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.:	**470-8552**
SRP Section:	**16 – Technical Specifications**
Application Section:	**16.3.3.14 Instrumentation (Boron Dilution Alarms)**
Date of RAI Issue:	**04/26/2016**

Question No. 16-136

This is a follow up question regarding KHNP response to Sub-question 16-113.8. This issue was discussed during the Feb 24 & 25, 2016, meeting:

The surveillance column Note for SR 3.3.14.1, Channel Check of BDAS channels, proposed revision is not consistent with the STS convention for Notes that actually modify the surveillance frequency, not the applicability of the surveillance. The Note should say: “Not required to be performed until 1 hour after neutron flux is within the startup range,” which is what DCD Rev 0 says.

Response

The surveillance column Note for SR 3.3.14.1 will be revised as shown in the attached markup.

Impact on DCD

Same as the changes described in Impact on Technical Specifications.

Impact on PRA

There is no impact on PRA.

Impact on Technical Specifications

TS 3.3.14 will be revised as shown in the attached markup.

Impact on Technical/Topical/Environmental Reports

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

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. (continued)	B.2 Suspend all operations involving positive reactivity additions. Not required to be performed until 1 hour after	Immediately

Insert three blank lines

SURVEILLANCE REQUIREMENTS

~~This SR is applicable within 1 hour after the~~

	SURVEILLANCE	FREQUENCY
SR 3.3.14.1	---------- NOTE ---------- ~~Not required to be performed until 1 hour after~~ neutron flux is within the startup range.	
	Perform CHANNEL CHECK.	12 hours
SR 3.3.14.2	---------- NOTE ---------- Neutron flux detector is excluded from CHANNEL FUNCTIONAL TEST.	31 days of cumulative operation during shutdown
	Perform CHANNEL FUNCTIONAL TEST.	~~Total shutdown period 31 days~~
SR 3.3.14.3	---------- NOTE ---------- Neutron flux detector is excluded from CHANNEL CALIBRATION.	
	Perform CHANNEL CALIBRATION.	18 months

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RAI No.: **470-8552**

SRP Section: **16 – Technical Specifications**

Application Section: **16.3.3.1**

Date of RAI Issue: 0**4/26/2016**

Question No. 16-138

The response to RAI-Question 16-95 proposed to use the phrase “daily power calibration” in place of the various phrases listed in the Bases for SR 3.3.1.4 and also in SR 3.3.1.4 itself. However, since the response did not state what is meant by the phrase “daily power calibration” the proposed changes did not provide the needed clarity and consistency. The applicant is requested to revise SR 3.1.1.4 and associated Bases to be consistent with the following markup:

SR 3.3.1.4 ----------NOTES----------

2. The daily **power** calibration may be suspended during PHYSICS TESTS, provided calibration is performed upon reaching each major test power plateau and prior to proceeding to next major test power plateau.

Perform **the daily power calibration** ~~calorimetric calculation~~ **by calculating core THERMAL POWER from the daily secondary heat balance measurement (a calorimetric)** and adjust**ing the** linear power, CPC ΔT **power**, and CPC neutron flux power **channels** to agree with ~~calorimetric calculation~~ **the calculated THERMAL POWER** if any ~~of the linear power, CPC ΔT, and CPC neutron flux power is less than calorimetric calculation by~~ **channel indicates** more than 0.5% **RTP less than the calculated THERMAL POWER**.

SR 3.3.1.4

The daily power calibration is the calculation of the core THERMAL POWER by performing a secondary heat balance measurement (a calorimetric) and adjusting the linear power, CPC ΔT power, and CPC neutron flux power channels to agree with the calculated THERMAL POWER if any channel indicates more than 0.5% RTP below the calculated THERMAL POWER. A daily ~~heat balance~~ **power** calibration is performed when THERMAL POWER is greater than or equal to 15% **RTP**. The linear power level signal and the CPC addressable constant multipliers are adjusted **in each channel** to make **the linear power level signal and CPC-calculated signals for** CPC ΔT power and CPC **neutron flux** ~~nuclear~~ power ~~calculations~~ agree with the **calculated THERMAL POWER (**calorimetric**)** ~~calculation~~ if **the signal from any channel of linear power, CPC ΔT power, and CPC neutron flux power is more than 0.5% RTP less than the calculated THERMAL POWER** ~~the absolute difference is greater than or equal to 0.5%~~. The value of 0.5% **RTP** is adequate because this value is assumed in the safety analysis. These checks (and if necessary, the adjustment of the linear power level signal and CPC addressable constant coefficients) are adequate to ensure that the accuracy of these ~~CPC calculations~~ **CPC-calculated signals** is maintained within the analyzed error margins. ~~The power level~~ **Core THERMAL POWER** must be greater than 15% RTP to obtain accurate **secondary heat balance measurement (calorimetric)** data. At lower power levels, the accuracy of calorimetric data is ~~questionable~~ **inadequate**. The Frequency of 24 hours is based on plant operating experience and takes into account indications and alarms located in the MCR to detect deviations in channel outputs. The Frequency is modified by Note 1 indicating this Surveillance need only be performed within 12 hours after reaching 15% RTP. The 12 hours after reaching 15% RTP is required for plant stabilization, data taking, and flow verification. The secondary calorimetric **calculated THERMAL POWER** is inaccurate at lower power levels. A second note in the SR indicates the SR may be suspended during PHYSICS TESTS. The conditional suspension of the daily ~~calibrations~~ **power calibration** under strict administrative control is necessary to allow special testing to occur.

SR 3.3.1.5

The RCS flow rate indicated by each CPC is verified to be less than or equal to the RCS total flow rate every 31 days. The Note indicates the Surveillance is performed within 12 hours after THERMAL POWER is greater than or equal to 80% RTP. This check (and if necessary, the adjustment of the CPC addressable flow constant coefficients) ensures that the DNBR setpoint is conservatively adjusted with respect to actual flow indications as determined by a ~~calorimetric calculation~~**daily power calibration**. Operating experience has shown the specified Frequency is adequate, as instrument drift is minimal, and changes in actual flow rate are minimal over core life.

SR 3.3.1.8

... The detectors are excluded from CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Slow changes in detector sensitivity are compensated by performing the daily ~~CALORIMETRIC CALIBRATION~~ **power calibration** (SR 3.3.1.4) and the monthly linear **power** subchannel gain check (SR 3.3.1.6). In addition, the associated MCR indications are monitored by the operators.

Response

The SR 3.3.1.4 in the generic TS 3.3.1 and associated Bases (SR 3.3.1.4, SR 3.3.1.5 and SR 3.3.1.8) will be revised as follows:

(Generic TS)

SR 3.3.1.4 ----------NOTES----------

2. The daily power calibration may be suspended during PHYSICS TESTS, provided calibration is performed upon reaching each major test power plateau and prior to proceeding to next major test power plateau.

Perform the daily power calibration by calculating core THERMAL POWER from the daily secondary heat balance measurement (a calorimetric) and adjusting the linear power, CPC ΔT power, and CPC neutron flux power channels to agree with the calculated THERMAL POWER if any channel indicates more than 0.5% RTP less than the calculated THERMAL POWER.

(Bases)

SR 3.3.1.4

The daily power calibration is the calculation of the core THERMAL POWER by performing a secondary heat balance measurement (a calorimetric) and adjusting the linear power, CPC ΔT power, and CPC neutron flux power channels to agree with the calculated THERMAL POWER if any channel indicates more than 0.5% RTP below the calculated THERMAL POWER. A daily power calibration is performed when THERMAL POWER is greater than or equal to 15% RTP. The linear power level signal and the CPC addressable constant multipliers are adjusted in each channel to make the linear power level signal and CPC-calculated signals for CPC ΔT power and CPC neutron flux power agree with the calculated THERMAL POWER (calorimetric) if the signal from any channel of linear power, CPC ΔT power, and CPC neutron flux power is more than 0.5% RTP less than the calculated THERMAL POWER. The value of 0.5% RTP is adequate because this value is assumed in the safety analysis. These checks (and if necessary, the adjustment of the linear power level signal and CPC addressable constant coefficients) are adequate to ensure that the accuracy of these CPC-calculated signals is maintained within the analyzed error margins. Core THERMAL POWER must be greater than 15% RTP to obtain accurate secondary heat balance measurement (calorimetric) data. At lower power levels, the accuracy of calorimetric data is inadequate.

The Frequency of 24 hours is based on plant operating experience and takes into account indications and alarms located in the MCR to detect deviations in channel outputs. The

Frequency is modified by Note 1 indicating this Surveillance need only be performed within 12 hours after reaching 15% RTP. The 12 hours after reaching 15% RTP is required for plant stabilization, data taking, and flow verification. The secondary calorimetric calculated THERMAL POWER is inaccurate at lower power levels. A second note in the SR indicates the SR may be suspended during PHYSICS TESTS. The conditional suspension of the daily power calibration under strict administrative control is necessary to allow special testing to occur.

SR 3.3.1.5

The RCS flow rate indicated by each CPC is verified to be less than or equal to the RCS total flow rate every 31 days. The Note indicates the Surveillance is performed within 12 hours after THERMAL POWER is greater than or equal to 80% RTP. This check (and if necessary, the adjustment of the CPC addressable flow constant coefficients) ensures that the DNBR setpoint is conservatively adjusted with respect to actual flow indications as determined by a daily power calibration. Operating experience has shown the specified Frequency is adequate, as instrument drift is minimal, and changes in actual flow rate are minimal over core life.

SR 3.3.1.8

(Second Paragraph)

The detectors are excluded from CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Slow changes in detector sensitivity are compensated by performing the daily power calibration (SR 3.3.1.4) and the monthly linear power subchannel gain check (SR 3.3.1.6). In addition, the associated MCR indications are monitored by the operators.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

The LCO and Bases for TS 3.3.1 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

SURVEILLANCE REQUIREMENTS

NOTE

Refer to Table 3.3.1-1 to determine which SR shall be performed for each RPS Function.

	SURVEILLANCE	FREQUENCY
SR 3.3.1.1	Perform CHANNEL CHECK of each RPS instrument channel.	12 hours
SR 3.3.1.2	NOTE The performance shall be completed within 12 hours after THERMAL POWER ≥ 80 % RTP.	
	Verify total reactor coolant system (RCS) flow rate indicated by each CPC is less than or equal to the RCS total flow rate. If necessary, adjust CPC addressable constant flow coefficients such that each CPC indicated flow is less than or equal to RCS flow rate.	12 hours
SR 3.3.1.3	Check CPC system event log.	12 hours
SR 3.3.1.4	NOTE 1. The performance shall be completed within 12 hours after THERMAL POWER ≥ 15 % RTP. 2. The daily calibration may be suspended during PHYSICS TESTS, provided calibration is performed upon reaching each major test power plateau and prior to proceeding to next major test power plateau.	
	Perform ~~calorimetric calculation~~ and ~~adjust~~ linear power, CPC ΔT, and CPC neutron flux power to agree with ~~calorimetric calculation if any of the linear power, CPC ΔT, and CPC neutron flux power is less than calorimetric calculation by more than 0.5 %.~~	24 hours

power

by calculating core THERMAL POWER from the daily secondary heat balance measurement (a calorimetric)

the daily power calibration

power

adjusting the

channels

the calculated THERMAL POWER if any channel indicated more than 0.5% RTP less than the calculated THERMAL POWER.

Replace with the markup on the next page

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.4

A daily heat balance calibration is performed when THERMAL POWER is greater than or equal to 15%. The linear power level signal and the CPC addressable constant multipliers are adjusted to make the CPC ΔT power and CPC nuclear power calculations agree with the calorimetric calculation if the absolute difference is greater than or equal to 0.5%. The value of 0.5% is adequate because this value is assumed in the safety analysis. These checks (and if necessary, the adjustment of the linear power level signal and CPC addressable constant coefficients) are adequate to ensure that the accuracy of these CPC calculations is maintained within the analyzed error margins. The power level must be greater than 15% RTP to obtain accurate data. At lower power levels, the accuracy of calorimetric data is questionable.

The Frequency of 24 hours is based on plant operating experience and takes into account indications and alarms located in the MCR to detect deviations in channel outputs. The Frequency is modified by Note 1 indicating this Surveillance need only be performed within 12 hours after reaching 15% RTP. The 12 hours after reaching 15% RTP is required for plant stabilization, data taking, and flow verification. The secondary calorimetric is inaccurate at lower power levels. A second note in the SR indicates the SR may be suspended during PHYSICS TESTS.

power calibration

The conditional suspension of the daily ~~calibrations~~ under strict administrative control is necessary to allow special testing to occur.

calculated THERMAL POWER

SR 3.3.1.5

The RCS flow rate indicated by each CPC is verified to be less than or equal to the RCS total flow rate every 31 days. The Note indicates the Surveillance is performed within 12 hours after THERMAL POWER is greater than or equal to 80% RTP. This check (and if necessary, the adjustment of the CPC addressable flow constant coefficients) ensures that the DNBR setpoint is conservatively adjusted with respect to actual flow indications as determined by a ~~calorimetric calculation~~. Operating experience has shown the specified Frequency is adequate, as instrument drift is minimal, and changes in actual flow rate are minimal over core life.

daily power calibration

The daily power calibration is the calculation of the core THERMAL POWER by performing a secondary heat balance measurement (a calorimetric) and adjusting the linear power, CPC ΔT power, and CPC neutron flux power channels to agree with the calculated THERMAL POWER if any channel indicates more than 0.5% RTP below the calculated THERMAL POWER. A daily power calibration is performed when THERMAL POWER is greater than or equal to 15% RTP. The linear power level signal and the CPC addressable constant multipliers are adjusted in each channel to make the linear power level signal and CPC-calculated signals for CPC ΔT power and CPC neutron flux power agree with the calculated THERMAL POWER (calorimetric) if the signal from any channel of linear power, CPC ΔT power, and CPC neutron flux power is more than 0.5% RTP less than the calculated THERMAL POWER. The value of 0.5% RTP is adequate because this value is assumed in the safety analysis. These checks (and if necessary, the adjustment of the linear power level signal and CPC addressable constant coefficients) are adequate to ensure that the accuracy of these CPC-calculated signals is maintained within the analyzed error margins. Core THERMAL POWER must be greater than 15% RTP to obtain accurate secondary heat balance measurement (calorimetric) data. At lower power levels, the accuracy of calorimetric data is inadequate.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.8

A Note indicates that excore neutron detectors are excluded from CHANNEL CALIBRATION. A CHANNEL CALIBRATION of the linear power of excore neutron flux channel every 31 days ensures that the channels are reading accurately and within tolerance. The Surveillance verifies that the channel responds to a measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drifts between successive calibrations to ensure that the channel remains operational between successive tests. CHANNEL CALIBRATION must be performed consistent with the SCP.

The detectors are excluded from CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Slow changes in detector sensitivity are compensated by performing the daily ~~CALORIMETRIC CALIBRATION~~ (SR 3.3.1.4) and the monthly linear subchannel gain check (SR 3.3.1.6). In addition, the associated MCR indications are monitored by the operators.

power

power calibration

SR 3.3.1.9

SR 3.3.1.9 is the performance of a CHANNEL CALIBRATION every 18 months.

CHANNEL CALIBRATION is a complete check of the instrument channel including the sensor. The surveillance verifies that the channel responds to a measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drifts between successive calibrations to ensure that the channel remains operational between successive tests. CHANNEL CALIBRATION must be performed consistent with the plant protection system setpoint analysis.

The Frequency is based upon the assumption of an 18-month calibration interval for the determination of the magnitude of equipment drift in the setpoint analysis as well as operating experience and consistency with the 18-month fuel cycle.