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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Question No. 19-57

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

Section 19.1.5.2.2 of APR1400 design control document (DCD), Rev. 0, states that "[t]he 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." In using the internal events PRA model explain how KHNP evaluated the systems and equipment that are important for Level 2 and affected by internal fire. Revise the DCD accordingly.

Response

The impact on Level 2 systems and equipment from fire effects is handled in the same way as it is for the Level 1 analysis. Specifically, for both Level 1 and Level 2, all fire PRA credited components which are impacted by the fires described in each fire scenario are assumed to fail their safe shutdown function. Practically, this is achieved by setting the appropriate basic events for the affected components to logical TRUE in the fire scenario flag files. The DCD will be revised to more clearly state that the fire PRA is based off of both the Level 1 and Level 2 internal events PRA models.

Impact on DCD

The DCD will be revised to more clearly state that the fire PRA is based off of both the Level 1 and Level 2 internal events PRA models 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 Environmental Report.

facility, and sanitary water treatment facility. Miscellaneous support structures and parking lots are also located throughout the licensee-controlled area, but not included in the global plant analysis boundary.

Meaningful fire analysis within the global plant analysis boundary requires establishment of realistic bounds that describe the expected extent of individual fires. The plant boundary and partitioning task establishes these analysis areas by dividing the global plant analysis boundary into discrete physical analysis units (PAU) or fire compartments. A fire compartment is a well-defined volume within the plant that is expected to substantially contain the effects of fire within the compartment. This volume is typically considered to be a room or clearly distinguishable area of the plant that is separated from other plant areas by substantial construction or other features that would contain the damaging effects of a fire within the compartment. Almost all fire compartments are completely enclosed by 3-hour fire barriers (or equivalent); however, a few fire compartments have one or more barriers that have only a 1- or 2-hour fire rating. A total of 391 fire compartments are identified (Table 19.1-45).

Level 1 and Level 2

Task 2 identifies the components to be included in the fire PRA. Components are selected mainly based on a review of the internal events PRA, Fire Safe Shutdown Analysis, and the Post-Fire Human Reliability Analysis (Task 12), and included:

a. Equipment that if damaged as a result of fire will lead to a plant trip either directly or as a result of operator action

b. Equipment needed to respond to the initiating events identified

c. Equipment whose spurious operation as a result of fire will either cause a fire-induced initiating event or adversely affect the response of systems or operator actions required to respond to a fire

and Task 5 Level 1 and Level 2

As part of Task 2, the internal events PRA model was reviewed to identify the accident sequences that should potentially be included in the fire PRA model. Some of the sequences included in the internal events PRA are eliminated from the fire PRA model. The elimination criteria of the sequences are as follows:

a. Sequences associated with initiating events involving a passive/mechanical failure that can be assumed not to occur as a direct result of a fire. Therefore, initiating events that are caused by primary or secondary side pipe breaks, vessel failure, and SGTRs can be eliminated from the PRA model.

b. Sequences associated with events that, while it is possible that a fire could cause the events, a low frequency of occurrence argument could be justified. For example, the ATWS sequence has not been treated in the fire PRA because fire-induced failures will almost certainly remove power from the control rods (resulting in a trip), rather than cause a "failure-to-scram" condition. Additionally, fire frequencies multiplied by the independent failure-to-scram probability can be seen as small contributors to fire risk.

As a result, the following accident sequences have been eliminated from the fire PRA model.

a. LOCAs (from pipe breaks)

b. Reactor vessel rupture

c. SGTR

d. Feedwater/main steam line break

e. ATWS

f. Spurious safety injection signal

The fire PRA credited components and their locations (i.e., fire compartments) within the plant are entered into a fire PRA database. As part of Task 5, fire scenario flag files were developed from the information in the fire PRA database which fails all Level 1 and Level 2 fire PRA credited equipment impacted by the fire scenario by setting the appropriate basic events to logical TRUE during quantification of the fire scenario.

In Tasks 3 and 9, the cables associated with fire PRA components were identified, and failure modes for the associated equipment are assigned using Assumptions 2 to 7 above as guidance. All cables for fire PRA equipment are included in the fire PRA database, which also contains cable routing information on a fire compartment and raceway basis. The internal events PRA model has been edited as necessary to incorporate the additional components and failure modes unique to the fire PRA.

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

Level 1 and Level 2

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.~~

models described in Subsections 19.1.4.1 and 19.1.4.2.

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

a. Fire CDF: 1.9×10^{-6}/year

   1) Single-compartment fire CDF: 1.6×10^{-6}/year

   2) Multi-compartment fire CDF: 2.6×10^{-7}/year

b. Fire LRF: 1.7×10^{-7}/year

   1) Single-compartment fire LRF: 1.5×10^{-7}/year

   2) Multi-compartment fire LRF: 2.2×10^{-8}/year

c. Conditional large release probability: 0.09

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).

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