KHNPDCDRAIsPEm Resource

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Sent:	Wednesday, May 03, 2017 6:50 PM
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Subject:	APR1400 Design Certification Application RAI 546-8782 [14.3.3 - Piping Systems and Components ITAAC]
Attachments:	APR1400 DC RAI 546 MEB 8782.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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REQUEST FOR ADDITIONAL INFORMATION 546-8782

Issue Date: 05/03/2017
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 14.03.03 - Piping Systems and Components - Inspections, Tests, Analyses, and Acceptance Criteria
Application Section: 14.3.2.3

QUESTIONS

14.03.03-3

The NRC regulations in 10 CFR 52.47(b)(1) require that a Design Certification (DC) application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Atomic Energy Act, and the Commission's rules and regulations. The NRC staff has reviewed the ITAAC in Revision 1 of the APR1400 Design Control Document (DCD) Tier 1 and compared them to standardized ITAAC developed in a joint effort between NRC staff and the Nuclear Energy Institute (NEI), which was shared with the applicant in a letter dated August 3, 2016. Based on its review, the NRC staff has determined that certain ITAAC proposed in APR1400 DCD Tier 1 are not sufficient to satisfy 10 CFR 52.47(b)(1). Therefore, the staff requests in this question and the following five questions, additional information regarding the applicant’s proposed ITAAC in order to make a safety finding for compliance with 10 CFR 52.47(b)(1).

Several ITAAC for Tier 1 systems include Design Commitments that state ASME Code SSCs (piping or components) are designed and constructed in accordance with ASME Section III requirements. The ITAAC inconsistently refer to ASME Section III Design Reports and/or Data Reports for verification. Based on discussion from the April 4, 2017, public meeting on the applicant’s ITAAC, it is understood that verification of construction activities is performed through review of Data Reports. Therefore, in order to fully satisfy the Design Commitment, the applicant is requested to either revise their ITAAC referring to SSCs designed and constructed in accordance with ASME Section III requirements to refer to ASME Section III Data Reports in the Inspections, Tests, and Analyses and Acceptance Criteria instead of “design report(s) or data report(s)” or to provide justification for the proposed ITAAC’s ability to satisfy the Design Commitment.

14.03.03-4

In DCD Tier 1, ITAAC 2.2.6.2 discusses the Design Commitment for the ASME Code components identified in Table 2.2.6-1 to be designed and constructed in accordance with ASME Section III Subsection NG requirements. The ITA for this Design Commitment is that “Inspection of the fabricated components will be performed.” This wording is inconsistent with similar ITAAC for other Tier 1 sections, in that it specifically excludes the phrase “as-built” when describing the components. The applicant is requested to provide an explanation for this inconsistency, or to align the wording of this ITAAC with the similar ITAAC found in other Tier 1 sections.

14.03.03-5

In DCD Tier 1, several systems contain ITAAC regarding protection from high energy line break effects. However, the wording of these ITAAC are insufficient. Please address the following issues:

a. GDC 4, "Environmental and dynamic effects design bases," requires in part, that SSCs important to safety be designed to accommodate the effects of environmental and dynamic conditions resulting from equipment failures and other postulated events. High energy piping system failures must consider both dynamic and environmental effects. Moderate energy piping systems should be evaluated for environmental effects. The ITAAC do not make this clear. For systems where portions of the piping are considered high energy and other portions are considered moderate energy, both must be addressed in the ITAAC. Please revise the ITAAC associated with the effects of pipe break hazards to address both dynamic and environmental effects for high energy piping system failures, as well as mention both high and moderate energy piping for those systems that contain both types of piping.

b. Providing pipe break hazards ITAAC on a systematic basis requires that the applicant be very clear and deliberate about the scope of the ITAAC. It is understood that the piping system referred to in the ITAAC is the system addressed by the Tier 1 section. However, the "safety-related SSCs" which must be protected from the effects of the pipe break are not clearly identified. Because the ITAAC is contained within a DCD section addressing a specific system, one could mistakenly interpret the scope of "safety-related SSCs" to only be those safety-related SSCs belonging to the specific system addressed by the DCD section rather than all safety-related SSCs in the plant which are within proximity of the system postulated to fail. The applicant is requested to clarify the scope of these ITAAC within their respective system sections, or to implement a non-system-based approach to eliminate any confusion.

c. Table 2.3-2 provides an incomplete and inconsistent listing of piping systems evaluated for the dynamic and environmental effects of piping failures. The Process and Post-Accident Sampling System is not listed in Table 2.3-2, despite the system having an ITAAC for this evaluation. Main Feedwater System is listed, although this title is inconsistent with DCD Tier 1 Section 2.7.1.4, which is titled Condensate and Feedwater System. Finally, the Diesel Fuel Oil Transfer System is listed as a separate entry, but does not contain its own Tier 1 Section and ITAAC. It appears the Diesel Fuel Oil Transfer System may be considered part of the Emergency Diesel Generator System (DCD Tier 1, Section 2.6.2). The applicant is requested to revise Table 2.3-2 accordingly.

14.03.03-6

DCD Tier 1 addresses equipment qualification for electrical equipment but is silent on the topic of equipment qualification for nonmetallic parts of mechanical equipment. Additional ITAAC are needed related to this topic – guidance is provided in Standardized ITAAC Q03 and should be applied to all systems that contain safety-related pumps, valves, or dynamic restraints.

14.03.03-7

DCD Tier 1, Table 2.3-1 lists systems with ASME Section III Class 1, 2, and 3 Piping Systems and Components. Earlier discussion in DCD Tier 1, Section 2.3 refers to the systems in this table as "designed to retain their pressure integrity and functional capability under internal design and operating pressures and design basis loads." Upon staff review of the table, it was noted that DCD Tier 1 Section 2.11.3, the Containment Isolation System, was not a listed system. Please include this system or provide justification to preclude its presence in this table.

14.03.03-8

Based on its review, the NRC staff has determined that certain ITAAC in the APR1400 DCD Tier 1 related to the qualification and testing of pumps and valves to be used in the APR1400 nuclear power plant are not sufficient to satisfy 10 CFR 52.47(b)(1). Therefore, the NRC staff requests that the APR1400 DC applicant update its ITAAC in the APR1400 DCD Tier 1 for pumps and valves as described below:

a. Regarding pump functional capability qualification, ITAAC 2.4.3.9.b.i in the APR1400 DCD Tier 1 for the Safety Injection (SI) System specifies in the Design Commitment that the SI pumps identified in the applicable ITAAC table perform their safety function under expected ranges of fluid flow, pump head, electrical conditions, and temperature conditions up to and including design-basis conditions. The Inspections, Tests, and Analyses (ITA) for this ITAAC specify the performance of type tests or a combination of type tests and analyses of each SI pump to demonstrate the ability of the pump to perform its safety function under expected ranges of fluid flow, pump head, electrical conditions, and temperature conditions up to and including design-basis conditions. The Acceptance Criteria for this ITAAC specifies that a report exists and concludes that the pumps identified in the applicable ITAAC table perform their safety functions under expected ranges of fluid flow, pump head, electrical conditions, and temperature conditions up to and including the design-basis conditions.

   (1) If the APR1400 DC applicant prefers not to specify the functional capability qualification process for safety-related pumps as Tier 2* information in APR1400 DCD Tier 2, Chapter 3, "Design of Structures, Systems, and Components, and Equipment," the Acceptance Criteria for the SI pump functional capability qualification ITAAC should specify the completion of the Functional Qualification and Application Report prepared in conformance to the American Society of Mechanical Engineers (ASME) Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," as accepted in NRC Regulatory Guide (RG) 1.100, Revision 3, "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants."

   (2) The NRC staff considers the SI pump functional capability qualification ITAAC 2.4.3.9.b.i in the APR1400 DCD Tier 1 to be consistent with the standardized ITAAC for pump functional capability qualification with one exception. Consistent with QME-1-2007, as required in DCD Tier 2 Section 3.9.3.3, the staff requests that the APR1400 DC applicant revise the SI pump functional capability qualification ITAAC to include the phrase "with debris-laden fluids" following "temperature conditions" in the Design Commitment, ITA, and Acceptance Criteria to provide assurance that the qualification of

the SI pumps will address this performance capability for adverse fluid conditions following a loss of coolant accident.

(3) In the APR1400 DCD Tier 1, ITAAC 2.4.4-9.c.i and ITAAC 2.11.2.13 address the functional capability qualification of pumps in the Shutdown Cooling System (SCS) and Containment Spray System (CSS), respectively, similar to the SI pump functional capability qualification ITAAC. However, several sections in the APR1400 DCD Tier 1 do not appear to include ITAAC for pump functional capability qualification, such as Section 2.4.6 for the Chemical and Volume Control System (CVCS), Section 2.7.1.5 for the Auxiliary Feedwater System (AFWS), Section 2.7.2.1 for the Essential Service Water System (ESWS), Section 2.7.2.2 for the Component Cooling Water System (CCWS), Section 2.7.2.3 for the Essential Chilled Water System (ECWS), and Section 2.7.4.3 for the Spent Fuel Pool Cooling and Cleanup System (SFPCCS). Therefore, the NRC staff requests that the APR1400 DC applicant update or include (as appropriate) ITAAC for pump functional capability qualification in the applicable sections of the APR1400 DCD Tier 1 to be consistent with the SI pump functional capability qualification ITAAC as addressed in the above two paragraphs.

b. Regarding valve functional capability qualification, ITAAC 2.4.3.7.a.i in the APR1400 DCD Tier 1 for the SI valves specifies in the Design Commitment that motor-operated valves (MOVs), solenoid-operated valves (SOVs), air-operated valves (AOVs), and check valves in the applicable ITAAC table perform an active safety function to change position as indicated in the table. The ITA for this ITAAC specifies that tests or type tests of the MOVs, SOVs, and AOVs will be performed that demonstrate the capability of the valve to operate under their design conditions. The Acceptance Criteria for this ITAAC specifies that a test report exists and concludes that each MOV, SOV, and AOV changes position as indicated in the applicable ITAAC table under design conditions.

(1) The SI valve functional capability qualification ITAAC 2.4.3.7.a.i in the APR1400 DCD Tier 1 does not demonstrate the functional capability qualification of the SI valves over their full range of operating conditions with applicable fluid conditions. Therefore, the NRC staff requests that the APR1400 DC applicant modify the SI valve functional capability qualification ITAAC to be consistent with the standardized ITAAC for valve functional capability qualification. In particular, the Design Commitment should specify that the SI valves identified in the applicable ITAAC table will be functionally designed and qualified to perform their safety-related function for the full range of fluid flow, differential pressure, electrical conditions, and temperature conditions with debris-laden coolant fluids up to and including design-basis accident conditions. The ITA should specify that a type test or a combination of type test and analysis will be performed for the valves listed in the applicable ITAAC table. The Acceptance Criteria should specify that a report exists and concludes that the system's safety-related valves listed in the ITAAC table are capable of performing their safety-related functions under the full range of fluid flow, differential pressure, electrical conditions, and temperature conditions with debris-laden coolant fluids up to and including design-basis accident conditions. If the APR1400 DC applicant prefers not to specify functional capability qualification of safety-related valves as Tier 2* information in APR1400 DCD Tier 2, Chapter 3, the Acceptance Criteria for the SI valve functional capability qualification ITAAC should specify the completion of the Functional Qualification and Application Report prepared in conformance to the ASME Standard QME-1-2007 as accepted in RG 1.100, Revision 3.

(2) In the APR1400 DCD Tier 1, the APR1400 DC applicant proposes ITAAC to demonstrate the functional capability qualification of valves in various APR1400 fluid systems, such as ITAAC 2.4.1.7.a.i (Reactor Coolant System [RCS]), 2.4.2.7.a.i (In-containment Water Storage System [IWSS]), 2.4.3.7.a.i (SI System), 2.4.4.7.a.i (SCS), 2.4.5.7.a.i (Reactor Coolant Gas Vent System [RCGVS]), 2.4.6.7.a.i (CVCS), 2.7.1.2.7.a.i (Main Steam System [MSS]), 2.7.1.4.7.a.i (Condensate and Feedwater System), 2.7.1.5.7.a.i (AFWS), 2.7.1.5.7.b.i (AFWS), 2.7.1.8.7.a.i (Steam Generator Blowdown System [SGBS]), 2.7.2.1.7.a.i (ESWS), 2.7.2.2.7.a.i (CCW System), 2.7.2.3.7.a.i (ECWS), 2.7.2.5.6.a.i (Equipment and Floor Drainage System [EDF]), 2.7.2.6.7.a.i (Process and Post-Accident Sampling System), 2.11.2.7.a.i (CSS), and 2.11.3.7.a.i (Containment Isolation System [CIS]). Similar to the discussion above regarding the SI valve functional capability qualification ITAAC, the ITAAC for the other APR1400 systems do not demonstrate the functional capability qualification of the applicable valves in those systems over their full range of operating conditions with applicable fluid conditions. In addition, the ITA language in ITAAC 2.7.2.5.6.a.i for the EFDS that “MOV and AOV will be performed that demonstrate the capability of the valve to operate under its design conditions” is not clear. Therefore, the NRC staff requests that the APR1400 DC applicant update the ITAAC for valve functional capability qualification in the applicable sections of the APR1400 DCD Tier 1 as addressed in the above paragraph.

c. Regarding pump net positive suction head (NPSH) verification, APR1400 DCD Tier 1, Section 2.4.6, “Chemical and Volume Control System,” does not appear to include an ITAAC for CVCS pump NPSH verification. The NRC staff requests that that the APR1400 DC applicant include a CVCS pump NPSH verification ITAAC in APR1400 DCD Tier 1, Section 2.4.6. For example, the Design Commitment should specify that the CVCS safety-related pumps have an NPSH available (NPSHA) that is greater than or equal to their NPSH required (NPSHR). The ITA should specify that a test will be performed of the CVCS safety-related pumps. The Acceptance Criteria should specify that each CVCS safety-related pump listed in the ITAAC table has an NPSHA that is greater than or equal to the NPSHR while the system is aligned in an emergency operating lineup.

d. Regarding valve preoperational testing, ITAAC 2.4.3.7.a.ii for the SI valves in the APR1400 DCD Tier 1 specifies in the Design Commitment that MOVs, SOVs, AOVs, and check valves in the applicable ITAAC table for the SI system perform an active safety function to change position as indicated in the table. The ITA specifies that tests and/or analyses of the as-built MOVs, SOVs and AOVs will be performed under preoperational flow, differential pressure, and temperature conditions. The Acceptance Criteria specifies that upon receipt of the actuating signal, each as-built MOV, SOV or AOV changes position as indicated in the ITAAC table under preoperational test conditions.

(1) The SI valve preoperational test ITAAC 2.4.3.7.a.ii in the APR1400 DCD Tier 1 does not demonstrate that the as-built SI valves will perform their safety functions over their full range of operating conditions, and incorrectly allows either testing or analysis for preoperational verification. Therefore, the NRC staff requests that the APR1400 DC applicant modify the SI valve preoperational test ITAAC to be consistent with the standardized ITAAC for valve preoperational testing. In particular, the Design Commitment should specify that the SI valves change position under design-basis temperature, differential pressure, and flow conditions. The ITA should specify that a diagnostic stroke test will be performed of the SI valves under preoperational temperature, differential pressure, and flow conditions. The Acceptance Criteria should

specify that each SI safety-related valve listed in the ITAAC table strokes fully open and fully closed by remote operation (or manual operation if a manually operated valve) under preoperational temperature, differential pressure, and flow conditions with sufficient diagnostic data to correlate valve performance to its design-basis capability as established by the type test performed in accordance with the applicable valve functional capability qualification ITAAC.

(2) In the APR 1400 DCD Tier 1, the APR1400 DC applicant proposes ITAAC for preoperational testing of valves in various APR1400 fluid systems, such as ITAAC 2.4.1.7.a.ii (RCS), 2.4.2.7.a.ii (IWSS), 2.4.3.7.a.ii (SI System), 2.4.4.7.a.ii (SCS), 2.4.5.7.a.ii (RCGVS), 2.4.6.7.a.ii (CVCS), 2.7.1.2.7.a.ii (MSS), 2.7.1.4.7.a.ii (Condensate and Feedwater System), 2.7.1.5.7.a.ii (AFWS), 2.7.1.5.7.b.ii (AFWS), 2.7.1.8.7.a.ii (SGBS), 2.7.2.1.7.a.ii (ESWS), 2.7.2.2.7.a.ii (CCWS), 2.7.2.3.7.a.ii (ECWS), 2.7.2.5.6.a.ii (EDF System), 2.7.2.6.7.a.ii (Process and Post-Accident Sampling System), 2.11.2.7.a.ii (CSS), and 2.11.3.7.a.ii (CIS). Similar to the discussion above regarding the SI valve preoperational test ITAAC, the ITAAC for the other APR1400 systems do not specify preoperational testing to demonstrate that the applicable valves will perform their safety functions over their full range of operating conditions, and incorrectly allows either testing or analysis for preoperational verification. Therefore, the NRC staff requests that the APR1400 DC applicant update the ITAAC for valve preoperational testing in the applicable sections of the APR1400 DCD Tier 1 as addressed in the above paragraph.