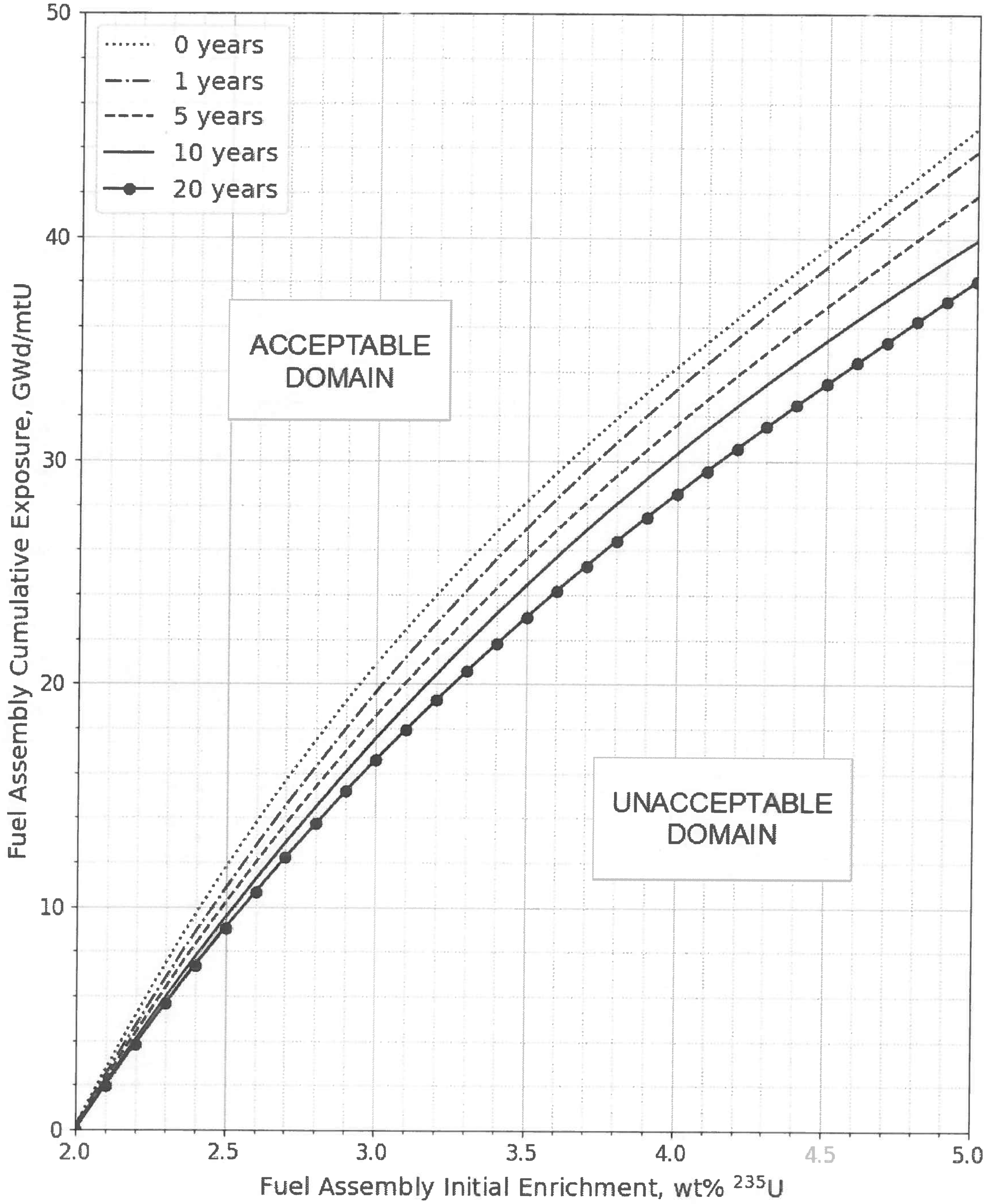

Figure 2 –Example of Proposed TS Figure 3.7.17-1

The proposed burnup curves apply to all fuel currently in the SFP, as well as the anticipated future fuel design. As discussed in Section 5.1.2 of NEI 12-16, each of the legacy fuel types, along with the future GAIA fuel assemblies were evaluated.

An additional constraint of the current CSA involves assumptions around the depletion parameters that are specific to the incumbent fuel. The Framatome GAIA fuel is not necessarily bounded in its operation and design compared to the incumbent fuel. The revised CSA addresses these fuel-specific characteristics. For example, Section 7.6.4 of Attachment 6 discusses the reactivity effects of the axial burnup profiles, the basis for assumptions (References 14 and 15), and the results of the calculations for the limiting fuel assembly in determining the limiting conditions for fuel assembly storage in Region 2.

3.3.4 *BORAL areal density uncertainty*

The updated CSA has accounted for the uncertainty in the nominal BORAL panel areal density as discussed in Section 3.7.2 of Attachment 6. The analysis demonstrated that available margins from other negative reactivity sources can be utilized to offset up to a 20% reduction in the minimum areal density while still not violating regulatory safety requirements. Table 7-24 of Attachment 6 presents the analysis results for postulated BORAL areal density reduction. FSAR Section 19.1.38, "Monitoring of Neutron Absorbing Materials Other Than Boraflex," defines the aging management program requirements to assure that aging of the BORAL neutron-absorbing material used in the spent fuel storage racks does not invalidate the criticality analysis of the spent fuel pool. This is a new aging management program (established in connection with renewal of the Callaway operating license) that is required to be implemented prior to the period of extended operation set to begin at midnight October 18, 2024.

3.4 <u>Fuel Storage Criticality Safety Analysis – General</u>

For each normal operational and postulated accident scenario in the SFP, the criticality safety evaluation conservatively assumes that each fuel assembly is of a design that maximizes fuel reactivity. The limiting design is a bounding composite of current and historical fuel designs that is analyzed to be bounding for the future GAIA fuel design. The analyses assume bounding conservative depletion conditions for depleted fuel and account for biases and uncertainties as described in the criticality safety evaluation. Analyses also addressed the reactivity effect associated with varying B_4C particle size, with the results presented in Table 7-26 of Attachment 6.

As discussed in Section 3.3.6.3 of Attachment 6, fuel assemblies stored in the SFP may contain various forms of control components/materials used during operation and subject to in-core depletion. These include Pyrex, wet annular burnable absorber (WABA), and rod cluster control assemblies (RCCAs), hereafter referred to as fuel inserts. All of these components/materials are inserted into the guide tubes of the fuel assembly during operation. Additionally, fuel assemblies can contain IFBAs, consisting of neutron absorbing material mixed into the fuel pellet (Gadolinia) or added as a coating on the fuel pellet (ZrB_2). The penalties for these different burnable poisons were accounted for in the CSA. Callaway has not used flux suppression rods such as those used in some reactors to reduce the neutron leakage to the reactor vessel belt-line welds, nor has it used grey rods for flux peaking suppression.

The administrative process for verifying proper fuel assembly loading using the new burnup curves will be similar to the process used for the present burnup curves. The fuel assembly discharge data, i.e., cooling time, is readily available and is not technically challenging to account for. Also, the operational response to a fuel assembly misloading event remains the same. There are no changes regarding how fuel assemblies are handled and moved, nor are there any changes in how they are inserted into or removed from their SFP storage locations. The administrative means used to ensure that fuel assemblies are not dropped or misloaded remains unchanged too. There are no changes to how rod cluster control assemblies (RCCAs) are handled and moved, nor are there any changes in how they are inserted into or removed from a fuel assembly. There are no changes in how personnel verify fuel assembly storage in the SFP. The proposed license amendment does not result in any equipment modifications to the plant or any changes regarding how equipment is operated and maintained.

Throughout the updated CSA, similar to the current CSA, the double contingency principle is applied. Under this principle, two unlikely independent and concurrent incidents or postulated accidents are beyond the scope of the required analysis. This principle precludes the necessity of considering the simultaneous occurrence of multiple accident conditions (consistent with Reference 2).

3.5 Spent Fuel Pool Criticality Safety Analysis – Normal Storage Conditions

As summarized in Section 8.0 of Attachment 6, results of the SFP CSA show that the proposed Region 2 SFP storage configuration will maintain $k_{eff} < 1.0$ with 0 ppm of soluble boron in the SFP water, and $k_{eff} \leq 0.95$ with the SFP filled with 550 ppm soluble boron for normal fuel assembly storage conditions (including biases and uncertainties). The proposed Region 1 storage configuration will maintain $k_{eff} \leq 0.95$ with 0 ppm soluble boron.

Fresh fuel with nominal enrichments ≤ 5.0 wt% U-235 are stored in Region 1.

Region 2 locations are analyzed to accommodate fuel assemblies of various initial fuel enrichments and which have accumulated a combination of minimum cumulative depletion (e.g., burnup) and cooling times following discharge from the core within the acceptable domain according to the updated Figure 3.7.17-1 in LCO 3.7.17. Fuel assemblies not meeting the accumulated minimum burnups and associated cooling times shall be stored in Region 1.

As discussed in Section 3.4.1, 3.4.2 and 3.4.3 of Attachment 6, the interface and boundary conditions associated with Regions 1 and 2, including those within the same SFR, were evaluated and determined to be acceptable. The different configuration combinations are depicted in Figure 3-5 in Attachment 6.

The updated CSA will establish a two-region storage configuration within the SFRs. To support the criticality analyses performed for this two-region storage model, the revised CSA takes credit for soluble boron under normal conditions within Region 2, as described in Section 3.3.7.3 of Attachment 6. Because soluble boron is now credited in the analyses, a minimum soluble boron concentration will be required whenever fuel assemblies are stored in the spent fuel storage pool. This assumed boron concentration is well within the TS LCO 3.7.16 requirement for a minimum SFP soluble boron concentration of 2165 ppm. However, the Applicability for TS 3.7.16 is being revised to remove the wording that makes the LCO non-applicable when an administrative verification has been performed for ensuring that all assemblies are properly located in their designated location (i.e., by removing the provision that makes LCO 3.7.16 applicable if "a fuel storage pool verification has not been performed since the last movement of fuel assemblies in the fuel storage pool"). The removal of this conditional Applicability simplifies compliance with the LCO by removing an administrative tracking requirement versus just performing sampling of the boron concentration on a regular frequency. The process of controlling and measuring boron concentration and responding accordingly in the event the concentration is found to be below the required minimum will remain the same.

The updated CSA also evaluated the operational evolutions that may occur with a fuel assembly. As discussed in Section 3.5 of Attachment 6, these evolutions include normal fuel movement, fuel insertion and removal, storage of fuel assemblies with missing pins, storage of the fuel rod storage rack, storage of low-burned fuel assemblies, and fuel reconstitution.

As described in FSAR Section 9.1.2.2, the damaged fuel storage basket, also referred to as the fuel rod storage rack (FRSR), is used to collect and store individual fuel rods extracted from other fuel assemblies. Section 3.5.3 of Attachment 6 provides an analysis of the maximum reactivity effect associated with the FRSR. The analysis concluded that the reactivity effect of the FRSR is substantially lower that the bounding reactivity configurations in the surrounding regions. As a result, the FRSR may be conservatively placed in any cell designated to hold a fuel assembly in either Region 1 or 2.

3.6 Spent Fuel Pool Criticality Safety Evaluation – Accident Conditions

As summarized in Section 7.10 of Attachment 6, the SFP criticality safety evaluation analyzed multiple events and ensured that the following postulated accident conditions provide a bounding analysis:

- misloaded fuel assembly
- incorrect loading curve
- boron dilution event

3.6.1 *Misloaded Fuel Assembly*

Given that it is physically possible to mistakenly place a fuel assembly that is not qualified for a given loading region in that region, the CSA has evaluated this condition to determine that regulatory limits are still met. As a bounding approach, the misload of a single fresh fuel assembly of the highest permissible enrichment (5.0 wt% U-235) into a storage cell that provides the largest positive reactivity increase is considered. The following cases are evaluated:

- Misloading into an empty storage cell in Region 1, and
- Misloading into one of the storage cells intended to store a spent fuel assembly in Region 2.

As discussed in Sections 3.6.5 and 7.10.1 of Attachment 6, the misloaded fuel assembly accident evaluations assume an 8x8 array of storage cells. The analyses demonstrate that Region 2 presents the limiting location for a misloaded fuel assembly under the most conservative assumptions and that a minimum soluble boron concentration of 1081.2 ppm is needed, when increased by 50 ppm to account for neglecting certain minor structural components in the analysis, to ensure that the maximum k_{eff} value does not exceed the regulatory limit.

3.6.2 *Incorrect Loading Curve*

While several independent misloaded fuel assemblies are precluded by the double contingency principle, an event involving multiple misloaded assemblies could occur as a result of an incorrect application of the loading curves. As a bounding approach, the spent fuel assemblies with the lowest burnup requirement are assumed to be accidentally loaded into all storage cells qualified for spent fuel in the loading regions with the highest burnup requirement. This scenario involves the hypothetical placement of multiple limiting fuel assemblies intended to be placed in Region 1 into Region 2. As discussed in Section 7.10.2 of Attachment 6, it was determined that a minimum soluble boron concentration of 902.5 ppm is required to ensure that the effective neutron multiplication factor (k_{eff}) of the SFP does not exceed 0.95. The 902.5 ppm value represents the most restrictive boron concentration from the evaluated accident scenarios, i.e., 852.5 ppm plus an additional 50 ppm consistent with Paragraph 5.1.1 of Reference 2. This value is substantially below the TS LCO 3.7.16 value of 2165 ppm, resulting in significant conservatism with respect to the requirements of 10 CFR 50.68(b)(4).

3.6.3 *Boron Dilution*

The proposed change will not alter the LCO 3.7.16 requirement of ≥ 2165 ppm soluble boron concentration. No equipment that could contribute to or mitigate a boron dilution event will be changed as part of this proposed change. Thus, no new avenues for a boron dilution event will be created. There are no proposed changes regarding boron concentration maintenance, including any procedural changes in response to a boron dilution event. Although significant loss or dilution of the soluble boron concentration in the SFP is extremely unlikely, the guidance presented in Reference 2 requires a boron dilution analysis be performed and that it must confirm sufficient time is available to detect and suppress the worst dilution event that can occur to reduce the boron concentration to the level needed to maintain k_{eff} less than or equal to 0.95. The physical limitations and operator response time assumptions are discussed in Section 7.10.3 of Attachment 6.

The criticality safety evaluation performed for Callaway includes an SFP boron dilution analysis that assumes a dilution from 2165 ppm to 550 ppm[3] soluble boron, as described Sections 3.6.8 and 7.10.3 in Attachment 6. The systems that could dilute SFP boron, either by direct connection to the spent fuel pool or by a potential pipe crack/break or heat exchanger tube leak, were analyzed via a constant-volume concentration change methodology. The analysis demonstrates that sufficient time is available, with significant margin, to detect and mitigate a boron dilution event prior to the SFP boron concentration reaching a value of less than or equal to 550 ppm that is assumed under normal operating conditions to satisfy regulatory acceptance criteria.

3.7 <u>Spent Fuel Pool Storage – Other Items</u>

Seismic Response

The criticality safety evaluation includes analysis of the reactivity impact of a postulated seismic event under the proposed storage requirements, and it found that the spent fuel racks would maintain $k_{eff} \leq 0.95$. The evaluation considered fuel assembly and spent fuel rack motion during the event. The worst-case rack movement scenario for the entire SFP is when the water gap width between all SFRs is as low as allowed by the baseplate. This accident condition is bounded by the evaluations of the

[3] includes an additional 50 ppm consistent with Paragraph 5.1.1 of Reference 2

design basis cases discussed in Section 3.3 of Attachment 6, since the design basis models consider all the racks at their closest approach, i.e., a laterally infinite arrangement of 2x2 arrays such that the gap between the racks is neglected. Therefore, no further evaluations are necessary.

As noted previously, the Callaway SFP is currently licensed to store a total of 2642 fuel assemblies per FSAR Section 9.1.2.2 and the TS Bases for LCO 3.7.16. Of these 2642 fuel assemblies, 2363 are located in the SFP and an additional 279 assemblies could be placed in racks located in the cask loading area should those racks be installed. Because Callaway uses the cask loading area for the purpose of loading dry fuel storage casks, the racks have not been installed and no fuel is stored in this area. The proposed change will not change the number of fuel storage locations or fuel assemblies, nor will it physically change any of the spent fuel racks. Thus, the SFP seismic/structural loading requirements for the proposed change are bounded by the existing TS requirements.

Radiological and Thermal Impact
Callaway has considered the impact of the proposed CSA revision on the Callaway licensing basis fuel handling accident dose consequence assessment and the analyzed SFP heat load. The proposed change does not alter the existing limits on enrichment, burnup limits, peaking factors, or gap fractions in the Callaway core. There are no changes proposed to the design and operational properties that affect the source or attenuation of radiation from the spent fuel assemblies stored in the SFP. In addition, there are no changes to the operation of the assembly that would alter the decay heat magnitude of the fuel assemblies. Therefore, there is no impact on the radiological assessment or the SFP heat load.

3.8 Implementation Considerations

Ameren Missouri plans to fully implement the revised TS within 90 days after NRC approval of this proposed license amendment.

3.9 Conclusions

Implementation of the proposed license amendment (if approved) would continue to ensure that the storage of spent fuel assemblies in the Callaway SFP meet established regulatory acceptance criteria and, thus, would continue to ensure the health and safety of the public. The proposed change will make no modifications to plant equipment or how equipment is operated or maintained. There are no changes to how fuel is handled, including how fuel is moved, inserted into, and removed from the SFP storage locations. There are no changes to how RCCAs are handled, including how they are moved, inserted into, and removed from a fuel assembly. There are no changes to the verification process for fuel stored in the SFP. There are no changes to the required response to a fuel misloading or drop event. Also, since the proposed license amendment does not modify plant equipment or its operation and maintenance, including equipment used to maintain SFP soluble boron concentrations, the proposed license amendment will not impact the low likelihood or the analysis and assumptions regarding a boron dilution event or plant, nor would it impact the plant's response to such an event. This change does not involve the new fuel storage facility.

SFP fuel storage requirements will continue to be maintained by administrative means, including the applicable TS requirements (as revised), to ensure compliance with the proposed two-region storage configuration. The consequences of, or plant response to, a fuel misloading event are not changed.

The criticality safety evaluation shows that the SFP will maintain $k_{eff} \leq 0.95$ under normal and postulated accident conditions with credit for soluble boron. The SFP will also maintain $k_{eff} < 1.0$ with no soluble boron under normal conditions under the most reactive fuel storage configuration allowed by the proposed change. These acceptance criteria are consistent with the requirements of 10 CFR 50.68(b)(4).

3.10 Nuclear Energy Institute (NEI) 12-16 Guidance

The criticality safety analysis was performed using the guidance in Nuclear Energy Institute (NEI) 12-16 (Reference 2). NEI 12-16 provides comprehensive guidance regarding an acceptable approach to comply with NRC regulations. NEI 12-16, Revision 4 was endorsed by the NRC as described in RG 1.240 (Reference 1). NEI 12-16 Appendix C provides a criticality safety analysis checklist to ensure that all applicable subject areas of NEI 12-16 are addressed. The completed NEI 12-16 Appendix C checklist for the criticality safety analysis for this submittal is provided in Appendix A of Attachment 6.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements / Criteria

The regulatory requirements associated with this amendment application include the following:

- Appendix A to Title 10 of the *Code of Federal Regulations*, Part 50 (10 CFR 50), General Design Criterion (GDC) 61, “Fuel storage and handling and radioactivity control,” requires that fuel storage systems be designed to assure adequate safety under normal and postulated accident conditions. The Callaway FSAR Section 3.1, "Conformance with NRC General Design Criteria," describes conformance with GDC 61. The criticality safety evaluation demonstrates continued conformance with GDC 61. No administrative or physical changes are proposed that affect the ability to perform inspections and testing, shielding for radiation protection, confinement and filtering of potential effluents, or decay heat removal, nor is there any impact on assumed fuel storage coolant inventory under accident conditions.

- 10 CFR 50 Appendix A, GDC 62, "Prevention of criticality in fuel storage and handling," states that "criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations." The NRC has established a 5% subcriticality margin (i.e., k-effective (k_{eff}) less than or equal to 0.95) for nuclear power plant licensees to comply with GDC 62. The criticality safety evaluation demonstrates the continued conformance with GDC 62. The proposed storage practices are not appreciably different than those currently employed to store fuel assemblies in the SFP.

- 10 CFR 50.68, "Criticality accident requirements," subpart (b), regarding spent fuel storage specifies that:

  "(4) if credit is taken for soluble boron, 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. If credit is taken for soluble boron, 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 borated water, and the k-effective must remain below 1.0 (subcritical), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water." The updated criticality safety analyses performed for Callaway demonstrate that the 10 CFR 50.68(b)(4) criteria are met.

- 10 CFR 50.36, “Technical specifications,” details the content and information that must be included in a station's Technical Specifications (TSs). In accordance with 10 CFR 50.36, TSs are required to include (1) safety limits, limiting safety system settings, and limiting control settings; (2) limiting conditions for operation; (3) surveillance requirements; (4) design features; and (5) administrative controls. The spent fuel storage racks are design features which are included in the Callaway TSs in accordance with 10 CFR 50.36. The proposed changes to the Callaway TSs would ensure that the design features relied upon in the criticality safety analysis (i.e., the storage configuration within the spent fuel storage racks) are properly described in the TSs. The proposed TS changes are consistent with the format, level of detail, and structure of NUREG-1431, Standard Technical Specifications Westinghouse Plants, Volume 1 Specifications, Revision 5.0 dated March 2021.

The following regulatory requirements pertinent to this amendment application are unaffected by the proposed changes:

- 10 CFR 50 Appendix A, GDC Criterion 1, “Quality Standards and Records”
- 10 CFR 50 Appendix A, GDC Criterion 2, “Design Bases for Protection Against Natural Phenomena”
- 10 CFR 50 Appendix A, GDC Criterion 3, “Fire Protection”
- 10 CFR 50 Appendix A, GDC Criterion 4, “Environmental and Dynamic Effects Design Bases”
- 10 CFR 50 Appendix A, GDC Criterion 5, “Sharing of Structures, Systems and Components”
- 10 CFR 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"

In the regulatory requirements and criteria identified above, requirements pertaining to new fuel storage racks/facility are not addressed, since this license amendment request only pertains to the storage of fuel within the spent fuel pool.

Callaway does not propose any changes related to the criticality monitoring system as required by FSAR Chapter 16, "Technical Requirements," Section 16.3.3.6, "Spent Fuel Pool Criticality Monitor Limiting Condition for Operation," or as described in FSAR Section 12.3.4.1.2.8, "Criteria for the

Location of Area Monitors." Compliance with the requirements established in 10 CFR 70.24, "Criticality accident requirements," would remain unchanged by the proposed license amendment.

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

4.2 Precedent

The supporting CSA for this LAR was developed using analysis methods consistent with the guidance contained in NEI 12-16 (Reference 2) as endorsed by RG 1.240 (Reference 1).

The following license amendment submittal involves a criticality safety analysis prepared by HOLTEC International which demonstrates application of the analysis methods used in association with this LAR:

> Exelon Generation (now Constellation) submitted a license amendment request supporting an updated criticality safety analysis for spent fuel storage for their LaSalle County Station (ADAMS Accession No. ML21265A538) (Reference 8).

4.3 No Significant Hazards Consideration Determination

Ameren Missouri has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No

   The proposed license amendment would revise the Technical Specifications (TSs) to reflect the results of an updated Criticality Safety Analysis (CSA) for the storage of spent fuel at Callaway. The updated CSA will: 1) revise the current CSA based on the latest methodologies consistent with current NRC guidance and expectations; 2) simplify the storage configuration by establishing two regions within the spent fuel racks (SFRs) located within the spent fuel pool (SFP); and 3) provide an evaluation that encompasses a future fuel design. Specifically, the updated CSA adopts currently accepted computational methods, assumptions, and limitations to demonstrate compliance with regulatory standards as described in RG 1.240. The resultant changes include the adoption of an analysis that credits soluble boron, adoption of a two-region model for storage of fuel in the SFRs based on initial U-235 enrichment, burnup depletion, and cooling time following removal from the core, removal of requirements tied to the presence of integral fuel burnable absorbers (IFBAs), and use of the acceptance criteria given in 10 CFR 50.68(b)(4). The scope of the proposed changes does not include the new fuel storage facility.

The proposed changes will not affect plant equipment or structures, including the SFP, the SFRs, or fuel handling equipment, nor do they affect how the equipment is operated and maintained. This amendment does not apply to the new fuel storage racks. There are no changes to the equipment for fuel handling or how fuel assemblies are handled, including how fuel assemblies are inserted into and removed from the SFR storage locations. There is no change to the administrative means for verifying correct fuel assembly storage in the SFP, or to the required response to a fuel assembly misload or drop event. There are no changes to how rod cluster control assemblies (RCCAs) are handled, including how RCCAs are inserted into or removed from a fuel assembly or other location such as an SFP storage location. Also, since the proposed changes do not modify plant equipment or its operation and maintenance, including equipment used to maintain SFP soluble boron levels, the proposed changes will not increase the likelihood of a boron dilution event or the plant response to mitigate one should it occur. Thus, the probability of a fuel assembly misloading or a fuel assembly drop in the SFP will not significantly increase due to the proposed changes.

Several postulated accidents for the SFP were reviewed for the proposed changes, which included postulated fuel assembly misload scenarios. The criticality safety evaluation for the SFP concluded that the limiting accident, which bounds the other scenarios, is the incorrect application of the fuel loading curve resulting in multiple misloaded fuel assemblies in the Region 2 fuel storage region. The criticality safety evaluation concluded that an SFP soluble boron concentration of 1081.2 ppm will maintain $k_{eff} \leq 0.95$, including uncertainties and biases, for this postulated scenario, and therefore, the TS required minimum soluble boron concentration of 2165 ppm (as proposed) will provide significant margin. Callaway has maintained SFP soluble boron concentration greater than this value for many years, so the proposed changes will not affect the routine maintenance of the boron concentration.

As noted above, there are no changes to plant equipment, including its operation and maintenance, as a result of the proposed changes. This includes equipment associated with maintaining SFP soluble boron concentration within its limit or possible flow paths that could contribute to a boron dilution event. Thus, no new avenues for a boron dilution event will be created. There is no change regarding how the plant maintains boron concentration or responds to a boron dilution event. The criticality safety evaluation for the postulated boron dilution event shows the SFP maintains keff $\leq$ 0.95 at 550 ppm soluble boron. Thus, there is no significant increase in the probability or consequences of a boron dilution accident.

The Callaway SFP is currently licensed to store 2642 fuel assemblies, which includes a possible 279 fuel assemblies in racks located within the cask loading pool that are not installed. These maximum storage limits are unchanged. The SFP seismic/structural loading requirements under the proposed changes are bounded by the existing design and analysis, and thus, required safety margins continue to be met. The criticality safety evaluation shows that keff will be maintained $\leq$ 0.95 during a postulated seismic event. Thus, there is no increase in the consequences of a seismic event.

In each of the above scenarios, the proposed changes do not significantly increase the probability of an accident previously evaluated, as the required k_{eff} margin is shown to be maintained. Therefore, it is concluded that this change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No

The proposed changes involve no change to any plant equipment, including how equipment is operated and maintained. There is no change to equipment used to handle fuel assemblies (or any heavy load) over the SFP, and there is no change regarding how the fuel assemblies are stored, inserted into, and removed from fuel storage locations. There is no change to how RCCAs will be inserted into or removed from a fuel assembly or other location, or otherwise how RCCAs are handled. There is no change in the manner in which SFP boron concentration is measured or maintained, as compliance with the specified TS limit would continue to be required. Thus, no new accidents are required to be postulated beyond the existing postulated accidents of a fuel misloading event or a fuel assembly drop in the SFP. There is no change in the application of the double contingency principle such that a new combination of conditions could be postulated resulting in a new or different kind of accident.

Since the proposed changes do not involve changes to plant equipment, including fuel/RCCA handling equipment or how fuel assemblies and RCCAs are handled and stored, there is no mechanism for creating a new or different kind of accident not previously evaluated. Therefore, it is concluded that the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No

The margin of safety is established through equipment design, operating parameters, and the setpoints at which automatic actions are initiated. The proposed changes do not alter equipment design or the way in which the equipment is operated or maintained in regard to the SFP and fuel handling activities involving the SFP. The operating parameters for the spent fuel pool are not altered by the proposed change. Further, there are no automatic actions associated with the spent fuel pool or other automatic actions within the scope of the proposed amendment. The licensing requirement for the SFP is that k_{eff} remains ≤ 0.95 under normal and postulated accident conditions (with credit for soluble boron). The criticality safety evaluation completed in support of the proposed amendment concluded that this requirement is met. The analyses apply to all of the fuel assemblies currently stored in the Callaway SFP and to the future anticipated fuel design.

In addition, the criticality safety evaluation concludes that the SFP will maintain $k_{eff} < 1.0$ with 0 ppm soluble boron in the SFP under normal conditions, with the maximum allowed reactivity fuel assembly stored in each fuel storage location.

The criticality safety evaluation also allows the following storage configurations:

- Storing non-fuel components in any spent fuel rack storage location where fuel assemblies are allowed.
- Storing non-fuel components in the guide tubes of any fuel assembly.

For each analyzed case, the storage configuration does not increase reactivity, thus ensuring that k_{eff} margin is maintained.

Therefore, it is concluded that the proposed change does not involve a significant reduction in a margin of safety.

In consideration of all of the above, Ameren Missouri concludes that the proposed changes present no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and on that basis, a finding of "no significant hazards consideration" is justified.

4.4 Conclusions

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

5.0 ENVIRONMENTAL EVALUATION

The proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or a significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

6.0 REFERENCES

1. Regulatory Guide (RG) 1.240, "Fresh and Spent Fuel Pool Criticality Analyses" Revision 0, dated March 2021 (ADAMS Accession No. ML20356A127)
2. Nuclear Energy Institute, NEI 12-16, "Guidance for Performing Criticality Analyses of Fuel Storage at Light-Water Reactor Power Plants," Revision 4 (ADAMS Accession No. ML19269E069)
3. U.S. Code of Federal Regulations (CFR), “Domestic licensing of production and utilization facilities,” Part 50, Chapter 1, Title 10, “Energy”
4. 10 CFR 50 Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion (GDC) 62, “Prevention of criticality in fuel storage and handling”
5. 10 CFR 70, “Domestic licensing of special nuclear material”
6. 10 CFR 50.68, "Criticality accident requirements"
7. Not used.
8. Exelon Generation letter, "License Amendment Request Regarding New Fuel Storage Vault and Spent Fuel Storage Pool Criticality Methodologies, with Proposed Changes to Technical Specifications Sections 4.3.1 and 5.6.5," dated June 30, 2021 (ADAMS Accession No. ML21265A538)
9. Ameren Missouri letter ULNRC-06753, "Presentation Information for Pre-Submittal Meeting Regarding Updated Spent Fuel Criticality Safety Analysis," and Enclosure dated June 23, 2022 (ADAMS Accession Nos. ML22174A346, ML22174A347)
10. Callaway FSAR Standard Plant (SP) Section 9.1.2
11. NRC Safety Evaluation Report for Callaway Plant Amendment 129, "Revising TS to Allow an Increase in Callaway Plant, Unit 1 Spent Fuel Pool Storage Capacity from 1344 to 2363 Fuel Assemblies," dated January 19, 1999 (ADAMS Accession No. ML021640249)
12. Callaway FSAR SP Appendix 9.1A.1.3
13. Callaway FSAR SP Appendix 9.1A.2
14. NUREG/CR-6760, "Study of the Effect of Integral Burnable Absorbers for PWR Burnup Credit," ORNL-TM-2000/321, USNRC Office of Nuclear Regulatory Research, March 2002
15 HOLTEC International report HI-951251, "Safety Analysis Report HI-STAR 100 Cask System," USNRC Docket 71-9261, Revision 20
16. NUREG-1431, Standard Technical Specifications Westinghouse Plants, Volume 1 Specifications, Revision 5.0 dated March 2021
17. NRC letter "Summary of June 29, 2022, Public Meeting with Union Electric Company dba Ameren Missouri to Discuss Upcoming License Amendment Request to Revise Technical Specifications to Reflect Revised Spent Fuel Pool Criticality Safety Analysis for Callaway Plant, Unit No. 1, (EPID L-2022-LRM-0048)," dated July 22, 2022 (ADAMS Accession No. ML022181A001)