KHNPDCDRAIsPEm Resource

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Sent:	Friday, August 07, 2015 5:29 PM
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Subject:	APR1400 Design Certification Application RAI 136-8081 (4.6 - Functional Design of Control Rod Drive System)
Attachments:	APR1400 DC RAI 136 SRSB 8081.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 136-8081

Issue Date: 08/07/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 04.06 - Functional Design of Control Rod Drive System
Application Section:

QUESTIONS

04.06-1

10 CFR 52.47(b)(1) requires that a DC application contain the proposed ITAAC necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and should operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations. Standard Review Plan (SRP) Section 14.3, “Inspections, Tests, Analyses, and Acceptance Criteria,” provides ways to comply with 10 CFR 52.47(b)(1) and states that Tier 1 information should be clear and consistent with Tier 2 information.

DCD Tier 1, Table 2.4.1-2, “Reactor Coolant System Components List,” indicates that the CEDMs are qualified for a harsh environment. However, in DCD Tier 2, Table 3.11-3, “Equipment Qualification Equipment List,” the environmental condition listed for the CEDM is “N/A.”

Please address this inconsistency between the Tier 1 and Tier 2 information, and update the DCD accordingly.

04.06-2

GDC 26, “Reactivity Control System Redundancy and Capability,” requires two independent reactivity control systems of different design principles that are capable of reliably controlling reactivity changes during normal operation. The control rod drive system (CRDS) is one of those systems, and the areas of review under SRP Section 4.6, “Functional Design of Control Rod Drive System,” include functional tests for the CRDS and ensuring that the CRDS cooling system meets design requirements.

In addition, 10 CFR 50.34(b)(6)(iii) requires an applicant to provide plans for preoperational testing, and SRP Section 14.2, “Initial Test Program – Design Certification and New License Applicants,” provides guidance for this area of review. SRP Section 14.2 states that the applicant should provide test abstracts of SSCs and unique design features, including tests and acceptance criteria.

a. In a number of instances in the DCD Tier 2, Chapter 14 preoperational tests related to the CRDS, the acceptance criteria are not sufficient to ensure adequacy of the test results. These include:

    1. The acceptance criteria for the digital rod control system test in Subsection 14.2.12.1.27 point to DCD Tier 2, Subsections 4.6.1 and 4.6.2. However, these subsections do not provide specific acceptance criteria for DRCS performance.

2. The CEDM cooling system test described in Subsection 14.2.12.1.36 requires verification of system airflow and the proper operation of interlocks and alarms, and the acceptance criterion is that the system performs as described in DCD Tier 2, Subsection 9.4.6.2.1.3. However, Subsection 9.4.6.2.1.3 does not specify the required system airflow rate or the system interlocks and alarms.

3. Part of the test method in Subsection 14.2.12.1.54, "Pre-Core Control Element Drive Mechanism Performance Test," is balancing the CEDM cooling system as required to maintain the coil temperatures within the specified limits. The acceptance criteria reference DCD Tier 2 Subsection 7.7.1.1 a., but staff cannot find the coil temperatures there or in other portions of the DCD.

4. In Subsection 14.2.12.2.4, "Post-Core Control Element Drive Mechanism Performance," one acceptance criterion is that insertion and withdrawal times meet design requirements. It is unclear where these required insertion and withdrawal times are located.

For each of the above concerns, please either (1) provide the testing requirements and acceptance criteria in the DCD Tier 2 subsections referenced in the acceptance criteria for the associated test or (2) provide the specific test acceptance criteria for each test method in the Chapter 14 test description. If determination of any of the acceptance criteria is the responsibility of a COL applicant, please identify this in the DCD as appropriate.

b. In addition, in Subsection 14.2.12.2.4, some aspects of Part 4.0, "Data Required," are unclear or seem to be missing based on other parts of the subsection. These include:

1. Does Point 4.2, "RCS temperature and pressure to be taken during measurement and recording of drop time for each CEA," mean that, for each measurement, the RCS temperature and pressure are recorded in addition to rod drop time for that corresponding temperature and pressure?

2. Parts 3.0 and 5.0, "Test Method" and "Acceptance Criteria," indicate that CEA insertion and withdrawal times are examined, yet they aren't listed in "Data Required."

3. Part 2.0, "Prerequisites," says that CEDM coil resistance has been measured. Should the resistance be part of "Data Required"?

Please update DCD Subsection 14.2.12.2.4 to clarify the points described above.

04.06-3

GDC 25, "Reactivity Control System Redundancy and Capability," requires, in pertinent part, that the reactivity control system using control rods shall be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as stuck rods, specified acceptable fuel design limits are not exceeded. SRP Section 4.6 states that the test program for the CRDS should include experimental verification of system operation where a single failure (e.g., stuck rod) has been assumed.

However, the staff could not find such experimental verification in the CRDS test descriptions. Please address how system operation is experimentally verified in the event of a single failure, and update the test descriptions in the DCD appropriately.

04.06-4

GDC 26, “Reactivity Control System Redundancy and Capability,” requires two independent reactivity control systems of different design principles to be provided, each of which should be capable of controlling reactivity changes under normal operation. GDC 27, “Combined Reactivity Control Systems Capability,” requires that the combined capability of the reactivity control systems, in conjunction with poison addition by the emergency core cooling system, can reliably control reactivity changes to assure that the capability to cool the core is maintained under postulated accident conditions.

Subsection 4.6.5 of the DCD states that the CVCS is not required but is designed for a high degree of redundancy and reliability. However, DCD Tier 2, Section 4.6 does not expand on how the CVCS or the other reactivity control systems provided in the APR1400 design contribute to the redundancy and capability of controlling reactivity changes required by GDC 26. Please clarify how the function of these systems provides redundancy in reactivity control, and include this information in DCD Tier 2, Section 4.6.

04.06-5

GDC 26, “Reactivity Control System Redundancy and Capability,” and 27, “Combined Reactivity Control Systems Capability,” require, in pertinent part, the redundant reactivity control systems to be capable of reliably controlling reactivity changes. SRP Section 15.0, “Introduction - Transient and Accident Analyses,” states that the applicant should specify only safety-related systems or components for use in mitigating anticipated operational occurrences and postulated accident conditions.

Subsection 4.6.4 of the DCD states that Table 4.6-1 lists all the design basis events (DBEs) analyzed in Chapter 15 that take credit for two or more reactivity control systems for preventing or mitigating each event. As shown in Table 4.6-1, the chemical and volume control system (CVCS) does not appear to be credited for any DBEs, nor should it be per the statement in Chapter 15 that only safety-related systems are credited in the APR1400 safety analyses. Therefore, it is unclear why Subsection 4.6.4 discusses crediting more than two reactivity control systems. Please explain this statement, and make any necessary corrections to it in DCD Subsection 4.6.4.

04.06-6

GDC 27, “Combined Reactivity Control Systems Capability,” requires that the combined capability of the reactivity control systems, in conjunction with poison addition by the emergency core cooling system, can reliably control reactivity changes to assure that the capability to cool the core is maintained under postulated accident conditions. Evaluation of the combined functional performance of the reactivity systems under accident conditions is performed under SRP Section 4.6.

Subsection 4.6.5 of the DCD suggests that two DBEs assume the availability of two reactivity control systems to prevent or mitigate the accident: steam line break (SLB) and control element assembly (CEA) ejection. However, this is not consistent with Table 4.6-1, which shows that feedwater line break (FLB), loss-of-coolant accident (LOCA), letdown line break (LDLB), and steam generator tube rupture (SGTR) also assume availability of two reactivity control systems. Furthermore, some of the required reactivity control systems for the DBEs listed in Table 4.6-1 appear to be inconsistent with the Chapter 15 analyses. In particular, the FLB, LDLB, and CEA ejection are shown in Table 4.6-1 to require use of the SIS to mitigate the events. However, Chapter 15 analyses do not mention SIS actuation for these three events.

Please explain these apparent inconsistencies and update the DCD as appropriate to ensure that the information presented in Subsection 4.6.5, Table 4.6-1, and the Chapter 15 analyses is consistent.

04.06-7

GDC 28, “Reactivity Limits,” requires the reactivity control systems to be designed with appropriate limits on the potential amount and rate of reactivity increase to assure that the effects of postulated reactivity accidents can neither result in damage to the reactor coolant boundary nor disturb the core and its support structures to impair significantly the capability to cool the core.

DCD Tier 2, Section 4.6 does not address how the reactivity control systems meet GDC 28. Please indicate how GDC 28 is met, and update DCD Tier 2, Section 4.6 accordingly.