
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.: 439-8524
SRP Section: 16 – Technical Specifications
Application Section: 16.3.1
Date of RAI Issue: 03/11/2016

Question No. 16-125

In LCO 3.1.1211, “Special Test Exceptions (STE) – Reactivity Coefficient Testing,” the applicant is requested to replace the last phrase “limits specified in their LCOs” with:

“... may be suspended, provided **Linear Heat Rate (LHR)** and **Departure from Nucleate Boiling Ratio (DNBR)** do not exceed the limits specified in: ~~their LCOs.~~

LCO 3.2.1, “Linear Heat Rate (LHR)”; and
LCO 3.2.4, “Departure from Nucleate Boiling Ratio (DNBR).”

With the above change to the LCO statement, Condition A can be simplified as indicated: “LHR or DNBR outside ~~the limits specified in their LCOs.~~

The Frequency of SR 3.1.11.1 is “Continuously,” which is impractical if COLSS is out of service. It should be replaced by a short time interval that is greater than the typical time needed to perform SR 3.2.1.1 (Verify LHR, as indicated on **each** OPERABLE local power density channel, is within its limit. | 2 hours) and SR 3.2.4.1 (Verify DNBR, as indicated on **all** OPERABLE DNBR channels, is within limit of Figure 3.2.4-2 or 3.2.4-3 of COLR, as applicable. | 2 hours). Each of these surveillances is only applicable when COLSS is not monitoring parameters (out of service), because COLSS monitors LHR and DNBR continuously. Also, if just one of the four LHR and DNBR channels is operable with COLSS out of service, can the LHR and DNBR verifications required by SR 3.1.11.1 by performing SR 3.2.1.1 and SR 3.2.4.1 be met?

In addition, The LCO section of the Bases for Subsection 3.1.11 says “The requirements of LCOs 3.1.7, 3.1.8 and 3.4.1 (for RCS cold leg temperature only) may be suspended during the performance of PHYSICS TESTS *provided COLSS is in service.*” The Notes in SR 3.2.1.1 for LHR verification and SR 3.2.4.1 for DNBR verification say that these verifications are not required to be met if COLSS is in service. Therefore, this Bases statement renders SR 3.1.11.1 ambiguous. Staff suggests that reference to SR 3.2.1.1 and SR 3.2.4.1 not be used;

rather SR 3.1.11.1 should be self-contained. For example:

SURVEILLANCE	FREQUENCY
<p>SR 3.1.11.1 -----NOTE-----</p> <p>Only required to be met when COLSS is out of service. With COLSS in service, LHR is continuously monitored.</p> <p>-----</p> <p>Verify LHR, as indicated on each OPERABLE Core Protection Calculator local power density channel, is within its the limit specified in the COLR.</p>	15 minutes
<p>SR 3.1.11.2 -----NOTE-----</p> <p>Only required to be met when COLSS is out of service. With COLSS in service, DNBR is continuously monitored.</p> <p>-----</p> <p>Verify DNBR, as indicated on all OPERABLE Core Protection Calculator DNBR channels, is within the limits of Figure 3.2.4-2 or Figure 3.2.4-3 of the COLR, as applicable.</p>	15 minutes

These SRs seem ambiguous. Consider whether the high-lighted words “each” and “all” can be replaced by “one or more”; or “each” can be replaced by “all”; or “all” replaced by “each.”

The 15 minute Frequency is a suggestion based on the 15 minute Completion Time of Required Action B.1 of Specifications 3.2.1 and 3.2.4.

Conforming changes to the Bases for Specifications 3.1.11, 3.2.1, and 3.2.4 should also be made.

Response – (Rev. 2)

The last phrase of LCO 3.1.12 (Special Test Exceptions (STE) – Reactivity Coefficient Testing) “may be suspended, provided LHR and DNBR do not exceed the limits specified in their LCOs.” will be revised to spell out the acronyms and to specify the associated LCOs that are applicable.

The originally specified surveillance 3.1.12.1 reflected the use of the COLSS which continuously monitors LHR and DNBR. When COLSS is not available, the core protection calculator (CPC) channel should be used to verify that the LHR and DNBR are within the limits specified in the COLR. Therefore, the surveillance requirement will be changed to consider the conditions when COLSS is in the out-of-service condition. The surveillance frequency will be changed to the more appropriate period of 15 minutes when the COLSS is not available. The

15-minute frequency is adequate to allow the operator to monitor the LHR and DNBR with the CPC. This frequency is also consistent with Actions B.1 of LCO 3.2.1 and LCO 3.2.4. Also, a surveillance requirement, 3.1.12.2, will be added to address the LHR and DNBR surveillances separately.

The LCO 3.3.1 defines the conditions for operation of the Reactor Protection System (RPS). According to LCO 3.3.1, having only one operable LHR or DNBR channel is not acceptable. The pre-requisite for reactivity coefficient testing requires that all CPC channels be operable and the COLSS be in service.

SRs 3.2.1.1, 3.2.4.1 and the Bases of SR 3.2.1.1 will be revised to align the terminology in the operable channels to consistently refer to any channels which is consistent with the STS and with the previous response provided to RAI 295-8263-Question16-109.

LCO 3.1.12 will be revised to clarify condition of Action A and for correction of a typographical error.

Impact on DCD

Same as changes described in Impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

LCO 3.1.12 in DCD Tier 2 will be revised as shown in Attachment 1.

LCO 3.1.11 in DCD Tier 2 will be revised as shown in Attachment 2.

Impact on Technical/Topical/Environmental Reports

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

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3.1 REACTIVITY CONTROL SYSTEMS

3.1.12 Special Test Exceptions (STE) – Reactivity Coefficient Testing

LCO 3.1.12 During performance of PHYSICS TESTS, the requirements of:

LCO 3.1.7, “Regulating Control Element Assembly (CEA) Insertion Limits”

LCO 3.1.8, “Part Strength CEA Insertion Limits”

LCO 3.4.1, “RCS Pressure, Temperature and Flow limits”
 (LCO 3.4.1.b, RCS Cold Leg Temperature only)

~~may be suspended, provided LHR and DNBR do not exceed the limits specified in their LCOs.~~

may be suspended, provided Linear Heat Rate (LHR) and Departure from Nucleate Boiling Ratio (DNBR) do not exceed the limits specified in:

LCO 3.2.1, “Linear Heat Rate (LHR)”; and
 LCO 3.2.4, “Departure from Nucleate Boiling Ratio (DNBR).”

Insert

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. LHR or DNBR outside the limits specified in their LCOs.	A.1 Reduce THERMAL POWER to restore LHR and DNBR to within limits.	15 minutes
B. Required Action and associated Completion Time not met.	B.1 Suspend PHYSICS TESTS.	1 hour

not within

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.1.12.1	Verify LHR and DNBR do not exceed limits by performing SR 3.2.1.1 and SR 3.2.4.1.	Continuously

Replace with revised SR 3.1.12.1 on following page and add new 3.1.12.2.

SURVEILLANCE	FREQUENCY
<p>SR 3.1.12.1 -----NOTE----- Only required to be performed when COLSS is out of service. With COLSS in service, LHR is continuously monitored.</p> <p>-----</p> <p>Verify LHR, as indicated on any OPERABLE Core Protection Calculator local power density channel, is within the limit specified in the COLR.</p>	<p>15 minutes</p>
<p>SR 3.1.12.2 -----NOTE----- Only required to be performed when COLSS is out of service. With COLSS in service, DNBR is continuously monitored.</p> <p>-----</p> <p>Verify DNBR, as indicated on any OPERABLE Core Protection Calculator DNBR channel, is within the limits of Figure 3.2.4-2 or Figure 3.2.4-3 of the COLR, as applicable.</p>	<p>15 minutes</p>

See Next Page

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
<p>SR 3.1.11.1</p> <p>-----NOTE----- Only required to be performed when Core Operating Limits Supervisory System (COLSS) is out of service. With COLSS in service, LHR is continuously monitored.</p> <p>-----</p> <p>Verify LHR, as indicated on any OPERABLE Core Protection Calculator local power density channel, is within the limit specified in the CORE OPERATING LIMITS REPORT (COLR).</p>	<p>15 minutes</p>
<p>SR 3.1.11.2</p> <p>-----NOTE----- Only required to be performed when COLSS is out of service. With COLSS in service, DNBR is continuously monitored.</p> <p>-----</p> <p>Verify DNBR, as indicated on any OPERABLE Core Protection Calculator DNBR channels, is within the limits of Figure 3.2.4-2 or Figure 3.2.4-3 of the COLR, as applicable.</p>	<p>15 minutes</p>

channel

Comment : This markup will be revised in next revision.

BASES

LCO This LCO permits Part Strength CEAs and Regulating CEAs to be positioned outside of their normal group heights and insertion limits, and RCS cold leg temperature to be outside its limits during the performance of PHYSICS TESTS. These PHYSICS TESTS are required to determine the isothermal temperature coefficient (ITC), MTC, and power coefficient.

SR 3.1.12.1

With THERMAL POWER greater than or equal to 20% RTP, LHR can be continuously monitored using the COLSS since the COLSS is available with THERMAL POWER above 20% RTP. If COLSS is not available, the operator must monitor the LHR using any OPERABLE CPC channel to verify that the LHR is within the specified limit in the COLR. A 15-minute Frequency is adequate to allow the operator to identify trends that would result in an approach to the LHR limit.

RCS cold leg
temperature

THERMAL POWER greater than
20% RTP
PHYSICS TESTS described

SR 3.1.12.2

With THERMAL POWER greater than or equal to 20% RTP, DNBR can be continuously monitored using the COLSS since the COLSS is available with THERMAL POWER above 20% RTP. If COLSS is not available, the operator must monitor the DNBR using any OPERABLE CPC channel to verify that the DNBR is within the limits of Figure 3.2.4-2 or Figure 3.2.4-3 of the COLR, as applicable. A 15-minute Frequency is adequate to allow the operator to identify trends in conditions that would result in an approach to the DNBR limit.

for LCOs,
Completion Time
LHR or DNBR to

within the required Completion Time, PHYSICS TESTS must be suspended within 1 hour. Allowing 1 hour for suspending PHYSICS TESTS allows the operator sufficient time to change any abnormal conditions back to within the limits of LCOs 3.1.7, 3.1.8, and 3.4.1 (for RCS cold leg temperature only). During suspending PHYSICS TEST STE, the corresponding LCOs shall be restored.

SURVEILLANCE REQUIREMENTS

SR 3.1.12.1

With THERMAL POWER greater than or equal to 20% RTP, LHR and DNBR can be continuously monitored using the COLSS since the COLSS is available with THERMAL POWER above 20% RTP. If COLSS is not available, LHR and DNBR can be continuously monitored using any OPERABLE CPC channel. Continuous monitoring is required to ensure that the LHR and DNBR limits are satisfied at all times. SRs 3.2.1.1 and 3.2.4.1 provide the specific requirements for performing this SR.

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.1.1	<p>----- NOTE -----</p> <p>Only required to be met when COLSS is out of service. With COLSS in service, LHR is continuously monitored.</p> <p>-----</p> <p>Verify LHR, as indicated on <u>each</u> OPERABLE local power density channel, is within its limit.</p>	2 hours
SR 3.2.1.2	Verify COLSS margin alarm actuates at a THERMAL POWER equal to or less than the core power operating limit based on LHR.	31 days

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. DNBR outside the region of acceptable operation when COLSS is out of service.	B.1 Determine trend in DNBR.	Once per 15 minutes
	<u>AND</u>	
	B.2.1 With an adverse trend, restore DNBR to within limit.	1 hour
	<u>OR</u>	
	B.2.2 With no adverse trend, restore DNBR to within limit.	4 hours
C. Required Action and associated Completion Time not met.	C.1 Reduce THERMAL POWER to ≤ 20 % RTP.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
<p>SR 3.2.4.1</p> <p>----- NOTE ----- Only applicable when COLSS is out of service. With COLSS in service, this parameter is continuously monitored.</p> <p>channel → Verify DNBR, as indicated on <u>all</u> OPERABLE DNBR channels, is within limit of Figure 3.2.4-2 or 3.2.4-3 of COLR, as applicable.</p>	<p>any</p> <p>2 hours</p>
<p>SR 3.2.4.2</p> <p>Verify COLSS margin alarm actuates at a THERMAL POWER level equal to or less than core power operating limit based on DNBR.</p>	<p>31 days</p>

BASES

**SURVEILLANCE
REQUIREMENTS**SR 3.2.1.1

any

With the COLSS out of service, the operator must monitor the LHR with **each** OPERABLE local power density channel.

A 2-hour Frequency is sufficient to allow the operator to identify trends that would result in an approach to the LHR limits.

This SR is modified by a Note that states that the SR is applicable only when the COLSS is out of service. Continuous monitoring of the LHR is provided by the COLSS, which calculates core power and core power operating limits based on the LHR and continuously displays these limits to the operator. A COLSS margin alarm is annunciated in the event that the THERMAL POWER exceeds the core power operating limit based on LHR.

SR 3.2.1.2

Verification that the COLSS margin alarm actuates at a THERMAL POWER level equal to or less than the core power operating limit based on the LHR (W/cm) ensures the operator is alerted when conditions approach the LHR operating limit.

The 31-day Frequency for performance of this SR is consistent with the historical testing Frequency of reactor protection and monitoring systems.

REFERENCES

1. DCD Tier 2, Chapter 15.
 2. DCD Tier 2, Chapter 6.
 3. APR1400-F-C-TR-12002-P, Rev. 0, "KCE-1 Critical Heat Flux Correlation for PLUS7 Thermal Design," November 2012.
 4. 10 CFR Part 50, Appendix A, GDC 10.
 5. 10 CFR 50.46.
 6. NUREG-0800, Rev. 3, March 2007.
 7. 10 CFR Part 50, Appendix A, GDC 26.
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