ENCLOSURE 1

DESCRIPTION AND ASSESSMENT OF THE PROPOSED CHANGE

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1.0 SUMMARY DESCRIPTION

Ameren Missouri (Union Electric Company) is proposing to amend Renewed Operating License NPF-30 for Callaway Plant Unit 1 (Callaway). The proposed amendment would revise the Technical Specifications to allow use of Framatome GAIA fuel with M5[1] as a fuel cladding material. Since the Framatome GAIA fuel will use M5 fuel rod cladding, a 10 CFR 50.46 and 10 CFR 50 Appendix K exemption request is included as part of this license amendment request (LAR). The exemption request is provided in Enclosure 2.

Ameren Missouri is implementing a plan that provides for the option of transitioning from the use of fuel manufactured by Westinghouse Electric Company (Westinghouse), as currently used in the Callaway reactor core, to the use of fuel manufactured by Framatome, Inc. Implementation of the plan has already begun, as four Framatome lead fuel assemblies were placed into service (in non-limiting locations) during operating cycle 25. The plan will proceed to and through the point in time when a management decision will be made on whom to award the fuel contract for subsequent Callaway operation.

Ameren Missouri has contracted with Framatome to establish a Vendor Qualification Program (VQP) for the use of GAIA fuel at Callaway as well as Framatome's evaluation methodologies for application at Callaway. The VQP entails a safety-related project to deliver fully qualified fuel in accordance with Callaway's Quality Assurance Program including supporting technical reports and licensing information. The fuel design is detailed in the NRC approved GAIA Fuel Assembly Mechanical Design Topical Report (Reference 36). An overview of the design and identification of key attributes is provided in Section 2 of Attachment 9. Attachment 9 also provides a description of the analysis methodologies employed by Framatome to support use of the GAIA fuel.

The requested license amendment would modify the Technical Specifications to accommodate Framatome GAIA fuel assemblies. During operating cycle 27, up to eight (8) Framatome GAIA fuel assemblies are planned to be loaded in the core. These eight assemblies will consist of four (4) Framatome GAIA assemblies acquired under the VQP and four (4) Framatome GAIA lead fuel assemblies (LFAs) previously present in the core during operating cycle 25. Due to core reload analysis considerations and limitations, no Framatome GAIA fuel was present in the core during operating cycle 26.

To accommodate the Framatome GAIA assemblies starting in operating cycle 27, changes to TS Section 2, "Safety Limits," and Section 4, "Design Features," are proposed along with a regulatory exemption to accommodate the Framatome GAIA M5 fuel clad material. To accommodate the core design for operating cycle 27, the proposed TS changes require approval by September 30, 2023.

Westinghouse will provide core reload analysis support for Callaway, compatible with the Technical Specification (TS) Section 3.2, "Power Distribution Limits" (i.e., Limiting Condition for Operation

[1] M5 is a registered trademark of Framatome, Inc.

(LCO) 3.2.1 through LCO 3.2.4), using the currently approved Westinghouse Core Operating Limits Report (COLR) methodologies currently in place. Framatome will provide confirmatory analyses in support of the reload evaluations.

Previously, a license amendment request was submitted to the NRC that addressed a potential transition from Westinghouse fuel to Framatome GAIA fuel (Reference 38). The subject of that license amendment request was presented to the NRC staff during pre-submittal meetings held on May 20, 2021 (References 9 and 18); October 14, 2021 (References 1, 2 and 19); and February 28, 2022 (References 20 and 21). As a result of a management decision deferring the selection of the fuel vendor, the original license amendment (Reference 38) was withdrawn as communicated in a letter dated August 4, 2022 (Reference 39).

During the acceptance review of the original license amendment request (Reference 38), the NRC staff identified four items in Reference 41 deemed insufficiencies in the original submittal. In the NRC's acknowledgment letter of the Reference 38 license amendment withdrawal (Reference 40), the NRC staff stipulated that should Ameren Missouri decide to re-submit the license amendment request, the identified insufficiencies must be addressed. To address this stipulation, the insufficiencies are addressed in Attachment 13 to this Enclosure. The subject of this license amendment request was discussed with the NRC staff on September 12, 2022 (Reference 43). Feedback, recommendations and discussion points from those meetings are reflected in this LAR.

This enclosure contains thirteen attachments. Regarding the first three attachments, Attachment 1 provides the marked-up version of the current Technical Specifications depicting the proposed changes. Attachment 2 provides the clean, re-typed version of the Technical Specifications assuming approval of the proposed changes. Attachment 3 provides marked-up TS Bases pages to show the conforming changes for information only. TS Bases changes will be managed in accordance with TS 5.5.14, "Technical Specifications (TS) Bases Control Program."

In support of Ameren Missouri's intent to license the Framatome GAIA fuel design and Framatome's evaluation methodologies, Framatome developed a series of technical reports that provide details supporting this license amendment request, including summaries of the evaluations performed for transients and accidents described in the Callaway Final Safety Analysis Report (FSAR). These evaluations demonstrate continued compliance with license basis and regulatory acceptance criteria. The proprietary versions of the technical reports are contained in Attachments 9 through 12. Note that the technical reports were written to support a full transition to Framatome GAIA fuel including intermediate batch load quantities of fuel. Operation with eight assemblies starting in operating cycle 27 is bounded by the evaluations performed although not explicitly stated in all locations. A separate license amendment request will be required at a later date to address the potential transition to Framatome GAIA fuel.

The technical reports provided as Attachments 9 through 12 contain information that is proprietary to Framatome. Attachment 4 contains four (4) affidavits signed by Framatome that set forth the basis on which the proprietary information in Attachments 9 through 12 may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in

10 CFR 2.390(b)(4). Non-proprietary (public) versions of Attachments 9 through 12 are provided as Attachments 5 through 8, respectively, and are described below.

Attachment 5 provides a non-proprietary version of technical report ANP-3947P, "Callaway Unit 1 License Amendment Request Inputs for Use of Framatome Fuel," Revision 3. Attachment 9 provides the proprietary version of this report. As noted above, the proprietary version must be withheld from public disclosure.

Attachment 6 provides a non-proprietary version of technical report ANP-3944P, "Callaway Realistic Large Break LOCA Analysis with GAIA Fuel Design," Revision 1. Attachment 10 provides the proprietary version of this report. As noted above, the proprietary version must be withheld from public disclosure.

Attachment 7 provides a non-proprietary version of technical report ANP-3943P, "Callaway Small Break LOCA Analysis with GAIA Fuel Design," Revision 1. Attachment 11 provides the proprietary version of this report. As noted above, the proprietary version must be withheld from public disclosure.

Attachment 8 provides a non-proprietary version of technical report ANP-3969P, "Callaway Non-LOCA Summary Report," Revision 2. Attachment 12 provides a proprietary version of this report. As noted above, the proprietary version must be withheld from public disclosure.

Attachment 13 provides a response to the four insufficiency items identified during the staff's acceptance review of the first license amendment request as stipulated in Reference 40.

2.0 DETAILED DESCRIPTION

2.1 Technical Specification Changes

Changes to the Callaway Plant Technical Specifications are required to allow the use of the Framatome GAIA fuel procured under the VQP starting in operating cycle 27. As noted previously, Attachment 1 to this Enclosure provides the marked-up version of the current Technical Specifications which depicts the proposed TS changes. Attachment 2 provides the clean re-typed version of the TS assuming approval of the proposed changes.

Specifically, the proposed TS changes are driven by the need to accommodate Framatome GAIA fuel assemblies starting with operating cycle 27, which affects TS 2.1.1 and TS 4.2.1. Westinghouse fuel will continue to constitute the vast majority of the fuel in the core. Callaway will continue to operate in accordance with the TS Section 3.2, "Power Distribution Limits," (i.e., TS 3.2.1 through TS 3.2.4) as supported by the current Westinghouse methods for COLR development. A summary of the TS changes is provided below:

TS 2.1.1 – Reactor Core SLs

Revise TS 2.1.1.1 and TS 2.1.1.2 – Clarify that the existing Technical Specifications specify a Westinghouse-supplied fuel limiting Departure from Nucleate Boiling Ratio (DNBR), DNB correlation, and peak fuel centerline temperature. Other than the designation as Westinghouse fuel limits, the current Safety Limits and the corresponding DNB correlation are unchanged.

Add new TS 2.1.1.3 and TS 2.1.1.4 – Add corresponding Framatome GAIA fuel Safety Limits for DNBR and peak fuel centerline temperature, along with the Framatome GAIA fuel-specific DNB correlation.

TS 4.2.1 – Fuel Assemblies

Revise TS 4.2.1 to include reference to the M5 fuel cladding material and change the spelling of Zircalloy to zircaloy[2]. The first change is necessary to support the GAIA fuel assembly use of M5 fuel cladding material. The corresponding regulatory exemption request is provided in Enclosure 2. The second change from Zircalloy to zircaloy is considered editorial and establishes consistency with 10 CFR 50.46 language.

These changes are supported by the evaluations presented in Attachments 9 through 12. Attachment 9 provides a detailed description of the GAIA fuel, supporting bases for these proposed TS changes, and a summary of the analyses performed to support the acceptability of the use of GAIA fuel at Callaway. Attachments 10 through 12 provide the summary results of the analyses performed to support the FSAR Chapter 15 Accident Analyses and continued compliance with the NRC regulatory requirements.

2.2 Disposition of FSAR Section 15.4.7, "Inadvertent Loading and Operation of a Fuel Assembly in Improper Position"

An insufficiency item (bullet four) in References 40 and 41 identified that Attachment 12 of Enclosure 1 specified that evaluation of the inadvertent loading and operation of a fuel assembly in an improper position event will be provided by the licensee. To the contrary, this evaluation was omitted from the original submittal.

The event description and conclusions provided in FSAR Section 15.4.7, "Inadvertent Loading and Operation of a Fuel Assembly in Improper Position," remain correct and bound the use of GAIA fuel. Based on review of the event description in the FSAR and after consultation with Westinghouse, it is concluded that the ability to detect significant power distribution anomalies due to fuel assembly loading errors before exceeding the specified acceptable fuel design limits (SAFDLs) remains true. The analyses provided during plant licensing were fuel design independent and the presence of the GAIA fuel assemblies have no effect on the event conclusions.

[2] Callaway TS 4.2.1 uses the word Zircalloy in lieu of zircaloy as given in 10 CFR 50.46.

2.3 Disposition of FSAR Section 15.4.8, "Spectrum of Rod Cluster Control Assembly Ejection Accidents"

With regard to the ejected rod analysis described in FSAR Section 15.4.8, "Spectrum of Rod Cluster Control Assembly Ejection Accidents," this postulated event has been evaluated using the NRC-approved AREA methodology using the GALILEO fuel rod thermal mechanical methodology as described in Section 6.1.1 of Attachment 9 against the acceptance criteria given in Reference 29. The results of the analysis are available for NRC review (Reference 45).

2.4 Additional Considerations

Spent Fuel Pool Criticality Analysis

To accommodate the storage of the Framatome GAIA fuel in the spent fuel pool and during fuel handling, the spent fuel criticality safety analyses have been updated. Therefore, independent of this license amendment request, a separate LAR has been submitted to reflect the updated spent fuel pool criticality analysis (Reference 42). Changes to TS 3.7.16, "Fuel Storage Pool Boron Concentration"; TS 3.7.17, "Spent Fuel Assembly Storage"; and TS 4.3, "Fuel Storage" have been proposed. That LAR demonstrates compliance with the requirements of 10 CFR 50.68, "Criticality accident requirements," and conforms to the guidance in Regulatory Guide 1.240, "Fresh and Spent Fuel Pool Criticality Analyses" (Reference 44).

GL 2004-02 / GSI-191 resolution

Regarding Ameren Missouri's resolution of Generic Letter (GL) 2004-02 (i.e., Generic Safety Issue (GSI) 191 involving the potential for containment sump screen clogging and downstream effects as a result of loss of coolant accident debris generation and transport), Ameren Missouri is in the process of closing out GL 2004-02 for the resident (Westinghouse) fuel (References 3, 4, 5, 6, 7, and 8) using the NRC staff guidance provided in Reference 30. Ameren Missouri determined that Callaway is a Category 4 plant that required a plant specific analysis.

Regarding operation with eight GAIA fuel assemblies starting in operating cycle 27, a qualitative assessment confirms the acceptability of the core against the NRC staff guidance provided in Reference 30. A restriction will be applied that precludes the GAIA assemblies from residing in a face-to-face configuration.

The Callaway-specific analysis described in the GL 2004-02 response demonstrated that the total amount of fiber reaching the reactor vessel was 89 grams per fuel assembly (g/FA). While this mass of fiber exceeds the allowed mass of fiber at the core inlet, conservatisms are available that can be credited as discussed in Reference 30 and Reference 32, Section 4.5.1.1. Specifically, the fibrous debris that reaches the core inlet will not build up in a uniform fashion due to variations in the flow velocities expected at the core inlet. This non-uniform buildup of debris will allow more debris to be tolerated at the core inlet than the amount for any specific fuel type. At some point, sufficient debris may build up at the core inlet to divert flow through the alternate flow path. Therefore, as long as the total amount of fiber reaching the Reactor Cooling System (RCS) is below the maximum value

allowed by WCAP-17788P (Reference 31, Section 9.1.1), the requirements of GL 2004-02 are met. This is true regardless of fuel design. Since the total amount of fiber that reaches the RCS is not dependent on use of GAIA fuel, Callaway will continue to meet the requirements of GL 2004-02 while using Framatome's GAIA fuel.

Accident Source Term (AST)

Ameren Missouri currently has a license amendment request under review by the NRC staff to adopt the provisions described in 10 CFR 50.67, "Accident source term" (References 33 and 34). The proposed amendment would revise the technical specifications and authorize changes to the final safety analysis report to support application of the regulations in 10 CFR 50.67, as described in Regulatory Guide 1.183 (Reference 35). Specifically, the amendment would revise TS 3.7.10, "Control Room Emergency Ventilation System (CREVS)," TS 5.5.11, "Ventilation Filter Testing Program," and TS 5.5.17, "Control Room Envelope Habitability Program." That license amendment request is expected to be approved prior to operating cycle 27. Accident source terms are verified for each core reload design, and the operating cycle 27 source terms will be compared to those of the approved bounding analysis in effect at the time. Any changes in source term will be reviewed under 10 CFR 50.59 as part of the core reload design process. Given the limited number of GAIA assemblies in operating cycle 27, a more than minimal increase in dose consequences is not anticipated. Future operating cycle core designs will continue to be compared to the approved bounding analysis and reviewed under 10 CFR 50.59 to determine if an additional license amendment request is required for those operating cycles.

2.5 Technical Specification Bases Changes

Changes to the TS Bases will be needed to ensure consistency with the proposed TS changes. The marked-up pages for the TS Bases changes described within this LAR are provided in Attachment 3 for information only. Final TS Bases changes will be processed under the program for updates per TS 5.5.14, "Technical Specifications Bases Control Program," at the time this amendment is implemented.

2.6 Core Operating Limits Report (COLR) Changes

The COLR will be maintained in accordance with the administrative controls governing core reload design control and coordination, as specified in TS 5.6.5, "Core Operating Limits Report (COLR)." Westinghouse methods will continue to be utilized consistent with the methods specified in TS 5.6.5, with confirmatory analyses performed by Framatome. For this reason, no changes are necessary for the COLR to support operating cycles containing the Framatome GAIA fuel assemblies.

3.0 TECHNICAL EVALUATION

In support of this amendment to license the Framatome GAIA fuel design and Framatome's evaluation methodologies, Framatome developed a series of technical reports that provide details supporting this license amendment request, including summaries of the evaluations performed for transients and

accidents described in the Callaway FSAR. These evaluations demonstrate continued compliance with license basis and regulatory acceptance criteria. The technical reports are contained in Attachments 9 through 12. Note that the technical reports were written to support a full transition to Framatome GAIA fuel including intermediate batch load quantities of fuel. Operation with eight assemblies starting in operating cycle 27 is bounded by the evaluations performed although not explicitly stated in all locations. A separate license amendment request will be required at a later date to address the potential transition to Framatome GAIA fuel.

The following paragraphs provide the proposed TS changes and their justification. Attachment 1 to this Enclosure provides the marked-up version of the current TS which depicts the proposed changes discussed below. Attachment 2 provides the clean re-typed version of the TS following approval of these proposed changes.

TS 2.1.1 – Reactor Core SLs

As discussed in the TS Bases, General Design Criteria (GDC) 10 requires that specified acceptable fuel design limits are not exceeded during steady state operation, normal operational transients, and anticipated operational occurrences (AOOs). This is accomplished by having a departure from nucleate boiling (DNB) design basis, which requires that the minimum departure from nucleate boiling ratio (DNBR) of the limiting rod during Condition I and II events is greater than or equal to the DNBR correlation limits. The restrictions of the Safety Limits (SLs) prevent overheating of the fuel and cladding, as well as possible cladding perforation, which would result in the release of fission products to the reactor coolant. Overheating of the fuel is prevented by maintaining the steady state peak linear heat rate (LHR) below the level at which fuel centerline melting occurs. Overheating of the fuel cladding is prevented by restricting fuel operation to within the nucleate boiling regime, where the heat transfer coefficient is large and the cladding surface temperature is slightly above the coolant saturation temperature. Fuel centerline melting occurs when the local LHR, or power peaking, in a region of the fuel is high enough to cause the fuel centerline temperature to reach the melting point of the fuel. Expansion of the pellet upon centerline melting may cause the pellet to stress the cladding to the point of failure, allowing an uncontrolled release of activity to the reactor coolant. The combination of operation within a defined set of power distribution limits, proper operation of the Reactor Trip System, and proper operation of safety valves prevents violation of the reactor core SLs. The current TS Bases and the FSAR, as updated, provide the description regarding how these limits are derived and met during operation.

The current Callaway SLs are supported by Westinghouse analysis methods as described in the TS Bases, FSAR and documentation supporting the current COLR methodologies. The current SLs are:

TS 2.1.1 Reactor Core SLs

In MODES 1 and 2, the combination of THERMAL POWER, Reactor Coolant System (RCS) highest loop average temperature, and pressurizer pressure shall not exceed the limits specified in the COLR, and the following SLs shall not be exceeded:

TS 2.1.1.1 The departure from nucleate boiling ratio (DNBR) shall be maintained ≥ 1.17 for the WRB-2 DNB correlation.

TS 2.1.1.2 The peak fuel centerline temperature shall be maintained < 5080°F, decreasing by 58°F per 10,000 MWd/MTU of burnup.

This LAR will revise TS 2.1.1.1 and TS 2.1.1.2 to clarify that the existing TS specify a Westinghouse-supplied fuel limiting DNBR and peak fuel centerline temperature. Other than the designation as Westinghouse fuel limits, the current Safety Limits are unchanged. Westinghouse will continue to perform analyses of its fuel in accordance with the currently established analysis methods listed in the TS 5.6.5.b. This LAR will add a new TS 2.1.1.3 and TS 2.1.1.4 which provide the corresponding Framatome GAIA fuel Safety Limits for DNBR and peak fuel centerline temperature, along with the applicable DNB correlation. The revised TS are given below. Additions are shown with underlined text.

TS 2.1.1.1 For Westinghouse fuel, the departure from nucleate boiling ratio (DNBR) shall be maintained ≥ 1.17 for the WRB-2 DNB correlation.

TS 2.1.1.2 For Westinghouse fuel, the peak fuel centerline temperature shall be maintained < 5080°F, decreasing by 58°F per 10,000 MWd/MTU of burnup.

TS 2.1.1.3 For Framatome GAIA fuel, the DNBR shall be maintained ≥ 1.12 for the ORFEO-GAIA DNB correlation.

TS 2.1.1.4 For Framatome GAIA fuel, the peak fuel centerline temperature shall be maintained < 4901°F, decreasing linearly by 13.7°F per 10,000 MWd/MTU of burnup.

Section 3 of Attachment 9 provides the neutronics design characteristics of the reactor and Section 5 of Attachment 9 provides the thermal-hydraulic design of the reactor. Section 5.5 of Attachment 9 provides the analysis that demonstrates the GAIA fuel can meet steady-state and transient performance requirements without violating the safety limits. Supporting technical analyses are provided in Attachments 10 through 12. In combination, these attachments demonstrate the acceptability of the GAIA fuel for use in the Callaway reactor core as stipulated in Section 4.0, "Limitations and Conditions," of the Final Safety Evaluation for ANP-10342P-A, "GAIA Fuel Assembly Mechanical Design" (Reference 35). Section 2.4.3.1 of Attachment 9, "GAIA Mechanical Topical Report Restrictions," explicitly addresses this subject.

The addition of these Framatome fuel-specific safety limits ensures continued compliance with the requirements of 10 CFR 50.36(c)(1).

The Callaway TS Bases will be updated to reflect the addition of the DNBR and the peak fuel centerline temperature safety limits for the GAIA fuel.

TS 4.2.1 – Fuel Assemblies

The requested license amendment will revise TS 4.2.1 to add reference to the M5 cladding material. This change is necessary to support the GAIA fuel assembly use of M5 fuel cladding material. In addition, Zircalloy is revised to read zircaloy consistent with 10 CFR 50.46 which corrects a spelling error.

The use of nuclear fuel cladding material M5 in PWR reactor fuel is approved by the NRC in topical report BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," (Reference 11) and its use in Framatome approved methods is approved in topical report BAW-10240(P)(A), "Incorporation of M5 Properties in Framatome ANP Approved Methods" (Reference 12). The M5 cladding is a Framatome Proprietary material composed of zirconium and niobium. This composition has demonstrated superior corrosion resistance and reduced irradiation induced growth relative to both standard and low-tin zircaloy. The resulting alloy microstructure is highly stable under irradiation and provides improved in-reactor thermal and mechanical performance over other zirconium alloys.

A 10 CFR 50.46 and 10 CFR 50 Appendix K exemption request for the implementation of M5 fuel rod cladding is provided in Enclosure 2 of this LAR. This request is necessary since both of these regulatory requirements state or assume that either zircaloy or ZIRLO[3] is to be used as the fuel rod cladding material and the requirements are not inclusive of the M5 cladding.

As described in Attachment 9, the following Framatome-developed, NRC-approved analytical methods for neutronics, fuel mechanical, thermal-hydraulics, and safety analyses are used to support the analyses performed by Framatome to ensure the acceptability of the GAIA fuel in the core:

1. EMF-2103(P)(A), “Realistic Large Break LOCA Methodology for Pressurized Water Reactors.” [Methodology for Specification 3.2.1, F_Q]
2. EMF-2328(P)(A), “PWR Small Break LOCA Evaluation Model, S-RELAP5 Based.” [Methodology for Specification 3.2.1, FQ]
3. EMF-2310(P)(A), “SRP Chapter 15 Non-LOCA Methodology for Pressurized Water Reactors.”
4. XN-NF-82-21(P)(A), “Application of Exxon Nuclear Company PWR Thermal Margin Methodology to Mixed Core Configurations.”
5. EMF-92-081(P)(A), “Statistical Setpoint/Transient Methodology for Westinghouse Type Reactors.”

[3] Note that ZIRLO is a registered trademark of Westinghouse Electric Co.

6 ANP-10341(P)(A), “The ORFEO-GAIA and ORFEO-NMGRID Critical Heat Flux Correlations.”
7 XN-75-21(P)(A), “XCOBRA-IIIC: A Computer Code to Determine the Distribution of Coolant During Steady State and Transient Core Operation.”
8 ANP-10311P-A, “COBRA-FLX: A Core Thermal-Hydraulic Analysis Code.”
9 XN-NF-82-06(P)(A) Supplement 2, 4, and 5, “Qualification of Exxon Nuclear Fuel for Extended Burnup.”
10 XN-75-32(P)(A) Supplements 1, 2, 3, and 4, “Computational Procedure for Evaluating Fuel Rod Bowing.”
11 ANP-10297P-A, “The ARCADIA Reactor Analysis System for PWRs Methodology Description and Benchmarking Results.”
12 ANP-10297P-A, Supplement 1PA, “The ARCADIA Reactor Analysis System for PWRs Methodology Description and Benchmarking Results.”
13 ANP-10338P-A, “AREA – ARCADIA Rod Ejection Accident.”
14 ANP-10323P-A, “GALILEO Fuel Rod Thermal-Mechanical Methodology for Pressurized Water Reactors.”
15 BAW-10231P-A, “COPERNIC Fuel Rod Design Computer Code.”

Attachment 9 provides a description of the analyses performed, a description of the analysis methods, a discussion of limitations and conditions associated with the methods, and the conclusions of the analyses. Within Attachment 9, Section 7, "Methodology Applicability," provides a cross-reference between the above listed topical reports and the locations in the supporting summary reports (i.e., Attachments 9 through 12) where the method is discussed. In addition, Attachments 10 through 12 contain summaries of the accident and transient analyses performed by Framatome in support of this LAR. They similarly include a description of the analyses performed, a description of the analysis methods, a discussion of limitations and conditions associated with the methods, and the conclusions of the analyses.

In response to insufficiency item 2 identified in References 40 and 41, Attachment 13 has been added to this LAR. This attachment provides a cross-reference between the topical report for each of the above listed methods, the applicable Framatome summary report (i.e., Attachments 9 through 12), and the disposition of the limitations and conditions identified in the safety evaluation report (SER) for the topical report.

With respect to the methodology identified in Item 13, Section 6.1.1 of Attachment 9 provides a description of the analyses performed and the acceptance criteria used to ensure that the FSAR 15.4.8, "Spectrum of Rod Cluster Control Assembly Ejection Accidents," conclusions are addressed. These analyses were performed using the "AREA – ARCADIA Rod Ejection Accident" model (Reference 28) against the acceptance criteria defined in Reference 29. The results of this analysis are available for NRC review (Reference 45).

Assessment of Current Methodologies Retained in TS 5.6.5.b

Since Westinghouse fuel will constitute the majority of the core and Westinghouse will continue to be responsible for development of the COLR limits using the listed NRC-approved methods during

operating cycle 27 and subsequent operating cycles, the Westinghouse Topical Reports, which are listed in TS 5.6.5.b, are retained.

The ability of Westinghouse to provide core reload analysis support given the presence of the eight Framatome GAIA fuel assemblies was assessed. This assessment took into account the already demonstrated ability to model and account for the first four GAIA lead fuel assemblies in operating cycle 25. The reload analysis process involves Westinghouse's proprietary method and is described in WCAP-9272-P-A, "Westinghouse Reload Safety Evaluation Methodology," which is an NRC-approved method listed as item b.1 in TS 5.6.5, "Core Operating Limits Report (COLR)." The method described in the WCAP involves the solicitation and aggregation of pertinent data and potential plant changes using the Reload Safety and Licensing Checklist (RS&LC), confirmatory analyses, assessment against design and licensing standards, and generation of the Reload Safety Analysis Checklist (RSAC). This process has been used numerous times over the life of Callaway Plant. Given the application of this process for the four GAIA lead fuel assemblies, Ameren Missouri has confidence in its application to the four additional GAIA VQP assemblies to be loaded in operating cycle 27.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements / Criteria

The regulatory requirements and/or guidance documents associated with this amendment application include the following:

Technical Specifications

Section 182a of the Atomic Energy Act requires applicants for nuclear power plant operating licenses to include Technical Specifications (TS) as part of the license. The TS ensure the operational capability of structures, systems, and components that are required to protect the health and safety of the public. The U.S. Nuclear Regulatory Commission's (NRC's) requirements related to the content of the TSs are contained in Section 50.36 of Title 10 of the Code of Federal Regulations (10 CFR 50.36) which requires that the TSs include items in the following specific categories: (1) safety limits, limiting safety systems settings, and limiting control settings; (2) limiting conditions for operation; (3) surveillance requirements per 10 CFR 50.36(c)(3); (4) design features; and (5) administrative controls. This amendment request involves two of the five categories in 10 CFR 50.36(c)(1) through 10 CFR 50.36(c)(5). This LAR describes the manner in which the 10 CFR 50.36 requirements continue to be met through the specification of appropriate safety limits, and design feature description.

10 CFR 50.46 requires, in part, that each boiling or pressurized light-water nuclear power reactor fueled with uranium oxide pellets within cylindrical zircaloy or ZIRLO cladding must be provided with an emergency core cooling system (ECCS) that must be designed so that its calculated cooling performance following postulated loss-of-coolant accidents conforms to the criteria set forth in 10 CFR 50.46(b). Appendix K to 10 CFR Part 50 establishes the regulations for conservative ECCS evaluation models. Enclosure 2 contains an exemption

request from 10 CFR 50.46 and Appendix K to 10 CFR Part 50, in accordance with 10 CFR 50.12. In Reference 11, the NRC approved the use of M5 as an acceptable fuel rod cladding material for Framatome fuel designs. The analyses discussed in Attachments 10 and 11 demonstrate the continued acceptability of the Callaway ECCS to meet the performance criteria in 10 CFR 50.46.

General Design Criteria

Callaway Final Safety Analysis Report-Standard Plant (FSAR-SP) Section 3.1 discusses the extent to which the design criteria for Westinghouse Standardized Nuclear Unit Power Plant System (SNUPPS) plant structures, systems, and components important to safety comply with Title 10, Code of Federal Regulations, Part 50 (10 CFR 50), Appendix A, "General Design Criteria for Nuclear Power Plants" (GDC). Compliance with pertinent GDC are discussed in the following paragraphs:

Criterion 10 – Reactor Design

"The reactor core and associated coolant, control, and protection systems shall be designed with an appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences."

The vast majority of the fuel in the core continues to be supplied by Westinghouse and supported by NRC-approved Westinghouse analysis methods, consistent with historical practices. This ensures the reactor core will be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs. With respect to the Framatome GAIA fuel, as summarized in Section 5 in Attachment 9, NRC-approved methods will be used by Framatome to similarly ensure that the GAIA fuel will operate with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs. Therefore, GDC 10 continues to be satisfied.

Criterion 11 – Reactor Inherent Protection

"The reactor core and associated coolant systems shall be designed so that in the power operating range the net effect of the prompt inherent nuclear feedback characteristics tends to compensate for a rapid increase in reactivity."

The vast majority of the fuel in the core continues to be supplied by Westinghouse and its operating characteristics are unchanged. For this reason, the core will continue to demonstrate that the net effect of the prompt inherent nuclear feedback characteristics tends to compensate for a rapid increase in reactivity. As described in Section 3 of Attachment 9, the presence of the GAIA fuel will have a negligible effect on the existing core behavior characteristics such that the net effect of the prompt inherent nuclear feedback characteristics will tend to compensate for a rapid increase in reactivity. Therefore, GDC 11 continues to be satisfied.

Criterion 12 - Suppression of Reactor Power Oscillations

"The reactor core and associated coolant, control, and protection systems shall be designed to assure that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed."

The vast majority of the fuel in the core continues to be supplied by Westinghouse and its operating characteristics are unchanged. For this reason, the design of the core will continue to ensure the ability to control power oscillations that could challenge the SAFDLs. As described in Attachment 9, the presence of the GAIA fuel will have a negligible effect on the existing core behavior characteristics such that power oscillations, which can result in conditions exceeding SAFDLs, are not possible or can be reliably and readily detected and suppressed. Therefore, GDC 12 continues to be satisfied.

Criterion 20 - Protection System Functions

"The protection system shall be designed (1) to initiate automatically the operation of appropriate systems including the reactivity control systems, to assure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences and (2) to sense accident conditions and to initiate the operation of systems and components important to safety."

The presence of the GAIA fuel will have a negligible effect on the existing core behavior characteristics such that automatic initiation of the reactivity control systems will continue to assure that acceptable fuel design limits are not exceeded as a result of AOOs and to automatically initiate operation of systems and components important to safety under accident conditions. As described in Attachment 9, analyses demonstrate the continued acceptability of the over-temperature delta temperature and over-power delta temperature trip setpoints for cores containing GAIA fuel. Therefore, GDC 20 continues to be satisfied.

Criterion 25 - Protection System Requirements for Reactivity Control Malfunctions

"The protection system shall be designed to assure that specified acceptable fuel design limits are not exceeded for any single malfunction of the reactivity control systems, such as accidental withdrawal (not ejection or dropout) of control rods."

As described in Attachment 9, the GAIA fuel assemblies will not adversely affect the mechanical performance of the Westinghouse fuel assemblies. Further, the GAIA fuel assemblies do not alter the plant such that any new malfunction of any reactivity control system is possible. As described in Attachment 9, the protection system will continue to be designed to assure that the protection system assures that SAFDLs are not exceeded for any single malfunction of the reactivity control systems. Therefore, GDC 25 continues to be satisfied.

Criterion 26 - Reactivity Control System Redundancy and Capability

"Two independent reactivity control systems of different design principles shall be provided. One of the systems shall use control rods, preferably including a positive means for inserting the rods, and shall be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as stuck rods, specified acceptable fuel design limits are not exceeded. The second reactivity control system shall be capable of reliably controlling the rate of reactivity changes resulting from planned, normal power changes (including xenon burnout) to assure that the acceptable fuel design limits are not exceeded. One of the systems shall be capable of holding the reactor core subcritical under cold conditions."

The presence of the GAIA fuel assemblies will not adversely affect the mechanical performance of the Westinghouse fuel assemblies. Further, the GAIA fuel assemblies do not alter the plant such that the performance of the control rods is changed. Two independent reactivity control systems will continue to be provided, with both systems capable of reliably controlling the rate of reactivity changes from planned, normal power changes. Therefore, GDC 26 continues to be satisfied.

Criterion 27 - Combined Reactivity Control Systems Capability

"The reactivity control systems shall be designed to have a combined capability, in conjunction with poison addition by the emergency core cooling system, of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained."

The vast majority of the fuel in the core continues to be supplied by Westinghouse and its operating characteristics are unchanged. The presence of the eight GAIA fuel assemblies will have a negligible effect on the existing core operating reactivity characteristics. Analyses demonstrate that the reactivity control systems will continue to be designed to have a combined capability, in conjunction with poison addition by the ECCS, of reliably controlling reactivity changes under postulated accident conditions, with appropriate margin for stuck rods, to assure the capability to cool the core is maintained. Therefore, GDC 27 continues to be satisfied.

Criterion 28 - Reactivity Limits

"The reactivity control system shall be designed with appropriate limits on the potential amount and rate of reactivity increase to assure that the effects of postulated reactivity accidents can neither (1) result in damage to the reactor coolant pressure boundary greater than limited local yielding nor (2) sufficiently disturb the core, its support structures or other reactor pressure vessel internals to impair significantly the capability to cool the core. These postulated reactivity accidents shall include consideration of rod ejection (unless prevented by positive means), rod dropout, steam line rupture, changes in reactor coolant temperature and pressure, and cold water addition."

Analyses performed for the GAIA fuel demonstrates its compatibility and similarity to the co-resident fuel, thus, the reactivity control systems will continue to to assure that the effects of postulated reactivity accidents can neither result in damage to the RCPB greater than limited local yielding, nor disturb the core, its support structures, or other reactor vessel internals so as to significantly impair the capability to cool the core. Therefore, GDC 28 continues to be satisfied.

Criterion 35 – Emergency Core Cooling

"A system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts."

Both the co-resident Westinghouse fuel and the Framatome GAIA fuel assemblies to be installed in Callaway's core have been evaluated and analyses demonstrate that fuel and cladding damage will not occur to the extent that it interferes with the continued effective core cooling following a loss of coolant accident. Further, analyses demonstrate that the clad metal-water reaction is limited to amounts that meet acceptance criteria. The use of the Framatome GAIA fuel has no effect on the design characteristics or functional capability of the emergency core cooling systems. The reload core design process incorporates checks to ensure that operating cycle core design continues to comply with the established limits. Therefore, GDC 35 continues to be satisfied.

There are no changes being proposed in this amendment application such that conformance or commitments to the regulatory requirements and/or guidance documents above would come into question. The evaluations documented herein confirm that Callaway will continue to comply with all applicable regulatory requirements.

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 following licensing activities have involved either NRC review of GAIA fuel or have involved the review of the Framatome analysis methods associated with this LAR:

Duke Energy submitted a license amendment request to transition from Framatome High Thermal Performance (HTP) fuel to GAIA fuel at the Shearon Harris Nuclear Power Plant, Unit 1 (ADAMS Accession No. ML19100A442) that was approved in 2019 by the NRC (ADAMS Accession No. ML20212L594). The NRC evaluated the analytical methods specific to GAIA fuel as part of the amendment application. Shearon Harris is a Westinghouse three loop pressurized

water reactor sharing many comparable design elements and operating characteristics with Callaway.

Arizona Public Service submitted a license amendment request to transition to Framatome Advanced Combustion Engineering 16x16 HTP fuel with M5 as a fuel rod cladding material and gadolinia as a burnable absorber for all three units at the Palo Verde Nuclear Generating Station that was approved in 2020 by the NRC (ADAMS Accession No. ML20031C947). Palo Verde is a Combustion Engineering two steam generator and four cold leg pressurized water reactor.

NextEra Energy submitted a license amendment request to transition to Framatome (then AREVA) Combustion Engineering 16x16 HTP fuel with M5 as a fuel rod cladding material for its St. Lucie Plant, Unit 2, that was approved in 2016 by the NRC (ADAMS Accession No. ML16063A121). St. Lucie Unit 2 is a Combustion Engineering two steam generator and four cold leg pressurized water reactor.

Constellation Energy submitted a license amendment request to transition to Framatome (then AREVA) Advanced Combustion Engineering 14x14 HTP fuel with gadolinium oxide burnable poison with M5 as a fuel rod cladding material for its Calvert Cliffs Nuclear Power Plant, Units 1 and 2, that was approved in 2011 by the NRC (ADAMS Accession No. ML110390263). Calvert Cliffs is a Combustion Engineering two steam generator and four cold leg pressurized water reactor.

Exelon Generation submitted a license amendment request to allow use of up to two accident tolerant fuel lead test assemblies in its Calvert Cliffs Nuclear Power Plant, Units 1 and 2. The application requested the ability to load Framatome PROtect™ fuel design (ADAMS Accession No. ML19347A779). The NRC's permission to load the lead test assemblies is documented in the amendment approval letter along with the safety evaluation dated January 26, 2021 (ADAMS Accession No. ML20363A242). Calvert Cliffs is a Combustion Engineering two steam generator and four cold leg pressurized water reactor.

Florida Power and Light submitted a license amendment request for an extended power uprate for a core using AREVA 14x14 high thermal performance fuel. The review of the amendment request included a review of Framatome (then AREVA) analysis methods that are also included in this amendment request. The license amendment request was approved as documented in the safety evaluation dated July 9, 2012 (ADAMS Accession No. ML12181A019).

Section 2.2 of Attachment 9 provides a synopsis of the operational experience of Framatome GAIA fuel assemblies in Westinghouse 3-loop and 4-loop designs.

4.3 No Significant Hazards Consideration Determination

The standards used to arrive at a determination that a request for amendment involves a No Significant Hazards Consideration are included in the Commission's regulation, 10 CFR 50.92, "Issuance of amendment," which states that No Significant Hazards Considerations are involved if the operation of the facility in accordance with the amendment would not:

(1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or
(2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or
(3) Involve a significant reduction in a margin of safety.

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 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 modify the TS to include Framatome GAIA fuel-specific safety limits and allow the use of M5 fuel cladding material. In combination, these changes allow the use of eight GAIA fuel assemblies beginning in operating cycle 27.

The proposed changes incorporate into the TS a limit on the departure from nucleate boiling ratio (DNBR) safety limit and the peak fuel centerline temperature safety limit for the GAIA fuel design. These limits are based on NRC reviewed and approved correlations, and do not require a physical change to plant systems, structures or components. Plant operations and analysis will continue to be in accordance with the Callaway licensing basis. These changes do not impact any of the accident initiators. The departure from nucleate boiling ratio and the peak fuel centerline temperature are the basis for protecting the fuel and are consistent with the safety analysis.

The proposed safety limits ensure that fuel integrity will be maintained during normal operations and anticipated operational transients. The proposed safety limit values and supporting analysis methods do not affect the performance of any equipment used to mitigate the consequences of an analyzed accident. There is no impact on the pathways for radionuclide release assumed in accidents previously evaluated. Accident source terms are verified for each core reload design, and the o source terms will be compared to those of the approved bounding analysis in effect at the time. Any changes in source term will be reviewed under 10 CFR 50.59. Given the limited number of GAIA assemblies being introduced into the core, a more than minimal increase in dose consequences is not anticipated.

These changes also allow the use of Framatome M5 cladding material which has been previously evaluated and approved for use in pressurized water reactors. Analysis demonstrates the suitability of the cladding material and its ability to satisfy regulatory performance criteria during transients and anticipated operational occurrences. The presence of this material has no direct cause and effect relationship with the initiation of any evaluated accident.

For the reasons above, this proposed license amendment does not significantly increase the probability or consequences of an accident previously evaluated in the FSAR.

The proposed changes will allow use of Framatome GAIA fuel assemblies in the reactor core. The design characteristics have been analyzed to ensure their compatibility with co-resident fuel and that they comply with regulatory acceptance criteria. The presence of the GAIA fuel in the core does not alter or prevent the ability of structures, systems, and components (SSCs) from performing their intended functions to mitigate the consequences of an initiating event within the assumed acceptance limits.

The proposed use of Framatome GAIA fuel has been evaluated using NRC-approved methods that demonstrate the consequences of previously evaluated accidents are not significantly increased. The changes will not alter the licensed thermal power level of the reactor, nor will they alter any assumptions regarding assumed release pathways to the environment. For these reasons, the consequences of an accident are not significantly increased.

Therefore, it is concluded that the changes do 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

No new or different accidents result from the use of Framatome GAIA fuel assemblies in the Callaway core. Other than the fuel design change, the proposed license amendment does not involve a physical alteration of the plant or plant systems (i.e., no new or different type of equipment will be installed which would create a new or different kind of accident).

Physical changes associated with the proposed Framatome GAIA fuel design do not introduce any new accident initiators and do not adversely affect the performance of any structure, system, or component previously credited for accident mitigation. Use of Framatome fuel with M5 cladding in the Callaway reactor core is compatible with the plant design and does not introduce any new safety functions for plant structures, systems, or components. Analysis demonstrates that the fuel design performs within the fuel design limits.

The adoption of the Framatome specific safety limits and the use of M5 cladding do not affect or create any new or different accident initiator. There are no changes in the parameters within which the plant is normally operated and the changes do not impose any new or different operating requirements.

Therefore, it is concluded that the changes do 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 changes proposed in this license amendment request are related to the use of the GAIA fuel design with M5 cladding. The supporting analysis methods are approved by the NRC for this application. The analyses demonstrate continued compliance with the regulatory acceptance limits in a manner comparable to the existing safety analysis for the fuel supplied by the current vendor. The reactor will continue to be operated within its analyzed operating and design envelope. The overpressure limits for the reactor coolant system integrity and the containment integrity remain unchanged. The LOCA analyses meet all the applicable 10 CFR 50.46 acceptance criteria, and, thus, the proposed changes do not affect margin to safety for any accidents previously evaluated.

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

In consideration 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, 1) there is a reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner with the fuel design change, 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. Ameren Missouri letter ULNRC-06695, "Supplement to Presentation Information For Second Pre-Application Meeting Regarding Use of Framatome Fuel At Callaway Plant," dated October 6, 2021 (ADAMS Accession No. ML21279A286)
2. Ameren Missouri letter ULNRC-06694, “Presentation Information for Second Pre-Application Meeting Regarding Use of Framatome Fuel at Callaway Plant,” dated September 28, 2021 (ADAMS Accession No. ML21271A611)
3. Ameren Missouri letter ULNRC-06692, " Third Supplement to Request For License Amendment and Regulatory Exemptions for a Risk-Informed Approach To Address GSI-191 and Respond To GL 2004-02 (LDCN 19-0014) (EPID L-2021-LLA-0059 AND EPID L-2021-LLE-0021)," dated October 7, 2021 (ADAMS Accession No. ML21280A379)
4. Ameren Missouri letter ULNRC-06526, "Request for License Amendment and Regulatory Exemptions for a Risk-Informed Approach to Address GSI-191 and Respond to GL 2004-02 (LDCN 19-0014)," dated March 31, 2021 (ADAMS Accession No. ML21090A184)
5. Ameren Missouri Letter ULNRC-06664, "Supplement to Request for License Amendment and Regulatory Exemptions for a Risk-Informed Approach to Address GSI-191 and Respond to GL 2004-02 (LDCN 19-0014)," dated May 27, 2021 (ADAMS Accession No. ML21147A222)
6. Ameren Missouri letter ULNRC-06651, "Supplement to Request for License Amendment and Regulatory Exemptions for a Risk-Informed Approach to Address GSI-191 and Respond to GL 2004-02 (LDCN 19-0014)," dated July 22, 2021 (ADAMS Accession No. ML21203A192)
7. Ameren Missouri letter ULNRC-06690, " Fourth (Post-Audit) Supplement to Request for License Amendment and Regulatory Exemptions for a Risk-Informed Approach to Address GSI-191 and Respond to GL 2004-02 (LDCN 19-0014) (EPID L-2021 LLA 0059 AND EPID L-2021-LLE-0021)," dated January 27, 2022 (ADAMS Accession No. ML22027A805)
8. Ameren Missouri letter ULNRC-06683, "Transmittal of Documents Identified from NRC Audit of License Amendment Request Regarding Risk-Informed Approach to Closure of Generic Safety Issue 191 (EPID L-2021-LLA-0059)", dated August 23, 2021 (ADAMS Accession No. ML21237A136)
9. Ameren Missouri letter ULNRC-06654, "Presentation Information for Pre-Application Meeting Regarding Use of Framatome Fuel at Callaway Plant," dated May 3, 2021 (ADAMS Accession No. ML21123A259)
10. ANP-3947P, Revision 3, "Callaway Unit 1 License Amendment Request Inputs for Use of Framatome Fuel," dated October 2022.
11. BAW-10227P-A, Revision 1, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," dated June 2003.
12. BAW-10240(P)(A) Revision 0, "Incorporation of M5 Properties in Framatome ANP Approved Methods," dated May 2004.
13. Not used.
14. NRC Regulations, Title 10, Code of Federal Regulations, Part 50, “Domestic Licensing of Production and Utilization Facilities.”
15. ANP-3969P, Revision 2, "Callaway Non-LOCA Summary Report," dated October 2022.
16. ANP-3943P, Revision 1, "Callaway Small Break LOCA Analysis with GAIA Fuel Design," dated October 2022.

17. ANP-3944P, Revision 1, "Callaway Realistic Large Break LOCA Analysis with GAIA Fuel Design," dated October 2022.
18. NRC letter dated July 1, 2021, 'Summary of May 20, 2021, Partially Closed Pre-Application Teleconference with Union Electric Company Regarding Approval to Insert Framatome's GAIA Fuel Assemblies in Their Core in Reload Quantities for Callaway Plant, Unit No. 1 (EPID L-2021-LRM-0043),' (ADAMS Accession No. ML21168A002)
19. NRC letter dated November 17, 2021, 'Summary of October 14, 2021, Partially Closed Pre-Application Teleconference with Union Electric Company Regarding Approval to Insert Framatome's GAIA Fuel Assemblies in its Core in Reload Quantities for Callaway Plant, Unit No. 1 (EPID L-2021-LRM-0099).' (ADAMS Accession Number ML21308A074)
20. Ameren Missouri letter ULNRC-06716, "Presentation Information for Third Pre-Application Meeting Regarding Use of Framatome Fuel at Callaway Plant," dated February 15, 2022. (ADAMS Accession No. ML22047A093)
21. NRC letter dated April 6, 2022, 'Summary of February 28, 2022, Partially Closed Pre-Application Teleconference with Union Electric Company Regarding Approval to Insert Framatome's GAIA Fuel Assemblies in its Core in Reload Quantities for Callaway Plant, Unit No. 1 (EPID L-2022-LRM-0013),' (ADAMS Accession No. ML22089A229)
22. Not used.
23. Not used.
24. Not used.
25. Not used.
26. BAW-10227 Revision 2, Q3P Revision 0, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel", July 2021.
27. XN-75-32(P)(A) Supplements 1, 2, 3, and 4, "Computational Procedure for Evaluating Fuel Rod Bowing," February 1983.
28. ANP-10338P-A, Revision 0, "AREA™ – ARCADIA® Rod Ejection Accident," December 2017.
29. Regulatory Guide 1.236, "Pressurized-Water Reactor Control Rod Ejection and Boiling-Water Reactor Control Rod Drop Accidents," dated June 2020. (ADAMS Accession No. ML20055F490)
30. U.S. Nuclear Regulatory Commission Staff Review guidance for In-Vessel Downstream Effects Supporting Review of Generic Letter 2004-02 Responses, September 4, 2019, (ML19228A011).
31. WCAP-17788P, Volume 1, "Comprehensive Analysis and Test Program for GSI-191 Closure (PA-SEE-1090)."
32. PWROG-16057-P, "TSTF-567 Implementation Guidance, Evaluation of In-Vessel Debris Effects, Submittal Template for Final Response to Generic Letter 2004-02 and FSAR Changes."
33. Ameren Missouri letter ULNRC-06636, "License Amendment Request for Adoption of Alternate Source Term and Revision of Technical Specifications," dated September 28, 2021. (ADAMS Accession No. ML21272A167 (Package), ML21335A451 (Package)).
34. Ameren Missouri letter ULNRC-06696, "Supplement to License Amendment Request for Adoption of Alternate Source Term and Revision of Technical Specifications (EPID L-2021-LLA-0177)," dated December 1, 2021 (ADAMS Accession No. ML21335A451 (Package)).

35. Regulatory Guide 1.183, Revision 0, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors."
36. ANP-10342P-A, Revision 0, "GAIA Fuel Assembly Mechanical Design," dated September 2019 (ADAMS Accession No. ML19204A048).
37. NRC Safety Evaluation Report, "Transition to AREVA NP Fuel and Safety Analysis Methodology," Calvert Cliffs Nuclear Power Plant, dated February 18, 2011 (ADAMS Accession No. ML110390263).
38. Ameren Missouri letter ULNRC-06729, "Application for Technical Specification Change and Exemption Request Regarding Transition to Framatome Fuel, LDCN 22-0002," dated June 2, 2022 (ADAMS Accession No. ML22153A174).
39. Ameren Missouri letter ULNRC-06758, "Withdrawal of License Amendment Request and Exemption Request Regarding Transition to Framatome Fuel (LDCN 22-0002)" dated August 4, 2022 (ADAMS Accession No. ML22216A202).
40. NRC Letter "Callaway Plant, Unit No. 1 – Withdrawal of Requested Licensing Action re: License Amendment Request for Technical Specification Change and Exemption Request Regarding Transition to Allow Use of Framatome GAIA Fuel, Submitted to NRC for Acceptance Review (EPID L-2022-LLA-0083 and EPID L-2022-LLE-0019)," dated August 15, 2022 (ADAMS Accession No. ML22220A281).
41. NRC Letter "Callaway Plant, Unit No. 1 – Supplemental Information Needed for Acceptance of Requested Licensing Action re: Amendment to Allow Use of Framatome GAIA Fuel (EPID L-2022-LLA-0083)," dated July 19, 2022 (ADAMS Accession No. ML22199A177).
42. Ameren Missouri letter ULNRC-06723, "License Amendment Request Regarding Proposed Technical Specification Changes for Spent Fuel Storage (LDCN 22-0015)," dated August 29, 2022 (ADAMS Accession No. ML22242A123).
43. Ameren Missouri letter ULNRC-06767, "Presentation Information for Fourth Pre-Application Meeting regarding Use of Framatome Fuel at Callaway Plant," dated September 6, 2022 (ADAMS Accession No. ML22249A328).
44. Regulatory Guide 1.240, "Fresh and Spent Fuel Pool Criticality Analyses," Revision 0 dated March 2021 (ADAMS Accession No. ML20356A127).
45. ANP-4012P, Revision 0, "Callaway Rod Ejection Accident Analysis," dated July 2022.