KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Tuesday, November 10, 2015 7:26 AM
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Cc: Truong, Tung; Jackson, Terry; Ward, William; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 301-8280 (07.01 - Instrumentation and Controls - Introduction)
Attachments: APR1400 DC RAI 301 ICE 8280.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. However, KHNP requests, and we grant, the following response time for the RAI questions. We may adjust the schedule accordingly.

07.01-41: 90 days
07.01-42: 30 days
07.01-43: 30 days
07.01-44: 60 days
07.01-45: 30 days
07.01-46: 30 days
07.01-47: 45 days
07.01-48: 90 days
07.01-49: 90 days
07.01-50: 90 days
07.01-51: 90 days
07.01-52: 90 days

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

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REQUEST FOR ADDITIONAL INFORMATION 301-8280

Issue Date: 11/10/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 07.01 - Instrumentation and Controls - Introduction
Application Section:

QUESTIONS

07.01-41
The staff reviewed the response to RAI 34-7870, Question 7.1-1 and found that additional information was needed as described below.

10 CFR 50.36(c)(1)(ii)(A) states, in part, “Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded.” Technical Report (TeR) APR1400-Z-J-NR-14005-P, Rev.0, “Setpoint Methodology for Plant Protection System,” describes the setpoint methodology applied to the Plant Protection System (PPS) and Diverse Protection System (DPS) for the APR1400 and states conformance to BTP 7-12, Regulatory Guide 1.105 - Rev.3, and Regulatory Issue Summary (RIS) 2006-17.

For Question 7.1-1, the staff requested clarification regarding the relationships among the following items: analytical limit (AL), allowable value (AV), trip setpoint (TSP), and Draft TSP (DTSP). The applicant responded by proposing to update the TeR to correct an error in a reference to the DTSP and by stating "the AV is less conservative than the TSP by an offset which is greater than the PPS cabinet periodic test error." Since this response adequately clarified the observed inconsistency in the TeR's use of the terms AL, DTSP, TSP, AV, and PPS Cabinet Periodic Test Error, this portion of the request for clarification is resolved.

In Question 7.1-1, the staff also asked about the relationships among the DTSP, AV, and PPS Cabinet Periodic Test Error in light of the statement made in TeR APR1400-Z-J-NR-14005, Section 2.3.2.6, "PPS Cabinet Periodic Test Error for ARP1400 is not applicable since the [bistable?] processor module error and measurement test error are negligible." The applicant responded by stating that the "Periodic Test Error Band, as shown in Figure 1, is divided into individual periodic test acceptance criteria for the transmitter, APC-S, and PPS cabinet as described in Sections 2.3.2.2 and 2.3.3.5 of the TeR." Where in the TeR does the TeR describe that the periodic test error band depicted in Figure 1 consists of a transmitter periodic test error band, an APC-S periodic test error band, and a PPS cabinet periodic test error band? If this information is not explicitly provided in the TeR, then update the TeR with this new information and ensure the TeR clearly illustrates how these three error bands are combined in the DTSP calculation. The applicant also responded by stating that "When the PPS Cabinet Periodic Test Error is zero, the PPS Cabinet Periodic Test Error Band that is one of the Periodic Test Error Band[s] in Figure 1 will also be zero. Therefore, the upper limit of the PPS Cabinet Periodic Test Error Band is not equivalent to the AV since the AV has an enough margin by an offset from the TSP. However, the transmitter and APC-S Periodic Test Error Bands, which are not related to AV, are only used to ensure that the TSP does not exceed the AL." The staff does not understand this response. The staff originally requested clarification on the effect on the DTSP, AV, and TSP of having a PPS Cabinet Periodic Test Error Band with a value of zero, which is still an outstanding request.

07.01-42
For flow information, why is it acceptable to derive flow information from reactor coolant pump speed, SG differential pressure, and reactor coolant temperature?

10 CFR 50.55a(h) requires compliance to IEEE Std 603-1991. Clause 6.4, "Derivation of System Inputs," of IEEE Std 603-1991 requires, in part, that sense and command feature inputs shall be derived from signals that are direct measures of the desired variables as specified in the design basis, when practical. In other words, minimize the number of variables or derivatives of direct measured variables and secondary calculations required to provide the required measurement. The staff used SRP Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std 603," as guidance for this area of the evaluation.

Technical Report, APR1400-Z-J-NR-14001, Revision 0, "Safety I&C System," Section A.6.4, states “in so far as is practicable, system inputs are derived from signals that are direct measures of the desired variables,” and that the “process variables and derived parameters used for the PPS actuation functions are set by the safety analysis.” Flow information is derived from reactor coolant pump speed measurement, SG differential pressure, and reactor coolant temperature. It is not clear to the staff why flow information is derived and not measured directly. Staff request applicant to provide rationale as to why it is acceptable to measure flow indirectly per Clause 6.4 of IEEE Std 603-1991.

07.01-43

Reconcile BTP 7-3, "Guidance on Protection System Trip Point Changes for Operation with Reactor Coolant Pumps Out of Service," conformance statements in APR1400 FSAR Tier 2, Table 1.9.2, "APR1400 Conformance with the Standard Review Plan," (sheet 15 of 33) with APR1400 FSAR Tier 2 Table 7.1-1, "Regulatory Requirements Applicability Matrix," Item 60, and Section 7.1.2.60, "Conformance with BTP 7-3."

10CFR 50.55a(h) requires compliance with IEEE Std 603-1991. Clause 6.8.2 of IEEE Std 603-1991 includes requirements that when a reactor operation requires a more restrictive setpoint, the means for ensuring the use of the more restrictive setpoint shall be positive and must meet the other requirements of IEEE Std. 603-1991. BTP 7-3 is an acceptable approach to satisfy the required automatic adjustment to more restrictive settings of trips affecting reactor safety per Clause 6.8.2 of IEEE Std 603-1991. APR1400 FSAR Tier 2, Table 1.9.2, states conformance to BTP 7-3, but FSAR Table 7.1-1 and Section 7.1.2.60 states BTP 7-3 is not applicable because “the reactor is not permitted to operate with reactor coolant pump out of service. The PPS trips the reactor by low reactor coolant flow. Therefore, BTP 7-3 is not applicable.” Staff requests applicant to reconcile the conformance statements and update the FSAR accordingly.

07.01-44

Identify an ITAAC to verify the referenced Common Q platform is installed in according with the approved topical report, and to identify any modifications or changes to the Common Q platform design, processes, hardware, and software.

10 CFR Part 50, Appendix A, GDC 1, require structures, systems, and components to be designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function to be performed. Section 8 of Technical Report APR1400-Z-J-NR-14001-P, "Safety I&C System," Rev. 0, states "The safety I&C system is implemented on a common PLC platform using Common Q. The platform has been dedicated and qualified for nuclear power plants and accepted by NRC after reviewing Common Qualified Platform Topical Report, Revision 3. The platform is configured using various hardware building blocks and loaded with application software to develop safety I&C systems such as PPS, ESF-CCS, CPCS, and QIAS-P." The staff requests identification of an ITAAC that verifies the Common Q platform is installed in accordance with the approved Common Q topical report, and as necessary, provide corresponding updates to the APR1400 FSAR. The staff also requests details regarding any modifications to the Common Q platform design, processes, hardware, and software, since the Common Q topical report was approved by the staff.

07.01-45
Discuss how using one-sided tolerance limit factor is consistent with Regulatory Guide 1.105, "Setpoints for Safety-Related Instrumentation," Revision 3.

10 CFR 50.36(c)(1)(ii)(A) states, in part, “Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded.” Technical Report APR1400-F-C-NR-14001, Rev. 0, “CPC Setpoint Analysis Methodology for APR1400,” describes "Core Protection Calculator (CPC) setpoint analysis methodology for APR1400. The methodology is applied by combining uncertainties involved in the determination of the Local Power Density (LPD) and Departure from the Nucleate Boiling Ratio (DNBR) Limiting Safety System Settings (LSSS). The overall uncertainty factors assigned to LPD and DNBR establish that the adjusted LPD and DNBR are conservative at a 95/95 (probability/confidence) level throughout the core cycle, with respect to actual core conditions."

Section 2.1.3, "LPD LSSS statistical methods," of the CPC Setpoint Analysis Methodology Technical Report, states for Equations 2.3 and 2.5 state a normal distribution confidence coefficient of 1.645 for 95% confidence. It is not clear to the staff why these coefficients are consistent with the 95/95 tolerance limit discussion in Regulatory Guide 1.105, Rev. 3, which the staff interprets the limit to correspond to an error distribution approximately equal to two sigma value, 1.96, and not 1.645 as stated in the Technical Report APR1400-F-C-NR-14001. Provide the basis for using this factor with respect to Regulatory Guide 1.105, Revision 3.

07.01-46
Clarify the hot leg temperature and division description in Table 7.5-1, Accident Monitoring Instrumentation Variables," and describe the geometry of the installed hot leg sensors.

10 CFR 50.55a(h) requires compliance to IEEE Std 603-1991. Clause 4.6 of IEEE Std. 603-1991 requires identification of the minimum number and location of sensors for spatially-dependent process variables. Section A.4 of Technical Report APR1400-Z-J-NR-14001-P states “The number and location of the sensors provided to monitor those variables in Item 4 are given in Tables 7.2-3 ["Reactor Protection System Sensors"] and 7.3-4 ["ESFAS Sensors"] of the DCD. The location of precision RTD for measuring RCS hot leg temperature is assigned to measure appropriate coolant transmission effects by temperature difference and temperature distribution of hot leg.” Table 7.2-3 of APR1400 FSAR Tier 2 states there are eight precision RTDs in the hot leg piping which is used by the CPCS for generating high LPD and low DNBR trips. Table 7.5-1 of FSAR Tier 2 states Reactor Coolant Hot Leg Temperature (Wide Range) is a 4 channel, Type B Accident Monitoring Instrumentation Variable, and there are 2 Hot Leg signals per division (QIAS-P). It is not clear to the staff what is meant by "2 Hot Leg signals per division (QIAS-P)" since there are only 2 QIAS-P divisions. Also, provide a diagram of the geometry of the installed hot leg sensors.

07.01-47
Discuss the equipment protective functions for safety-related plant equipment.

10CFR 50.55a(h) requires compliance with IEEE Std 603-1991. Clause 4.11 of IEEE Std. 603-1991 requires identification of the equipment protective provisions that prevent the safety systems from accomplishing their safety functions. ITem 11 of Section A.4, "Safety System Designation," of Technical Report APR1400-Z-J-NR-14001 states "there is no equipment protective provisions that prevent the safety systems from accomplishing their safety functions" but did not discuss the equipment protective

functions. Typically, nuclear power plant actuators have equipment protective functions, such as overcurrent protection, thermal overload protection, and emergency diesel generator protective features; some of which could cause the equipment to trip even in the presence of a safety actuation signal. Discuss the protective functions for safety-related equipment and describe whether these protective functions could trip/disable the safety-related equipment in the presence of a safety actuation signal or why it could not trip/disable safety-related equipment in the presence of a safety actuation signal.

07.01-48

The staff reviewed the response to RAI 34-7870, Question 7.1-2 and found that additional information was needed as described below.

10 CFR 50.36(c)(1)(ii)(A) states, in part, “Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded.” Technical Report (TeR) APR1400-Z-J-NR-14005, Rev.0, “Setpoint Methodology for Plant Protection System,” describes the setpoint methodology applied to the Plant Protection System (PPS) and Diverse Protection System (DPS) for the APR1400 and states conformance to BTP 7-12, Regulatory Guide 1.105 - Rev.3, and Regulatory Issue Summary (RIS) 2006-17.

For Question 7.1-2, the staff requested clarification on the as-left limit and as-found limit of the five-point calibration of the instrument transmitter and how these limits relate to the TSP as-left limit and as-found limit. The applicant responded by stating, "The as-left limits of instrument transmitters are assigned to include the reference accuracy, power supply effect, and measurement and test error (M&TE) as described in Section 2.3.2.1 of TeR APR1400-Z-J-NR-14005-P, Rev.0. Then, the Square-Root-Sum-of-Squares (SRSS) combination will describe the tolerance to the five-point calibration for as-left limits which is implemented by the utility. Regarding the as-found limits, the drift, temperature effect, and radiation effect will be additionally included into the limits as described in Section 2.3.2.2 of the TeR. Calibration Error Band (as-left limit) illustrated in Figure 1 is composed of individual calibration acceptance criteria for the transmitter, auxiliary process cabinet – safety (APC-S), and PPS cabinet as described in Sections 2.3.2.1 and 2.3.2.4 of the TeR. Periodic Test Error Band (as found limit) in Figure 1 also includes individual periodic test acceptance criteria for the transmitter, APC-S, and PPS cabinet, as described in Sections 2.3.2.2 and 2.3.2.5 of the TeR. Calibration Error Band (as-left limit) illustrated in Figure 1 is composed of individual calibration acceptance criteria for the transmitter, auxiliary process cabinet – safety (APC-S), and PPS cabinet as described in Sections 2.3.2.1 and 2.3.2.4 of the TeR. Periodic Test Error Band (as found limit) in Figure 1 also includes individual periodic test acceptance criteria for the transmitter, APC-S, and PPS cabinet, as described in Sections 2.3.2.2 and 2.3.2.5 of the TeR. The as-left and as-found data of transmitter, APC-S, and PPS cabinet are required to be maintained appropriately within the corresponding Calibration Error Band and Periodic Test Error Band in order to ensure that the TSP does not exceed the Analytical Limit (AL) assumed in performing the safety analysis. The specific SRSS combination methods for the individual Calibration Error and Periodic Test Error Band for each trip parameter are described in appendices of the TeR. Therefore, there is no plan to revise TeR APR1400-Z-J-NR-14005-P, Rev.0, as referenced in Section 7.2.5, Item 14 of APR1400 DCD Tier 2, since the individual Calibration Error Band and Periodic Test Error Band are explained in Sections 2.3.2.1, 2.3.2.2, 2.3.2.4, and 2.3.2.5 and the detailed SRSS combination methods are described in appendices of the TeR."

The staff does not agree that the TeR adequately describes and explains the use of the individual Calibration Error Band and Periodic Test Error Band, for the transmitter, APC-S, and PPS Cabinet. Staff requests the applicant to clearly describe these error bands so staff can properly understand the relationship among DTSP, AV, TSP, as-left limit, and as-found limit.

07.01-49

The staff reviewed the response to RAI 34-7870, Question 7.1-3 and found that additional information was needed as described below.

10 CFR 50.36(c)(1)(ii)(A) states, in part, “Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded.” Technical Report (TeR) APR1400-Z-J-NR-14005, Rev.0, “Setpoint Methodology for Plant Protection System,” describes the setpoint methodology applied to the Plant Protection System (PPS) and Diverse Protection System (DPS) for the APR1400 and states conformance to BTP 7-12, Regulatory Guide 1.105 - Rev.3, and Regulatory Issue Summary (RIS) 2006-17.

For Question 7.1-3, the staff requested a description on how the change in measured TSP will be verified to be within predefined limits (double-sided acceptance criteria band) and the appropriate actions to be taken if the change is outside these limits per RIS 2006-17. The applicant responded by quoting Section 2.1 of TeR, "The calibration error band serves as an error limit during a periodic test...If the reading is outside of the periodic test error band, the instrumentation is not behaving as expected. The source of anomaly and the possibility of exceeding the AV should be investigated...." In the TeR, a description was provided for the scenario where the as-found TSP is not conservative with respect to the AV and the appropriate actions taken to address guidance in RIS 2006-17. However, it is not clear to the staff what appropriate actions are to be taken in scenario where the measured TSP value is outside the predefined limits (as-found tolerance band of the trip setting value) but is conservative with respect to the AV, or is conservative with respect to the as-left value of the trip setting at the beginning of a Channel Calibration surveillance interval, as described in RIS 2006-17. The staff requests that the applicant describe what appropriate actions are to be taken in case the measured TSP value is outside the predefined limits, that is, the double-sided (as-found) acceptance criteria band as described in RIS 2006-17.

07.01-50

The staff reviewed the response to RAI 34-7870, Question 7.1-4 and found that additional information was needed as described below.

10 CFR 50.36(c)(1)(ii)(A) states, in part, “Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded.” Technical Report (TeR) APR1400-Z-J-NR-14005, Rev.0, “Setpoint Methodology for Plant Protection System,” describes the setpoint methodology applied to the Plant Protection System (PPS) and Diverse Protection System (DPS) for the APR1400 and states conformance to BTP 7-12, Regulatory Guide 1.105 - Rev.3, and Regulatory Issue Summary (RIS) 2006-17.

For Question 7.1-4, the staff requested a description on how the offset between the final TSP and the AV is determined and to clarify the relationship between the terms margin and offset. The applicant responded by stating, "In order to reduce the possibility of a license event report, the final TSP would be offset from the AV by about 0.5 percent of span that is applied for the Korean nuclear power plants in service. The offset used...is based on engineering judgement...the offset is greater than the PPS cabinet periodic test error...this approach does not affect the safety aspect since the final TSP is moved in the conservative direction by reducing the plant operating margin." Although the applicant's response provided new information, the applicant did not propose to update the FSAR (DCD Tier 2) or the TeR with

this information. Regarding the new information, the applicant is requested to provide a technical basis as to why a 0.5 percent of span provides adequate margin between the TSP and the AV for all specified automatic reactor trip and safety system actuation instrumentation functions. The applicant is also requested to add a description of the basis or rationale for the stated offset value to the APR1400 FSAR Tier 2 or to the TeR.

07.01-51

The staff reviewed the responses to RAI 34-7870, Questions 7.1-1 through 7.1-5, and 7.1-9, and found that additional information was needed as described below.

10 CFR 50.36(c)(1)(ii)(A) states, in part, “Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded.” Technical Report (TeR) APR1400-Z-J-NR-14005, Rev.0, “Setpoint Methodology for Plant Protection System,” describes the setpoint methodology applied to the Plant Protection System (PPS) and Diverse Protection System (DPS) for the APR1400 and states conformance to BTP 7-12, Regulatory Guide 1.105 - Rev.3, and Regulatory Issue Summary (RIS) 2006-17.

For Question 7.1-5, the staff for identification of the Limiting Safety System Settings (LSSS) for the APR1400. The applicant responded by proposing to modify TeR Section 2.5.1 to say, "The LSSS, which is maintained in the TS, establishes the AV." Per Regulatory Guide 1.105, the allowable value (AV) is the limiting value that the trip setpoint can have when tested periodically, beyond which the instrument channel is considered inoperable and correction action must be taken in accordance with the technical specifications. The TeR states that the "AV is less conservative than the TSP by an offset which is greater than the PPS cabinet periodic test error...the PPS cabinet periodic test error is not applicable since there is no calibration associated with the PPS cabinet." Based on these statements, the staff understands that the AV is less conservative than the TSP by an offset that is greater than zero. TeR Section 2.3.2.2 discusses measurement channel periodic test error (equipment drift) for the transmitter and APC-S. What is the rationale for not including these two individual periodic test errors in the AV determination/calculation? The applicant is requested to explain why the proposed offset (0.5 percent of span), as described in the applicant's response to Question 7.1-4, provides an adequate margin to ensure that automatic protective action will correct an abnormal siutation before a safety limit is exceeded per Regulatory Guide 1.105.

07.01-52

The staff reviewed the response to RAI 34-7870, Question 7.1-9 and found that additional information was needed as described below.

10 CFR 50.36(c)(1)(ii)(A) states, in part, “Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded.” Technical Report (TeR) APR1400-Z-J-NR-14005, Rev.0, “Setpoint Methodology for Plant Protection System,” describes the setpoint methodology applied to the Plant Protection System (PPS) and Diverse Protection System (DPS) for the APR1400 and states conformance to BTP 7-12, Regulatory Guide 1.105 - Rev.3, and Regulatory Issue Summary (RIS) 2006-17.

For Question 7.1-9, staff requested a description on when reset setpoints would be used for reactor trip functions and the basis for manually changing the setpoint value. Also, describe how the new "fixed value" setpoint is determined and how this new setpoint is consistent with the more restrictive setpoint. The applicant responded by stating that "the low pressurizer pressure trip is provided to trip the

reactor when the measured pressurizer pressure falls to a low preset value. At pressures below the normal operating range, this setpoint can be manually decreased to a fixed increment below the existing pressurizer pressure down to a minimum value. The incremental and minimum values are given in Table 7.2-4. This provides the capability to trip the reactor when required during plant cooldown." The section also states, "The low SG pressure trip is provided to trip the reactor when the measured SG pressure falls below a preset value. At SG pressure below normal, the setpoint can be manually decreased to a fixed increment below the existing system pressure. This is used during plant cooldown. The fixed increment is provided in Table 7.2-4." Regarding the "fixed value" APR1400 FSAR Tier 2, Chapter 7, Table 7.2-4 (2 of 2), Note (4), states, "Setpoint can be manually decreased to a fixed increment below existing pressure as pressure is reduced during controlled plant cooldown and is automatically increased as pressure is increased maintaining a fixed increment. This fixed increment is 28 kg/cm2 (400 psi) for pressurizer pressure and 14 kg/cm2 (200 psi) for steam generator pressure." The staff finds the response acceptable since applicant plans to use manual reduction of the setpoints for low pressurizer pressure and low SG pressure trips to shut down the plant without any unnecessary protective actions for plant cooldown. However, it is not clear to the staff if one Setpoint Reset switch on the Safety Console applies to both low pressurizer pressure and low SG pressure trips or if there are two switches, one for each manual reduction. Clarify the capability of the Setpoint Reset switch.


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