
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.: 327-8354
SRP Section: 06.02.01.01.A – PWR Dry Containments, Including Subatmospheric Containments
Application Section: 06.02.01.01 Containment Structure
Date of RAI Issue: 12/03/2015

Question No. 06.02.01.01.A-4

Containment Initial and Boundary Conditions for the LOCA Analyses

General Design Criteria (GDC) 50, “Containment design basis”, and GDC 16, “Containment design”, of Appendix A to 10 CFR Part 50 require, in part, that the reactor containment structure and associated heat removal system shall be designed with sufficient margin to accommodate the calculated pressure and temperature conditions resulting from any loss-of-coolant accident (LOCA). NUREG-0800, SRP Section 6.2.1.1A, Acceptance Criterion No. 1 specifies that the containment design pressure should provide at least a 10% margin above the accepted peak calculated containment pressure following a LOCA, or a steam line or feedwater line break, to satisfy the GDC 16 and 50 requirements for sufficient design margin. In addition, ANSI/ANS 56.4-1983, which has established detailed guidelines for containment response to design basis accidents, specifies that initial conditions should be chosen to yield a conservatively high peak containment atmosphere pressure and temperature. In selecting the initial dry primary containment atmospheric conditions and structural temperatures, consideration should be given to the competing effects of the initial air mass and the active and passive heat sink thermal capacities.

In this backdrop, the staff seeks the following additional information to gain safety insights into the initial and boundary conditions the applicant used for the limiting LOCA analysis for the containment. The applicant is also requested to update the APR1400 DCD and/or the Technical Report (TeR), “LOCA Mass and Energy Release Methodology,” APR1400-Z-A-NR-14007-P, Rev.0, to appropriately document the respective explanations.

The initial containment atmosphere temperature is an important parameter such that its upper value constitutes a technical specification. The initial atmosphere temperature not only affects the containment response to a design basis LOCA but also other aspects of the accident such

as the safety injection water temperature from safety injection tanks (SITs). As discussed in Appendix C of the TeR, "Case studies for modeling characteristics", and given in Table C-1A, the maximum containment temperature is 120 °F beyond which the limiting conditions for operation apply. An instrument uncertainty of 5 °F is commonly used by the industry in containment response analysis. If the value listed in Table C-1A includes an instrument uncertainty then the initial atmosphere temperature of 115 °F would not be conservative; and if it doesn't, then an initial atmosphere temperature of 125 °F should have been used for all the analyses. Please explain whether the containment initial atmosphere temperature is based on the typical value commonly used in the containment response analysis or obtained from an energy balance analysis for the reactor coolant system (RCS) heat loss versus fan coolers heat removal.

Supplemental Question (August 9, 2016 Public Teleconference)

NRC regulations GDC 38 and 50 require that the most severe accident conditions should be selected that result in the highest calculated containment pressure or temperature. KHNP did use the most severe initial pressure of 16.12 psia resulting from adding a 0.42 psi instrument uncertainty to the tech specs limit of 1 psig (LCO 3.6.4→1+.42+14.7). However, only the tech specs limit of 120 F (LCO 3.6.5) has been used as the initial containment temperature without adding any instrument uncertainty in the temperature measurement to bias it to the most severe condition [RAI 8354, Question 06.02.01.01.A-4]. Please update the GOTHIC analyses or justify not using the temperature measurement uncertainty.

Second Supplemental Question (September 22, 2016 Public Teleconference)

The staff issued RAI 8354, Question 28471 (06.02.01.01.A-4) to ask the applicant to explain the basis for selecting the containment initial atmosphere temperature used for the peak pressure/temperature analyses. The applicant's response, dated December 30, 2015, clarified that the value of 49 °C (120 °F) in Table C-1A is chosen from the temperature LCO and also confirmed that no uncertainty is assumed in the initial atmosphere temperature. In the July 7, 2016 public teleconference, the staff raised the question of not adding any instrument uncertainty to the LCO for additional conservatism. The applicant submitted a written response for the August 9, 2016 public teleconference that stated that the NRC regulation 10 CFR 50.50.36 defines the LCO as the "lowest functional capability or performance levels of equipment required for safe operation of the facility". The response also quoted from SECY-11-00-14 that "LCO limits shall be used for the bounding values as the initial conditions for containment accident analysis." The staff would find the response to be acceptable, pending the submittal of the revised RAI response on the docket. Therefore, this is tracked as an open item.

Response – (Rev. 1)

A temperature of 120°F is chosen from the limiting conditions for operation (LCO) of the Technical Specification (TS), Section 3.6.5, as the upper bounding value for the containment peak pressure analysis.

With regard to the LCO limits, NRC regulations (10CFR50 50.36 - Technical Specifications) describe the definition of the LCO as follow; "Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility". That is, the LCO should be the actual limiting values that may be possible in normal operating conditions.

In addition, according to the NRC's document issued for the Containment Accident Pressure (CAP) analysis for the Emergency Core Cooling System (ECCS) and Containment heat removal pump performance in accidents (SECY-11-00-14), the LCO limits shall be used for the bounding values as the initial conditions for containment analysis. These documents stipulate that all parameters having a significant effect on the containment pressure and temperature are assumed to be simultaneously at their bounding values; these values are typically either technical specification limits, such as limiting conditions for operation, or values known to bound the expected value of a parameter.

The containment atmosphere temperature in a normal operating condition is maintained by the containment HVAC system, which is designed to have the capacity capable of maintaining the containment temperature within the LCO limits. The heat removal capacity of the HVAC system is determined from the energy balance between the maximum estimated RCS heat loss during normal operating conditions and the heat removal rate of the Reactor Core Fan Cooler (RCFC), with appropriate margin.

Thus, based on the NRC's regulations describing usage of the LCO limits for containment analysis and the capacity of the HVAC system that ensures not to exceed the LCO, the maximum value of 120°F within the LCO ranges is chosen as the most conservative initial temperature in calculating the APR1400 containment peak pressure and temperature.

Impact on DCD

There is no impact on the DCD.

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 Report

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