

## Enclosure 1

# Request for Exemptions for Callaway Risk-Informed Approach to Resolution for Generic Letter 2004-02

### ATTACHMENTS:

- 1-1 Request for Exemption from 10 CFR 50.46(a)(1)
- 1-2 Request for Exemption from GDC 35
- 1-3 Request for Exemption from GDC 38
- 1-4 Request for Exemption from GDC 41

## Requests for Exemptions for Callaway Risk-Informed Approach to Resolution for Generic Letter 2004-02

### Introduction

In support of Callaway Plant, Unit No. 1 (Callaway), Union Electric Company (d.b.a. Ameren Missouri) proposes to adopt the Callaway risk-informed approach described herein to address Generic Safety Issue (GSI)-191 and provide a final response to NRC Generic Letter (GL) 2004-02.

In SECY 12-0093, "Closure Options for Generic Safety Issue - 191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance," the NRC provided the following options for resolving the issues that pertain to loss-of-coolant accident (LOCA)-generated debris effects:

- Option 1: Compliance with 10 CFR 50.46 Based on Approved Models
- Option 2: Mitigative Measures and Alternative Methods Approach
- Option 3: Different Regulatory Treatment for Suction Strainer and In-Vessel Effects

Two approaches were provided for resolution under Option 2:

- a. Continue to pursue refinements to the evaluation methods (i.e., use a deterministic approach).
- b. Use the South Texas Project (STP) risk-informed approach, which focuses plant modifications on the most risk significant aspects of GSI-191 for each plant.

For plants with sufficiently low fiber loading in containment, or for which modifications to reduce fiber loading are practical, Options 1 or 2a may be employed to deterministically demonstrate by analysis and/or testing that debris generated from postulated LOCAs will not cause containment sump strainer blockage or result in adverse downstream effects such as blockage of downstream components or in-vessel core blockage.

Callaway does not have a sufficiently low fiber loading in containment to allow adoption of Options 1 or 2a. Although mitigative measures have been taken to reduce fiber loading in the Callaway containment by replacing fibrous insulation with material that is not susceptible to fiber debris formation, removal of the remaining fibrous insulation would result in an undue hardship in terms of occupational dose and represent a substantial economic cost without a corresponding benefit in safety. Therefore, Ameren Missouri proposes to address GSI-191 and provide a final response to GL 2004-02 by using the risk-informed approach described herein in accordance with SECY 12-0093, Option 2b.

Attachments 1-1 through 1-4 to this enclosure provide Ameren Missouri's requests for exemptions under 10 CFR 50.12 from certain requirements in 10 CFR 50.46, "Acceptance Criteria for emergency core cooling systems for light-water nuclear power reactors," and Appendix A to 10 CFR 50, "General Design Criteria for Nuclear Power Plants." The exemption requests complement a License Amendment Request (LAR) provided in Enclosure 2 to this letter, proposing methodology changes that will be incorporated in the Callaway Technical Specifications (TS) and Final Safety Analysis Report (FSAR) based on NRC acceptance of the risk-informed approach taken by Ameren Missouri to address GSI-191/GL 2004-02. Specifically, the exemption requests support application of the "RoverD" method for addressing the concerns of GSI-191/GL 2004-02, which is further described in Enclosure 3 and which relies, in part, on risk-informed methods. This risk-informed method/approach serves to confirm the adequacy of Callaway's design in regard to the systems and functions potentially affected by LOCA-generated debris effects, and as such, the method/approach necessitates exemptions from the deterministically based General Design Criteria. However, application of Ameren Missouri's risk-informed approach does not undermine the underlying intent of the General Design Criteria nor the underlying criteria in paragraph 10 CFR 50.46(b) for providing an emergency core cooling system designed to keep peak cladding temperature from exceeding 2200°F.

The exemption requests specifically pertain to requirements in General Design Criterion (GDC) 35, "Emergency Core Cooling"; GDC 38, "Containment Heat Removal"; GDC 41, "Containment Atmosphere Cleanup"; and to the criteria set forth for core cooling performance in 10 CFR 50.46(a)(1). Each request is further explained in its own attachment to the enclosure, identified as follows:

Attachment 1-1, Request for Exemption from 10 CFR 50.46(a)(1)

Attachment 1-2, Request for Exemption from GDC 35

Attachment 1-3, Request for Exemption from GDC 38

Attachment 1-4, Request for Exemption from GDC 41

Approval of the exemptions will allow use of a risk-informed method to account for the probabilities and uncertainties associated with mitigation of the effects of debris following postulated LOCAs. The method evaluates the effects on strainer blockage and core blockage resulting from debris concerns raised by GL 2004-02. In order to confirm acceptable sump design, the risk associated with GL 2004-02 concerns is evaluated to include the failure mechanisms associated with loss of core cooling and strainer blockage.

Each of Attachment 1-1 through Attachment 1-4 identifies the applicable rule from which the exemption is requested, the regulatory requirements involved, the purpose of the request, and the technical basis and justification for the exemption request, including the presence of special circumstances pursuant to 10 CFR 50.12(a). The requested exemptions are part of a risk-informed approach to resolve GL 2004-02 issues. The risk-informed approach is designed to be consistent with the guidance in Regulatory

Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis."

With respect to other requirements for the emergency core cooling system (ECCS), the final section of this document (titled "Discussions of Other Regulatory Requirements") addresses the balance of 10 CFR 50.46, 10 CFR 50 Appendix K, 10 CFR 100, and GDCs 2, 4, and 19. Based on their evaluations below, Ameren Missouri concluded that no exemptions were needed to these requirements.

The scope of the exemptions applies for all debris effects addressed in the risk-informed element of the Callaway RoverD methodology described in Enclosure 3 that was used to respond to GL 2004-02, and which are associated with LOCA break sizes and locations that potentially generate fine fiber debris that exceeds the quantity deterministically bounded by the Callaway plant-specific testing described in Enclosure 3, Attachment 3-2.

The Callaway risk-informed approach addresses the five key principles in RG 1.174 for risk-informed decision-making:

1. The proposed change meets the current regulations unless it is explicitly related to a requested exemption (i.e., a specific exemption under 10 CFR 50.12, "Specific Exemptions").
2. The proposed change is consistent with a defense-in-depth philosophy.
3. The proposed change maintains sufficient safety margins.
4. When proposed changes result in an increase in core damage frequency (CDF) or risk, the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.
5. The impact of the proposed change should be monitored using performance measurement strategies.

The resulting risk metrics, i.e., changes in CDF and large early release frequency (LERF), associated with GL 2004-02 concerns are used to determine whether plant modifications are warranted to ensure acceptable sump performance. The requested exemptions support this approach. A generic methodology for the Callaway approach is provided in Enclosure 3, Attachment 3-3 to this letter.

Based on the results for Callaway showing that the risk for the effects of debris is less than the threshold for Region III, "Very Small Changes," of RG 1.174, no additional physical changes to the facility or changes to the operation of the facility are proposed.

## Background and Overview

GSI-191 concerns the possibility that debris generated during a LOCA could clog the containment sump strainers in pressurized-water reactors (PWRs) and result in loss of net positive suction head (NPSH) for the ECCS and containment spray system (CSS) pumps, impeding the flow of water from the sumps. GL 2004-02 requested licensees to address GSI-191 issues focused on demonstrating compliance with the 10 CFR 50.46 ECCS acceptance criteria. GL 2004-02 requested licensees to perform new, more realistic analyses using an NRC-approved methodology and to confirm the functionality of the ECCS and CSS during design basis accidents that require containment sump recirculation. As stated in GL 2004-02:

*Although not traditionally considered as a component of the 10 CFR 50.46 ECCS evaluation model, the calculation of sump performance is necessary to determine if the sump and the ECCS are predicted to provide enough flow to ensure long-term cooling.*

*Based on the new information identified during the efforts to resolve GSI-191, the staff has determined that the previous guidance used to develop current licensing basis analyses does not adequately and completely model sump screen debris blockage and related effects. As a result, due to the deficiencies in the previous guidance, an analytical error could be introduced which results in ECCS and CSS performance that does not conform with existing applicable regulatory requirements outlined in this generic letter. Therefore, the staff is revising the guidance for determining the susceptibility of PWR recirculation sump screens to the adverse effects of debris blockage during design basis accidents requiring recirculation operation of the ECCS or CSS. In light of this revised staff guidance, it is appropriate to request that addressees perform new, more realistic analyses and submit information to confirm the functionality of the ECCS and CSS during design basis accidents requiring recirculation operations.*

Also, in its section on Applicable Regulatory Requirements, GL 2004-02 identifies requirements from the Code of Federal Regulations, as excerpted below.

*NRC regulations in Title 10, of the Code of Federal Regulations Section 50.46, 10 CFR 50.46, require that the ECCS have the capability to provide long-term cooling of the reactor core following a LOCA. That is, the ECCS must be able to remove decay heat, so that the core temperature is maintained at an acceptably low value for the extended period of time required by the long-lived radioactivity remaining in the core.*

*Similarly, for PWRs licensed to the General Design Criteria (GDCs) in Appendix A to 10 CFR 50, GDC 38 provides requirements for containment*

*heat removal systems, and GDC 41 provides requirements for containment atmosphere cleanup. Many PWR licensees credit a CSS, at least in part, with performing the safety functions to satisfy these requirements, and PWRs that are not licensed to the GDCs may similarly credit a CSS to satisfy licensing basis requirements. In addition, PWR licensees may credit a CSS with reducing the accident source term to meet the limits of 10 CFR Part 100 or 10 CFR 50.67. GDC 35 is listed in 10 CFR 50.46(d) and specifies additional ECCS requirements. PWRs that are not licensed to the GDCs typically have similar requirements in their licensing basis.*

Ameren Missouri has implemented compensatory and mitigative measures in response to Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," and GL 2004-02 to address the potential for sump strainer clogging and other concerns associated with GSI-191. Larger containment sump strainers have been installed (under a modification implemented in 2007) that greatly reduce the potential for loss of NPSH. Jacketed fiberglass blanket insulation for the steam generators has been replaced with reflective metal insulation that is not susceptible to formation of fiber debris. Defense-in-depth measures such as operating procedures and instrumentation to monitor core level and temperature, and actions taken by operators if core blockage is indicated, are described in Enclosure 3, Attachment 3-4.

The Commission issued Staff Requirements Memorandum (SRM)-SECY-10-0113 directing the staff to consider alternative options for resolving GSI-191. (SRM)-SECY-12-0093 described the staff plans to use South Texas Project (STP) as a pilot for other licensees choosing to use the risk-informed approach proposed by STP. The STP approach was referred to as risk-informed Option 2 (i.e., Option 2b). This approach requires an exemption request in accordance with 10 CFR 50.12 from certain requirements of 10 CFR 50.46, based in part on meeting the guidance in RG 1.174. Because the residual risk of GL 2004-02 concerns meets RG 1.174 acceptance guidelines, the approach allows fiber insulation and other contributors to GL 2004-02 concerns to remain in containment in light of the acceptably low risk.

Following the precedent of this STP pilot-plant approach, the Callaway methodology is described in Enclosure 3, Attachments 3-2 and 3-3. This enclosure (Enclosure 1, with Attachments 1-1, 1-2, 1-3, and 1-4) addresses the deterministic requirements in 10 CFR 50.46, GDC 35, GDC 38, and GDC 41 with proposed exemptions.

**Special Circumstances Common to Proposed Exemptions to 10 CFR 50.46(a)(1), GDC 35, GDC 38, and GDC 41**

According to 10 CFR 50.12, in regard to the granting of regulatory exemptions, the Commission will not consider granting an exemption unless special circumstances are present. Per 10 CFR 50.12(a)(2)(ii), special circumstances are present when:

*Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule.*

An objective of each of the regulations (10 CFR 50.46(a)(1), GDC 35, GDC 38 and GDC 41) for which an exemption is proposed is to maintain low risk to the public health and safety, in this case, through functions (ECCS and/or CSS) that are supported by the containment sumps. By regulatory precedent, licensees are required to demonstrate this capability by the use of a bounding calculation or other deterministic method. The supporting analysis demonstrates that a risk-informed approach to sump performance is consistent with the Commission's Safety Goals for nuclear power plants and supports operation of the noted functions with a high degree of reliability. Consequently, the special circumstances described in 10 CFR 50.12(a)(2)(ii) apply to each of the exemptions proposed by Ameren Missouri.

In further regard to the granting of exemptions, special circumstances are also present when, per 10 CFR 50.12(a)(2)(iii):

*Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated.*

As more fully described in Enclosure 3, the risk-informed RoverD method follows the guidance of Regulatory Guide 1.174 to assess the risk associated with the debris concerns raised in GL 2004-02. The RoverD approach includes a model/methodology (CASA Grande) used to evaluate the magnitude of pipe breaks (LOCAs) required to exceed the risk-based metric referred to as the fiber threshold (for which the results of head-loss testing were taken into account). The risk-based metric is used to classify scenarios as "deterministic" or "risk informed." Deterministic scenarios are those for which the amount of low-density fiber glass (LDFG) estimated to arrive on the emergency strainers does not exceed the fiber, or risk-based, threshold. Risk-informed scenarios are those for which the amount of LDFG estimated to arrive at the ECCS strainers exceeds the amount of LDFG used in strainer testing, as expected for the largest analyzed pipe breaks. For the latter, the risk contribution of those breaks is evaluated (using the noted method/methodology) against the RG 1.174 quantitative criteria for core-damage frequency {CDF,  $\Delta$ CDF} and large early-release frequency {LERF,  $\Delta$ LERF}.

In order to meet a deterministic threshold value for containment debris loading for all postulated pipe breaks, the amount of debris-generating contributors in the Callaway plant design would need to be significantly reduced through insulation replacement with reflective metal insulation (RMI) and other modifications. Radiological exposure for insulation modifications could be significant and would exceed the industry ALARA standard value for annualized collective radiation exposure. The highest dose contributor to such modifications would be personnel working in close proximity to high dose sources such as steam generator and primary coolant piping.

The dose estimates to make the necessary modifications at Callaway to plant fiber debris source terms (i.e., to meet the deterministic threshold value for containment debris loading by removing the remaining jacketed fiberglass blanket insulation and replacing it with reflective metal insulation) were estimated to be greater than 50 person-rem. For comparison, this value is greater than the 42 person-rem dose that was incurred for an entire outage workload during the Callaway refueling outage in 2012. It is clear that the greater than 50 person-rem dose allocation would be an undue hardship as defined by 10 CFR 50.12(a)(2)(iii).

### **Environmental Consideration**

Pursuant to the requirements of 10 CFR 51.41 and 10 CFR 51.21, "Criteria for and identification of licensing and regulatory actions requiring environmental assessments," the following information is provided. As demonstrated below, the proposed exemptions qualify for a categorical exclusion in 10 CFR 51.22. However, if the NRC determines that an environmental assessment is necessary, this information will support a finding of no significant impact. The assessment applies to all of the proposed exemptions.

#### Identification of the Proposed Action

The proposed exemptions are to allow for use of a risk-informed approach to evaluate the residual risk associated with GL 2004-02, i.e., those concerns that have not been fully addressed using deterministic methods, for the purpose of amending the design basis for acceptable mitigation of the effects of debris during recirculation mode following postulated LOCAs. Approval of the proposed exemption would complement approval of the TS, TS Bases and FSAR changes described in Enclosure 2 to this letter, for implementation of the risk-informed method for Callaway.

#### Need for the Proposed Action

In the Commission's Policy Statement on "Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities," the Commission stated that "the use of PRA technology in NRC regulatory activities should be increased to the extent supported by the state-of-the-art in PRA methods and data and in a manner that complements the NRC's deterministic approach," consistent with traditional defense-in-depth concepts.



The intent of the Commission's Policy Statement is to use the PRA to further understand the risk associated with a proposed change for the purpose of removing unnecessary conservatism associated with regulatory requirements in order to focus attention and allocation of resources to areas of true safety significance.

To implement the Commission's Policy Statement, the NRC issued RG 1.174 to provide guidance on an acceptable approach to risk-informed decision-making, based on a set of five key principles. The proposed exemptions are needed to allow Ameren Missouri to use a risk-informed method to address the issues associated with GL 2004-02 concerns regarding the potential for insulation damage and other debris generated in the event of a postulated LOCA within the containment to impact acceptable recirculation operation for ECCS, and challenge the ability of the ECCS to provide adequate long-term core cooling. This proposed exemption is consistent with the key principle in RG 1.174 which requires proposed changes to meet current regulations unless explicitly related to a requested exemption.

#### Environmental Impacts Consideration

The changes that are supported by the proposed exemptions have been evaluated and determined to result in no significant radiological environmental impacts associated with the implementation of the changes. This conclusion is based on the following.

The proposed exemptions are to allow use of a risk-informed method for demonstrating that the design and licensing bases for the ECCS and CSS are not significantly affected by debris effects identified in GL 2004-02. No physical modifications or changes to operating requirements are proposed for the site or facility, including any systems, structures and components relied upon to mitigate the consequences of a LOCA. The intent of the proposed changes is to quantify the risk associated with GL 2004-02 concerns. This quantification, provided in the form of risk metrics using the guidance in RG 1.174, demonstrates that the risk is less than the threshold for Region III, "Very Small Changes," in RG 1.174. Therefore, the proposed exemptions support a change that represents a very small change in LERF, which corresponds to an insignificant impact on the environment.

Based on the results of the risk-informed method demonstrating that the increases in risk are very small, the changes that are supported by the proposed exemptions has a negligible effect on accident probability, and adequate assurance of public health and safety is maintained. The changes supported by the proposed exemptions do not involve any changes to the facility or facility operations that could create a new or significantly affect a previously analyzed accident or release path, and therefore would result in no significant changes in the types or quantities of radiological effluents that may be released offsite. Therefore, the proposed exemptions support changes that do not affect the generation of any radioactive effluents, and does not affect any of the permitted effluent release paths.

The changes supported by the proposed exemptions have no impact on requirements related to the integrity of the reactor coolant system piping or any other aspect related to the initiation of a LOCA. No physical modifications or changes to operating requirements are proposed for the facility, including any systems, structures and components relied upon to mitigate the consequences of a LOCA. Therefore, the proposed exemptions support change that do not affect the probability of an accident initiator.

The changes that are supported by the proposed exemptions do not significantly impact a release of radiological effluents during and following a postulated LOCA. The design-basis LOCA radiological consequence analysis in the current licensing basis is a deterministic evaluation based on the assumption of a major rupture of the reactor coolant system piping and a significant amount of core damage. The current licensing basis analysis shows the resulting doses to the public, control room and Technical Support Center personnel are acceptable. The proposed changes validate and do not change the input parameter values used in the radiological analysis. Therefore, the proposed exemptions support changes that do not affect the amount of radiation exposure resulting from a postulated LOCA.

The changes that are supported by the proposed exemptions do not involve any changes to the site property, physical changes to the facility, or changes to the operation of the facility. Therefore, there are no irreversible and irretrievable commitments of resources involved in implementation of the proposed exemptions. The risk-informed method requires a determination that the risk associated with the proposed changes meets the Commission's safety goals. Therefore, the proposed changes would not result in a significant increase in any radiological hazard beyond those events previously analyzed in the FSAR. There will be no change to radioactive effluents that affect radiation exposures to plant workers and members of the public. Therefore, no significant changes or different types of radiological impacts are expected as a result of the proposed changes. The changes that are supported by the proposed exemptions do not change the input parameter values used in the radiological analysis. Therefore, the proposed exemptions support changes that would not significantly increase the probability or consequences of an accident, and there will be no significant offsite impact to the public from approval of the proposed exemptions.

No additional physical modifications or changes to operating requirements are proposed for the facility, including any systems, structures and components relied upon to mitigate the consequences of a LOCA. Therefore, the proposed exemptions support changes that do not result in a significant increase in individual or cumulative occupational radiation exposure, and will not cause radiological exposure in excess of the dose criteria for restricted and unrestricted access specified in 10 CFR Part 20.

The changes that are supported by the proposed exemptions do not involve any changes to non-radiological plant effluents or any activities that would adversely affect the environment. The proposed changes do not affect any procedures used to operate

the facility, or any physical characteristics of the facility, system, structure and components. The proposed changes only pertain to the licensing basis for components located within the restricted area of the facility, to which access is limited to authorized personnel. Therefore the proposed exemptions support changes that would not create any significant non-radiological impacts on the environment in the vicinity of the plant.

Since implementation of the changes that are supported by the requested exemptions, if approved, would result in no physical changes to the facility, there is no possibility of irreversible or irretrievable commitments of resources. Similarly, the proposed changes do not involve the use of any resources not previously considered by the NRC in its past environmental statements for issuance of the facility operating licenses or other licensing actions for the facility. As a result, the proposed exemptions support changes that do not involve any unresolved conflicts concerning alternative uses of available resources.

### Alternatives

The alternative to the requested exemptions and associated risk-informed change is complete compliance with the existing provisions in 10 CFR 50.46(a)(1) and the relevant General Design Criteria. Compliance with 10 CFR 50.46(a)(1) and the relevant General Design Criteria would entail removal and disposal of significant amounts of insulation and installation of new insulation that is less likely to impact sump performance in the event of a LOCA. As discussed below, the alternative would not be environmentally preferable or cost justified.

The requested exemptions and associated changes entail a very small risk (and correspondingly, an environmental impact), which is so small that it is remote and speculative for environmental purposes.

As previously noted, removal and reinstallation of insulation would entail appreciable radiation exposures to workers (estimated to be greater than 50 person-rem). This option would result in extensive modifications to the facility and in significant occupational dose. As such, the alternative is not environmentally preferable. Additionally, the likely cost of \$50 million plus is not justified in light of the very small risk associated with the risk-informed exemptions.

### Categorical Exclusion Consideration

Ameren Missouri has evaluated the proposed exemptions against the criteria for identification of licensing and regulatory actions requiring environmental assessments in accordance with 10 CFR 51.21 and determined that the proposed exemptions meet the criteria and are eligible for categorical exclusion as set forth in 10 CFR 51.22, "Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review," paragraph (c)(9).

This determination is based on the fact that the requested exemptions are exemptions from requirements under 10 CFR 50 with respect to the installation or use of a facility component(s) located within the restricted area, as defined in 10 CFR 20, specifically to authorize a change to the licensing bases for the ECCS and CSS as they relate to acceptable containment sump performance in the recirculation mode following a postulated LOCA. The proposed exemptions and associated risk-informed change to the plant's licensing basis have been evaluated to meet the following criteria under 10 CFR 51.22(c)(9).

(i) The exemption(s) involves no significant hazards consideration.

The requested exemptions are needed to resolve compliance conflicts with the noted, deterministically based regulatory requirements that would otherwise result from approval and implementation of the risk-informed changes proposed in this letter and its enclosures/attachments. The proposed exemptions are thus a part of and/or required by those proposed changes to the plant's licensing basis. The changes have been subject to evaluation per the three criteria set forth in 10 CFR 50.92(c) to confirm whether the changes necessitating the exemptions involve no significant hazards consideration. That evaluation is documented in Enclosure 2, Section 4.3. As documented therein, the change (and thus the requested exemptions) involves no significant hazards consideration.

(ii) The exemption(s) involves no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

No physical modifications or changes to operating requirements are proposed for the facility, including any systems, structures and components relied upon to mitigate the consequences of a LOCA. Approval of the proposed exemptions requires the calculated risk associated with GL 2004-02 to meet the acceptance guidelines in RG 1.174, thereby maintaining public health and safety. Therefore there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

(iii) The proposed exemption(s) involves no significant increase in individual or cumulative occupational radiation exposure.

No physical modifications or changes to operating requirements are proposed for the facility, including any systems, structures and components relied upon to mitigate the consequences of a LOCA. Therefore, with respect to installation or use of a facility component located within the restricted area, there would be no significant increase in individual or cumulative occupational radiation exposure as a result of granting the requested exemptions.

Based on the above, Ameren Missouri concludes that the proposed exemptions meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Additional

technical justification for this conclusion is provided on the basis that the guidance and acceptance criteria provided in RG 1.174 are satisfied as described in Enclosure 3.

### **Discussions of other Regulatory Requirements**

Several regulatory requirements closely related to ECC are addressed below, where it is reasoned that no exemptions are necessary to meet their requirements under the current licensing basis.

#### Evaluation of Impacts on the Balance of 10 CFR 50.46 and 10 CFR 50 Appendix K

The exemption request to support closure for GL 2004-02 for Callaway is intended to address ECCS cooling performance design as presented in 10 CFR 50.46(a)(1) as it relates to imposing the requirements of the General Design Criteria.

For the purposes of demonstrating the balance of the acceptance criteria of 10 CFR 50.46, the design and licensing basis descriptions of accidents requiring ECCS operation, including analysis methods, assumptions, and results, which are provided in Callaway FSAR Chapters 6 and 15 remain unchanged. The performance evaluations for accidents requiring ECCS operation described in FSAR Chapters 6 and 15, based on the Appendix K Large-Break Loss-of-Coolant Accident (LBLOCA) analysis, demonstrate that for breaks up to and including the double-ended guillotine break (DEGB) of a reactor coolant pipe, the ECCS will limit the clad temperature to below the limit specified in 10 CFR 50.46 and assure that the core will remain in place and substantially intact with its essential heat transfer geometry preserved.

The requirements of 10 CFR 50.46(a)(1) remain applicable to the model of record that meets the required features of Appendix K. Approval of the requested exemption does not impact the current ECCS evaluation. This evaluation model remains the licensing basis for demonstrating that the ECCS calculated cooling performance following postulated LOCAs does not exceed the acceptance criteria.

The Callaway risk-informed approach uses the break frequencies from NUREG-1829, "Estimating Loss-of-Coolant Accident (LOCA) Frequencies Through the Elicitation Process," to quantify the residual risk associated with GL 2004-02 for those LOCAs which have not been resolved using deterministic methods, and shows that the quantified risk meets the acceptance guidelines defined in RG 1.174. The exemption request related to 10 CFR 50.46(a)(1) is specific to the regulation's design requirement for demonstrating the calculated cooling performance of the ECCS. (The regulation states that ECCS cooling performance must be calculated in accordance with an acceptable evaluation model and must be calculated for a number of postulated loss-of-coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated loss-of-coolant accidents are calculated.) The requested exemption pertains to the required deterministic analyses of LOCAs of different sizes, locations and other properties. The proposed exemption is not intended

to be applicable to other requirements specified in 10 CFR 50.46 or Appendix K to 10 CFR 50.

Consistent with what has been previously noted, and as further explained in Attachment 1-1, the NRC staff considers the modeling of sump performance as an input to the ECCS evaluation model, and therefore, the requirements of 10 CFR 50.46 are applicable. Consistent with this, the requirements and attributes for the proposed Callaway risk-informed method include evaluation of a full spectrum of postulated DEGBs, up to and including the largest piping in containment.

Engineering analyses and evaluations used to perform plant-specific testing to address the deterministic scope of the Callaway analysis consider a wide range of effects, including those addressed in NEI 04-07 and related NRC guidance for evaluation of sump performance. The proposed exemption does not affect any of the 10 CFR 50.46(a)(1) or Appendix K requirements for an acceptable ECCS evaluation model, and does not change the ECCS acceptance criteria in 50.46(b) as it applies to the calculated results. Application of the exemption request allows use of a risk-informed approach to evaluate the effects of LOCA debris associated with GL 2004-02 that may be present in an acceptable evaluation model. The results of the risk-informed method demonstrate that the risk associated with GL 2004-02 meets the acceptance guidelines of RG 1.174. The current licensing basis for addressing the adequacy of ECCS to meet the criteria of 10 CFR 50.46, including the Appendix K large-break LOCA analysis and the associated Chapter 15 accident analysis for LOCA, remains in place.

#### Evaluation of Impacts on GDC 2

With respect to protection against natural phenomena, GDC 2 states that SSCs important to safety shall be designed to withstand the effects of natural phenomena without the loss of capability to perform their safety functions. As applied to Callaway, GDC 2 compliance means the ECCS strainers are required to withstand the effects of a design basis seismic event and remain functional, including their function during post-accident recirculation. The high debris mass added onto the strainers after a postulated high-energy line break could increase the forces acting on the component to failure loads.

All breaks that lie within the RoverD debris load limits are acceptable from a structural standpoint. This means that all breaks for which the strainer is demonstrated to handle via deterministic means do not add enough mass onto the strainers to risk structural failure.

When both strainer trains are in operation, no breaks can create enough debris to risk structural failure. The debris load is split between the active strainers, and the increased mass does not reach the value where structural integrity of the component is challenged.

Any debris loads resulting from seismically-induced failures of welds on large diameter high-energy lines (i.e., large high-energy line breaks (HELBs)) during ECCS operation that would challenge the structural integrity of the strainer are all located outside the RoverD debris load limit. In other words, all breaks that produce enough debris to fail the structural limits of the strainers are also over the tested debris limit of the strainer. This means that the failure of a loaded, operating strainer during emergency core cooling due to a seismic event is already included in the basis for the license amendment request and in the analysis of Enclosure 3. The low probability of both events occurring simultaneously further reduces the risk of this type of failure.

For this reason, Ameren Missouri is not seeking exemption to the requirements of safety-related SSC being protected from natural phenomena and believes GDC 2 is being met.

#### Evaluation of Impacts on GDC 4

With respect to environmental and dynamic effects, GDC 4 states that SSCs important to safety shall be designed to withstand and be compatible with effects of missile and discharge fluids due to all accidents. Specifically for Callaway, this requirement includes assessing the break jet and resulting post-LOCA conditions that challenge the ECCS strainer.

The strainers at Callaway are protected against pipe whip and break jets due to their location in the plant, which is separated from high-energy lines by robust barriers and floors. The strainers are designed for the high-temperature, pH-buffered fluid environment, and the 10 CFR 50 Appendix K analyses include the characteristics of this fluid and environment. The strainer performance is qualified up to the RoverD debris load limit as described in Enclosure 3.

It should also be noted that very large pipe breaks of the reactor coolant system and residual heat removal system are not included in dynamics effects analyses at Callaway, which credits leak-before-break exclusions.

#### Evaluation of Impacts on 10 CFR 100 and GDC 19

The impact of the proposed exemptions on the licensing basis analysis for demonstrating that the radiological consequences of the design basis LOCA meet the radiological dose guidelines specified in 10 CFR 100 and the dose limits specified in GDC 19 has been evaluated. The risk-informed method provides confirmation of reliable ECCS and CSS performance as required for the licensing basis analyses that demonstrate compliance with the requirements of 10 CFR 100 and GDC 19. The method demonstrates that sump performance continues to support reliable plant design and operation and does not entail any exemption from 10 CFR 100 or GDC 19.

### *10 CFR 100 and GDC 19 Accidents Source Term*

For Callaway, the source term for the 10 CFR 100 analysis and GDC evaluation follows RG 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors," guidelines which assume large amounts of radioactivity are released suddenly from the core. There is no line break or LOCA associated with this source term, and the large source term equates to significant core damage that would only occur after failure of the ECCS. There is no logical sequence of events that causes such core damage without first making the ECCS inoperable. For this reason, the licensing basis analysis used to meet the requirements of 10 CFR 100 and GDC 19 is not affected by the debris in containment, and does not correspond to any analysis done for Callaway's response to GL 2004-02.

### *CSS Credit*

The analysis used for 10 CFR 100 and GDC 19 applies credit for operating the CSS for up to 10.5 hours depending on operator action. Of this time duration, a majority of the benefit of running the CSS occurs in the first few hours. According to FSAR Chapter 15, the RWST will feed the spray system for approximately 20 minutes after a large break LOCA. After that, within 8 minutes, the operators manually switch the CSS to draw water from the containment sumps. Several pool turnovers would have to occur before debris accumulation would challenge the strainer function. Given worst case conditions for flow rate (8,750 gpm per train), an active containment pool volume of 31,575 ft<sup>3</sup> at residual heat removal (RHR) switchover and 44,171 ft<sup>3</sup> at containment spray switchover, and the worst case break (1157 lbm of transportable fiber debris), the containment sump strainers are assumed to fail in less than 20 minutes. Therefore, the CSS would operate with full availability for a duration of less than 20 minutes after switchover under worst case conditions. This duration of containment spray is very beneficial to reduce radiological consequences and dose to the boundaries of 10 CFR 100 and the control room.

The CSS is shown to have a high probability of meeting the requirements credited in the 10 CFR 100 and GDC 19 analyses. Based on the safety margins in the evaluation of the debris effects described in Attachment 3-4 and the conservatism in the dose calculation, the current licensing basis analyses for 10 CFR 100 and GDC 19 are considered to be met such that no exemption from 10 CFR 100 or GDC 19 is needed in this regard.



Attachment 1-1

Request for Exemption from  
10 CFR 50.46(a)(1)

## Request for Exemption from Certain Requirements of 10 CFR 50.46(a)(1)

### 1-1.1 Exemption Request

Pursuant to 10 CFR 50.12, "Specific Exemptions," Union Electric Company (d.b.a. Ameren Missouri) is submitting this request for exemption from certain requirements of 10 CFR 50.46(a)(1), namely, "other properties," as it relates to using specific deterministic methodology to evaluate the effects of debris on long-term core cooling.

10 CFR 50.46(a)(1) is shown below with the "other properties" portion (for which exemption is requested) in bold.

*(a)(1)(i) 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 paragraph (b) of this section. ECCS cooling performance must be calculated in accordance with an acceptable evaluation model and must be calculated for a number of postulated loss-of-coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated loss-of-coolant accidents are calculated. Except as provided in paragraph (a)(1)(ii) of this section, the evaluation model must include sufficient supporting justification to show that the analytical technique realistically describes the behavior of the reactor system during a loss-of-coolant accident. Comparisons to applicable experimental data must be made and uncertainties in the analysis method and inputs must be identified and assessed so that the uncertainty in the calculated results can be estimated. This uncertainty must be accounted for, so that, when the calculated ECCS cooling performance is compared to the criteria set forth in paragraph (b) of this section, there is a high level of probability that the criteria would not be exceeded. Appendix K, Part II Required Documentation, sets forth the documentation requirements for each evaluation model. This section does not apply to a nuclear power reactor facility for which the certifications required under §50.82(a)(1) have been submitted.*

*(ii) Alternatively, an ECCS evaluation model may be developed in conformance with the required and acceptable features of appendix K ECCS Evaluation Models.*

The Callaway Plant, Unit No. 1 (Callaway) risk-informed approach to addressing GSI-191 and responding to GL 2004-02 is consistent with the NRC staff safety evaluation of NEI 04-07 that discussed the modeling of sump performance as follows:

*While not a component of the 10 CFR 50.46 ECCS evaluation model, the calculation of sump performance is necessary to determine if the sump and the residual heat removal system are configured properly to provide enough flow to ensure long-term cooling, which is an acceptance criterion of 10 CFR 50.46. Therefore, the staff considers the modeling of sump performance as the validation of assumptions made in the ECCS evaluation model. Since the modeling of sump performance is a boundary calculation for the ECCS evaluation model, and acceptable sump performance is necessary for demonstrating long-term core cooling capability (10 CFR 50.46(b)(5)), the requirements of 10 CFR 50.46 are applicable.*

Ameren Missouri requests an exemption from those deterministic requirements in order to enable the use of a risk-informed method to demonstrate acceptable sump performance and LOCA debris mitigation and to validate assumptions in the ECCS evaluation model. The result will be that the risk-informed methodology will be allowed rather than the currently required demonstration of mitigation capability by use of a bounding calculation or other deterministic method to model LOCA debris effects, as discussed in Generic Letter 2004-02 and associated guidance documents such as NEI 04-07 and its associated NRC Safety Evaluation.

The scope of the exemption applies for all debris effects addressed in the Callaway RoverD methodology described in Enclosure 3 that was used to respond to GL 2004-02, and which are associated with LOCA break sizes and locations that potentially generate fine fiber debris that exceeds the quantity bounded by Callaway Plant Unit 1 plant-specific testing also described in Enclosure 3. That scope is generally described as any breaks where more than 300 lbm of fiber debris can be generated and transported to the sumps. Sixty weld locations that are within the scope of the exemption have currently been identified on the RHR and RCS piping. To minimize the potential that a later analysis could cause the specific locations to change, the requested exemption is based on the breaks' ability to generate sufficient transportable debris, as described in RoverD. The key elements of the exemption request are:

1. It applies only to the effects of debris as described in Enclosure 3.
2. It applies only for LOCA breaks that can generate and transport fiber debris that is not bounded by Callaway plant-specific testing.

3. It applies to any LOCA break that can generate and transport fiber debris that is not bounded by Callaway plant-specific testing and is not limited to the 60 specific break locations noted in this application, provided that the incremental core damage frequency ( $\Delta$ CDF) and incremental large early release frequency ( $\Delta$ LERF) associated with the break size remain in Region III of RG 1.174.

This exemption request is complemented by the accompanying License Amendment Request (LAR) (Enclosure 2) seeking NRC approval of proposed changes to the Callaway Technical Specifications, TS Bases and Final Safety Analysis Report, to amend the licensing basis based on acceptable design of the containment sumps. The risk-informed method provides assurance, with high probability, for acceptable sump performance and debris mitigation during ECCS operation in recirculation mode as calculated by the ECCS evaluation model.

### 1-1.2 Regulatory Requirements Involved

By regulatory precedent, licensees are required to demonstrate compliance with the relevant regulations by the use of a bounding calculation or other deterministic method. Ameren Missouri seeks exemption to the extent that 10 CFR 50.46(a)(1) "other properties" would require deterministic calculations and/or analyses to address the concerns raised by GL 2004-02 related to acceptable plant performance during the recirculation mode in containment following a LOCA. The effects of LOCA debris have been evaluated using deterministic methods; however, those evaluations have not been shown to address fully the debris effects for the as-built, as-operated plant. The risk-informed approach evaluates the debris effects as part of the assessment of the residual risk associated with GL 2004-02 concerns. The proposed changes to the licensing basis (i.e., the Technical Specifications, TS Bases and FSAR) as submitted for NRC approval per Enclosure 2 address GSI-191 and provide closure to GL 2004-02 for Callaway Unit 1 on the basis that the associated risk is shown to meet the acceptance guidelines in RG 1.174 and that in conjunction with the existing licensing basis, adequate safety is demonstrated.

#### Evaluation of Impacts on other Regulatory Requirements

The proposed exemption does not result in any physical changes to the facility or changes to the operation of the plant, and does not change any of the programmatic requirements. Based on demonstrating acceptable LOCA debris mitigation and containment sump and ECCS design for amending the current licensing basis for 10 CFR 50.46(a)(1) as described above, compliance with other regulatory requirements that rely on acceptable design for these systems and components continue to be met in the current licensing basis.

### 1-1.3 Basis for the Exemption Request

Under 10 CFR 50.12, a licensee may request and the NRC may grant exemptions from the requirements of 10 CFR 50 which are authorized by law, will not present an undue risk to the public health and safety, are consistent with the common defense and security, and when special circumstances are present.

The exemption request meets a key principle of RG 1.174, which states, "The proposed change meets the current regulations unless it is explicitly related to a requested exemption." This exemption request is provided in conjunction with the LAR provided in Enclosure 2.

#### Justification for the Exemption Request

As required by 10 CFR 50.12(a)(2), the Commission will not consider granting an exemption unless special circumstances are present. Special circumstances are present whenever one of the listed items (i) through (vi) under 10 CFR 50.12(a)(2) is applicable. Ameren Missouri has evaluated the proposed exemption against the conditions specified in 10 CFR 50.12(a) and determined that this proposed exemption meets the requirements for granting an exemption from the regulation and that special circumstances are present. The information supporting the determination is provided below.

Pursuant to 10 CFR 50.12, "Specific exemptions," the NRC may grant exemptions from the requirements of this part provided the following three conditions are met as required by 10 CFR 50.12(a)(1):

*The exemption is authorized by law.*

The NRC has authority under the Atomic Energy Act of 1954, as amended, to grant exemptions from its regulations if doing so would not violate the requirements of law. This exemption is authorized by law as is provided by 10 CFR 50.12 which provides the NRC authority to grant exemptions from 10 CFR 50 requirements with provision of proper justification. Approval of this exemption from 10 CFR 50.46(a)(1) would not conflict with any provisions of the Atomic Energy Act of 1954, as amended, any of the Commission's regulations, or any other law.

*The exemption does not present an undue risk to the public health and safety.*

The purpose of 10 CFR 50.46 is to establish acceptance criteria for ECCS performance, and together with GDC 35, to provide a high confidence that the systems will perform the required functions. The proposed exemption does not involve any modifications to the plant that could introduce a new accident precursor or affect the probability of postulated accidents, and therefore the probability of postulated initiating events is not increased. The PRA and engineering analysis demonstrate that the calculated risk is small and consistent with the intent of the Commission's Safety Goal Policy Statement, which defines an acceptable level of risk that is a small fraction of other risks to which the public is exposed.

As discussed in previous 10 CFR 50.46 rulemaking, the probability of a large break LOCA is sufficiently low that the application of a risk-informed approach to evaluate the ability of the ECCS to meet 10 CFR 50.46 and relevant General Design Criteria with high probability and with low uncertainty, rather than using a calculation model using deterministic methods to achieve similar understanding, would have little effect on public risk. This is applicable to evaluating acceptable containment sump design in support of ECCS and CSS recirculation modes.

The proposed change/exemption is to apply a risk-informed method rather than a traditional deterministic method to quantify the risk associated with GL 2004-02 and to establish a high probability of success for performance of ECCS in accordance with the ECCS cooling performance design addressed in 10 CFR 50.46. The risk-informed approach involves a complete evaluation of the spectrum of LOCA breaks, including double-ended guillotine breaks (DEGBs), up to and including the largest pipe in the reactor coolant system. The risk-informed approach analyzes LOCAs, regardless of break size, using the same methods, assumptions, and criteria in order to quantify the uncertainties and overall risk metrics. This ensures that large break LOCAs that have relatively small contribution to CDF due to the low probabilities of their occurrence as well as smaller break LOCAs with higher probabilities of occurrence are considered in the results. Since the design basis requirement for consideration of a DEGB of the largest pipe in the reactor coolant system is retained and since no physical changes to the facility or changes to the operation of the facility are being made, the existing defense-in-depth and safety margin established for the design of the facility is not reduced.

This exemption only affects 10 CFR 50.46(a)(1) and does not impact the adequacy of the acceptance criteria for cladding performance that is important to maintain adequate safety margins.

*The exemption is consistent with the common defense and security.*

The proposed exemption involves a change to the licensing basis for the plant that has no relation to the control of licensed material or any security requirements that apply to Callaway. Therefore the proposed exemption is consistent with the common defense and security.

### Special Circumstances

This section discusses the presence of special circumstances as related to 10 CFR 50.12(a). 10 CFR 50.12(a)(2) states that the NRC will not consider granting an exemption to the regulations unless special circumstances are present. Special circumstances are present whenever one of the listed items (i) through (vi) under 10 CFR 50.12(a)(2) is applicable.

Such special circumstances are present in this instance to warrant exemption from the implicit requirement in 10 CFR 50.46(a)(1) "other properties" which use deterministic calculation methods as the design basis for acceptable sump performance to validate the results of the ECCS evaluation model demonstrating long-term cooling criterion. Approval of this exemption request would allow the use of a risk-informed method to amend the design basis for acceptable performance of the containment sumps, as a validation of inputs in the ECCS evaluation model, and in support of the existing licensing bases for compliance with 10 CFR 50.46.

Specifically, 10 CFR 50.12(a)(2)(ii) applies:

*Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule.*

The intent of 10 CFR 50.46(a)(1) is to ensure ECCS cooling performance design requirements imposed by 10 CFR 50.46 are determined by a rigorous method that provides a high level of confidence in ECCS performance. This exemption request is consistent with that purpose in that use of the proposed risk-informed approach accounts for the effect of debris on the ECCS cooling performance and supports a high probability of successful ECCS performance, based on the risk results meeting the acceptance guidelines of RG 1.174.

As discussed in the Commission's Policy Statement on "Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities," NRC regulations and their implementation are generally based on deterministic approaches that consider a set of challenges to safety and determine how those challenges should be mitigated.

The need for this exemption is based on the requirements in the regulations for using deterministic methods to demonstrate acceptable design. Regulatory requirements are largely based on a deterministic framework and are established for design basis accidents, such as the LOCA, with specific acceptance criteria that must be satisfied. Licensed facilities must be provided with safety systems capable of preventing and mitigating the consequences of design basis accidents to protect public health and safety. The deterministic regulatory requirements were designed to ensure that these systems are highly reliable. The LOCA analysis and the General Design Criteria were established as part of this deterministic regulatory framework.

In comparison, the risk-informed approach considers nuclear safety in a more comprehensive way by examining the likelihood of a broad spectrum of initiating events and potential challenges, considering a wide range of credible events and assessing the risk based on mitigating system reliability.

An objective of 10 CFR 50.46 is to maintain low risk to the public health and safety through a reliable ECCS, as supported by the containment sump. The supporting analysis demonstrates that a risk-informed approach to sump performance is consistent with the Commission's Safety Goals for nuclear power plants and supports ECCS operation with a high degree of reliability. Consequently, the special circumstances described in 10 CFR 50.12(a)(2)(ii) apply.

Specifically, 10 CFR 50.12(a)(2)(iii) applies:

*Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated.*

The specific hardship is the excessive (greater than 50 person-rem) occupational radiological dose that is estimated to be incurred for plant modifications to remove insulation, as described in Enclosure 1.

In conclusion, special circumstances in 10 CFR 50.12(a)(2)(ii) and 10 CFR 50.12(a)(2)(iii) are present as required by 10 CFR 50.12(a)(2) for consideration of the request for exemption.



#### **1-1.4**            Technical Justification for the Exemption

Technical justification for the risk-informed method is provided in Enclosure 3, and in the LAR (Enclosure 2), which includes descriptions of the ECCS and containment sump designs and performance criteria.

The proposed risk-informed approach meets the key principles in RG 1.174 in that it is consistent with the defense-in-depth philosophy, maintains sufficient safety margins, results in small increase in risk, and is monitored using performance measurement strategies. Detailed descriptions of the risk assessment and supporting engineering analyses are provided in Enclosure 3 to this letter. This proposed exemption to allow use of the risk-informed method is consistent with the key principle in RG 1.174 that requires the proposed change to meet current regulations unless explicitly related to a requested exemption.

The results show that the risk associated with GL 2004-02 concerns is less than the threshold in Region III, “Very Small Changes,” of RG 1.174, and therefore are consistent with the Commission’s Safety Goals for public health and safety.

#### **1-1.5**            Conclusion

Approval of an exemption to allow the use of the risk-informed approach is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security as required by 10 CFR 50.12(a)(1). Furthermore, special circumstances required by 10 CFR 50.12(a)(2) are present for item 10 CFR 50.12(a)(2)(ii) in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule.

Based on the determination that the risk of the exemption meets the acceptance guidelines of RG 1.174, the results demonstrate there is reasonable assurance that the ECCS will function in the recirculation mode and that the public health and safety will be protected.

#### **1-1.6**            Implementation

Ameren Missouri requests that this exemption request be approved for implementation by April 1, 2022.

Attachment 1-2

Request for Exemption from  
General Design Criterion 35

## Request for Exemption from Certain Requirements of GDC 35

### 1-2.1 Exemption Request

Pursuant to 10 CFR 50.12, Union Electric Company (d.b.a. Ameren Missouri) is submitting this request for exemption from certain requirements of 10 CFR 50 Appendix A, General Design Criterion (GDC) 35, which states:

*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.*

*Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.*

By regulatory precedent, licensees are required to demonstrate this capability by the use of a bounding calculation or other deterministic method. Ameren Missouri requests an exemption from this deterministic requirement in order to enable the use of a risk-informed method to demonstrate acceptable sump design and emergency core cooling system (ECCS) performance with regard to the effects of debris following postulated loss-of-coolant accidents (LOCAs).

Approval of this exemption will allow use of a risk-informed method to account for the probabilities and uncertainties associated with mitigation of the effects of debris following postulated LOCAs. The method evaluates the effects on strainer blockage and core blockage resulting from debris concerns raised by GL 2004-02. In order to confirm acceptable sump design, the risk associated with LOCA generated and transported debris is evaluated to include the failure mechanisms associated with loss of core cooling due to strainer blockage.

The scope of the exemption applies for all debris effects addressed in the Callaway Plant, Unit No. 1 (Callaway) RoverD methodology described in Enclosure 3 that was used to respond to GL 2004-02, and which are associated with LOCA break sizes and locations that potentially generate fine fiber debris that exceeds the quantity bounded by Callaway plant-specific testing described in Enclosure 3. That scope is generally described as any breaks where more than

300 lbm of fiber debris can be generated and transported to the sumps. Sixty weld locations that are within the scope of the exemption have currently been identified on the RHR and RCS piping. To minimize the potential that a later analysis could cause the specific locations to change, the requested exemption is based on the breaks' ability to generate sufficient transportable debris, as described in RoverD. The key elements of the exemption request are:

1. It applies only to the effects of debris as described in Enclosure 3.
2. It applies only for LOCA breaks that can generate and transport fiber debris that is not bounded by Callaway plant-specific testing.
3. It applies to any LOCA break that can generate and transport fiber debris that is not bounded by Callaway plant-specific testing and is not limited to the 60 specific break locations noted in this application, provided that the incremental core damage frequency ( $\Delta$ CDF) and incremental large early release frequency ( $\Delta$ LERF) associated with the break size remains in Region III of RG 1.174.

This exemption request is complemented by the accompanying License Amendment Request (LAR) (Enclosure 2) seeking NRC approval of the methodology changes that will be incorporated in the Callaway Technical Specifications, TS Bases, and Final Safety Analysis Report, to amend the licensing basis based on acceptable design of the containment sumps. The risk-informed method provides assurance, with high probability, of acceptable sump performance and debris mitigation during ECCS operation in the recirculation mode as calculated by the ECCS evaluation model.

## **1-2.2** Regulatory Requirements Involved

Ameren Missouri seeks exemption to the extent that GDC 35 would require deterministic calculations or other analyses to address the concerns raised by GL 2004-02 related to acceptable plant performance during the recirculation mode in containment following a LOCA. The effects of LOCA debris have been evaluated using deterministic methods; however, these evaluations have not been shown to address fully the debris effects for the as-built, as-operated plant. The risk-informed approach evaluates the debris effects as part of the assessment of the residual risk associated with GL 2004-02 concerns. The proposed changes to the licensing basis (i.e., the Technical Specifications, TS Bases and FSAR) submitted for NRC approval with the LAR in Enclosure 2 address GSI-191 and provide closure to GL 2004-02 for Callaway on the basis that the associated risk is shown to meet the acceptance guidelines in RG 1.174 and that, in conjunction with the existing licensing basis, adequate safety is demonstrated.

## Evaluation of Impacts on other Regulatory Requirements

The proposed exemption does not result in any physical changes to the facility or changes to the operation of the plant, and does not change any of the programmatic requirements. Based on demonstrating acceptable containment sump and ECCS design for amending the current licensing basis for compliance with GDC 35 as described above, compliance with other regulatory requirements that rely on acceptable design for these systems and components continue to be met in the current licensing basis.

### **1-2.3 Basis for the Exemption Request**

Under 10 CFR 50.12, a licensee may request and the NRC may grant exemptions from the requirements of 10 CFR 50 which are authorized by law, will not present an undue risk to the public health and safety, are consistent with the common defense and security, and when special circumstances are present.

The exemption request meets a key principle of RG 1.174, which states, "The proposed change meets the current regulations unless it is explicitly related to a requested exemption." This exemption request is provided in support of the LAR provided in Enclosure 2.

### Justification for the Exemption Request

As required by 10 CFR 50.12(a)(2), the Commission will not consider granting an exemption unless special circumstances are present. Special circumstances are present whenever one of the listed items (i) through (vi) under 10 CFR 50.12(a)(2) is applicable. Ameren Missouri has evaluated the proposed exemption against the conditions specified in 10 CFR 50.12(a) and determined that this proposed exemption meets the requirements for granting an exemption from the regulation and that special circumstances are present. The information supporting the determination is provided below.

Pursuant to 10 CFR 50.12, "Specific exemptions," the NRC may grant exemptions from the requirements of this part provided the following three conditions are met as required by 10 CFR 50.12(a)(1):

*The exemption is authorized by law.*

The NRC has authority under the Atomic Energy Act of 1954, as amended, to grant exemptions from its regulations if doing so would not violate the requirements of law. This exemption is authorized by law as is provided by 10 CFR 50.12 which provides the NRC authority to grant exemptions from 10 CFR 50 requirements with provision of proper justification. Approval of this exemption from GDC 35 would not conflict with any provisions of the Atomic Energy Act of 1954, as amended, any of the Commission's regulations, or any other law.

*The exemption does not present an undue risk to the public health and safety.*

The proposed change/exemption is to apply a risk-informed method rather than a traditional deterministic method in order to quantify the residual risk associated with GL 2004-02 and to establish a high confidence of acceptable ECCS design. The purpose of GDC 35 is to establish acceptable design for ECCS, and together with the acceptance criteria of 10 CFR 50.46, to provide a high probability that the systems will perform the required functions. The proposed exemption does not involve any modifications to the plant that could introduce a new accident precursor or affect the probability of postulated accidents, and therefore the probability of postulated initiating events is not increased. The PRA and engineering analysis demonstrate that the calculated risk is very small and consistent with the intent of the Commission's Safety Goal Policy Statement, which defines an acceptable level of risk that is a small fraction of other risks to which the public is exposed.

As discussed in previous 10 CFR 50.46 rulemaking, the probability of a large break LOCA is sufficiently low that the application of a risk-informed approach to evaluate the ability of the ECCS to meet 10 CFR 50.46 and relevant General Design Criteria with high probability and with low uncertainty, rather than using a calculation model using deterministic methods to achieve similar understanding, would have little effect on public risk. This is applicable to evaluating acceptable containment sump design in support of ECCS and CSS recirculation modes.

The risk-informed approach involves a complete evaluation of the spectrum of LOCA breaks, including double-ended guillotine break (DEGB), up to and including the largest pipe in the reactor coolant system. The risk-informed approach analyzes LOCAs, regardless of break size, using the same methods, assumptions, and criteria in order to quantify the uncertainties and overall risk metrics. This ensures that large break LOCAs with relatively small contribution to core damage frequency (CDF) due to the low probabilities of their occurrence as well as smaller break LOCAs with higher probabilities of occurrence are considered in the results. Since the design basis requirement for consideration of a DEGB of the largest pipe in the reactor coolant system is retained, and since

no physical changes to the facility or changes to the operation of the facility are being made, the existing defense-in-depth and safety margin established for the design of the facility is not reduced.

*The exemption is consistent with the common defense and security.*

The exemption involves a change to the licensing basis for the plant that has no relation to the control of licensed material or any security requirements that apply to Callaway. Therefore the exemption is consistent with the common defense and security.

### Special Circumstances

This section discusses the presence of special circumstances as related to 10 CFR 50.12(a). 10 CFR 50.12(a)(2) states that NRC will not consider granting an exemption to the regulations unless special circumstances are present. Special circumstances are present whenever one of the listed items (i) through (vi) under 10 CFR 50.12(a)(2) is applicable.

Such special circumstances are present in this instance to warrant exemption from the implicit requirement in GDC 35 to use a deterministic method to evaluate for acceptable containment sump design. Approval of the exemption request would allow use of a risk-informed method to amend the design basis for acceptable containment sump design in support of the ECCS design for compliance with GDC 35. Specifically, 10 CFR 50.12(a)(2)(ii) applies:

*Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule.*

The intent of GDC 35 is to ensure ECCS design provides abundant core cooling to mitigate fuel and clad damage and clad metal-water reaction following any loss of reactor coolant. GDC 35 sets forth the general ECCS cooling performance design requirements, which are in addition to the requirements of 10 CFR 50.46. This exemption request is consistent with that purpose in that use of the proposed risk-informed approach demonstrates a high probability of successful ECCS performance, which includes realistically available long term cooling, based on the risk results meeting the acceptance guidelines of RG 1.174. The risk-informed approach assesses ECCS design for a full spectrum of breaks, and assesses equipment failures that include loss of offsite power and worst case single failure, consistent with the GDC 35 requirements.

Since the proposed exemption does not involve any physical changes to the plant, there is no effect on the GDC 35 requirements for ECCS design for redundancy in components and features, interconnections, leak detection,

isolation, and containment capabilities. The current licensing basis evaluations for ECCS compliance with GDC 35 for these aspects continue to be met.

As discussed in the Commission's Policy Statement on "Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities," NRC regulations and their implementation are generally based on deterministic approaches that consider a set of challenges to safety and determine how those challenges should be mitigated.

This request does not seek exemption from any explicit language in the regulatory requirements. Rather, the need is based on the implicit requirements in the regulations for using deterministic methods to demonstrate acceptable design. Regulatory requirements are largely based on a deterministic framework, and are established for design basis accidents, such as the LOCA, with specific acceptance criteria that must be satisfied. Licensed facilities must be provided with safety systems capable of preventing and mitigating the consequences of design basis accidents to protect public health and safety. The deterministic regulatory requirements were designed to ensure that these systems are highly reliable. The LOCA analysis and the GDC were established as part of this deterministic regulatory framework.

In comparison, the risk-informed approach considers nuclear safety in a more comprehensive way by examining the likelihood of a broad spectrum of initiating events and potential challenges, considering a wide range of credible events and assessing the risk based on mitigating system reliability.

An objective of GDC 35 is to maintain low risk to the public health and safety through a reliable ECCS, as supported by the containment sumps. The supporting analysis demonstrates that a risk-informed approach to sump performance is consistent with the Commission's Safety Goals for nuclear power plants and supports ECCS operation with a high degree of reliability. Consequently, the special circumstances described in 10 CFR 50.12(a)(2)(ii) apply.

Specifically, 10 CFR 50.12(a)(2)(iii) also applies:

*Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated.*

The specific hardship is the excessive (greater than 50 person-rem) occupational radiological dose that is estimated to be incurred for plant modifications to remove insulation, as described in Enclosure 1.



In conclusion, special circumstances in 10 CFR 50.12(a)(2)(ii) and 10 CFR 50.12(a)(2)(iii) are present as required by 10 CFR 50.12(a)(2) for consideration of the request for exemption.

#### **1-2.4**            Technical Justification for the Exemption

Technical justification for the risk-informed method is provided in Enclosure 3.

The proposed risk-informed approach meets the key principles in RG 1.174 in that it is consistent with the defense-in-depth philosophy, maintains sufficient safety margins, results in small increase in risk, and is monitored using performance measurement strategies. This proposed exemption to allow use of the risk-informed method is consistent with the key principle in RG 1.174 that requires the proposed change to meet current regulations unless explicitly related to a requested exemption.

The results show that the risk associated with GL 2004-02 concerns is less than the threshold in Region III, "Very Small Changes," of RG 1.174, and therefore are consistent with the Commission's Safety Goals for public health and safety.

#### **1-2.5**            Conclusion

Approval of an exemption to allow the use of the risk-informed approach is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security as required by 10 CFR 50.12(a)(1). Furthermore, special circumstances required by 10 CFR 50.12(a)(2) are present for item 10 CFR 50.12(a)(2)(ii) in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule.

Based on the determination that the risk of the exemption meets the acceptance guidelines of RG 1.174, the results demonstrate there is reasonable assurance that the ECCS will function in the recirculation mode and that the public health and safety will be protected.

#### **1-2.6**            Implementation

Ameren Missouri requests that this exemption request be approved for implementation by April 1, 2022.

Attachment 1-3

Request for Exemption from  
General Design Criterion 38

## Request for Exemption from Certain Requirements of GDC 38

### 1-3.1 Exemption Request

Pursuant to 10 CFR 50.12, Union Electric Company (d.b.a. Ameren Missouri) is submitting this request for exemption from certain requirements of 10 CFR 50 Appendix A, General Design Criterion (GDC) 38, which states:

*Criterion 38 — Containment heat removal. A system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels.*

*Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.*

By regulatory precedent, licensees are required to demonstrate this capability by the use of a bounding calculation or other deterministic method. Ameren Missouri requests an exemption from this deterministic requirement in order to enable the use of a risk-informed method to demonstrate acceptable sump design and emergency core cooling system (ECCS) and containment spray system (CSS) performance with regard to the effects of debris following postulated loss-of-coolant accidents (LOCAs).

Approval of this exemption will allow use of a risk-informed method to account for the probabilities and uncertainties associated with mitigation of the effects of debris following postulated LOCAs. The method evaluates the effects on strainer blockage and core blockage resulting from debris concerns raised by GL 2004-2. In order to confirm acceptable sump design, the risk associated with LOCA generated and transported debris is evaluated to include the failure mechanisms associated with loss of core cooling and containment spray due to strainer blockage.

The scope of the exemption applies for all debris effects addressed in the Callaway Plant, Unit No. 1 (Callaway) RoverD methodology described in Enclosure 3 that was used to respond to GL 2004-02, and which are associated with LOCA break sizes and locations that potentially generate fine fiber debris that exceeds the quantity bounded by Callaway plant-specific testing described in

Enclosure 3. That scope is generally described as any breaks where more than 300 lbm of fiber debris can be generated and transported to the sumps. Sixty weld locations that are within the scope of the exemption have currently been identified on RHR and RCS piping. To minimize the potential that a later analysis could cause the specific locations to change, the requested exemption is based on the breaks' ability to generate sufficient transportable debris, as described in RoverD. The key elements of the exemption request are:

1. It applies only to the effects of debris as described in Enclosure 3.
2. It applies only for LOCA breaks that can generate and transport fiber debris that is not bounded by Callaway plant-specific testing.
3. It applies to any LOCA break that can generate and transport fiber debris that is not bounded by Callaway plant-specific testing and is not limited to the 60 specific break locations noted in this application, provided that the  $\Delta$ CDF and  $\Delta$ LERF associated with the break size remains in Region III of RG 1.174.

This exemption request is complemented by the accompanying License Amendment Request (LAR) (Enclosure 2) seeking NRC approval of the methodology changes that will be incorporated in the Callaway Technical Specifications, TS Bases and Final Safety Analysis Report, to amend the licensing basis based on acceptable design of the containment sumps. The risk-informed method provides assurance, with high probability, for acceptable sump performance and debris mitigation during ECCS and CSS operation in recirculation mode as calculated by the ECCS evaluation model.

### **1-3.2 Regulatory Requirements Involved**

Ameren Missouri seeks exemption to the extent that GDC 38 would require deterministic calculations or other analyses to address the concerns raised by GL 2004-02 related to acceptable plant performance during the recirculation mode in containment following a LOCA. The effects of LOCA debris have been evaluated, using deterministic methods; however, these evaluations have not been shown to address fully the debris effects for the as-built, as-operated plant. The risk-informed approach evaluates the debris effects as part of the assessment of the residual risk associated with GL 2004-02 concerns. The proposed changes to the licensing basis (i.e., the Technical Specifications, TS Bases and FSAR) submitted for NRC approval with the LAR in Enclosure 2, address GSI-191 and provide closure to GL 2004-02 for Callaway on the basis that the associated risk is shown to meet the acceptance guidelines in RG 1.174 and that, in conjunction with the existing licensing basis, adequate safety is demonstrated.

### Evaluation of Impacts on other Regulatory Requirements

The proposed exemption does not result in any physical changes to the facility or changes to the operation of the plant, and does not change any of the programmatic requirements. Based on demonstrating acceptable containment heat removal design for amending the current licensing basis for compliance with GDC 38 as described above, compliance with other regulatory requirements that rely on acceptable design for these systems and components continue to be met in the current licensing basis.

#### **1-3.3**            Basis for the Exemption Request

Under 10 CFR 50.12, a licensee may request and the NRC may grant exemptions from the requirements of 10 CFR 50 which are authorized by law, will not present an undue risk to the public health and safety, are consistent with the common defense and security, and when special circumstances are present.

#### Justification for the Exemption Request

As required by 10 CFR 50.12(a)(2), the Commission will not consider granting an exemption unless special circumstances are present. Special circumstances are present whenever one of the listed items (i) through (vi) under 10 CFR 50.12(a)(2) is applicable. Ameren Missouri has evaluated the proposed exemption against the conditions specified in 10 CFR 50.12(a) and determined that this proposed exemption meets the requirements for granting an exemption from the regulation, and that special circumstances are present. The information supporting the determination is provided below.

Pursuant to 10 CFR 50.12, "Specific exemptions," the NRC may grant exemptions from the requirements of this part provided the following three conditions are met as required by 10 CFR 50.12(a)(1):

*The exemption is authorized by law.*

The NRC has authority under the Atomic Energy Act of 1954, as amended, to grant exemptions from its regulations if doing so would not violate the requirements of law. This exemption is authorized by law as is provided by 10 CFR 50.12 which provides the NRC authority to grant exemptions from 10 CFR 50 requirements with provision of proper justification. Approval of this exemption from GDC 38 would not conflict with any provisions of the Atomic Energy Act of 1954, as amended, any of the Commission's regulations, or any other law.

*The exemption does not present an undue risk to the public health and safety.*

The proposed change/exemption is to apply a risk-informed method rather than a traditional deterministic method in order to quantify the residual risk associated with GL 2004-02 and to establish a high confidence of acceptable ECCS and CSS design. The purpose of GDC 38 is to establish acceptable design for ECCS and CSS, and together with the acceptance criteria of 10 CFR 50.46, to provide a high probability that the systems will perform the required functions. The proposed exemption does not involve any modifications to the plant that could introduce a new accident precursor or affect the probability of postulated accidents, and therefore the probability of postulated initiating events is not increased. The PRA and engineering analysis demonstrate that the calculated risk is very small and consistent with the intent of the Commission's Safety Goal Policy Statement, which defines an acceptable level of risk that is a small fraction of other risks to which the public is exposed.

As discussed in previous 10 CFR 50.46 rulemaking, the probability of a large break LOCA is sufficiently low that the application of a risk-informed approach to evaluate the ability of the ECCS to meet 10 CFR 50.46 and relevant General Design Criteria with high probability and with low uncertainty, rather than using a calculation model using deterministic methods to achieve similar understanding, would have little effect on public risk. This is applicable to evaluating acceptable containment sump design in support of ECCS and CSS recirculation modes.

The risk-informed approach involves a complete evaluation of the spectrum of LOCA breaks, including double-ended guillotine break (DEGB), up to and including the largest pipe in the reactor coolant system. The risk-informed approach analyzes LOCAs, regardless of break size, using the same methods, assumptions, and criteria in order to quantify the uncertainties and overall risk metrics. This ensures that large break LOCAs with relatively small contribution to core damage frequency (CDF) due to the low probabilities of their occurrence as well as smaller break LOCAs with higher probabilities of occurrence are considered in the results. Since the design basis requirement for consideration of a DEGB of the largest pipe in the reactor coolant system is retained and since no physical changes to the facility or changes to the operation of the facility are being made, the existing defense-in-depth and safety margin established for the design of the facility is not reduced.

*The exemption is consistent with the common defense and security.*

The proposed exemption involves a change to the licensing basis for the plant that has no relation to the control of licensed material or any security requirements that apply to Callaway. Therefore the proposed exemption is consistent with the common defense and security.

### Special Circumstances

This section discusses the presence of special circumstances as related to 10 CFR 50.12(a). 10 CFR 50.12(a)(2) states that the NRC will not consider granting an exemption to the regulations unless special circumstances are present. Special circumstances are present whenever one of the listed items (i) through (vi) under 10 CFR 50.12(a)(2) is applicable.

Such special circumstances are present in this instance to warrant exemption from the implicit requirement in GDC 38 to use a deterministic method to evaluate for acceptable containment sump design. Approval of the exemption request would allow use of a risk-informed method to amend the design basis for acceptable containment sump design in support of ECCS and CSS design for compliance with GDC 38. Specifically, 10 CFR 50.12(a)(2)(ii) applies:

*Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule.*

The intent of GDC 38 is to ensure a containment heat removal system is provided to rapidly reduce containment pressure and temperature following any LOCA and maintain them at acceptably low levels. This exemption request is consistent with that purpose in that use of the proposed risk-informed approach demonstrates a high probability of successful ECCS and CSS performance, which includes realistically available recirculation flow, based on the risk results meeting the acceptance guidelines of RG 1.174. The risk-informed approach assesses the design for a full spectrum of breaks, and assesses equipment failures that include loss of offsite power and worst case single failure, consistent with the GDC 38 requirements.

Since the proposed exemption does not involve any physical changes to the plant, there is no effect on the GDC 38 design requirements for redundancy in components and features, interconnections, leak detection, isolation, and containment capabilities. The current licensing basis evaluations for ECCS and CSS compliance with GDC 38 for these aspects continue to be met.

As discussed in the Commission's Policy Statement on "Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities," NRC regulations and their implementation are generally based on deterministic approaches that consider a set of challenges to safety and determine how those challenges should be mitigated.

This request does not seek exemption from any explicit language in the regulatory requirements. Rather, the need is based on the implicit requirements in the regulations, for using deterministic methods to demonstrate acceptable

design. Regulatory requirements are largely based on a deterministic framework, and are established for design basis accidents, such as the LOCA, with specific acceptance criteria that must be satisfied. Licensed facilities must be provided with safety systems capable of preventing and mitigating the consequences of design basis accidents to protect public health and safety. The deterministic regulatory requirements were designed to ensure that these systems are highly reliable. The LOCA analysis and the GDC were established as part of this deterministic regulatory framework.

In comparison, the risk-informed approach considers nuclear safety in a more comprehensive way by examining the likelihood of a broad spectrum of initiating events and potential challenges, considering a wide range of credible events and assessing the risk based on mitigating system reliability.

An objective of GDC 38 is to maintain low risk to the public health and safety through a reliable CSS, as supported by the containment sumps. The supporting analysis demonstrates that a risk-informed approach to sump performance is consistent with the Commission's Safety Goals for nuclear power plants, and supports OS5 operation with a high degree of reliability. Consequently, the special circumstances described in 10 CFR 50.12(a)(2)(ii) apply.

Specifically, 10 CFR 50.12(a)(2)(iii) also applies:

*Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated.*

The specific hardship is the excessive (greater than 50 person-rem) occupational radiological dose that is estimated to be incurred for plant modifications to remove insulation, as described in Enclosure 1.

In conclusion, special circumstances in 10 CFR 50.12(a)(2)(ii) and 10 CFR 50.12(a)(2)(iii) are present as required by 10 CFR 50.12(a)(2) for consideration of the request for exemption.

#### **1-3.4**            Technical Justification for the Exemption

Technical justification for the risk-informed method is provided in Enclosure 3, and in the LAR (Enclosure 2), which includes descriptions of the ECCS, CSS and containment sump designs and performance criteria.

The proposed risk-informed approach meets the key principles in RG 1.174 in that it is consistent with the defense-in-depth philosophy, maintains sufficient safety margins, results in small increase in risk, and is monitored using



performance measurement strategies. Detailed descriptions of the risk assessment and supporting engineering analyses are provided in Enclosure 3 to this letter. This proposed exemption to allow use of the risk-informed method is consistent with the key principle in RG 1.174 that requires the proposed change to meet current regulations unless explicitly related to a requested exemption.

The results show that the risk associated with GL 2004-02 concerns is less than the threshold in Region III, "Very Small Changes," of RG 1.174, and therefore are consistent with the Commission's Safety Goals for public health and safety.

### **1-3.5** Conclusion

Approval of an exemption to allow the use of the risk-informed approach is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security as required by 10 CFR 50.12(a)(1). Furthermore, special circumstances required by 10 CFR 50.12(a)(2) are present for item 10 CFR 50.12(a)(2)(ii) in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule.

Based on the determination that the risk of the exemption meets the acceptance guidelines of RG 1.174, the results demonstrate there is reasonable assurance that the ECCS and CSS will function in the recirculation mode and that the public health and safety will be protected.

### **1-3.6** Implementation

Ameren Missouri requests that this exemption request be approved for implementation by April 1, 2022.

Attachment 1-4

Request for Exemption from  
General Design Criterion 41

## Request for Exemption from Certain Requirements of GDC 41

### 1-4.1 Exemption Request

Pursuant to 10 CFR 50.12, Union Electric Company (d.b.a. Ameren Missouri) is submitting this request for exemption from certain requirements of 10 CFR 50 Appendix A, General Design Criterion (GDC) 41, which states:

*Criterion 41 — Containment atmosphere cleanup. Systems to control fission products, hydrogen, oxygen, and other substances which may be released into the reactor containment shall be provided as necessary to reduce, consistent with the functioning of other associated systems, the concentration and quality of fission products released to the environment following postulated accidents, and to control the concentration of hydrogen or oxygen and other substances in the containment atmosphere following postulated accidents to assure that containment integrity is maintained.*

*Each system shall have suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) its safety function can be accomplished, assuming a single failure.*

By regulatory precedent, licensees are required to demonstrate this capability by the use of a bounding calculation or other deterministic method. Ameren Missouri requests an exemption from this deterministic requirement in order to enable the use of a risk-informed method to demonstrate acceptable sump design and containment atmosphere cleanup performance using the containment spray system (CSS) with regard to the effects of debris following postulated loss-of-coolant accidents (LOCAs).

Approval of this exemption will allow use of a risk-informed method to account for the probabilities and uncertainties associated with mitigation of the effects of debris following postulated LOCAs. The method evaluates the effects on containment sump strainer blockage and core blockage resulting from debris concerns raised by GL 2004-02. In order to confirm acceptable sump design, the risk associated with LOCA generated and transported debris is evaluated to include the failure mechanisms associated with loss of containment atmosphere cleanup due to strainer blockage affecting CSS recirculation mode.

The scope of the exemption applies for all debris effects addressed in the Callaway Plant, Unit No. 1 (Callaway) RoverD methodology described in Enclosure 3 that was used to respond to GL 2004-02, and which are associated with LOCA break sizes and locations that potentially generate fine fiber debris that exceeds the quantity bounded by Callaway plant-specific testing described in Enclosure 3. That scope is generally described as any breaks where more than 300 lbm of fiber debris can be generated and transported to the sumps. Sixty weld locations that are within the scope of the exemption have currently been identified on the RHR and RCS piping. To minimize the potential that a later analysis could cause the specific locations to change, the requested exemption is based on the breaks' ability to generate sufficient transportable debris, as described in RoverD. The key elements of the exemption request are:

1. It applies only to the effects of debris as described in Enclosure 3.
2. It applies only for LOCA breaks that can generate and transport fiber debris that is not bounded by Callaway plant-specific testing.
3. It applies to any LOCA break that can generate and transport fiber debris that is not bounded by Callaway plant-specific testing and is not limited to the 60 specific break locations noted in this application, provided that the  $\Delta$ CDF and  $\Delta$ LERF associated with the break size remains in Region III of Regulatory Guide 1.174.

This exemption request is complemented by the accompanying License Amendment Request (Enclosure 2) seeking NRC approval of the proposed changes that will be incorporated in the Callaway Technical Specifications, TS Bases, and Final Safety Analysis Report, to amend the licensing basis based on acceptable design of the containment sumps. The risk-informed method provides assurance, with high probability, for acceptable sump performance and debris mitigation during CSS operation in recirculation mode as calculated by the ECCS evaluation model.

#### **1-4.2 Regulatory Requirements Involved**

Ameren Missouri seeks exemption to the extent that GDC 41 would require deterministic calculations or other analyses to address the concerns raised by GL 2004-02 related to acceptable plant performance during the recirculation mode in containment following a LOCA. The effects of LOCA debris have been evaluated, using deterministic methods; however, these evaluations have not been shown to address fully the debris effects for the as-built, as-operated plant. The risk-informed approach evaluates the debris effects as part of the assessment of the residual risk associated with GL 2004-02 concerns. The proposed changes to the licensing basis (i.e., the Technical Specifications, TS Bases and FSAR) submitted for NRC approval with the LAR in Enclosure 2, address GSI-191 and provide closure to GL 2004-02 for Callaway on the basis that the associated risk is shown to meet the acceptance guidelines in RG 1.174

and that, in conjunction with the existing licensing basis, adequate safety is demonstrated.

#### Evaluation of Impacts on other Regulatory Requirements

The proposed exemption does not result in any physical changes to the facility or changes to the operation of the plant, and does not change any of the programmatic requirements. Based on demonstrating acceptable containment sump and CSS design for amending the current licensing basis for compliance with GDC 41 as described above, compliance with other regulatory requirements that rely on acceptable design for these systems and components continue to be met in the current licensing basis.

#### **1-4.3 Basis for the Exemption Request**

Under 10 CFR 50.12, a licensee may request and the NRC may grant exemptions from the requirements of 10 CFR 50 which are authorized by law, will not present an undue risk to the public health and safety, are consistent with the common defense and security, and when special circumstances are present.

#### Justification for the Exemption Request

As required by 10 CFR 50.12(a)(2), the Commission will not consider granting an exemption unless special circumstances are present. Special circumstances are present whenever one of the listed items (i) through (vi) under 10 CFR 50.12(a)(2) is applicable. Ameren Missouri has evaluated the proposed exemption against the conditions specified in 10 CFR 50.12(a) and determined that this proposed exemption meets the requirements for granting an exemption from the regulation and that special circumstances are present. The information supporting the determination is provided below.

Pursuant to 10 CFR 50.12, "Specific exemptions," the NRC may grant exemptions from the requirements of this part provided the following three conditions are met as required by 10 CFR 50.12(a)(1):

#### *The exemption is authorized by law*

The NRC has authority under the Atomic Energy Act of 1954, as amended, to grant exemptions from its regulations if doing so would not violate the requirements of law. This exemption is authorized by law as is provided by 10 CFR 50.12 which provides the NRC authority to grant exemptions from 10 CFR 50 requirements with provision of proper justification. Approval of this exemption from GDC 41 would not conflict with any provisions of the Atomic Energy Act of 1954, as amended, any of the Commission's regulations, or any other law.

*The exemption does not present an undue risk to the public health and safety.*

The proposed change/exemption is to apply a risk-informed method rather than a traditional deterministic method in order to quantify the residual risk associated with GL 2004-02 and to establish a high confidence of acceptable CSS design. The purpose of GDC 41 is to establish acceptable design for containment atmosphere cleanup and to provide a high probability that the systems will perform the required functions. The proposed exemption does not involve any modifications to the plant that could introduce a new accident precursor or affect the probability of postulated accidents, and therefore the probability of postulated initiating events is not increased. The PRA and engineering analysis demonstrate that the calculated risk is very small and consistent with the intent of the Commission's Safety Goal Policy Statement, which defines an acceptable level of risk that is a small fraction of other risks to which the public is exposed.

The probability of a large break LOCA is sufficiently low that the application of a risk-informed approach to evaluate the ability of the CSS to meet GDC 41 with high probability and with low uncertainty, rather than using a calculation model using deterministic methods to achieve similar understanding, would have little effect on public risk. This is applicable to evaluating acceptable containment sump design in support of ECCS and CSS recirculation modes.

The risk-informed approach involves a complete evaluation of the spectrum of LOCA breaks, including double-ended guillotine break (DEGB), up to and including the largest pipe in the reactor coolant system. The risk-informed approach analyzes LOCAs, regardless of break size, using the same methods, assumptions, and criteria in order to quantify the uncertainties and overall risk metrics. This ensures that large break LOCAs with relatively small contribution to CDF due to the low probability of such a break as well as smaller break LOCAs with higher probabilities of occurrence are considered in the results. Since the design basis requirement for consideration of a DEGB of the largest pipe in the reactor coolant system is retained and since no physical changes to the facility or changes to the operation of the facility are being made, the existing defense-in-depth and safety margin established for the design of the facility is not reduced.

*The exemption is consistent with the common defense and security.*

The proposed exemption involves a change to the licensing basis for the plant that has no relation to the control of licensed material or any security requirements that apply to Callaway. Therefore the proposed exemption is consistent with the common defense and security.

### Special Circumstances

This section discusses the presence of special circumstances as related to 10 CFR 50.12(a). 10 CFR 50.12(a)(2) states that the NRC will not consider granting an exemption to the regulations unless special circumstances are present. Special circumstances are present whenever one of the listed items (i) through (vi) under 10 CFR 50.12(a)(2) is applicable.

Such special circumstances are present in this instance to warrant exemption from the implicit requirement in GDC 41 to use a deterministic method to evaluate for acceptable containment atmosphere cleanup design. Approval of the exemption request would allow use of a risk-informed method to amend the design basis for acceptable containment sump design in support of CSS design for compliance with GDC 41.

Specifically, 10 CFR 50.12(a)(2)(ii) applies:

*Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule.*

The intent of GDC 41 is to ensure systems in the plant design to control fission products, hydrogen, oxygen, and other substances which may be released into the reactor containment shall be provided as necessary to reduce, consistent with the functioning of other associated systems, the concentration and quality of fission products released to the environment following postulated accidents. These systems are used to control the concentration of hydrogen or oxygen and other substances in the containment atmosphere following postulated accidents to assure that containment integrity is maintained. This exemption request is consistent with that purpose in that use of the proposed risk-informed approach demonstrates a high probability of successful containment sump and CSS performance, which includes realistically available recirculation flow, based on the risk results meeting the acceptance guidelines of RG 1.174. The risk-informed approach assesses the design for a full spectrum of breaks, and assesses equipment failures that include loss of offsite power and worst case single failure, consistent with the GDC 41 requirements.

Since the proposed exemption does not involve any physical changes to the plant, there is no effect on the GDC 41 design requirements for redundancy in components and features, interconnections, leak detection, isolation, and containment capabilities. The current licensing basis evaluations for CSS compliance with GDC 41 for these aspects continue to be met.

As discussed in the Commission's Policy Statement on "Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities," NRC regulations and

their implementation are generally based on deterministic approaches that consider a set of challenges to safety and determine how those challenges should be mitigated.

This request does not seek exemption from any explicit language in the regulatory requirements. Rather, the need is based on the implicit requirements in the regulations for using deterministic methods to demonstrate acceptable design. Regulatory requirements are largely based on a deterministic framework and are established for design basis accidents, such as the LOCA, with specific acceptance criteria that must be satisfied. Licensed facilities must be provided with safety systems capable of preventing and mitigating the consequences of design basis accidents to protect public health and safety. The deterministic regulatory requirements were designed to ensure that these systems are highly reliable. The LOCA analysis and the GDC were established as part of this deterministic regulatory framework.

In comparison, the risk-informed approach considers nuclear safety in a more comprehensive way by examining the likelihood of a broad spectrum of initiating events and potential challenges, considering a wide range of credible events and assessing the risk based on mitigating system reliability.

An objective of GDC 41 is to maintain low risk to the public health and safety through a reliable containment atmosphere cleanup, as supported by the CSS and containment sumps. The supporting analysis demonstrates that a risk-informed approach to sump performance is consistent with the Commission's Safety Goals for nuclear power plants and supports CSS operation with a high degree of reliability. Consequently, the special circumstances described in 10 CFR 50.12(a)(2)(ii) apply.

Specifically, 10 CFR 50.12(a)(2)(iii) also applies:

*Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated.*

The specific hardship is the excessive (greater than 50 person-rem) occupational radiological dose that is estimated to be incurred for plant modifications to remove insulation, as described in Enclosure 1.

In conclusion, special circumstances in 10 CFR 50.12(a)(2)(ii) and 10 CFR 50.12(a)(2)(iii) are present as required by 10 CFR 50.12(a)(2) for consideration of the request for exemption.



#### **1-4.4** Technical Justification for the Exemption

Technical justification for the risk-informed method is provided in Enclosure 3.

The proposed risk-informed approach meets the key principles in RG 1.174 in that it is consistent with the defense-in-depth philosophy, maintains sufficient safety margins, results in small increase in risk, and is monitored using performance measurement strategies. This proposed exemption to allow use of the risk-informed method is consistent with the key principle in RG 1.174 that requires the proposed change to meet current regulations unless explicitly related to a requested exemption.

The results show that the risk associated with GL 2004-02 concerns is less than the threshold in Region III, "Very Small Changes," of RG 1.174, and therefore are consistent with the Commission's Safety Goals for public health and safety.

#### **1-4.5** Conclusion

Approval of an exemption to allow the use of the risk-informed approach is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security as required by 10 CFR 50.12(a)(1). Furthermore, special circumstances required by 10 CFR 50.12(a)(2) are present for item 10 CFR 50.12(a)(2)(ii) in that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule.

Based on the determination that the risk of the exemption meets the acceptance guidelines of RG 1.174, the results demonstrate there is reasonable assurance that the CSS will function in the recirculation mode and that the public health and safety will be protected.

#### **1-4.6** Implementation

Ameren Missouri requests that this exemption request be approved for implementation by April 1, 2022.