

**ENCLOSURE 2**

**License Amendment Request**

**Callaway Unit No. 1  
Renewed Facility Operating License NPF-30  
NRC Docket No. 50-483**

**Revise Technical Specifications to Adopt Risk-Informed  
Completion Times TSTF-505, Revision 2, "Provide Risk-Informed  
Extended Completion Times – RITSTF Initiative 4b"**

**Information Supporting Consistency with Regulatory Guide 1.200, Revision 2**

## **1.0 Introduction**

This enclosure provides information on the technical adequacy of the Callaway Plant, Unit No. 1 (Callaway) Probabilistic Risk Assessment (PRA) Internal Events, Internal Flooding, High Winds, Fire, and Seismic PRA models in support of the license amendment request (LAR) to adopt TSTF-505, "Provide Risk-Informed Extended Completion Times – RITSTF Initiative 4b", Revision 2 (Reference [1]).

The Callaway Internal Events, Internal Flooding, High Winds, Fire, and Seismic PRA models described within this LAR are the same as those described within Ameren Missouri submittals regarding adoption of 10 CFR 50.69, "Risk-Informed Categorization and Treatment of Structures, Systems and Components for Nuclear Power Reactors" (Reference [2]). Each hazard model has the Internal Events model as the base with hazard specific initiators added and fault tree modifications and additions made as necessary. A screening assessment was performed for Other External Hazards.

Nuclear Energy Institute (NEI) Topical Report NEI 06-09-A, Revision 0 (Reference [3]), as clarified by the NRC final safety evaluation of this report (Reference [4]), defines the technical attributes of a PRA model and its associated Configuration Risk Management Program (CRMP) tool required to implement this risk-informed application. Meeting these requirements satisfies Regulatory Guide (RG) 1.174, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities", Revision 3 (Reference [5]), requirements for risk-informed plant-specific changes to a plant's licensing basis.

Ameren Missouri employs a multi-faceted approach to establishing and maintaining the technical adequacy and fidelity of PRA models for Callaway. This approach includes both a PRA maintenance and update process procedure and the use of self-assessments and independent peer reviews.

The Callaway PRA models are at-power models consisting of four hazard models – Internal Flooding, Fire, Seismic, and High Wind. Each hazard model has the Internal Events model as the base with hazard specific initiators added and fault tree modifications and additions made, as necessary. Each model directly addresses plant configurations during plant Modes 1, 2 and 3 of reactor operation. The models provide both core damage frequency (CDF) and large early release frequency (LERF).

The Callaway Configuration Risk Management Program tool applied for Risk Informed Completion Time (RICT) Program implementation will be an integrated probabilistic risk assessment (PRA) model, applying the Phoenix Risk Monitor (PRM) software, reflecting the five separate (or federated) PRAs described in this Enclosure. All five of these PRA models were developed to comply with RG 1.200 Revision 2.

- Section 2.0 of this enclosure describes the peer review findings closure process.
- Section 3.0 of this enclosure describes the requirements related to the scope of the Callaway PRA models.
- Section 4.0 of this enclosure addresses the technical adequacy of the Callaway PRA Internal Events and Internal Flooding model for this application.

- Section 5.0 of this enclosure addresses the technical adequacy of the Callaway PRA High Winds model for this application.
- Section 6.0 of this enclosure addresses the technical adequacy of the Callaway PRA Seismic model for this application.
- Section 7.0 of this enclosure addresses the technical adequacy of the Callaway PRA Fire model for this application.

## **2.0 Peer Review Findings Closure Process**

All of the PRA models discussed in this Enclosure have been peer reviewed and assessed against RG 1.200 Revision 2 (Reference [6]).

The review and closure of finding-level F&Os was performed by an independent assessment team using the process documented in Appendix X to NEI 05-04, NEI 07-12 and NEI 12-13, "Close-out of Facts and Observations" (F&Os) (Reference [7]) as accepted by NRC in the letter dated May 3, 2017 (ML17079A427) (Reference [8]). All of the reviews also met the requirements of NEI 17-07 Revision 2 (Reference [9]).

The assessment team assessed whether each F&O was closed through application of a PRA maintenance or upgrade activity, as defined by the ASME/ANS PRA Standard, or through application of a new method. Note that, per APC 17-13, Subject: "NRC Acceptance of Industry Guidance on Closure of PRA Peer Review Findings," dated May 8, 2017 with attachment Appendix X, a new method represents a fundamentally new approach in addressing a technical aspect of PRA. The results of the peer reviews and independent assessments have been documented and are available for NRC audit.

The PRA scope and technical adequacy is met for this application as the Standard requirements for all models are met at Capability Category II (CCII) or higher. There are no open Finding F&Os against any of the models discussed in this application, and all Finding F&Os have been independently assessed and closed using the processes discussed above. The resolved findings and the basis for resolution are documented in the Callaway PRA documentation and the F&O Closure Review reports.

## **3.0 Scope of the Callaway PRA Models**

The Internal Events, Internal Flooding, Fire, High Winds, and Seismic PRA models are at power models (i.e., they directly address plant configurations during plant Modes 1, 2 and 3 of reactor operation). The models provide both core damage frequency (CDF) and large early release frequency (LERF). The PRA models described within this LAR are the same as those described within the Ameren submittal of the LAR to adopt 10 CFR 50.69 (Reference [2]).

Note that the Callaway PRA models do not incorporate the risk impacts of external events except for High Winds and Seismic. The treatment of non-modeled external risk hazards are discussed in Enclosure 4 which shows that all non-modeled external risk hazards screen for all configurations.

#### **4.0 Technical Adequacy of the Callaway Internal Events and Internal Flooding PRA Model**

Topical Report NEI 06-09-A requires that the PRA be reviewed to the guidance of RG 1.200 (Reference [6]) for a PRA that meets Capability Category II (CCII) for the supporting requirements of the Internal Events at power ASME/ANS PRA Standard (Reference [10]). It also requires that deviations from these CCs relative to the Risk Informed Completion Time (RICT) Program be justified and documented.

The information provided in this section demonstrates that the Callaway Internal Events PRA model (including Internal Flooding) meets the expectations for PRA scope and technical adequacy as presented in ASME/ANS RA-Sa-2009 (Reference [10]) and RG 1.200 to fully support the requirements of the RICT Program. The Ameren Missouri risk management process ensures that the PRA model used in this application reflects the as-built and as-operated plant for Callaway.

The Callaway RICT process for the Internal Events and Flooding hazard will use the peer reviewed plant-specific PRA model. The Callaway risk management process ensures that the PRA model used in this application reflects the as-built and as-operated plant.

Related to the technical adequacy of the Internal Events model, the Internal Events discussion below describes implementation of the methodology provided in PWROG-18027-NP (Reference [11]) for assessing the loss of room cooling in PRA modeling. Following, but unrelated to, implementation of the method provided in PWROG-18027-NP into the Callaway PRA, this method was chosen by the PWROG and NEI to pilot the Newly Developed Methods (NDM) peer review process established in NEI 17-07 (Reference [9]). The NEI 17-07 process was successfully completed with all applicable NDM attributes met at Capability Category I/II (CC I/II) and no open peer review Findings against the method in PWROG-18027-NP.

In addition, an implementation peer review and associated F&O closure review have been completed using NRC-approved processes, with no open Findings identified against implementation of the method. While the NEI 17-07 process was completed successfully, it is recognized that this process was not an endorsed process until RG 1.200, "Acceptability of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 3 was issued in December 2020. As a result, the NRC staff may decide to independently review the method in PWROG-18027-NP for technical adequacy. The PWROG-18027-NP report contains the technical basis for the acceptability of the method and is available for NRC audit.

##### Peer Review Summary

The Internal Events/ Internal Flooding PRA was peer reviewed in April 2019. This peer review was a full-scope review of the technical elements of the Internal Events and Internal Flooding at-power PRA as documented in PWROG-19012-P (Reference [12]). As a full scope review, it included those supporting requirements (SRs) specified in PWROG-19020-NP (Reference [27]) for implementation of the methodology for loss of room cooling modeling provided in PWROG-18027-NP (Reference [11]).

An Independent Assessment of F&Os was conducted in November 2019 and documented in PWROG-19034-P (Reference [13]). The scope of the assessment included all Facts and Observations (F&Os) generated in the April 2019 peer review. All F&Os except for one were closed. The remaining F&O was related to implementation of the methodology provided in

PWROG-18027-NP (Reference [11]) for assessing the loss of room cooling in PRA modeling. Following, but unrelated to, incorporation of the method provided in PWROG-18027-NP into the Callaway PRA, this method was chosen by the PWROG and NEI to pilot the Newly Developed Methods (NDM) peer review process established in NEI 17-07 (Reference [9]). Despite the Callaway assessment, and acknowledgement by the PWROG, that the method provided in PWROG-18027-NP did not necessarily meet the definition of a NDM, Callaway decided to suspend resolution of the associated F&O until the NDM peer review and closure of any F&Os were completed using the process established in NEI 17-07. Also, during the November 2019 independent assessment, two F&O resolutions were determined to be upgrades to the Internal Events/ Internal Flooding PRA. Thus, a focused-scope peer review was required. Based on this focused scope peer review, one new Internal Events F&O was generated.

During February and March 2020, a new peer review, following the guidance in NEI 17-07 Revision 2, was conducted on the method provided in PWROG-18027-NP and documented in PWROG-19020-NP. Based on the results of this review all applicable NDM attributes are met at CC I/II and there are no open peer review Findings against the method in PWROG-18027-NP.

In June 2020, an independent assessment of F&O resolution and a focused scope peer review, completing the review of PWROG-18027-NP implementation, were conducted on the Callaway Internal Events and Fire PRA models. The focused scope peer review determined that all of the SRs that were examined, including the SR associated with the F&O related to implementation of the method in PWROG-18027-NP, satisfy CCII or higher requirements as documented in AMN#PES00031-REPT-001 (Reference [14]). The independent assessment of F&Os included an assessment of all remaining open F&O Findings. The results of this review are documented in AMN#PES00031-REPT-002 (Reference [15]).

There are no open peer review Findings for the Internal Events/ Internal Flooding PRA model.

## **5.0 Technical Adequacy of Callaway High Winds PRA Model**

The information provided in this section demonstrates that the Callaway High Winds PRA model meets the expectations for PRA scope and technical adequacy as presented in ASME/ANS RA-Sa-2009 (Reference [10]) and RG 1.200 to fully support the requirements of the RICT Program. The Ameren Missouri risk management process ensures that the PRA model used in this application reflects the as-built and as-operated plant for Callaway.

### Peer Review Summary

The High Winds PRA was peer reviewed in April 2019 and documented in PWROG-19022-P (Reference [16]). The scope of this work was to review the Callaway External Hazards Screening Assessment and High Winds PRA against the technical elements in Sections 6 and 7 of the ASME/ANS RA-Sa-2009 Standard, and in RG 1.200.

An Independent Assessment of F&O resolution was conducted in November 2019 and documented in PWROG-19034-P (Reference [13]). The scope of the assessment included all F&Os generated in the April 2019 peer review. All F&Os were closed.

There are no open peer review Findings for the Other External Hazards Screening or the High Winds PRA model.

## **6.0 Technical Adequacy of Callaway Seismic PRA Model**

The information provided in this section demonstrates that the Callaway Seismic PRA model meets the expectations for PRA scope and technical adequacy as presented in ASME/ANS RA-S CASE 1, Case for ASME/ANS RA-Sb-2013 (Reference [17]) and RG 1.200 to fully support the requirements of the RICT Program. The Ameren Missouri risk management process ensures that the PRA model used in this application reflects the as-built and as-operated plant for Callaway.

### Peer Review Summary

The Seismic PRA was peer reviewed in June 2018 and documented in PWROG-18044-P (Reference [18]). This peer review was conducted against the requirements of the Code Case for ASME/ANS RA-Sb-2013 (Reference [17]), as amended by the Nuclear Regulatory Commission (NRC) on March 12, 2018 (Reference [19]). The Code Case is an approved alternative to Part 5 of ASME/ANS RA-Sb-2013 Addendum B, the American Society of Mechanical Engineers (ASME) / American Nuclear Society (ANS) Probabilistic Risk Assessment (PRA) Standard.

An Independent Assessment of F&Os was conducted in March 2019. The scope of the assessment included all but two of the F&Os generated in the June 2018 peer review. All in-scope F&Os were closed as documented in PWROG-19011-P (Reference [20]). Also, in the March 2019 review documented in PWROG-19011-P, three SRs were the subject of a focused-scope peer review based on the closures of associated F&Os being assessed as upgrades. As a result of that peer review, the three SRs were determined to be met at CCII.

Subsequently, another Independent Assessment of F&Os was conducted in June 2020 and documented in AMN#PES00031-REPT-002 (Reference [15]). The scope of the assessment included all remaining F&Os generated in the June 2018 peer review. All F&Os were closed.

There are no open peer review Findings for the Seismic PRA model.

## **7.0 Technical Adequacy of Callaway Fire PRA Model**

The information provided in this section demonstrates that the Callaway Fire PRA model meets the expectations for PRA scope and technical adequacy as presented in ASME/ANS RA-Sa-2009 (Reference [10]) and RG 1.200 to fully support the requirements of the RICT Program. The Ameren Missouri risk management process ensures that the PRA model used in this application reflects the as-built and as-operated plant for Callaway.

The Internal Fire PRA model was developed consistent with NUREG/CR-6850 (Reference [21]) and only utilizes methods previously accepted by the NRC. Callaway was approved to implement NFPA-805 in January 2014, and since that time, there have been numerous updates to the approved methods through the issuance of Fire PRA frequently asked questions and new or revised guidance documents. New or revised guidance is specifically addressed through the Callaway PRA maintenance and update process. The Ameren Missouri risk management process ensures that the PRA model used in this application reflects the as-built and as-operated plant for Callaway.

It should also be noted that, as part of transition to NFPA-805, there were several committed modifications and implementation items as documented in NFPA-805 LAR Attachment S, "Plant Modifications and Items to be Completed during Implementation," which described the Callaway plant modifications necessary to implement the NFPA 805 licensing basis. All NFPA-805 LAR Attachment S items have been implemented; therefore, there are no NFPA-805 open items impacting this application.

### Peer Review Summary

The Fire PRA was prepared using the methodology defined in NUREG/CR-6850, "Fire PRA Methodology for Nuclear Power Facilities," to support a transition to National Fire Protection Association (NFPA) Standard 805, "Performance Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants." The Fire PRA was peer reviewed to ASME/ANS RA-Sa-2009 and RG 1.200 Revision 2 in October 2009. The review is documented in LTR-RAM-11-10-019 (Reference [22]).

An Independent Assessment of F&Os was conducted in June 2019 and documented in AMN#PES00021-REPT-001 (Reference [23]).

In June 2020, an independent assessment of F&Os and a focused scope peer review were conducted for the Callaway Internal Events and Fire PRA models. The focused scope peer review generated additional Fire PRA related F&Os as documented in AMN#PES00031-REPT-001 (Reference [14]). The independent assessment of F&Os included an assessment of all remaining open F&O Findings. As documented in AMN#PES00031-REPT-002 (Reference [15]), all Finding F&Os were closed, including the Fire PRA Findings identified in the Focused Scope peer review.

In fulfillment of Commitment 50437 in Enclosure 4 to ULNRC-06550 (ML20304A456) and associated with closure of NFPA 805 LAR Table S-3 Implementation Item 13-805-001, a focused scope peer review was conducted in November 2020, as documented in AMN#PES00031-REPT-003 (Reference [24]), for the resolution of Fire PRA Suggestion F&O FSS-B1-03, which a July 2019 F&O closure review had determined to be an upgrade, as documented in AMN#PES00021-REPT-001 (Reference [23]).

As documented in AMN#PES00042-REPT-002 (Reference [25]), the F&Os from this focused scope peer review were closed during an F&O closure review in February 2021. The results of this review formally closed Commitment 50437.

There are no open peer review Findings for the Fire PRA model.

## **8.0 Summary**

The PRA scope and technical adequacy is met for this application as the Standard requirements for all models are met at CCII or higher. There are no open Finding F&Os against any of the models discussed in this Enclosure, and all Finding F&Os have been independently assessed and closed using the processes discussed in Section 2 of this Enclosure. In addition, all of the reviews also met the requirements of NEI 17-07 Revision 2 (Reference [9]).

## 9.0 References

- [1] Letter from the Technical Specification Task Force (TSTF) to the NRC, "TSTF Comments on Draft Safety Evaluation for Traveler TSTF-505, 'Provide Risk-Informed Extended Completion Times' and Submittal of TSTF-505, Revision 2," Revision 2, dated July 2, 2018 (ADAMS Accession No. ML18183A493).
- [2] Letter from Union Electric to the NRC, "Application to Adopt 10 CFR 50.69, 'Risk-Informed Categorization and Treatment of Structures, Systems and Components for Nuclear Power Reactors'," ULNRC-06550, dated October 30, 2020 (ML20304A455).
- [3] Nuclear Energy Institute (NEI) Topical Report (TR) NEI 06-09, "Risk-Informed Technical Specifications Initiative 4b, Risk-Managed Technical Specifications (RMTS) Guidelines," Revision 0-A, October 12, 2012 (ADAMS Accession No. ML 12286A322).
- [4] Letter from Jennifer M. Golder (NRC) to Biff Bradley (NEI), "Final Safety Evaluation for Nuclear Energy Institute (NEI) Topical Report (TR) NEI 06-09, "Risk-Informed Technical Specifications Initiative 4b, Risk-Managed Technical Specifications (RMTS) Guidelines," May 17, 2007 (ML071200238).
- [5] NRC Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 3, January 2018 (ADAMS Accession No. ML17317A256).
- [6] RG 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 2, March 2009.
- [7] NEI Letter to NRC, "Final Revision of Appendix X to NEI 05-04/07-12/12-16, Close-Out of Facts and Observations (F&Os)," (ADAMS Accession No. ML17086A431), dated February 21, 2017.
- [8] Nuclear Regulatory Commission (NRC) Letter to Mr. Greg Krueger (NEI), "U.S. Nuclear Regulatory Commission Acceptance on Nuclear Energy Institute Appendix X to Guidance 05-04, 7-12, and 12-13, Close Out of Facts and Observations (F&Os)," May 3, 2017, Accession Number ML17079A427.
- [9] NEI 17-07, Revision 2, "Performance of PRA Peer Reviews Using the ASME/ANS PRA Standard," July 2019 (ADAMS Accession No. ML19228A242).
- [10] ASME/ANS RA-S-2009, Addenda to ASME/ANS RA-S-2008, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," February 2009.
- [11] PWROG-18027-NP Revision 0, "Loss of Room Cooling in PRA Modeling," April 2020.
- [12] PWROG-19012-P, "Peer Review of the Callaway Internal Events and Internal Flood Probabilistic Risk Assessment Model," April 2019.
- [13] PWROG-19034-P, "Independent Assessment of Facts & Observations Closure and Focused Scope Peer Review of the Callaway Probabilistic Risk Assessments," November 2019.
- [14] AMN#PES00031-REPT-001, "Callaway Energy Center Probabilistic Risk Assessment Focused Scope Peer Review," July 2020.
- [15] AMN#PES00031-REPT-002, "Callaway Energy Center Probabilistic Risk Assessment Peer Review F&Os Closure," July 2020.
- [16] PWROG-19022-P, "Peer Review of the Callaway External Hazard Screening Assessment and High Winds Probabilistic Risk Assessment," April 2019.
- [17] ASME/ANS RA-S CASE 1, Case for ASME/ANS RA-Sb-2013, "Standard for Level 1/Large



- Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," ASME and ANS, November 2017.
- [18] PWROG-18044-P, "Peer Review of the Callaway Seismic Probabilistic Risk Assessment," June 2018.
- [19] NRC Letter, U.S. Nuclear Regulatory Commission Acceptance of ASME/ANS RA-S Case 1, March 12, 2018 (ADAMS access ML18017A964 and ML18017A966).
- [20] PWROG-19011-P, "Independent Assessment of Facts & Observations Closure and Focused Scope Peer Review of the Callaway Seismic Probabilistic Risk Assessment," March 2019.
- [21] NUREG/CR-6850 (also EPRI 1011989), "Fire PRA Methodology for Nuclear Power Facilities," September 2005, with Supplement 1 (EPRI 1019259), September 2010.
- [22] LTR-RAM-II-10-019, "Fire PRA Peer Review Against the Fire PRA Standard SRs From Section 4 of the ASME/ANS Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessments for Nuclear Power Plant Applications for The Callaway Nuclear Plant Fire PRA," October 2009.
- [23] AMN#PES00021-REPT-001, "Callaway Energy Center Fire Probabilistic Risk Assessment Peer Review F&Os Closure," June 2019.
- [24] AMN#PES00031-REPT-003, "Callaway Energy Center Probabilistic Risk Assessment Focused Scope Peer Review," November 2020.
- [25] AMN#PES00042-REPT-002, "Callaway Energy Center Fire Probabilistic Risk Assessment Peer Review F&Os Closure Review," February 2021.
- [26] RG 1.200, "Acceptability of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 3, December 2020.
- [27] PWROG-19020-NP Revision 1, "Newly Developed Method Peer Review Pilot – General Screening Criteria for Loss of Room Cooling in PRA Modeling Risk Management Committee," PA-RMSC-1647, Revision 1, April 2020.