REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

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

Docket No. 52-046

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SRP Section:	**SRP 19**
Application Section:	**19.1**
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Question No. 19-100

During a June 25, 2015 public conference call between the NRC and KHNP and in KHNP's response to Question PRA-120 from the APR1400 PRA audit, KHNP informed the staff that the entire PRA software platform will be switched to EPRI R&R Workstation, i.e., SAREX and TREX to CAFTA. Realizing the impact a computer code change would have on the PRA modeling and results, the staff needs information about how the applicant will use CAFTA and the results and insights produced, and how the DCD will be updated to reflect the new PRA computer code and results. Therefore, the staff issued RAI 8352, Question 28658 to address this issue. When the LPSD PRA is switched to CAFTA, the staff is requesting KHNP to confirm the low power and shutdown (LPSD) large release frequency (LRF) point estimate and the mean, and correct the DCD if necessary. In DCD Section 19.1.6, the LPSD LRF for internal events is stated as 1.2E-7/year. However, the mean value is stated as 6.8E-8/yr. There is a factor of 2 difference in these values.

Response - (Rev .1)

The EPRI R&R Workstation suite is utilized in a manner similar to that of SAREX in terms of generation of cutset results in the Level 1 PRA. The approaches of event tree, fault tree and data analysis, while not exactly the same, are similar in their approaches to the generation of cutsets. The Level 2 PRA methodology is different between SAREX and the EPRI suite in that the SAREX Level 2 software does not utilize fault trees for Containment Event Tree (CET) or Decomposition Event Tree (DET) evaluation. Instead, the SAREX Level 2 is developed using Plant Damage State (PDS) event trees, and all subsequent CET/DET calculations are either split fraction probabilities or logic rules applied to each sequence. The Level 2 analysis, utilizing the EPRI suite (i.e., the CAFTA code), utilizes fault trees for the solution of the CETs and DETs. Split fraction probabilities are applied using fault tree gates, but all system logic is also applied to CETs and DETs using the system and sequence fault trees that are utilized in the Level 1 analysis.

The updated Level 2 analysis, using the EPRI suite, does not directly use the PDS event trees or PDS binning diagram, but they are utilized in the creation of the CAFTA Level 2 CET and DET logic, as documented in the FPIE Level 2 PRA conversion document. Therefore, the PDS binning diagram is still relevant to the Level 2 analysis, even though it is not explicitly utilized in the updated Level 2 quantification. The CET and DET logic was explicitly created in the CAFTA fault tree software, and the diagrams shown in the Level 2 documents are still accurate representations of the Level 2 modeling.

Regarding the LPSD internal events LRF reported in the DCD, Section 19.1.6.2.2.3 notes that because POSs 1-4A and 13-15 estimate LRF using the at-power conditional probability of large release (CPLR), no new insights into the LPSD risk would be gained by performing importance analyses or other detailed results evaluations. Therefore, the uncertainty analysis in Section 19.1.6.2.2.6 actually only includes cutsets from POSs 4B-12A. The text of Section 19.1.6.2.2.6 is revised to explicitly note that the uncertainty analysis was only performed on POSs 4B-12A.

Impact on DCD

The DCD subsection 19.1.6.2.2.6 is revised as shown in the Attachment.

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.

pressure only reached 30 psia before ECSBS was initiated, so the impact of the assumption is not as significant.

E. ECSBS was credited for containment heat removal in the LPSD analysis, which is consistent with the at-power Level 2 analysis and the LPSD-specific MAAP analyses.

F. Many severe accident phenomenological probability estimates from the at-power Level 2 analysis were used in the LPSD Level 2. This is conservative because of lower decay heat levels and RCS pressure in LPSD sequences.

19.1.6.2.2.6 Uncertainty Analysis

This section presents the parametric uncertainty analyses performed on the internal events LRF cutsets for LPSD operations. The resultant uncertainty parameters are:

5 percent value: 1.6×10^{-8}/year

Mean value: 6.8×10^{-8}/year

Point estimate 6.64 x 10^{-8}/year

95 percent value: 1.8×10^{-7}/year

The uncertainty analysis was performed using a Monte Carlo sampling, with a sample size of 10,000.

19.1.6.2.2.7 Risk Insights

New text is added as shown A

The LPSD CDF is dominated by overdrain events while in mid-loop operation. For cutsets in which the failure of SI is caused by operator error, the LPSD Level 2 analysis credits a second cue for SI initiation. This SAMG action mitigates a large portion of the mid-loop operation CDF. The action also mitigates other LPSD POS and initiating events, and its importance is seen in the associated basic event's Fussell-Vesely LRF importance of approximately 5.0×10^{-1}.

Offsite power recovery for LOOP sequences that did not result in SBO has a significant impact on the LRF. The Level 2 analysis credits offsite power recovery in non-SBO LOOP sequences to estimate a more realistic LRF.

A

Note that this uncertainty analysis is only performed on the LPSD LRF cutsets generated for POSs 4B through 12A. Since the LRF for the other POSs was conservatively approximated (as described in Section 19.1.6.2.1.1), no LPSD LRF cutsets were generated for those POSs. As such, the uncertainty analysis can only be performed on POSs 4B through 12A.