ENCLOSURE 4

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 Justification of Excluding Sources of Risk Not Addressed by the PRA Models

1.0 INTRODUCTION AND SCOPE

Nuclear Energy Institute (NEI) Topical Report NEI 06-09-A, "Risk-Informed Technical Specifications Initiative 4b, Risk-Managed Technical Specifications (RMTS) Guidelines", Revision 0 (Reference [1]), as clarified by the NRC final safety evaluation (Reference [2]), requires that the license amendment request (LAR) provide a justification for exclusion of risk sources from the Probabilistic Risk Assessment (PRA) model based on their insignificance to the calculation of configuration risk, and to discuss conservative or bounding analyses applied to the configuration risk calculation. Enclosure 4 addresses this requirement by discussing the overall generic methodology to identify and disposition such risk sources, and provides the Callaway Plant, Unit No. 1 (Callaway) specific results of the application of the generic methodology and the disposition of impacts on the Callaway Risk-Informed Completion Time (RICT) Program.

Section 3.0 presents the justification for excluding analysis of Other External Hazards from the Callaway PRA. The Callaway Internal Events, Internal Flooding, High Winds, Fire, and Seismic PRA models described within this LAR are the same as those described within the Callaway submittal regarding adoption of 10 CFR 50.69, "Risk-Informed Categorization and Treatment of Structures, Systems and Components for Nuclear Power Reactors" (Reference [3]).

Topical Report NEI 06-09-A does not provide a specific list of hazards to be considered in a RICT Program. However, non-mandatory Appendix 6-A of the American Society of Mechanical Engineers (ASME) / American Nuclear Society (ANS) RA-Sa-2009 PRA Standard (hereafter "ASME/ANS PRA Standard"), "Addenda to ASME/ANS RA-S-2008 Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications" (Reference [4]) provides a guide for identification of most of the possible external events for a plant site. Additionally, NUREG-1855, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision Making", Revision 1 (Reference [5]), also provides a discussion of hazards that should be evaluated to assess uncertainties in plant PRAs and support the risk-informed decision-making process. Table D-1 of Regulatory Guide 1.200 Revision 3 (Reference [6]) provides a list of external hazards to be considered in risk-informed applications. These hazards were reviewed for Callaway, along with a review of information pertaining to the site region and plant design to identify the set of external events to be considered and evaluated. The information from the Callaway Final Safety Analysis Report (FSAR) (Reference [7]) and the Callaway Other External Hazards Screening Assessment Notebook (Reference [8]) were reviewed. No new site-specific or plant-unique external hazards were identified through this review. The list of hazards from Table D-1 of Regulatory Guide 1.200 Revision 3 that were considered for Callaway are summarized in Table E4-1.

The scope of this enclosure is consideration of the hazards listed in Table E4-1 for applicability to Callaway. Listed external hazards are evaluated and screened as low risk in Section 3.0.

2.0 TECHNICAL APPROACH

The guidance contained in NEI 06-09-A states that all hazards that contribute significantly to incremental risk of a configuration must be quantitatively addressed in the implementation of the RICT Program. The following approach focuses on the risk implications of specific external hazards in the determination of the risk management action time (RMAT) and RICT for the Technical Specification (TS) Limiting Conditions for Operation (LCO) selected as part of the RICT Program.

Consistent with NUREG-1855, Revision 1, external hazards may be addressed as follows:

1. Screening the hazard based on a low frequency of occurrence,

2. Bounding the potential impact and including it in the decision-making, or

3. Developing a PRA model to be used in the RMAT/RICT calculation.

The overall process for addressing external hazards considers two aspects of the external hazard contribution to risk.

- The first is the contribution from the occurrence of beyond design basis conditions, e.g., winds greater than design, seismic events greater than design-basis earthquake (DBE), etc. These beyond design basis conditions challenge the capability of the systems, structures, and components (SSCs) to maintain functionality and support safe shutdown of the plant.

- The second aspect addressed is the challenges caused by external conditions that are within the design basis, but still require some plant response to assure safe shutdown (e.g., high winds or seismic events causing loss of offsite power, etc.). While the plant design basis assures that the safety-related equipment necessary to respond to these challenges are protected, the occurrence of these conditions nevertheless cause a demand on these systems that in and of itself presents a risk.

2.1 Hazard Screening

The first step in the evaluation of the external hazard is screening based on an estimation of a bounding core damage frequency (CDF) for beyond design basis hazard conditions. An example of this type of screening is reliance on the NRC's 1975 Standard Review Plan (SRP) (Reference [9]) which is acknowledged in the NRC's Individual Plant Examination of External Events (IPEEE) procedural guidance (Reference [10]) as assuring a bounding CDF of less than 1E-06 per year for each hazard. The bounding CDF estimate is often characterized by the likelihood of the site being exposed to conditions that are beyond the design basis limits and an estimate of the bounding conditional core damage probability for those conditions. If the bounding CDF for the hazard can be shown to be less than 1E-06 per year, then beyond design basis challenges from the hazard can be screened and do not need to be addressed quantitatively in the RICT Program.

The basis for this is as follows:

- The overall calculation of the RICT is limited to an incremental core damage probability (ICDP) of 1E-05.
- The maximum time interval allowed for the RICT is 30 days.
- If the maximum CDF contribution from a hazard is <1E-06 per year, then the maximum ICDP from the hazard is <1E-07 (1E-06/year * 30 days/365 days/year).
- Thus, the bounding ICDP contribution from the hazard is shown to be less than 1% of the permissible ICDP in the bounding time for the condition. Such a minimal contribution is not significant to the decision in computing a RICT.

The Callaway hazard screening analysis from the IPEEE (Reference [11]) has been replaced with an updated screening analysis for external hazards (Reference [8]) to reflect current site conditions. The results are discussed in Section 3.0, and show that all events listed in Table E4-1 can be screened for Callaway, except for seismic and high wind events, which are addressed by site-specific PRAs.

2.2 Hazard Analysis for CDF Contribution

There are two options in cases where the bounding CDF for the external hazard cannot be shown to be less than 1E-06 per year. The first option is to develop a PRA model that explicitly models the challenges created by the hazard and the role of the SSCs included in the RICT Program in mitigating those challenges. This approach was used for the seismic and high winds hazards. The second option for addressing an external hazard is to compute a bounding CDF contribution from the hazard.

2.3 Evaluation of Bounding Large Early Release Frequency (LERF) Contribution

The RICT Program requires addressing both core damage and large early release risk. When a comprehensive PRA does not exist, the LERF considerations can be estimated based on the relevant parts of the internal events LERF analysis. This can be done by considering the nature of the challenges induced by the hazard and relating those to the challenges considered in the Internal Events PRA. This can be done in a realistic manner or a conservative manner. The goal is to provide a representative or bounding conditional large early release probability (CLERP) that aligns with the bounding CDF evaluation.

The incremental large early release frequency (ILERF) is then computed as:

$$ILERF_{Hazard} = ICDF_{Hazard} * CLERP_{Hazard}$$

2.4 Risks from Hazard Challenges

Given the selection of an estimated bounding CDF and LERF, the analysis approach must assure that the RICT Program calculations reflect the change in CDF and LERF caused by out-of-service equipment. The above steps address the direct risks from damage to the facility from external hazards. While the direct CDF contribution from beyond design basis hazard conditions can be shown to be non-significant without a full PRA, there may be risks that are related to the fact that some external hazards can cause a plant challenge even for hazard severities that are less than the design basis limit. For example, depending on the site, external floods can challenge the availability of normal plant heat removal mechanisms.

The approach to be taken in this step is to identify the plant challenges caused by the occurrence of the hazard within the design basis and evaluate whether the risks associated with these events are either already considered in the existing PRA model or they are not significant to the risk. Section 3.0 provides an analysis of the representative external hazards for Callaway.

3.0 EVALUATION OF EXTERNAL EVENT CHALLENGES

This Section provides an evaluation of Other External Hazards. The results of the assessment of these hazards is provided in Table E4-1. Table E4-2 provides the summary criteria for screening of the hazards listed in Table E4-1.

3.1 Hazard Screening

The Callaway Other External Hazards: Screening Assessment Notebook (Reference [8]) provides an assessment of risk to the Callaway Plant associated with Other External Hazards. This notebook (Reference [8]) documents additional analyses that have been done since the IPEEE to provide updated risk assessments of various hazards, such as aircraft impacts, industrial facilities and pipelines, and external flooding (Reference [8]).

Table E4-1 reviews the bases for the evaluation of these hazards, identifies any challenges posed, and identifies any additional treatment of these challenges, if required. Table E4-2 provides the criteria applied in the progressive screening process used in this assessment. The conclusions of the assessment, as documented in Table E4-1, assure that the hazard either does not present a design-basis challenge to Callaway, or is adequately addressed in the PRA.

3.2 Impacts to RICT

In the application of RICTs, a significant consideration in the screening of external hazards is whether particular plant configurations could impact the decision on whether a particular hazard that screens under the normal plant configuration and the base risk profile would still screen given the particular configuration. The external hazards screening evaluation for Callaway has been performed accounting for such configuration-specific impacts. The process involves several steps.

As a first step in this screening process, hazards that screen for one or more of the following criteria (as defined in Table E4-2) still screen regardless of the configuration, as these criteria are not dependent on the plant configuration.

- The occurrence of the event is of sufficiently low frequency that its impact on plant risk does not appreciably impact CDF or LERF. (Criterion C2)
- The event cannot occur close enough to the plant to affect it. (Criterion C3)
- The event which subsumes the external hazard is still applicable and bounds the hazard for other configurations. (Criterion C4)
- The event develops slowly, allowing adequate time to eliminate or mitigate the hazard or its impact on the plant. (Criterion C5)

The next step in the screening process is to consider the remaining hazards (i.e., those not screened per the above criteria) to consider the impact of the hazard on the plant given particular configurations for which a RICT is allowed.

The following hazards are screened for configurations, using criteria other than C2 - C5, as discussed above. Configurations involving SSCs associated with LCOs in scope of the RICT program do not have an impact from these hazards:

- Ice Cover and Low Winter Temperature
- Lightning
- Release of Chemicals
- Soil Shrink
- Aircraft Accidents, Meteorites, and Turbine Missiles

Therefore, all of the non-modeled hazards remain screened for all RICT configurations.

Table E4-1 presents the results of the external hazards screening analysis for Callaway. Table E4-2 presents the progressive screening approach for addressing external hazards. A detailed description of the external events screening and evaluation process in presented in Reference [8].

Table E4-1. External Hazards Screening

External Hazard	Screening Result		
	Screened? (Y/N)	**Screening Criterion (Note a)**	**Comment**
Aircraft Impact	Y	PS4	Airports, military installations, and flight corridors have been considered. There are three low-altitude airways and three high-altitude airways that pass near the plant. A bounding analysis of aircraft impact associated with these airways results in a CDF < 1E-6/yr.
Avalanche	Y	C3	Not applicable to the site because of climate and topography.
Biological Events	Y	C5	Service Water and Essential Service Water systems include traveling water screens and backwash strainers to prevent intake of foreign matter. These design features would provide sufficient time to detect and mitigate the hazard.
Coastal Erosion	Y	C3	The site is not in proximity to any ocean or large body of water; therefore, costal erosion is not an applicable hazard.
Drought	Y	C1, C5	Plant design eliminates drought as a concern. In addition, this event is slowly developing.
External Flood	Y	C1, C3	External flooding is incorporated into High Tide, Lake Level, or River Stage, Seiche, Tsunami, Storm Surge, and Waves. Local Intense Precipitation (LIP) was analyzed and shown to be within the plant design basis. See also Precipitation, Intense

Table E4-1. External Hazards Screening

External Hazard	Screening Result		
	Screened? (Y/N)	**Screening Criterion (Note a)**	**Comment**
Extreme Winds and Tornadoes	N/A	N/A	Callaway possesses a High Winds PRA that addresses this hazard.
Fog	Y	C4	Negligible impact on the plant. Implicitly included in air, land, and water transportation.
Forest Fire	Y	C1, C3, C4	Limited occurrence and bounded by other events, primarily loss of offsite power (LOOP), for which the plant is designed. Not applicable to site due to limited vegetation and inability of hazard to propagate into Protected Area.
Frost	Y	C1, C4	Limited occurrence and bounded by other events for which the plant is designed. Frost impacts covered under ice and snow hazards.
Hail	Y	C4	Limited occurrence and bounded by other events for which the plant is designed. Consequences of this hazard are bounded by a loss of offsite power (LOOP), which is included in the Internal Events PRA weather-induced LOOP frequency.
High Summer Temperature	Y	C1, C5	Plant is designed for this hazard. Associated plant trips have not occurred and are not expected. In addition, this event is slowly developing.
High Tide	Y	C3	The site is not in proximity to any oceans or lakes, and is not susceptible to flooding by rivers. This hazard is not applicable due to the site location.
Hurricane (Tropical Cyclone)	Y	C4	Callaway possesses a High Winds (HW) PRA that addresses this hazard, thus it screens using C4. Note: The HW PRA screens hurricane winds using C3.

Table E4-1. External Hazards Screening

External Hazard	Screening Result		
	Screened? (Y/N)	**Screening Criterion (Note a)**	**Comment**
Ice Cover	Y	C1	Plant is designed for freezing temperatures, which are infrequent and short in duration.
Industrial or Military Facility Accident	Y	C3	The only industrial or military facility within 5 miles of the site is Mertens Quarry, located 4.5 miles northwest of the site. The amount of explosive material required to potentially damage the plant is significantly greater than the amount that would ever be stored at a quarry. Therefore, industrial or military facility accidents cannot occur close enough to the plant to affect it.
Internal Flood	N/A	N/A	Callaway possesses an Internal Flooding PRA that addresses this hazard.
Landslide	Y	C3	The site is located on a plateau, and there is no significantly higher ground within 5 miles. The topography of the site precludes this hazard.
Lightning	Y	C1	Lightning strikes causing loss of offsite power or turbine trip are contributors to the initiating event frequencies for these events. However, other causes are also included. The impacts are no greater than already modeled in the Internal Events PRA.
Low Lake Level or River Water Level	Y	C1, C5	The plant is designed for such events, and their impacts are slow to develop.
Low Winter Temperature	Y	C1	Extended freezing temperatures are rare, the plant is designed for such events.
Meteorite / Satellite Strikes	Y	PS4	The frequency of meteorites greater than 100 lb striking the plant is around 1E-8/yr and corresponding satellite impacts is around 2E-9/yr.

Table E4-1. External Hazards Screening

External Hazard	Screening Result		
	Screened? (Y/N)	Screening Criterion (Note a)	Comment
Pipeline Accident	Y	C3	There are no pipelines or tank farms within 5 miles of the site. Pipelines are not close enough to significantly impact plant structures.
Precipitation, Intense	Y	C1	Under very conservative assumptions no critical SSC elevations are reached.
Release of Chemicals from Onsite Storage	Y	C1	The plant is operated and designed for such events. No control room habitability problems from the potential release of hazardous chemicals have been identified.
River Diversion	Y	C1, C5	The Missouri River is strictly managed and highly regulated. It is extremely improbable that naturally occurring or man-made diversions would be allowed to continue unchecked or uncontrolled. Even so, the plant is designed for such events, and their impacts are slow to develop.
Sandstorm	Y	C1, C3	There are no recorded instances of sandstorms affecting Callaway county or any neighboring counties. The plant is designed for such events. Also, a procedure instructs operators to replace filters before they become inoperable.
Seiche	Y	C3	Site is not located near any bodies of water for which seiche flooding would apply. Onsite reservoirs and spray ponds are designed for seiches.
Seismic Activity	N/A	N/A	Callaway possesses a Seismic PRA that addresses this hazard.

Table E4-1. External Hazards Screening

External Hazard	Screening Result		
	Screened? (Y/N)	**Screening Criterion (Note a)**	**Comment**
Snow	Y	C1, C4	The event damage potential is less than other events for which the plant is designed. Consequences of this hazard are bounded by a loss of offsite power (LOOP), which is included in the Internal Events PRA weather-induced LOOP frequency. Potential flooding impacts covered under external flooding.
Soil Shrink-Swell	Y	C1	The potential for this hazard is low at the site, the plant design considers this hazard.
Storm Surge	Y	C3	The site is not located near any large bodies of water for which storm surge flooding would apply. This hazard is not applicable to the site because of location.
Toxic Gas	Y	C4	Toxic gas covered under release of chemicals in onsite storage, industrial or military facility accident, and transportation accident.
Transportation Accidents	Y	C1, C3, C4, C5	Road and highway, railroad, and water transport cannot occur close enough to the plant to affect it. Water transport collisions with intake structure are of lesser potential damage than the events for which the plant was designed, and would provide sufficient time to respond. Aviation and pipeline accidents covered under those specific categories.
Tsunami	Y	C3	The site is not located near any large bodies of water for which tsunami flooding would apply. This hazard is not applicable to the site because of location.

Table E4-1. External Hazards Screening

External Hazard	Screening Result		
	Screened? (Y/N)	**Screening Criterion (Note a)**	**Comment**
Turbine-Generated Missiles	Y	C1, PS4	The event is of equal or lesser damage potential than the events for which the plant has been designed and the core damage frequency, calculated using a bounding or demonstrably conservative analysis, has a mean frequency <1E-6/yr.
Volcanic Activity	Y	C3	The site is not located near any active volcano. This hazard is not applicable to the site because of location.
Waves	Y	C1	The plant design considers this hazard. Water levels in the UHS retention pond after wave run-up do not reach the critical water level.
Note a – See Table E4-2 for descriptions of the screening criteria.			

Table E4-2. Progressive Screening Approach for Addressing External Hazards

Event Analysis	Criterion	Source	Comments
Initial Preliminary Screening	C1. Event damage potential is < events for which plant is designed.	NUREG/CR-2300 ASME/ANS Standard RA-Sa-2009	
	C2. Event has lower mean frequency and no worse consequences than other events analyzed.	NUREG/CR-2300 ASME/ANS Standard RA-Sa-2009	
	C3. Event cannot occur close enough to the plant to affect it.	NUREG/CR-2300 ASME/ANS Standard RA-Sa-2009	
	C4. Event is included in the definition of another event.	NUREG/CR-2300 ASME/ANS Standard RA-Sa-2009	
	C5. Event develops slowly, allowing adequate time to eliminate or mitigate the threat.	ASME/ANS Standard	
Progressive Screening	PS1. Design basis hazard cannot cause a core damage accident.	ASME/ANS Standard RA-Sa-2009	
	PS2. Design basis for the event meets the criteria in the NRC 1975 Standard Review Plan (SRP).	NUREG-1407 ASME/ANS Standard RA-Sa-2009	Not utilized herein because conformance to the SRP does not guarantee that the CDF is less than $1x10^{-6}$ per year.

Table E4-2. Progressive Screening Approach for Addressing External Hazards

Event Analysis	Criterion	Source	Comments
	PS3. Design basis event mean frequency is < 1E-5/yr and the mean conditional core damage probability is < 0.1.	NUREG-1407 ASME/ANS Standard RA-Sa-2009	
	PS4. Bounding mean CDF is < 1E-6/yr.	NUREG-1407 ASME/ANS Standard RA-Sa-2009	
Detailed PRA	Screening not successful. PRA needs to meet requirements in the ASME/ANS PRA Standard.	NUREG-1407 ASME/ANS Standard RA-Sa-2009	

4.0 CONCLUSIONS

Based on this analysis of external hazards for Callaway, no additional external hazards need to be added to the existing PRA model. Both seismic and high winds external hazards are currently modeled in the Callaway PRA. The evaluation concluded that all other hazards either do not present a design-basis challenge to Callaway, the challenge is adequately addressed in the PRA, or the hazard has a negligible impact on the calculated RICT and can be excluded.

The ICDP/ILERP acceptance criteria of 1E-05/1E-06 will be used within the RICT Program framework to calculate the resulting RICT based on the total configuration-specific delta CDF/LERF attributed to Internal Events, Internal Flooding, Internal Fire, Seismic, and High Winds delta CDF/LERF values.

5. REFERENCES

[1] 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).

[2] 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).

[3] Letter (ULNRC-06550) 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'," dated October 30, 2020 (ML20304A455).

[4] 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.

[5] NUREG-1855, "Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-Informed Decision-making," USNRC, Revision 1, March 2017.

[6] NRC Regulatory Guide 1.200, "Acceptability of Probabilistic Risk Assessment Results for Risk-Informed Activities," Revision 3, December 2020.

[7] Callaway Energy Center Final Safety Analysis Report (FSAR), Rev. OL-24b, October 2020.

[8] PRA-OEH-ANALYSIS, "Other External Hazards: Screening Assessment Notebook," Revision 000, Update 8.

[9] NUREG-75/087, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, LWR Edition," 1975.

[10] NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," U.S. Nuclear Regulatory Commission, April 1991 (ADAMS Accession No. ML063550238).

[11] Callaway Plant IPEEE, June 30, 1995.