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.:	**91-7867**
SRP Section:	**14.2 – Initial Plant Test Program - Design Certification and New License Applicants**
Application Section:	**14.2**
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Question No. 14.02-3

REQUIREMENT

In APR1400 DCD Chapter 1, Table 1.91, “APR1400 Conformance to NRC Regulatory Guides,” Page 1.9-15, and DCD Subsection 14.2.7.3, NRC Regulatory Guide 1.79, “Preoperational Testing of Emergency Core Cooling Systems for Pressurized Water Reactors,” the DC applicant commits to Regulatory Guidance in RG 1.79.

RG 1.79, Prerequisite Section, page 4, 1st paragraph, 1st through 6th sentences state:

“NRC Regulatory Issue Summary (RIS) 2013-09, NRC Endorsement of NEI 09-10, Revision 1a-A, Guidelines for Effective Prevention and Management of System Gas Accumulation (Ref. 6) endorses Nuclear Energy Institute (NEI) topical report No. 09-10, Guidelines for Effective Prevention and Management of System Gas Accumulation, Rev. 1a-A, (Ref. 7) as an acceptable and recommended approach to managing gas accumulation in power reactor piping systems. The NRC staff uses this guidance when evaluating the applicant or licensee’s treatment of gas accumulation concerns. As a prerequisite to ECCS preoperational tests, the licensee or applicant should verify that all types of non-condensable gases (i.e., air, hydrogen, nitrogen, oxygen, etc.) in the ECCS systems are kept to an acceptable level. This verification should be accomplished by performing nondestructive examination techniques, opening vent valves to remove non-condensable gases, or by other methods justified through an engineering evaluation. The engineering evaluation should consider void volume, void transport to pumps and pump void acceptance criteria and include performance of void transport analysis. The evaluation should document the rationale and determination that gas intrusion into the ECCS system would not adversely affect the ability of the system to perform its function. If non-condensable gases are vented through high-point vent valves, verify closure of the valves before starting the ECCS pumps (active PWR plants designs only)."

ISSUE

To meet the prerequisite regulatory guidance in RG 1.79, the DC applicant should verify if adequate prerequisite test checks are performed on vent valves in safety related ECCS systems in APR1400 DCD Section 14.2. For example, APR1400 DCD Subsection 14.2.12.1.20, “Shutdown Cooling System Test,” contains Prerequisite 2.5, “All lines in the shutdown cooling system have been filled and vented,” but the prerequisite does not include any engineering evaluation for non-condensable gas intrusion into ECCS systems or prerequisite test checks to verify vent valves are closed before starting the shutdown cooling system pumps.

INFORMATION NEEDED

Please provide an engineering evaluation for gas intrusion into the ECCS systems and pre-requisite test checks to verify the vent valves are closed before starting the ECCS pumps.

Response – (Rev. 2)

The following are potential pathways for gas intrusion into the APR1400 safety injection system (SIS) and shutdown cooling system (SCS):

- Unobstructed pathways to the in-containment refueling water storage tank (IRWST) via safety injection suction lines during system standby.

- Unobstructed pathways to the IRWST via safety injection pump (SIP) mini-flow lines (i.e., discharge piping located above the IRWST level) during system standby.

- Unobstructed pathways to the containment atmosphere via SCS suction lines during reactor coolant system (RCS) mid-loop operation (i.e., refueling).

- Possible steam pockets produced via thermal conduction from the RCS, between the first two reactor coolant pressure boundary (RCPB) isolation valves in the SIS discharge lines, and in the RHRS suction lines from the RCS.

The following design features of the APR1400 SIS and SCS prevent or control gas accumulation to acceptable levels in order to maintain system operability:

- Continuous venting of the SIS suction lines via continuous sloping of pipes.

- Strainers installed in the IRWST to prevent vortex formation when the SIP and CSP are taking suction from the IRWST.

- Continuous venting of the SCS suction lines via continuous sloping of pipes.

- Continuous pressurization of the RCPB lines by the SITs during system standby to prevent steam pockets from developing as a result of heat transfer from the RCS.

- Vent lines located at piping high points.

- Periodic venting of the SIS and SCS discharge lines by gravity filling from Safety Injection Filling Tank (SIFT) located above the highest point of SIS piping.

Vent lines placed at piping high points precludes the accumulation of unacceptable levels of gas in the APR1400 SIS/SCS. Periodic surveillance of ECCS piping (e.g., Technical Specification Surveillance Requirements 3.4.6.4, 3.4.7.4, 3.4.8.3, and 3.5.2.3) is performed to prevent water hammer and ensure any gas accumulation is within acceptable levels using SIFT.

The prerequisites for tests in DCD Tier 2, Sections 14.2.12.1.20 and 14.2.12.21 will be revised to include verification that after the SCS and SIS are vented, the vent valves are closed before starting the SIP or SCP. The pre-operational test procedure for ECCS will describe the criteria for the amount of gas that would be considered acceptable rather than this information being included in the ITP.

Impact on DCD

DCD Tier 2, Sections 14.2.12.1.20 and 14.2.12.21, Subsection 2.0 Prerequisites will be revised as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

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

2.6 It shall be checked that all vent valves are closed before starting the shutdown cooling pumps.

2.2 Plant systems required to support testing are operable and temporary systems are installed and operable.

After verifying that there is no evidence of air through the vent valve, the vent valve shall be closed.

2.3 Permanently installed instrumentation is operable and calibrated.

2.4 Test instrumentation is available and calibrated.

2.5 All lines in the shutdown cooling system have been filled and vented.

2.6 The ~~low temperature overpressure protection (~~LTOP~~)~~ valve relief capacity has been verified by bench testing.

2.7

3.0 TEST METHOD

3.1 Verify proper operation of each shutdown cooling pump with minimum flow established.

3.2 Verify pump performance including head and flow characteristics for all design flow paths, which include the normal decay heat removal flow path and:

a. Shutdown cooling system flow to the chemical and volume control system for purification

b. Shutdown cooling system transfer of refueling water to the IRWST

c. Shutdown cooling system to cool the IRWST

3.3 Perform a full flow test of the shutdown cooling system.

3.4 Verify proper operation, stroking speed, position indication, and response to interlock of control and isolation valves.

3.5 Verify the proper operation of the protective devices, controls, interlocks, indications, and alarms using actual or simulated signals.

1.6 To verify the elevation of SIS containment isolation valves relative to the ~~in-containment refueling water storage tank (IRWST)~~IRWST water level

2.0 PREREQUISITES

2.1 Construction activities have been completed on the SIS.

2.2 Support systems and instrumentation required for operation of the SIS are essentially complete and operational.

2.3 The IRWST is filled with sufficient primary makeup water to conduct testing on the SI subsystem.

After verifying that there is no evidence of air through the vent valve, the vent valve shall be closed.

2.4 The reactor vessel head and internals have been removed.

2.5 Test instrumentation to be used for pump performance has been installed and calibrated.

2.8 It shall be checked that all vent valves are closed before starting the safety injection pumps.

2.6 SIS instrumentation has been checked and calibrated.

2.7 All in the safety injection system have been filled and vented

3.0 TEST METHOD

3.1 Operate control valves from all appropriate control locations and observe valve operation and position indication. —Where required, measure opening and closing times.

3.2 Verify power-operated valves fail to the position specified in Subsection 6.3.2 upon loss of motive power.

3.3 Operate SI from alternate electrical power sources and determine pump and valve responses including response times, when required.