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**

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Question No. 19-44

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)."

To allow the staff to reach a reasonable assurance finding on APR1400 PRA technical adequacy of the PRA, please include an evaluation of the parametric uncertainty intervals in the DCD for: Level 1 and Level 2 PRA models for at-power internal fire and at-power internal flooding.

Response

Uncertainty intervals were calculated for the Level 1 and Level 2 at-power internal fire and at-power internal flooding models using the UNCERT code which is part of the EPRI R&R Workstation. The analysis was performed using the Monte Carlo sampling method with 10,000 samples for each model evaluated. The DCD will be marked up to include the results of the parametric uncertainty (See Attachment for at-power fire and at-power flooding, respectively).

Impact on DCD

The DCD will be 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 Technical/Topical/Environmental Report.

etc.). Potential MCA compartments are screened if the exposed compartment has no PRA-credited equipment since the resulting cutsets will be non-minimal to the exposing single-compartment scenario. In addition, potential scenarios involving either the main turbine building (F000-TB) or the containment building (F000-C01) are screened due to the size and geometry, which preclude the formation of a hot gas layer or oil fire spread. In total, 1,055 unscreened MCA scenarios are identified and evaluated. MCA scenarios account for about 14 percent of the CDF and 13 percent of the LRF.

19.1.5.2.2 Results from the Internal Fire Risk Evaluation

The internal fire risk evaluation is performed using the design-specific fire protection features in Chapter 9, Appendix 9A and the internal events PRA model of Subsection 19.1.4.

The fire CDF and LRF for the APR1400 are as follows:

a. Fire CDF: 1.9×10^{-6}/year → 1.7

1) Single-compartment fire CDF: ~~1.6~~ $\times 10^{-6}$/year → 1.5

2) Multi-compartment fire CDF: ~~2.6~~ $\times 10^{-7}$/year → 1.6

b. Fire LRF: ~~1.7~~ $\times 10^{-7}$/year → 1.2

1) Single-compartment fire LRF: ~~1.5~~ $\times 10^{-7}$/year → 3.8

2) Multi-compartment fire LRF: ~~2.2~~ $\times 10^{-8}$/year

c. Conditional large release probability: ~~0.09~~ → 0.08

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).

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19.1.5.2.2.1 Fire-Induced Initiating Events

Table 19.1-46 shows the percentages of fires resulting in each identified fire-induced internal event initiator, ranked highest to lowest. Table 19.1-47 and Table 19.1-48 present the CDF and LRF, respectively, for each fire-induced initiator ranked from highest to lowest. The results show that the vast majority of the plant fire frequencies result in

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A parametric uncertainty analysis was performed on both the internal fire CDF and LRF using the Monte Carlo method with 10,000 samples.

The results of the parametric uncertainty for the Level 1 internal fire CDF are summarized below:

- 5 percent value: 1.1×10^{-6}/year
- Mean value: 1.9×10^{-6}/year
- 95 percent value: 3.2×10^{-6}/year

The results of the parametric uncertainty analysis for the Level 2 internal fire LRF are summarized below:

- 5 percent value: 7.7×10^{-8}/year
- Mean value: 1.6×10^{-7}/year
- 95 percent value: 3.0×10^{-7}/year

Although when displayed as two significant digits the internal fire CDF and LRF point estimates appear to be the same as the mean, the mean values for both the CDF and LRF are both actually larger than their respective point estimates. This results in a mean value for the joint probability that is larger than the product of the mean values of the event probabilities.

mitigation) already have a high stress level associated with them and the addition of a flood scenario results in a minimal increase in stress level.

Sufficient staffing is assumed to be present for the operating crew to investigate the cause of flooding symptoms and respond to events in the control room without compromising the ability to perform either function.

The effect of flooding on the HEP values for human actions performed within the MCR is considered to have a negligible effect on the overall HEP value. An examination of all credited human actions performed inside the MCR was performed and no outliers were found that warranted further analysis.

If a portion of the action is performed outside the MCR, limited or no credit should be taken for those flood scenarios in which the location of the action performance may be affected by the flooding effects. An analysis was performed to determine which human actions performed outside the control room should be failed as a result of flooding. The approach used is conservative in that, unless otherwise stated, a human action deemed to have a significantly degraded probability of success is modeled as being failed.

If the areas where a portion of the human actions are performed are subjected to spray or contain standing water as a result of direct deposition or propagation in a flood scenario, the human actions performed in that area are conservatively assumed to fail.

19.1.5.3.1.7 Quantification

For each postulated internal flooding scenario, the flooding initiating events and the flood-induced equipment failures are included in the logic models. Each internal flooding scenario is quantified a process similar to that used for the internal events PRA quantification to generate an estimated frequency of core damage.

19.1.5.3.2 Results from the Internal Flooding Evaluation

1.8

The total CDF from internal flooding events is 2.2×10^{-7}/year. Total LRF from internal flooding events is ~~1.7~~ $\times 10^{-8}$/year. It should be noted that units for CDF and LRF are

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B

A parametric uncertainty analysis was performed on both the internal flooding CDF and LRF using the Monte Carlo method with 10,000 samples.

The results of the parametric uncertainty for the Level 1 internal flooding CDF are summarized below:

- 5 percent value: 2.7×10^{-8}/year
- Mean value: 2.5×10^{-7}/year
- 95 percent value: 7.9×10^{-7}/year

The results of the parametric uncertainty analysis for the Level 2 internal flooding LRF are summarized below:

- 5 percent value: 1.5×10^{-9}/year
- Mean value: 2.2×10^{-8}/year
- 95 percent value: 7.2×10^{-8}/year

Although when displayed as two significant digits the internal flooding CDF and LRF point estimates appear to be the same as the mean, the mean values for both the CDF and LRF are both actually larger than their respective point estimates. This results in a mean value for the joint probability that is larger than the product of the mean values of the event probabilities.