
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.: 481-8546
SRP Section: 16 - Technical Specifications
Application Section: 16.3.4, 16.3.5, 16.3.6, 16.3.7, 16.3.9
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Question No. 16-143

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. Staff needs to evaluate all technical differences from standard TS (STS) NUREG-1432, STS Combustion Engineering Plants, Rev. 4, which is referenced by the DC applicant in DCD Tier 2 Section 16.1, and the docketed rationale for each difference because conformance to STS provisions is used in the safety review as the initial point of guidance for evaluating the adequacy of the generic TS to ensure adequate protection of public health and safety, and the completeness and accuracy of the generic TS Bases.

This request stems from discussion at the February 2016 meeting with the applicant.

In generic TS LCO 3.4.14, the applicant elects to include OPERABILITY of the containment atmosphere humidity monitor, which provides information about the containment atmosphere moisture content, and may "qualitatively" indicate the possibility of RCS LEAKAGE, in addition to the quantitative monitors for containment sump level and atmosphere particulate radioactivity. The gaseous radioactivity monitor specified in STS 3.4.15 is considered to be a qualitative RCS leakage monitor based on the guidance in Regulatory Guide (RG) 1.45, "Guidance on Monitoring and Responding to Reactor Coolant System Leakage," Revision 1.

The applicant is requested to address the following differences between the STS and the generic TS and Bases:

1. Condition A should say "Required containment sump (level) monitor inoperable" instead of "One or more required channel(s) inoperable"; Required Action A.2 should say

- “Restore required containment sump (level) monitor to OPERABLE status.” with a completion time of 30 days.
2. Condition B should say “Required containment atmosphere radioactivity (particulate) monitor inoperable.” Required Action B.2.1 should say “Restore required containment atmosphere radioactivity (particulate) monitor to OPERABLE status.” with a completion time of 30 days.
 3. Delete Required Action B.2.2, since it duplicates Required Action B.2.1, and an inoperable sump (level) monitor is the subject of Condition A (as pointed out in sub-question 1 above).
 4. Condition C should say “Required containment atmosphere humidity monitor inoperable.” Renumber Required Action C.2 as C.2.1, insert logical connector “AND” after Required Action C.2.1; and add Required Action C.2.2 which says “Restore required containment atmosphere humidity monitor to OPERABLE status.” with a completion time of 30 days.
 5. Delete Condition D Note, which says “Only applicable when the containment atmosphere gaseous radiation monitor is the only OPERABLE monitor.” The gaseous radiation monitor is not listed in the LCO 3.4.14 statement.
 6. Condition D should say “Required containment sump (level) monitor inoperable. AND Required containment atmosphere humidity monitor inoperable.” Revise Required Actions D.1 and D.2 to be similar to Required Actions E.1 and E.2 for Condition E, given that another quantitative monitor remains OPERABLE (that is, the containment atmosphere radioactivity (particulate) monitor).
 7. Add a new Condition F for “Required containment sump (level) monitor inoperable. AND Required containment atmosphere radioactivity (particulate) monitor inoperable.” With Required Actions and 7 day Completion Times similar to STS 3.4.15 Condition D for the situation where only a qualitative monitor remains OPERABLE (that is, the required containment atmosphere humidity monitor). Renumber Conditions F and G as Conditions G and H. Required Actions for new Condition F should say: “F.1 Restore required containment sump (level) monitor to OPERABLE status. | 7 days OR F.2 Restore required containment radioactivity (particulate) monitor to OPERABLE status. | 7 days”
 8. Revise the phrase “of the required containment ... monitor” in all SR statements. Add “(particulate)” after “radioactivity”, and “(level)” after “sump” in all locations in generic TS Subsection 3.4.14 and Bases Subsection B 3.4.14 when referring to the quantitative leakage monitors of the RCS leakage detection instrumentation required by LCO 3.4.14.
 9. Revise Subsection B 3.4.14 to reflect not only the above changes, but also the inclusion of the containment humidity monitor as an LCO required monitor.
 10. Generic TS SR 3.4.14.1 says, “Perform CHANNEL CHECK of required containment atmosphere radioactivity monitor.” If only one radioactivity particulate monitor channel is required, how is this surveillance accomplished?

11. Justify not providing an SR to perform a CHANNEL CHECK of the required containment atmosphere humidity monitor.

Response

Subquestions 1 through 9 and 11

Technical Specification 3.3.14 and Bases 3.3.14 will be revised to incorporate the comments.

Subquestion 10

The containment atmosphere radioactivity (particulate) is monitored by two independent monitors, RE-039A and RE-040B. The measuring range and sampling point of these two monitors are identical. When the CHANNEL CHECK of the RE-039A is performed, RE-040B continuously monitors the containment atmosphere particulate radioactivity. The particulate radioactivity of the containment atmosphere is monitored even when the CHANNEL CHECK of one monitor is being performed.

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

Technical Specification 3.3.14 and Bases 3.3.14 will be revised as shown in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.14 RCS Leakage Detection Instrumentation

- LCO 3.4.14 The following RCS leakage detection instrumentation shall be OPERABLE:
- a. One containment sump (level) monitor
 - b. One containment atmosphere radioactivity (particulate) monitor
 - c. One containment atmosphere humidity monitor

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>A. One or more required channel(s) inoperable.</p> <div style="border: 1px solid red; padding: 5px; width: fit-content; margin-top: 10px;"> <p>Required containment sump (level) monitor inoperable.</p> </div>	<p>A.1 ----- NOTE ----- Not required until 12 hours after establishment of steady state operation. -----</p> <p>Perform SR 3.4.12.1. (level)</p> <p><u>AND</u></p> <p>A.2 Restore required containment sump monitor to OPERABLE status.</p>	<p>Once per 24 hours</p> <p>30</p> <p>31 days</p>

ACTIONS (continued)		
CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Required containment atmosphere radioactivity monitor inoperable.	B.1.1 Analyze grab samples of the containment atmosphere.	Once per 24 hours
	<u>OR</u>	
	B.1.2 ----- NOTE ----- Not required until 12 hours after establishment of steady state operation. -----	Once per 24 hours
	Perform SR 3.4.12.1.	
<u>AND</u>		
B.2	B.2.1 Restore required containment sump monitor to OPERABLE status.	31 days
	<u>OR</u>	
	B.2.2 Restore required containment sump monitor to OPERABLE status.	31 days
C. Containment atmosphere humidity monitor inoperable.	C.1 Perform SR 3.4.14.1.	Once per 8 hours
	<u>OR</u>	
	C.2 ----- NOTE ----- Not required until 12 hours after establishment of steady state operation. -----	Once per 24 hours
Perform SR 3.4.12.1.		

(particulate)

B.2

atmosphere radioactivity (particulate)

30

Required

C.2.1

AND
C.2.2 Restore required containment atmosphere humidity monitor to OPERABLE status. | 30 days

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>NOTE Only applicable when the containment atmosphere gaseous radiation monitor is the only OPERABLE monitor.</p> <p>D. Required containment sump monitor inoperable.</p> <p>AND (level)</p> <p>AND Required</p> <p>Containment atmosphere humidity monitor inoperable.</p>	<p>D.1 Analyze grab samples of containment atmosphere.</p> <p>AND D.1 (level)</p> <p>D.2.1 Restore required containment sump monitor to OPERABLE status.</p> <p>D.2 OR required</p> <p>D.2.2 Restore containment atmosphere humidity monitor to OPERABLE status.</p>	<p>Once per 12 hours</p> <p>7 days</p> <p>7 days</p>
<p>E. Required containment atmosphere radioactivity monitor inoperable.</p> <p>AND Required</p> <p>Containment atmosphere humidity monitor inoperable.</p>	<p>E.1 Restore required containment atmosphere radioactivity monitor to OPERABLE status.</p> <p>(particulate) OR required</p> <p>E.2 Restore containment atmosphere humidity monitor to OPERABLE status.</p>	<p>31 days 30 (particulate)</p> <p>31 days 30</p>
<p>F. Required Action and associated Completion Time not met.</p> <p>G.</p>	<p>G.1</p> <p>F.1 Be in MODE 3.</p> <p>AND G.2</p> <p>F.2 Be in MODE 5.</p>	<p>6 hours</p> <p>36 hours</p>
<p>H.</p> <p>G. All required monitors inoperable.</p>	<p>H.1</p> <p>G.1 Enter LCO 3.0.3.</p>	<p>Immediately</p>

Insert "A" on the attached pages.

SR 3.4.14.2 Perform CHANNEL CHECK of the required containment atmosphere humidity monitor. | 12 hours

RCS Leakage Detection Instrumentation
3.4.14

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.14.1	Perform CHANNEL CHECK of the required containment atmosphere radioactivity monitor.	12 hours
SR 3.4.14.2	Perform CHANNEL FUNCTIONAL TEST on required containment atmosphere radioactivity monitor.	31 days 30
SR 3.4.14.3	Perform CHANNEL CALIBRATION of containment sump monitor.	18 months
SR 3.4.14.4	Perform CHANNEL CALIBRATION of required containment atmosphere radioactivity monitor.	18 months
SR 3.4.14.5	Perform CHANNEL CALIBRATION of required containment atmosphere humidity monitor.	18 months

SR 3.4.14.4 Perform CHANNEL FUNCTIONAL TEST of the required containment atmosphere humidity monitor. | 30 days

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.14 RCS Leakage Detection Instrumentation

BASES

BACKGROUND GDC 30 of Appendix A to 10 CFR Part 50 (Reference 1) requires means for detecting and, to the extent practical, identifying the location of the source of RCS leakage. NRC RG 1.45 (Reference 2) describes acceptable methods for selecting leakage detection systems.

Leakage detection systems must have the capability to detect significant reactor coolant pressure boundary (RCPB) degradation as soon after occurrence as practical to minimize the potential for propagation to a gross failure. Thus, an early indication or warning signal is necessary to permit proper evaluation of all unidentified leakage. In addition, to meet the OPERABLE requirements, the monitors are typically set to provide the most sensitive response without causing an excessive number of spurious alarms.

(level) monitor

The containment sump used to collect unidentified leakage and the containment atmosphere humidity monitor is instrumented to alarm for increases of above in the normal rates.

The reactor coolant contains radioactivity that, when released to the containment, can be detected by radiation monitoring instrumentation. Radioactivity detection systems are included for monitoring the particulate activity, because of its sensitivities and rapid responses to RCS leakage.

Other indications may be used to detect an increase in unidentified leakage. ~~However, they are not required to be OPERABLE by this LCO.~~ An increase in humidity of the containment atmosphere would indicate release of water vapor to the containment. Dew point temperature measurements can thus be used to monitor humidity levels of the containment atmosphere as an indicator of potential RCS leakage.

Since the humidity level is influenced by several factors, a quantitative evaluation of an indicated leakage rate by this means could be questionable and should be compared to observed increases in liquid flow into or from the containment sump ~~and atmosphere humidity monitor.~~

BASES

BACKGROUND (continued)

Humidity level monitoring is considered most useful as an indirect alarm or indication to alert the operator to a potential problem. ~~Humidity monitors are not required by this LCO.~~

Air temperature and pressure monitoring methods may also be used to infer unidentified leakage to the containment. Containment temperature and pressure fluctuate slightly during plant operation, but a rise above the normally indicated range of values could indicate RCS leakage into the containment. The relevance of temperature and pressure measurements is affected by containment free volume and, for temperature, detector location. Alarm signals from these instruments can be valuable in recognizing rapid and sizable leakage to the containment. Temperature and pressure monitors are not required by this LCO.

The above mentioned leakage detection methods or systems differ in sensitivity and response time. Some of these systems could serve as early alarm systems signaling the operators that closer examination of other detection systems is necessary to determine the extent of any corrective action that could be required.

APPLICABLE
SAFETY
ANALYSE

The need to evaluate the severity of an alarm or an indication is important to the operators, and the ability to compare and verify the indications from other systems is necessary.

The safety significance of RCS leakage varies widely depending on its source, rate, and duration. Therefore, detecting and monitoring of RCS leakage into the containment area is necessary. Quickly separating the identified leakage from the unidentified leakage provides quantitative information to the operators, allowing them to take corrective action should leakage occur detrimental to the safety of the facility and the public.

RCS leakage detection instrumentation satisfies Criterion 1 of 10 CFR 50.36(c)(2)(ii).

BASES

LCO

This LCO requires instruments of diverse monitoring principles to be OPERABLE to provide confidence that small amounts of unidentified leakage are detected in time to allow actions to place the plant in a safe condition when RCS leakage indicates possible RCPB degradation.

The LCO requires three instruments to be OPERABLE.

The containment sump is used to collect unidentified leakage. The containment sump consists of the normal sump and ICI cavity sump. The LCO requirements apply to the total amount of unidentified leakage collected in the both sumps. The monitor on the measuring tube inside the containment sump detects the leakage level or the operating frequency of discharge in the measuring tube inside containment sump. The measuring tube is instrumented to detect when there is leakage of an increase above the normal value by 0.5 gpm. The identification of an increase in unidentified leakage will be delayed by the time required for the unidentified leakage to travel to the containment sump and it could take longer than 1 hour to detect a 0.5 gpm increase in unidentified leakage, depending on the origin and magnitude of the leakage. This sensitivity is acceptable for containment sump monitor OPERABILITY.

(particulate)

(level)

The reactor coolant contains radioactivity that, when released to the containment, can be detected by the ~~particulate~~ containment atmosphere radioactivity monitor. Radioactivity detection systems are included for monitoring particulate activities because of its sensitivities and rapid responses to RCS leakage, but have recognized limitations. The reactor coolant radioactivity level will be low during initial reactor startup and for a few weeks thereafter, until activated corrosion products have been formed and fission products appear from fuel element cladding contamination or cladding defects.

(particulate)

If there are few fuel element cladding defects and low levels of activation products, it may not be possible for the ~~particulate~~ containment atmosphere radioactivity monitor to detect a 0.5 gpm increase within 1 hour during normal operation. However, the ~~particulate~~ containment atmosphere radioactivity monitor is OPERABLE when it is capable of detecting a 0.5 gpm increase in unidentified leakage within 1 hour given an RCS activity equivalent to that assumed in the design calculations for the monitors (Reference 3).

BASES

LCO (continued)

An increase in humidity of the containment atmosphere could indicate the release of water vapor to the containment. Containment humidity is instrumented to detect when there is an increase above the normal value by 1 gpm. The time required to detect a 1 gpm increase above the normal value varies based on environmental and system conditions and could take longer than 1 hour. This sensitivity is acceptable for containment atmosphere humidity monitor OPERABILITY.

The LCO is satisfied when monitors of diverse measurement means are available. Thus, the combination of containment sump monitors, in combination with a particulate radioactivity monitor and humidity monitors provides an acceptable minimum.

APPLICABILITY

Because of elevated RCS temperature and pressure in MODES 1, 2, 3, and 4, RCS leakage detection instrumentation is required to be OPERABLE.

In MODES 5 or 6, the temperature is less than or equal to 98.9 °C (210 °F) and pressure is maintained low or at atmospheric pressure. Since the temperatures and pressures are far lower than those for MODES 1, 2, 3, and 4, the likelihood of leakage and crack propagation is much smaller. Therefore, the requirements of this LCO are not applicable in MODES 5 and 6.

ACTIONS

A.1 and A.2

With the required containment sump monitor is inoperable, no other form of sampling can provide the equivalent information.

However, the containment atmosphere radioactivity monitor will provide indications of changes in leakage. Together with the containment atmosphere radioactivity monitor, the periodic surveillance for the RCS water inventory balance, SR 3.4.12.1, must be performed at an increased frequency of 24 hours to provide information that is adequate to detect leakage. A Note is added allowing that SR 3.4.12.1 is not required to be performed until 12 hours after establishing steady state operation (stable temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows). The 12-hour allowance provides sufficient time to collect and process all necessary data stable plant conditions are established.

BASES

ACTIONS (continued)

Restoration of the required ~~sump monitor~~ **containment sump (level) monitor** to OPERABLE status within a Completion Time ~~31~~ **30** days is required to regain the function after the monitor's failure. This time is acceptable considering the frequency and adequacy of the RCS water inventory balance required by Required Action A.1.

B.1.1, B.1.2, B.2.1, and B.2.2

With the ~~particulate~~ **(particulate)** containment atmosphere radioactivity monitoring instrumentation channel inoperable, alternative action is required. Either grab samples of the containment atmosphere must be taken and analyzed or water inventory balances, in accordance with SR 3.4.12.1, must be performed to provide alternate periodic information.

With a sample obtained and analyzed or water inventory balance performed every 24 hours, the reactor may be operated for up to ~~31~~ **30** days to allow restoration of the required containment atmosphere radioactivity monitors. Alternatively, continued operation is allowed if the containment atmosphere humidity monitor is OPERABLE, provided grab **(particulate)** samples are taken or water inventory balances performed every 24 hours.

The 24-hour interval provides periodic information that is adequate to detect leakage. A Note is added allowing that SR 3.4.12.1 is not required to be performed until 12 hours after establishing steady state operation (stable temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows). The 12-hour allowance provides sufficient time to collect and process all necessary data after stable plant conditions are established. The ~~31~~ **30**-day Completion Time recognizes at least one other form of leakage detection is available.

C.1 and C.2, **C.2.1, and C.2.2**

With the containment atmosphere humidity monitor inoperable, alternative action is again required. Either SR 3.4.14.1 must be performed or water inventory balance, in accordance with SR 3.4.12.1, must be performed to provide alternate periodic information. Provided a CHANNEL CHECK is performed every 8 hours, or a water inventory balances is performed every 24 hours, reactor operation may continue while awaiting restoration of the containment atmosphere humidity monitor to OPERABLE status. The 24-hour interval provides periodic information that is adequate to detect RCS leakage.

BASES

ACTIONS (continued)

The 30-day Completion Time recognizes at least one other form of leakage detection is available.

A Note is added allowing that SR 3.4.12.1 is not required to be performed until 12 hours after establishing steady state operation (stable temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows.) The 12-hour allowance provides sufficient time to collect and process all necessary data after stable plant conditions are established.

D.1 and D.2

D.1, D.2.1 and D.2.2

(particulate)

radioactivity (particulate)

(level)

This

With the required containment sump monitor and the containment atmosphere humidity monitor inoperable, the only means of detecting LEAKAGE is the required containment atmosphere radiation monitor. A Note clarifies that this condition is applicable when the only OPERABLE monitor is the containment atmosphere radioactivity monitor. The containment atmosphere radioactivity monitor typically cannot detect a 0.5 gpm leak within one hour when RCS activity is low. In addition, this configuration does not provide the required diverse means of leakage detection. Indirect methods of monitoring RCS leakage must be implemented. Grab samples of the containment atmosphere must be taken to provide alternate periodic information. The 12 hour interval is sufficient to detect increasing RCS leakage. The Required Action provides 7 days to restore another RCS leakage monitor to OPERABLE status to regain the intended leakage detection diversity. The 7-day Completion Time ensures that the plant will not be operated in a degraded configuration for a lengthy time period.

This

E.1 and E.2

(level)

(particulate)

With the required containment atmosphere radioactivity monitor and the containment atmosphere humidity monitor inoperable, the only means of detecting leakage is the containment sump monitor. This condition does not provide the required diverse means of leakage detection. The Required action is to restore either of the inoperable required monitors to OPERABLE status within 31 days to regain the intended leakage detection diversity. The 31-day Completion Time ensures that the plant will not be operated in a reduced configuration for a lengthy time period.

30

Insert "B" on the attached page.

This condition is applicable when the only OPERABLE monitor is the containment sump (level) monitor.

BASES

ACTIONS (continued)

G.1 and G.2

F.1 and F.2

If a Required Action of Condition A, B, C, D or E cannot be met, the plant must be brought to a MODE in which the requirement does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

G.1

H.1

If all required monitors inoperable, no automatic means of monitoring leakage are available, and immediate plant shutdown in accordance with LCO 3.0.3 is required.

SURVEILLANCE
REQUIREMENTSSR 3.4.14.1

SR 3.4.14.1 requires the performance of a CHANNEL CHECK of the required containment atmosphere radioactivity monitors. The check gives reasonable confidence that the channel is operating properly. The Frequency of 12 hours is based on instrument reliability and is reasonable for detecting off normal conditions.

SR 3.4.14.2

SR 3.4.14.2 requires the performance of a CHANNEL FUNCTIONAL TEST on the required containment atmosphere radioactivity monitor. The test ensures that the monitor can perform its function in the desired manner. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable CHANNEL FUNCTIONAL TEST of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications (TS) and non-TS tests at least once per refueling interval with applicable extensions. The test verifies the alarm setpoint and relative accuracy of the instrument string. The Frequency of 31 days considers instrument reliability, and operating experience has shown that it is proper for detecting degradation.

Insert "C" on the attached page.

Insert "D" on the attached page.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.14.3, SR 3.4.14.4, and SR 3.4.14.5



These SRs require the performance of a CHANNEL CALIBRATION for each of the RCS leakage detection instrumentation channels. The calibration verifies the accuracy of the instrument string, including the instruments located inside containment. The 18-month Frequency is a typical refueling cycle and considers channel reliability. Again, operating experience has proven that this Frequency is acceptable.

REFERENCES

1. 10 CFR Part 50, Appendix A, Section IV, GDC 30.
 2. NRC RG 1.45, Rev.1, May 2008
 3. DCD Tier 2, Chapter 5.
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C

SR 3.4.14.2

SR 3.4.14.2 requires the performance of a CHANNEL CHECK of the required containment atmosphere humidity monitors. The check gives reasonable confidence that the channel is operating properly. The Frequency of 12 hours is based on instrument reliability and is reasonable for detecting off normal conditions.

D

SR 3.4.14.4

SR 3.4.14.4 requires the performance of a CHANNEL FUNCTIONAL TEST on the required containment atmosphere humidity monitor. The test ensures that the monitor can perform its function in the desired manner. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable CHANNEL FUNCTIONAL TEST of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications (TS) and non-TS tests at least once per refueling interval with applicable extensions. The test verifies the alarm setpoint and relative accuracy of the instrument string. The Frequency of 30 days considers instrument reliability, and operating experience has shown that it is proper for detecting degradation.