

## KHNPDCRAIsPEm Resource

---

**From:** Ciocco, Jeff  
**Sent:** Wednesday, September 16, 2015 10:08 AM  
**To:** apr1400rai@khnp.co.kr; KHNPDCRAIsPEm Resource; Harry (Hyun Seung) Chang; Andy Jiyong Oh; Christopher Tyree  
**Cc:** Schmidt, Jeffrey; McKirgan, John; Steckel, James; Lee, Samuel  
**Subject:** APR1400 Design Certification Application RAI 216-8221 (15.04.06 - Inadvertent Decrease in Boron Concentration in the Reactor Coolant (PWR))  
**Attachments:** APR1400 DC RAI 216 SRSB 8221.pdf; image001.jpg

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.

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](mailto:jeff.ciocco@nrc.gov)



**Hearing Identifier:** KHNP\_APR1400\_DCD\_RAI\_Public  
**Email Number:** 265

**Mail Envelope Properties** (4baded7540d84bbf878c381c642fc7dd)

**Subject:** APR1400 Design Certification Application RAI 216-8221 (15.04.06 - Inadvertent Decrease in Boron Concentration in the Reactor Coolant (PWR))  
**Sent Date:** 9/16/2015 10:07:55 AM  
**Received Date:** 9/16/2015 10:07:57 AM  
**From:** Ciocco, Jeff

**Created By:** Jeff.Ciocco@nrc.gov

**Recipients:**

"Schmidt, Jeffrey" <Jeffrey.Schmidt2@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  
"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:** HQPWMSMRS07.nrc.gov

<b>Files</b>	<b>Size</b>	<b>Date &amp; Time</b>
MESSAGE	519	9/16/2015 10:07:57 AM
APR1400 DC RAI 216 SRSB 8221.pdf		91843
image001.jpg	5040	

**Options**

**Priority:** Standard  
**Return Notification:** No  
**Reply Requested:** No  
**Sensitivity:** Normal  
**Expiration Date:**  
**Recipients Received:**

# REQUEST FOR ADDITIONAL INFORMATION 216-8221

Issue Date: 09/16/2015

Application Title: APR1400 Design Certification Review – 52-046

Operating Company: Korea Hydro & Nuclear Power Co. Ltd.

Docket No. 52-046

Review Section: 15.04.06 - Inadvertent Decrease in Boron Concentration in the Reactor Coolant (PWR)

Application Section:

## QUESTIONS

15.04.06-2

Question 15.4.6-2.

10 CFR Part 50 Appendix A, GDC 10 requires that the reactor core and associated coolant, control and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. The inadvertent reactor coolant system (RCS) boron dilution event is classified as anticipated operational occurrence per SRP 15.4.6. SRP 15.4.6, Section III, "Review Procedures" states the reviewer confirms that analyses are included for a boron dilution incident during each of the plant initial conditions including power operation with rods in automatic.

In review of the DCD Tier 2, Section 15.4.6, staff could not find a mention of the plant response and time to re-criticality for Modes 1 and 2 (power operation) with rods in automatic. Justify the reason(s) for not including the discussion for control rods in automatic and update the DCD as necessary.

15.04.06-3

Question 15.4.6-3

10 CFR Part 50 Appendix A, GDC 10 requires that the reactor core and associated coolant, control and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. The inadvertent reactor coolant system (RCS) boron dilution event is classified as anticipated operational occurrence per SRP 15.4.6. SRP 15.4.6 states that at least a 15 minute operator action time should be available to terminate a dilution during Modes 1 and 2 power operations.

In determining the time to re-criticality during power operations with control rods in manual it is unclear if the initial boron concentration assumed is the concentration at the start of the dilution or the value at the time of the reactor trip. Staff requests the applicant state what is the initial boron concentration assumed for power operations with control rods in manual and what is the time to re-criticality. If the boron concentration at the start of the dilution is used to determine the time of re-criticality provide an explanation why this is conservative. Update the DCD as necessary.

15.04.06-4

Question 15.4.6-4

10 CFR Part 50 Appendix A, GDC 10 requires that the reactor core and associated coolant, control and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. The inadvertent reactor coolant system (RCS) boron dilution event

## REQUEST FOR ADDITIONAL INFORMATION 216-8221

is classified as anticipated operational occurrence per SRP 15.4.6. SRP 15.4.6 states that at least a 15 minute operator action time should be available to terminate a dilution during Modes 3 through 5.

In DCD Tier 2, Section 15.4.6.3.1, "Evaluation Model," the staff notes that equation 15.4-1 is ill-formed without an equals sign. Correct the equation by updating the DCD.

15.04.06-5

Question 15.4.6-5

10 CFR Part 50 Appendix A, GDC 10 requires that the reactor core and associated coolant, control and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. The inadvertent reactor coolant system (RCS) boron dilution event is classified as anticipated operational occurrence per SRP 15.4.6. SRP 15.4.6 states the minimum DNBR should be above the safety analysis DNBR limit for at power operations.

In DCD Tier 2, Section 15.4.6.6, "Conclusions," the applicant states that the minimum DNBR is equal to or greater than the 1.29 limit. Staff could not find, in the DCD, a supporting basis for this conclusion. Staff request the applicant to update the DCD, as necessary, with supporting information which demonstrates the DNBR value remains above the limit.

15.04.06-6

Question 15.4.6-6

10 CFR Part 50 Appendix A, GDC 10 requires that the reactor core and associated coolant, control and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. The inadvertent reactor coolant system (RCS) boron dilution event is classified as anticipated operational occurrence per SRP 15.4.6. SRP 15.4.6 states that at least a 15 minute operator action time should be available to terminate a dilution during Modes 1 through 5.

The dilution rate is a function of the maximum charging flow rate. In review of DCD Tier 1, Table 2.4.6-4 (6 of 6), "Chemical and Volume Control System ITAAC", ITAAC item 9.a, the staff noted that a minimum charging pump flow rate is established but no maximum value is provided. Staff needs to understand the basis for not establishing a maximum charging pump flow rate ITAAC item. The applicant is requested to provide the basis and update the DCD as appropriate.

15.04.06-7

Question 15.4.6-7

10 CFR Part 50 Appendix A, GDC 10 requires that the reactor core and associated coolant, control and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. The inadvertent reactor coolant system (RCS) boron dilution event is classified as anticipated operational occurrence per SRP 15.4.6. SRP 15.4.6 states that at least a 30 minute operator action time should be available to terminate a dilution during Mode 6, "Refueling."

In DCD Tier 2, Section 15.4.6.2(e), the applicant states that administrative controls are used to prevent dilution during Mode 6, "Refueling," therefore no evaluation of the time to reach criticality was performed.

## **REQUEST FOR ADDITIONAL INFORMATION 216-8221**

Staff needs a basis for using administrative controls instead of an explicit note in an existing Technical Specification or a new Technical Specification Limiting Condition of Operation prohibiting dilution, as administrative controls are controlled by the licensees. The applicant is requested to provide the basis and update the DCD as appropriate.

