KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Tuesday, October 13, 2015 8:49 AM
To: apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Harry (Hyun Seung) Chang; Andy Jiyong Oh; Christopher Tyree
Cc: Drzewiecki, Timothy; McKirgan, John; Steckel, James; Lee, Samuel; Ward, William
Subject: APR1400 Design Certification Application RAI 240-8318 (15.01.01 - 15.01.04 - Decrease in Feedwater Temperature, Increase in Feedwater Flow, Increase in Steam Flow, and Inadvertent Opening of a Steam Generator Relief or Safety Valve)
Attachments: APR1400 DC RAI 240 SRSB 8318.pdf

KHNP

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests and we grant the following days to respond to these RAI questions. We may adjust the schedule accordingly.

15.01.01-1: 30 days
15.01.01-2: 30 days
15.01.01-3: 30 days
15.01.01-4: 30 days
15.01.01-5: 45 days
15.01.01-6: 45 days

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

Jeff Ciocco
New Nuclear Reactor Licensing
301.415.6391
jeff.ciocco@nrc.gov

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United States Nuclear Regulatory Commission
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From: Ciocco, Jeff

Created By: Jeff.Ciocco@nrc.gov

Recipients:
"Drzewiecki, Timothy" <Timothy.Drzewiecki@nrc.gov>
Tracking Status: None
"McKirgan, John" <John.McKirgan@nrc.gov>
Tracking Status: None
"Steckel, James" <James.Steckel@nrc.gov>
Tracking Status: None
"Lee, Samuel" <Samuel.Lee@nrc.gov>
Tracking Status: None
"Ward, William" <William.Ward@nrc.gov>
Tracking Status: None
"apr1400rai@khnp.co.kr" <apr1400rai@khnp.co.kr>
Tracking Status: None
"KHNPDCDRAIsPEm Resource" <KHNPDCDRAIsPEm.Resource@nrc.gov>
Tracking Status: None
"Harry (Hyun Seung) Chang" <hyunseung.chang@gmail.com>
Tracking Status: None
"Andy Jiyong Oh" <jiyong.oh5@gmail.com>
Tracking Status: None
"Christopher Tyree" <Christopher.tyree@aecom.com>
Tracking Status: None

Post Office: HQPWMSMRS08.nrc.gov

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Options
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REQUEST FOR ADDITIONAL INFORMATION 240-8318

Issue Date: 10/13/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 15.01.01 - 15.01.04 - Decrease in Feedwater Temperature, Increase in Feedwater Flow, Increase in Steam Flow, and Inadvertent Opening of a Steam Generator Relief or Safety Valve
Application Section:

QUESTIONS

15.01.01-1

GDC 10 requires that the reactor coolant system (RCS) is designed with appropriate margin to ensure that specified acceptable fuel design limits are not exceeded during normal operations, including anticipated operational occurrences (AOOs). Additionally, sections 15.1.1-15.1.4 of the Standard Review Plan (NUREG-0800) state that the parameters used in the analytical model should be suitably conservative.

DCD Section 15.1.1 "Decrease in Feedwater Temperature" states that the maximum decrease in feedwater temperature due to a failure in the main feedwater system is less than 37.78 ^{o}C (100 ^{o}F), but it is not described how this value is obtained. This caused NRC staff to question whether this value is a bounding input for the analysis. NRC staff is requesting the applicant to explain why a decrease in feedwater temperature of 37.78 ^{o}C (100 ^{o}F) represents a bounding case.

15.01.01-2

GDC 10 requires that the reactor coolant system (RCS) is designed with appropriate margin to ensure that specified acceptable fuel design limits are not exceeded during normal operations, including anticipated operational occurrences (AOOs). Additionally, sections 15.1.1-15.1.4 of the Standard Review Plan (NUREG-0800) state that the parameters used in the analytical model should be suitably conservative.

Design control document (DCD) Sections 15.1.1.3.2, 15.1.2.3.2, and 15.1.3.3.2 state that the input parameters and initial conditions for the Decrease in Feedwater Temperature, Increase in Feedwater Flow, and Increase in Steam Flow events are bounded by the input for the Inadvertent Opening of a Steam Generator Safety Relief or Safety Valve event. Although the results of the analyses may demonstrate that the consequences of one event are limiting (i.e. bound the consequences of the other events), the input parameters and initial conditions for each event need to be chosen to be suitably conservative. NRC staff requests that DCD Sections 15.1, 15.2, and 15.3 be updated to reflect that suitably conservative input parameters and initial conditions were used in the evaluation of the Decrease in Feedwater Temperature, Increase in Feedwater Flow, and Increase in Steam Flow events.

15.01.01-3

GDC 10 requires that the reactor coolant system (RCS) is designed with appropriate margin to ensure that specified acceptable fuel design limits are not exceeded during normal operations, including anticipated operational occurrences (AOOs). Additionally, sections 15.1.1-15.1.4 of the Standard Review Plan (NUREG-0800) state that the parameters used in the analytical model should be suitably conservative.

DCD Section 15.1.2 "Increase in Feedwater Flow" states:

1. The maximum increase in main feedwater flow at full power is less nominal flow for the main feedwater system (i.e. the limiting increase in main feedwater flow is 100%), and
2. The maximum auxiliary feedwater flow is 950 gpm

However, there is no discussion regarding how these values are obtained. This caused NRC staff to question whether these values are bounding inputs for the analysis. NRC staff requests the applicant to explain why the values provided in the DCD are suitably conservative.

15.01.01-4

GDC 10 requires that the reactor coolant system (RCS) is designed with appropriate margin to ensure that specified acceptable fuel design limits are not exceeded during normal operations, including anticipated operational occurrences (AOOs). Additionally, sections 15.1.1-15.1.4 of the Standard Review Plan (NUREG-0800) state that the parameters used in the analytical model should be suitably conservative.

DCD Section 15.1.3 "Increase in Steam Flow" states that the inadvertent opening of a turbine admission valve can result in an increase in no more that 11 percent of the nominal full-power steam flow rate, but it does not described how this value is obtained. This caused NRC staff to question whether this value is a bounding input for the analysis. NRC staff is requesting the applicant to explain why 11 percent is a bounding increase in steam flow for the inadvertent opening of a turbine admission valve.

15.01.01-5

GDC 10 requires that the reactor coolant system (RCS) is designed with appropriate margin to ensure that specified acceptable fuel design limits are not exceeded during normal operations, including anticipated operational occurrences (AOOs). Additionally, sections 15.1.1-15.1.4 of the Standard Review Plan (NUREG-0800) state that the parameters used in the analytical model should be suitably conservative.

DCD Section 15.1.4 "Inadvertent Opening of a Steam Generator Relief or Safety Valve" presents the bounding analysis for AOOs that result in an increase in heat removal by the secondary system. The analysis provided in DCD Section 15.1.4 lacks sufficient detail for NRC staff to understand some of the input assumptions. This caused NRC staff to question

whether the input values are suitably conservative. NRC staff requests the following information:

1. DCD Section 15.1.4.3 states that initial conditions for the principle process variables are varied to determine the set of initial conditions that would produce the greatest overpower condition caused by the increase in steam flow. However, it is not necessarily true that the conditions that produce the greatest overpower condition result in the limiting case for the figures of merit that reflect the specified acceptance criteria (i.e. DNBR, peak pressure in the reactor coolant and main steam systems). NRC staff requests that DCD Section 15.1.4 be updated to reflect the analysis that produces the limiting case in terms of the specified acceptance criteria.
2. DCD Section 15.1.4.2 states the limiting single failure is the failure of the feedwater control system to receive the reactor trip override (RTO) signal to cut back the feedwater flow. However, there is no explanation regarding RTO logic in either DCD Sections 15.1.4 or 7.7, and no reference is cited. NRC staff requests that the DCD be updated with a description of the RTO logic and an explanation regarding how it was determined to be the limiting single failure.

15.01.01-6

GDC 10 requires that the reactor coolant system (RCS) is designed with appropriate margin to ensure that specified acceptable fuel design limits are not exceeded during normal operations, including anticipated operational occurrences (AOOs). Additionally, sections 15.1.1-15.1.4 of the Standard Review Plan (NUREG-0800) state that the parameters used in the analytical model should be suitably conservative.

DCD Section 15.1.4 "Inadvertent Opening of a Steam Generator Relief or Safety Valve" presents the bounding analysis for AOOs that result in an increase in heat removal by the secondary system. The analysis provided in DCD Section 15.1.4 lacks sufficient detail for NRC staff to verify the results of the calculation. This caused NRC staff to question whether a suitably conservative analysis was performed. NRC staff requests the following information:

1. Figures 15.1.4-1.1 through 15.1.4-1.15 and Figures 15.1.4-2.1 through 15.1.4-2.15 of the DCD present the salient NSSS parameters for the Inadvertent Opening of a Steam Generator Atmospheric Dump Valve (IOSGADV) event. The abscissas in the figures begin at 0 seconds, which coincides with the time that the atmospheric dump valve is opened. Therefore, it is not possible to view the magnitude of the perturbation to the system resulting from the opening of the atmospheric dump valve (this is most clearly demonstrated in Figures 15.1.4-1.9 and 15.1.4-2.9). NRC staff requests the figures in DCD Section 15.1.4 be updated to present a brief null transient before the initiation of the event.

2. Tables 15.1.4-1 and 15.1.4-2 of the DCD provide the sequence of events for the analyses of the IOSGADV event. These tables, however, are missing significant phenomena that occur during the transient. Furthermore, this phenomena is not discussed DCD Section 15.1.4.2 "Sequence of Events and System Operation" or DCD Section 15.1.4.3.3 "Results". NRC staff requests that the tables be updated, at a minimum, with the following phenomena:
- Steam generator water level reaches auxiliary feedwater actuation analysis setpoint, %WR (this is missing from Table 15.1.4-2)
- Explain what is causing the significant reduction in RCS pressure that occurs at approximately 2600 seconds
- Explain what is causing the significant increase in RCS pressure that occurs at approximately 2800 seconds

3. Figure 15.1.4-1.11 and 15.1.4-2.11 of the DCD show that the main feedwater enthalpy is not imapcted as a result of the IOSGADV event. However, as the feedwater mass flow rate is increased through the feedwater heaters, but the steam flow through the feedwater heaters does not increase proportionally, NRC staff expects the feedwater enthalpy to be reduced. NRC staff requests an explanation of the physical behavior of the feedwater enthalpy during the IOSGADV event.


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