REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:   418-8348

SRP Section: SRP 19

Application Section: 19.1

Date of RAI Issue: 02/23/2016

Question No. 19-49

10 CFR 52.47(a)(27) requires that a standard design certification applicant provide a description of the design specific PRA.

SRP Chapter 19.0, Revision 3 (Draft), Section "II. Acceptance Criteria," states that the staff determines whether, "…the technical adequacy of the PRA is sufficient to justify the specific results and risk insights that are used to support the DC or COL application.

Toward this end, the applicant's PRA submittal should be consistent with prevailing PRA standards, guidance, and good practices as needed to support its uses and applications and as endorsed by the NRC (e.g., RG 1.200)."

The staff noted that the PRA documentation (APR1400-K-P-NR-013503-P) considered flooding initiating events caused by inadvertent operation or erroneous operation of a plant component during maintenance.

The applicant concluded that these scenarios do not contribute significantly to the overall initiating event frequency. Please justify this conclusion in the DCD, for both at power and LPSD conditions.

Response – (Rev. 2)

DCD Section 19.1.5.3.1.5 will be revised to include justification that maintenance-induced internal flooding events are considered to be negligible contributors to full power internal flooding risk (see Attachment 1).

DCD Section 19.1.6.4.1.3 will be revised to include justification that maintenance-induced internal flooding events are considered to be negligible contributors to LPSD internal flooding risk (see Attachment 2).

Table 19.1-4 in DCD 19.1 will be revised to include the maintenance induced flood event will be added in the key assumptions and risk insights (See Attachment 3).

The section 2.1.1 of PRA documentation APR1400-K-P-NR-013503-P will be revised to include the maintenance induced flood event (The markup PRA documentation will be uploaded in the electrical report rooms(location: 01 PRA/SA/RAP – Audit / No_33(Submitted RAI Response)-1 / 13_19-49(RAI 418-8348))

Impact on DCD

The Subsection 19.1.5.3.1.5, 19.1.6.4.1.3 and Table 19.1-4 in DCD 19.1 will be revised as shown in the Attachment 1, 2 and 3.

The changes that were proposed in the original and revision1 of response to this RAI have been incorporated into Revision 1 of the DCD; therefore, only the pages containing proposed changes as a result of Revision 2 of this response are included in the Attachment 4.

The Subsection 19.1.6.4.1.3 will be revised as shown in the Attachment 4, due to duplication and change of the description in the 19.1.6.4.1.2.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environment Report.

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internal flooding analysis should be applicable to the LPSD flooding analysis when considering events that could cause failure of the operating SDC train.

Outage work is conducted on a train basis.   That is, while work on train A equipment is planned, no maintenance is performed on any train B equipment and vice versa.   This assumption regarding maintenance includes flood barriers separating the two divisions.

Additionally, the analysis assumes that auxiliary building flood barriers separating trains within a division are maintained consistent with the internal flooding design basis for the normally operating SDC train.   The normally-operating SDC train is from the Division which is not scheduled for maintenance during that portion of the outage.   Therefore, the propagation analysis developed for the at-power internal flooding analysis should be applicable to the LPSD flooding analysis when considering events that could cause failure of the operating SDC train.   Maintenance-induced flooding events are expected to be insignificant contributors to overall flooding risk.   However, absent the availability of plant-specific maintenance procedures and equipment unavailability data, calculation of maintenance-induced flood frequency cannot be performed.   The COL applicant will demonstrate that maintenance-induced floods are negligible contributors to risk when such information is available (COL 19.1(24)).

19.1.6.4.1.3   Accident Sequence

The AS development for LPSD flooding uses the loss of shutdown cooling sequences in the LPSD internal events analysis.   While there are many initiating events (i.e., many floods that can fail one or both trains of SC), each unique IE use the same, basic loss of shutdown cooling (LOSC) event tree for the subsequent accident analysis.

Since the initiating events are failures of the running train of shutdown cooling, the sequences include the same potential recovery actions.   First, the operators would attempt to recover the SCS via the standby train, if it is available.   If this action is not successful, the operators must proceed to feed and bleed cooling.

~~Maintenance-induced flooding events are considered to be negligible contributors to LPSD internal flooding risk.   As detailed in Subsection 19.1.5.3.1.5, the frequency of maintenance-induced flooding events was calculated using a bounding analysis to be less than 7.5E-07 per year, which is small in comparison to random system breaks. Furthermore, maintenance during shutdown is controlled on a divisional basis so that it is not likely that maintenance will be performed on the division of the operating shutdown~~

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~~cooling system if only one division is available. This practice further diminishes the potential for maintenance-induced floods to cause an initiating event during LPSD conditions.~~

19.1.6.4.1.4   Success Criteria

No changes to the success criteria are made for the internal flooding analysis, relative to the LPSD internal events PRA model. The same criteria for shutdown cooling (including supporting heat sinks), feed and bleed (including supporting heat sinks), and containment cooling are used throughout the evaluation.

19.1.6.4.1.5   Operator Actions

No changes are made to the LPSD internal events human error probabilities (HEPs) for the LPSD flood analysis. The operator actions for isolating LPSD pipe breaks involve similar timing and required similar actions as those operator actions for isolating at-power pipe breaks, so no new HEPs for LPSD are introduced.

19.1.6.4.1.6   Systems Analysis

No new systems are modeled for LPSD flooding, nor are any existing models expanded or revised for the LPSD flood analysis.

19.1.6.4.2   Results from Internal Flooding PRA for Low Power and Shutdown
                  Operations

19.1.6.4.2.1   Risk Metrics

The CDF for LPSD flooding is 1.8×10^{-8}/year. This figure is approximately two orders of magnitude less than LPSD internal events and internal fire, both of which are in the low 1×10^{-6}/year range for LPSD CDF. Because of the low CDF, all LPSD internal flood CDF is conservatively assigned to the LRF end state (i.e., LPSD flooding LRF equals 1.8×10^{-8}/year). The negligible frequency ensures that the conservative assumption has a negligible impact on the overall results. A detailed analysis is expected to show an LPSD internal flood CPLR similar to that seen in the LPSD internal events and fire analyses. It should be noted that units for CDF and LRF are expressed in terms of "reactor calendar year" (shortened to "/year" when displayed in the text in this section).