SUPPLEMENTAL 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.:	**239-8076**
SRP Section:	**16 – Technical Specifications**
Application Section:	**16.3.3**
Date of RAI Issue:	**10/09/2015**

Question No. 16-92

Paragraph (a)(11) of 10 CFR 52.47 and paragraph (a)(30) of 10 CFR 52.79 state that a design certification (DC) applicant and a combined license (COL) applicant, respectively, are to propose TS prepared in accordance with 10 CFR 50.36 and 50.36a. 10 CFR 50.36 sets forth requirements for technical specifications to be included as part of the operating license for a nuclear power facility.

NUREG-1432, “Standard Technical Specifications-Combustion Engineering Plants,” Rev. 4, provides NRC guidance on format and content of technical specifications as one acceptable means to meet 10 CFR 50.36 requirements.

Generic TS Table 3.3.1-1 Footnotes (a) and (c) differ from corresponding Footnotes (a) and (c) in STS Table 3.3.1-1 and Footnotes (a) and (e) in CE System 80+ generic TS Table 3.3.1-1 for the following RPS Functions with operating bypass features:

2. Logarithmic Power Level – High(a)
14. Local Power Density – High(c)
15. Departure from Nucleate Boiling Ration - Low(c)

Since the reasons for the differences with the STS footnotes are not clear to the NRC staff, the applicant is requested to discuss the differences with the STS footnotes and justify the proposed generic TS footnotes (a) and (c); including all related Bases discussions.

Response – (Rev. 1)

Regarding TS Table 3.3.1-1 Footnote (a), the operating bypass permissive and removal setpoints for Logarithmic Power Level – High function are for protection against a high reactivity insertion event during startup and low power condition. Since the trip setpoint is very

low, this trip function should be bypassed to enter the power operation mode and the bypass function is introduced to avoid an unwanted reactor trip. During the preliminary design of the Yonggwang 3 and 4 plant, the operating bypass setpoint was increased from 10^{-4}% to 10^{-3}% because CEA withdrawal event did not meet the acceptance criteria below the 10^{-3}% power initial condition. There was no specific need to change the operating bypass setpoint from 10^{-3}% to 10^{-4}%. The only inconvenience is that the operating bypass setpoint is temporarily changed to 10^{-4}% during low power physics test. Therefore, the operating bypass setpoint of 10^{-3}% power is applied in APR 1400.

The logarithmic power unit and the inequality, which are used for “Logarithmic Power Level - High,” “Local Power Density - High,” and “Departure from Nucleate Boiling Ratio - Low” functions will be revised to be consistent with STS.

In addition, LCO 3.1.10 states that trip function 2, “Logarithmic Power Level – High” in Table 3.3.1-1 is applied to the special test exception.

Regarding TS Table 3.3.1-1 Footnote (c), LCO 3.1.10 states that trip function 2, “Logarithmic Power Level – High” in Table 3.3.1-1 is applied to the special test exception.

Supplemental Response

The Logarithmic Power Level – High Reactor Trip may be manually bypassed during PHYSICS TESTS pursuant to LCO 3.1.9, “Special Test Exception (STE) – SHUTDOWN MARGIN (SDM).

The operating bypass setpoint for Logarithmic Power Level – High Reactor Trip needs to be temporarily changed to 10-4 % during the low power physics test because there may be a spurious trip during the low power physics test if the bypass is not modified. This phrase will be added to page B 3.3.1-20.

The use of “THERMAL POWER” as stated in Subsections 3.3.1, B 3.3.1, 3.3.2, and B 3.3.2 will be changed to “logarithmic power” to be consistent with STS.

The prior revisions of the RAI response have been incorporated into Rev. 1 of the DCD; therefore this revision starts and only contains mark-ups to Revision 1 of the DCD.

Impact on DCD

Same changes as identified in the Impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

Technical Specifications Sections 3.3.1, 3.3.2, B 3.3.1 and B 3.3.2 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

BASES

LCO (continued)

The operating bypass setpoint for Logarithmic Power Level - High Reactor Trip needs to be temporarily changed to 1E-4% during low power physics test in order to reduce the possibility of spurious trip.

The Allowable Value is high enough to provide an operating envelope that prevents unnecessary Logarithmic Power Level – High reactor trips during normal plant operations. The Allowable Value is low enough for the system to maintain a margin to unacceptable fuel cladding damage should a CEA withdrawal event occur.

The Logarithmic Power Level – High trip may be bypassed manually when THERMAL POWER is > 1E-3% to allow the reactor to be brought to power during a reactor startup. This bypass is automatically removed when THERMAL POWER is ≤ 1E-3%. Above 1E-3%, the Variable Overpower – High and Pressurizer Pressure – High trips provide protection for reactivity transients.

The trip may be manually bypassed during PHYSICS TEST pursuant to LCO 3.1.9, “Test Exceptions – SDM.” During this testing, the Variable Overpower – High trip and administrative controls provide the required protection.

3. Pressurizer Pressure – High

This LCO requires four channels of Pressurizer Pressure – High to be OPERABLE in MODES 1 and 2.

The Allowable Value is set below the nominal lift setting of the POSRVs, and its operation avoids the undesirable operation of these valves during normal plant operation. In the event of AOO and Accident causing overpressure, this setpoint ensures the reactor trip will take place, thereby assuring the integrity of the RCPB and preventing consequent pressure rise. The POSRVs can lift to prevent overpressurization of the RCS.

4. Pressurizer Pressure – Low

This LCO requires four channels of Pressurizer Pressure – Low to be OPERABLE in MODES 1 and 2.

The Allowable Value is set low enough to prevent a reactor trip during normal plant operation and pressurizer pressure transients. However, the setpoint is high enough that with a LOCA, the reactor trip will occur soon enough to allow the ESF Systems to perform as expected in the analyses and mitigate the consequences of the accident.

BASES

LCO (continued)

3. CEAC1 processor module failure – this failure is addressed in LCO 3.3.3.

4. CEAC2 processor module failure – this failure is addressed in LCO 3.3.3.

5. CPP1 processor module failure – this failure is addressed in LCO 3.3.3.

6. CPP2 processor module failure – this failure is addressed in LCO 3.3.3.

The CPC channels may be manually bypassed below 1E-4% as sensed by the logarithmic nuclear instrumentation. This bypass is enabled manually in all four CPC channels when plant conditions do not warrant the trip protection. The bypass effectively removes the DNBR – Low and LPD – High trips from the RPS automatically removed when enabling bypass conditions are no longer satisfied.

logic circuitry. The operating bypass is

This operating bypass is required to perform a plant startup, since both CPC generated trips will be in effect whenever shutdown CEAs are inserted. It also allows system tests at low power with pressurizer pressure – low or RCPs off.

During TESTS pursuant to LCO 3.1.9, the trip may be manually bypassed to make this test possible without reactor trip in condition ≤ 5% RTP.

15. Departure from Nucleate Boiling Ratio (DNBR) – Low

This LCO requires four channels of DNBR – Low to be OPERABLE. The LCO on the CPCs ensures that the SLs are maintained during all AOOs and the consequences of accidents are acceptable.

The CPC channel has many redundant features designed to improve channel reliability. A minimum subset of features must be functional in order for the CPC to be capable of performing its safety related trip function. Therefore, the channel can remain OPERABLE in the presence of a subset of channel failures, while maintaining the ability to provide the DNBR – Low trip function. On-line CPC channel diagnostics make use of redundant features to maintain channel OPERABILITY to the extent possible, and provide alarm and annunciation of detectable failures.

BASES

APPLICABILITY

Most RPS trips are required to be OPERABLE in MODES 1 and 2 because the reactor is critical in these MODES. The trips are designed to take the reactor subcritical, which maintains the SLs during AOOs and assists the Engineered Safety Features Actuation System (ESFAS) in providing acceptable consequences during accidents.

Most trips are not required to be OPERABLE in MODES 3, 4, and 5. In MODES 3, 4, and 5, the emphasis is placed on return to power events. The reactor is protected in these MODES by ensuring adequate SDM. Exceptions to this are:

a. The Logarithmic Power Level – High trip, RPS Logic RTCBs, and Manual Trip are required in MODES 3, 4, and 5, with the RTCBs closed, to provide protection for boron dilution and CEA withdrawal events. The Logarithmic Power Level – High trip in these lower MODES is addressed in this LCO. The RPS Logic in MODES 1, 2, 3, 4, and 5 is addressed in LCO 3.3.4, “Reactor Protection System (RPS) Logic and Trip Initiation.”

b. The Steam Generator #1 Pressure – Low trip, Steam Generator #2 Pressure – Low trip, RPS Logic, RTCBs and manual trip are required in MODES 3 and 4, with the RTCBs closed, to provide protection for MSLB. The Steam Generator Pressure – Low trip in shutdown MODE is described in LCO.

c. The Applicability is modified by a Note that allows the trip to be bypassed when logarithmic power is ≥ 1E-3%, and the bypass is automatically removed when logarithmic power is < 1E-3%.

The most common causes of channel inoperability are outright failure or drift of the bistable or process module sufficient to exceed the tolerance allowed by the plant specific setpoint analysis. Typically, the drift is found to be small and results in a delay of actuation rather than a total loss of function. This determination is generally made during the performance of a CHANNEL FUNCTIONAL TEST when the process instrument is set up for adjustment to bring it to within specification. If the trip setpoint is less conservative than the Allowable Value stated in the SCP, the channel is declared inoperable immediately, and the appropriate Condition(s) must be entered immediately.

In the event a channel's trip setpoint is found nonconservative with respect to the Allowable Value, or the excore logarithmic power channel or RPS bistable trip unit is found inoperable, then all affected Functions provided by that channel must be declared inoperable and the unit must enter the Condition for the particular protection Function affected.

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.3.1.5	NOTE Not required to be performed until 12 hours after THERMAL POWER ≥ 80% RTP.	
	Verify total RCS flow rate indicated by each CPC is less than or equal to RCS flow rate determined by secondary calorimetric calculations.	31 days
SR 3.3.1.6	NOTE Not required to be performed until 12 hours after THERMAL POWER ≥ 15% RTP.	
	Verify linear power subchannel gains of excore neutron detectors are consistent with values used to establish shape annealing matrix elements in the CPCs.	31 days
SR 3.3.1.7	NOTES 1. The CPC CHANNEL FUNCTIONAL TEST shall include verification that the correct values of addressable constants are installed in each OPERABLE CPC. 2. Not required to be performed for Logarithmic Power Level – High until 2 hours after reducing ~~THERMAL POWER~~ below 1E-3% and only if reactor trip circuit breakers (RTCBs) are open.	
	Perform CHANNEL FUNCTIONAL TEST for each RPS instrumentation channel in accordance with Setpoint Control Program.	31 days

logarithmic power

Table 3.3.1-1 (Page 1 of 3)
Reactor Protection System Instrumentation – Operating

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITION	SURVEILLANCE REQUIREMENTS
1. Variable Overpower	1, 2	SR 3.3.1.1 SR 3.3.1.4 SR 3.3.1.6 SR 3.3.1.7 SR 3.3.1.8 SR 3.3.1.9 SR 3.3.1.13
2. Logarithmic Power Level – High[(a)]	2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.12 SR 3.3.1.13
3. Pressurizer Pressure – High	1, 2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13
4. Pressurizer Pressure – Low[(b)]	1, 2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.12 SR 3.3.1.13

logarithmic power

(a) Trip may be bypassed when ~~THERMAL POWER~~ is > 1E-3%. Operating bypass shall be automatically removed when ~~THERMAL POWER~~ is ≤ 1E-3%. Trip may be manually bypassed during PHYSICS TESTS pursuant to LCO 3.1.9, “Special Test Exception (STE) – SHUTDOWN MARGIN (SDM).”

logarithmic power

(b) Pressurizer Pressure – Low trip setpoint may be decreased as pressurizer pressure is reduced to 7.0 kg/cm^{2}A (100 psia). The margin between pressurizer pressure and the setpoint shall be maintained at ≤ 28.1 kg/cm^2 (400 psi). The operating bypass shall be removed automatically at ≥ 35.2 kg/cm^{2}A (500 psia). The setpoint shall be increased automatically to normal setpoint as pressurizer pressure is increased.

Table 3.3.1-1 (Page 3 of 3)
Reactor Protection System Instrumentation – Operating

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITION	SURVEILLANCE REQUIREMENTS
13. Reactor Coolant Flow, Steam Generator #2 Water Level – Low	1, 2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13
14. Local Power Density – High[(c)]	1, 2	SR 3.3.1.1 SR 3.3.1.2 SR 3.3.1.3 SR 3.3.1.4 SR 3.3.1.5 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.10 SR 3.3.1.11 SR 3.3.1.12 SR 3.3.1.13
15. Departure From Nucleate Boiling Ratio (DNBR) – Low[(c)]	1, 2	SR 3.3.1.1 SR 3.3.1.2 SR 3.3.1.3 SR 3.3.1.4 SR 3.3.1.5 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.10 SR 3.3.1.11 SR 3.3.1.12 SR 3.3.1.13

logarithmic power

(c) Trip may be manually bypassed when ~~THERMAL POWER~~ is < 1E-4%. Operating bypass shall be automatically removed when ~~THERMAL POWER~~ is ≥ 1E-4%. During testing pursuant to LCO 3.1.9, trip may be bypassed below 5% RTP. Operating bypass shall be automatically removed when THERMAL POWER is > 5% RTP.

logarithmic power

Table 3.3.2-1 (Page 1 of 1)
Reactor Protection System Instrumentation – Shutdown

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITION	SURVEILLANCE REQUIREMENTS
1. Logarithmic Power Level – High[a]	3[b], 4[b], 5[b]	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.4 SR 3.3.2.5
2. Steam Generator Pressure #1 – Low[c]	3[b], 4[b]	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.5
3. Steam Generator Pressure #2 – Low[c]	3[b], 4[b]	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.5

logarithmic power

(a) Trip may be bypassed when ~~THERMAL POWER~~ is > 1E-3%. Operating bypass shall be automatically removed when ~~THERMAL POWER~~ is ≤ 1E-3%.

logarithmic power

(b) With any RTCBs closed, any control element assembly (CEA) capable of being withdrawn, and fuel loaded in reactor.

(c) Steam Generator Pressure – Low trip setpoint may be manually decreased as steam generator pressure is reduced in MODE 3 and 4, provided the margin between steam generator pressure and the setpoint is maintained at ≤ 14.1 kg/cm^2 (200 psi). The setpoint shall be increased automatically as steam generator pressure is increased.

BASES

APPLICABLE SAFETY ANALYSES (continued)

2. Logarithmic Power Level – High

logarithmic power

The Logarithmic Power Level-High trip protects the integrity of the fuel cladding and helps protect the RCPB in the event of an unplanned criticality from a shutdown condition.

In MODES 2, 3, 4, and 5, with the RTCBs closed and the CEA Drive System capable of CEA withdrawal, protection is required for CEA withdrawal events originating when ~~THERMAL POWER~~ is < 1E-3%. For events originating above this power level, other trips provide adequate protection.

MODES 3, 4, and 5, with the RTCBs closed, are addressed in LCO 3.3.2, "Reactor Protection System (RPS) Instrumentation – Shutdown."

In MODES 3, 4, or 5, with the RTCBs open or the CEAs not capable of withdrawal, the Logarithmic Power Level – High trip does not have to be OPERABLE. The indication and alarm Functions are addressed in LCO 3.3.13, "Logarithmic Power Monitoring Channels."

3. Pressurizer Pressure – High

The Pressurizer Pressure – High trip provides protection for the high RCS pressure SL. In conjunction with the pressurizer safety valves and the main steam pilot operated safety relief valve (POSRV), it provides protection against overpressurization of the RCPB during the following events:

- Loss of electrical load without a reactor trip being generated by the turbine trip (AOO);
- Loss of condenser vacuum (AOO);
- CEA withdrawal from low power conditions (AOO);
- Chemical and Volume Control System malfunction (AOO); and
- Main Feedwater System pipe break (accident).

BASES

LCO (continued)

The Allowable Value is high enough to provide an operating envelope that prevents unnecessary Logarithmic Power Level – High reactor trips during normal plant operations. The Allowable Value is low enough for the system to maintain a margin to unacceptable fuel cladding damage should a CEA withdrawal event occur.

logarithmic power

The Logarithmic Power Level – High trip may be bypassed manually when ~~THERMAL POWER~~ is > 1E-3% to allow the reactor to be brought to power during a reactor startup. This bypass is automatically removed when ~~THERMAL POWER~~ is ≤ 1E-3%. Above 1E-3%, the Variable Overpower – High and Pressurizer Pressure – High trips provide protection for reactivity transients.

RTP

The trip may be manually bypassed during PHYSICS TEST pursuant to LCO 3.1.9, “Test Exceptions – SDM.” During this testing, the Variable Overpower – High trip and administrative controls provide the required protection.

3. Pressurizer Pressure – High

This LCO requires four channels of Pressurizer Pressure – High to be OPERABLE in MODES 1 and 2.

The Allowable Value is set below the nominal lift setting of the POSRVs, and its operation avoids the undesirable operation of these valves during normal plant operation. In the event of AOO and Accident causing overpressure, this setpoint ensures the reactor trip will take place, thereby assuring the integrity of the RCPB and preventing consequent pressure rise. The POSRVs can lift to prevent overpressurization of the RCS.

4. Pressurizer Pressure – Low

This LCO requires four channels of Pressurizer Pressure – Low to be OPERABLE in MODES 1 and 2.

The Allowable Value is set low enough to prevent a reactor trip during normal plant operation and pressurizer pressure transients. However, the setpoint is high enough that with a LOCA, the reactor trip will occur soon enough to allow the ESF Systems to perform as expected in the analyses and mitigate the consequences of the accident.