
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.: 446-8535
SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation
Application Section
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Question No. 19-101

The staff has reviewed the applicant's revised response to RAI 19-4 dated September 30, 2015, and the applicant's response to PRA Item -18 on Low Temperature Over Pressure Protection (LTOP) during low power and shutdown conditions (LPSD). The staff needs additional justification in the DCD regarding the screening of shutdown events occurring in a water solid condition (the pressurizer full) since an interruption of the decay heat removal function or a small mass addition could challenge the SCS suction line relief valves, which provide LTOP to open. If these SCS suction line relief valves are opened but fail to reseal, there would be a low elevation, large flow rate RCS leak path. From discussions with KHNP, the staff understands that plant operating state (POS) 3b represents cooldown to 140 degrees Fahrenheit and could contain a water solid evolution. However, the staff reviewed proposed DCD table 19.1-93, "Summary of Analysis Results for Plant Operating States" which was provided in response to RAI 19-4. The assumed RCS level for POS 3b is normal operating level not level with water solid conditions (pressurizer full), which makes the plant more susceptible to an LTOP actuation of the SCS suction line relief valves.

Response

Shutdown initiating events during water-solid operation were not screened out. Risk with a water-solid pressurizer is explicitly analyzed by the RL initiating event, "LTOP Relief Valve Fails to Reclose." The LTOP valves are normally isolated during power operation. Once the Shutdown Cooling System (SCS) is placed in service during Mode 4 operation, the LTOP valves are unisolated to provide overpressure protection until a Reactor Coolant System (RCS) vent is established. These valves are vulnerable to a fail-open fault following a spurious lift event. However, a mass addition event was not included in the development of the RL initiating event frequency.

The information in the DCD table 19-93 presents the "Minimum RCS Water Level During POS." References to "Normal operation level" therefore do not exclude water-solid operation. In fact,

POS 3A, 3B and 13 all include short periods of water solid operation to vent non-condensable gases before draindown. However, the RCS is not water-solid for most of these states.

Key Assumption (f) in Section 19.1.6.1.2.5, which discussed risk during water-solid operation, will be deleted.

Impact on DCD

DCD 19.1.6.1.2.5 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 any Technical, Topical, or Environmental Report.

APR1400 DCD TIER 2

- a. The decay heat load is assumed to be constant during each state. The decrease in decay heat over time is conservatively neglected. Thus, the calculated time to boil off coolant is conservatively underestimated.
- b. IRWST cooling is not required when the RV head is removed, but makeup for boil-off is assumed to be required when heat removal is lost. More than 3 days are required to deplete the IRWST if steam is not condensed in the containment and returned to the IRWST. This conservative treatment provides the basis for neglecting IRWST cooling when the RV head is removed.
- c. Possible transient LOCA events through the RV and pressurizer (PZR) vents are not considered. The pressurizer vent is normally open during shutdown. The RV vent is open during reduced inventory operation and plant startup after refueling. Given RCS temperatures and pressures, a loss of inventory as steam is evaluated after a loss of RHR cooling. The pressurizer vent contains a flow restrictor, which significantly limits the flow to well below the makeup capacity of the CVCS. The RV vent is a 1 in line, and it would take a long time to uncover the core by venting steam through this line. The risk from this event is not considered significant because the operators have more than enough time to isolate the vent or to provide makeup to the RCS, and these events are screened out as potential initiating events.
- d. It is assumed that a transient-induced LOCA response requires feed and bleed cooling success, using the pressurizer relief valves, because the LOCA size may not be large enough to provide sufficient bleed flow.
- e. The probability of IRWST suction strainer plugging is not increased relative to the power operation PRA model. The IRWST design characteristics (e.g., large, separation between suction lines, debris filtering capability) and plant procedures (e.g., foreign material control) are expected to provide reasonable assurance that this probability is low.
- ~~f. Risk with a water solid pressurizer is not considered. The inadvertent start of an RCP or an SIP could cause an overpressure event when the pressurizer is solid. The SCS relief valves will protect the system from overpressure during this period and the exposure time is small. Thus, overflow events that could lead to a low temperature overpressure event have been screened out as potential initiating.~~