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.: **34-7870**

SRP Section: **07.01 – Instrumentation and Controls – Introduction**

Application Section: **07.01**

Date of RAI Issued: **06/16/2015**

Question No. 07.01-1

Clarify the relationships among Analytical Limit (AL), Allowable Value (AV), Trip Setpoint (TSP), and Draft TSP.

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 2006-17. Sections 2.1 and 2.5.3 of the TeR state, “The allowable value (AV) is less conservative than the TSP by the amount of the PPS cabinet periodic test error.” However, Figure 1 of the technical report, shows the difference between AV and TSP to be more than just the PPS Cabinet Periodic Test Error. Section 2.3.2.6 of the TeR states, “PPS Cabinet Periodic Test Error for APR1400 is not applicable since the processor module error and measurement test error are negligible.” If PPS Cabinet Periodic Test Error has no error, then Figure 1 implies that the AV and Draft TSP are equivalent? Also, would the upper limit of the Periodic Test Error Band be equivalent to the AV? Clarify the inconsistencies in the description of the relationships between the variables described above, and include appropriate modifications to the FSAR.

Response

As illustrated in Figure 1 of TeR APR1400-Z-J-NR-14005-P, Rev.0, the Draft Trip Setpoint (DTSP) is a more conservative value than the Analytical Limit (AL) by the amount of the total instrument channel uncertainty. The Allowable Value (AV) is less conservative than the DTSP by the amount of the PPS cabinet periodic test error. The TSP is a more conservative value

than the AV by the offset that is determined as a greater value than the PPS cabinet periodic test error.

In order to clarify the relationships among AL, AV, TSP, and DTSP, the term “TSP” in the statement of Section 2.1, “The allowable value (AV) is less conservative than the TSP by the amount of the PPS cabinet periodic test error,” will be changed to “DTSP” as shown in Attachment 1. Additionally, the statement described in Section 2.5.3, “The AV is less conservative than the TSP, by the amount of the PPS cabinet periodic test error,” will be changed to “The AV is less conservative than the TSP by an offset which is greater than the PPS cabinet periodic test error.” as shown in Attachment 2.

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. In order to ensure that the TSP does not exceed the AL, the individual periodic test results for the transmitter, APC-S, and PPS cabinet should be within the corresponding Periodic Test Error Band. In particular, the PPS cabinet Periodic Test Error Band is related to the AV since the PPS cabinet Periodic Test Error is used to determine the AV. If PPS Cabinet Periodic Test Error has no error, then Figure 1 implies that the AV and DTSP are equivalent. When the PPS Cabinet Periodic Test Error is zero, the PPS Cabinet Periodic Test Error Band that is one of Periodic Test Error Band 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 the AV, are only used to ensure that the TSP does not exceed the AL.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical/Environmental Reports

Technical Report APR1400-Z-J-NR-14005-P, Rev.0 will be revised as indicated in Attachments 1 and 2.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

2 SETPOINT METHODOLOGY

2.1 Basic Description

The PPS consists of the reactor protection system (RPS) and the engineered safety features actuation system (ESFAS).

The 13 reactor trip functions of RPS are as follows: high pressurizer pressure, low pressurizer pressure, low steam generator #1 level, low steam generator #2 level, high steam generator #1 level, high steam generator #2 level, low steam generator #1 pressure, low steam generator #2 pressure, high containment pressure, high variable overpower, high logarithmic power level, low reactor coolant flow–1, and low reactor coolant flow-2.

The 6 ESFAS signals are as follows: safety injection actuation signal (SIAS), containment isolation actuation signal (CIAS), containment spray actuation signal (CSAS), main steam isolation signal (MSIS), auxiliary feedwater actuation signal-1 (AFAS-1), and auxiliary feedwater actuation signal-2 (AFAS-2).

The DPS functions consist of the reactor-trip function and the engineered safety features (ESF) actuation function. The DPS logic uses 2 reactor-trip functions (high pressurizer pressure, and high containment pressure) and 3 ESF actuation functions (AFAS-1, AFAS-2, and SIAS).

Protective action is initiated when a process value exceeds a predetermined setpoint value, which is the trip setpoint (TSP). This TSP is established such that during design basis events (DBEs) the analytical limit (AL) is not exceeded. ALs are established such that safety limits (SLs) are not reached. SLs assure that unacceptable consequences do not occur during the DBE.

The relationship between nuclear safety-related setpoints is illustrated in Figure 1.

DTSP

The draft trip setpoint (DTSP) is a more conservative value than the AL by the amount of the total instrument channel uncertainty. The DTSP is synonymous with “limiting trip setpoint” as used in Reference 4.6. This uncertainty is the combination of all identified uncertainty elements. The allowable value (AV) is less conservative than the ~~TSP~~ by the amount of the PPS cabinet periodic test error. This uncertainty, already included conservatively in the TSP, accommodates the expected measurable equipment drift that could occur in a specified calibration interval. The final TSP is a more conservative value than the AV by the offset that is determined as a greater value than the PPS cabinet periodic test error to reduce the possibility of a licensee event report. The final TSP is synonymous with “nominal trip setpoint” as used in Reference 4.6.

The calibration error band serves as an error limit during a periodic test. If the instrument reading is within this tolerance band, no recalibration is necessary. If the instrument reading is outside the calibration error band, but within the periodic test error band, the channel segment is functioning as intended although recalibration is required. 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. Only the violation of the AV is a reportable incident.

3. Errors may have both random and non-random components. When this occurs, the notation A+A', B+B', C+C', …, N+N' is used to indicate the combination of the two error types.

2.4.11 Measurement Test Error

Measurement test error is taken twice in the calculation of periodic test error because it must be reapplied at the end of the test interval.

2.5 Setpoint Determination

2.5.1 Limiting Safety System Setting (LSSS)

Where an LSSS 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 (Reference 4.3). LSSS for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions.

The LSSS may be TSP, AV, or both according to Reference 4.1. The TSP is described in the DCD Sections 7.2 and 7.3 and the AV is required part of the TS.

2.5.2 Trip Setpoint

The TSP is established to provide the sufficient margin from the safety limit by adding/subtracting, in the conservative direction, the event-specific total instrument channel uncertainty to the corresponding AL. The most conservative event-specific value is then used as the TSP for a PPS function.

The high containment pressure TSP is determined by two methods. Starting from 0.0 cmH_2O, the lowest possible TSP is calculated that will not interfere with normal plant operation. This conforms to the containment isolation dependability requirements of NUREG-0737 (Reference 4.4). Starting from the AL, the highest possible TSP is calculated that will guarantee reactor trip and ESF actuation when required. The more conservative of the two values is chosen as the final TSP.

2.5.3 Allowable Value

The AV is less conservative than the TSP by an offset which is greater than the PPS cabinet periodic test error.

~~The AV is less conservative than the TSP, by the amount of the PPS cabinet periodic test error.~~ This uncertainty accommodates the maximum anticipated drift of the PPS cabinet equipment between calibrations. The TS requires that, if upon checking a setpoint, the value set in the PPS is less conservative than the AV, the channel must be declared inoperable until the PPS setpoint is reevaluated to a conservative value.

2.5.4 Drift Allowance

In general, the PPS cabinet periodic test error is very small. To prevent a licensee event report, the TSP is offset in a conservative direction from the calculated AV by a drift allowance that is greater than the PPS cabinet periodic test error. By calculating the TSP and AV in this manner, setpoint drifts that are inconsistent with the safety analysis are virtually eliminated. The TSP is also far enough away from the process, so spurious trips during normal operation are minimized.

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.: **34-7870**

SRP Section: **07.01 – Instrumentation and Controls – Introduction**

Application Section: **07.01**

Date of RAI Issued: **06/16/2015**

Question No. 07.01-2

Discuss the as-left limit and as-found limit of the five-point calibration (0%, 25%, 50%, 75%, 100% of the range) of the instrument transmitter and how these limits relate to the TSP, as-left limit, and as-found limit.

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.” TeR APR1400-Z-J-NR-14005-P, Rev.0, “Setpoint Methodology for Plant Protection System,” describes the setpoint methodology applied to the PPS and DPS for the APR1400 and states conformance to BTP 7-12, Regulatory Guide 1.105, Rev.3, and Regulatory Issue Summary 2006-17. In Figure 1 of the TeR depicts the relationship among the Calibration Error Band (as-left limit), Periodic Test Error Band (as-found limit), and the Trip Setpoint. The staff requests applicant to discuss the as-left limit and as-found limit of the five-point calibration (0%, 25%, 50%, 75%, 100% of the range) of the instrument transmitter, and how these limits relate to the TSP, as-left limit, and as-found limit as shown in Figure 1. Staff requests applicant to update the FSAR accordingly.

Response

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.

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.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical/Environmental Reports

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

Impact on Technical Specifications

There is no impact on the Technical Specifications.

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.: **34-7870**

SRP Section: **07.01 – Instrumentation and Controls – Introduction**

Application Section: **07.01**

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Question No. 07.01-3

Describe how the change in measured TSP will be verified to be within predefined limits as described in Regulatory Issue Summary 2006-17, "NRC Staff Position on the Requirements of 10 CFR 50.36, "Technical Specifications," Regarding Limiting Safety System Settings During Periodic Testing and Calibration of Instrument Channels".

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-Z-J-NR-14005-P, Rev.0, “Setpoint Methodology for Plant Protection System,” describes the setpoint methodology applied to the PPS and DPS for the APR1400 and states conformance to BTP 7-12, Regulatory Guide 1.105, Rev.3, and Regulatory Issue Summary 2006-17. Regulatory Issue Summary 2006-17, states, in part, "...the NRC staff expects licensees to verify during testing or calibration that the change in the measured TSP since the last test or calibration is within predefined limits (double-sided acceptance criteria band) and to take appropriate actions if the change is outside these limits." It is not clear how the APR1400 Setpoint Methodology addresses this RIS. The staff request applicant to address the guidance in the RIS and document in the FSAR the appropriate actions when change is outside the double-sided acceptance criteria.

Response

The following statements that address the change in measured TSP during the periodic testing and calibration are described in Section 2.1 of TeR APR1400-Z-J-NR-14005-P, Rev.0. “The calibration error band serves as an error limit during a periodic test. If the instrument reading is within this tolerance band, no recalibration is necessary. If the instrument reading is outside the calibration error band, but within the periodic test error band, the channel segment is functioning

as intended although recalibration is required. 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. Only the violation of the AV is a reportable incident."

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 way to address the change in measured TSP is covered by the above statements in Section 2.1 of the TeR.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical/Environmental Reports

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

Impact on Technical Specifications

There is no impact on the Technical Specifications.

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SRP Section: **07.01 – Instrumentation and Controls – Introduction**

Application Section: **07.01**

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Question No. 07.01-4

Describe how the offset between the final TSP and the AV is determined.

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.” TeR APR1400-Z-J-NR-14005-P, Rev.0, “Setpoint Methodology for Plant Protection System,” describes the setpoint methodology applied to the PPS and DPS for the APR1400 and states conformance to BTP 7-12, Regulatory Guide 1.105, Rev.3, and Regulatory Issue Summary 2006-17. Section 2.1 of the TeR states, “The final TSP is a more conservative value than the AV by the offset that is determined as a greater value than the PPS cabinet periodic test error to reduce the possibility of a licensee event report.” Describe how this offset is determined and to update the FSAR. Figure 1 used the term "margin." Is this the same as "offset?" Clarify the relationship between these two terms.

Response

In order to reduce the possibility of a licensee event report, the final TSP would be offset from the AV by about 0.5 percent of span that applied for the Korean nuclear power plants in service. The offset used for determining the final TSP is based on engineering judgment. The value is to be 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. 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 purpose and determination methodology of the offset between the final TSP and the AV is described in Section 2.1 of the TeR.

The terminology of “offset” is the same as “margin” illustrated in Figure 1.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical/Environmental Reports

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

Impact on Technical Specifications

There is no impact on the Technical Specifications.

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SRP Section: **07.01 – Instrumentation and Controls – Introduction**

Application Section: **07.01**

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Question No. 07.01-5

Identify the Limiting Safety System Setting (LSSS) for the APR1400.

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.” TeR APR1400-Z-J-NR-14005-P, Rev.0, “Setpoint Methodology for Plant Protection System,” describes the setpoint methodology applied to the PPS and DPS for the APR1400 and states conformance to Regulatory Guide 1.105, Rev.3, BTP 7-12, and Regulatory Issue Summary (RIS) 2006-17. Section 2.5.1 of the TeR states, “The LSSS may be TSP, AV, or both according to Reference 4.1.” Reference 4.1 is ANSI/ISA-S67.04-1994, “Setpoints for Nuclear Safety-Related Instrumentation”, which states “Depending on the methodology, the LSSS may be the allowable value, the trip setpoint, or both.” It is not clear to the staff what is the LSSS is for the APR1400. While the guidance allows flexibility in choosing the LSSS, a determination should be made in the application. Therefore, clearly define the LSSS for the APR1400 and update the FSAR accordingly.

Response

The LSSS for the APR1400, which is maintained in the Technical Specifications, is defined as the AV. The TSP is described in Sections 7.2 and 7.3 of APR1400 DCD Tier 2.

Therefore, the statement in Section 2.5.1 of the TeR, “The LSSS may be TSP, AV, or both according to Reference 4.1.” will be changed to “The LSSS, which is maintained in the TS, establishes the AV.” to maintain consistency with Section 5 of the TeR as shown in Attachment 1.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical/Environmental Reports

Technical Report APR1400-Z-J-NR-14005-P, Rev.0 will be revised as indicated in Attachment 1.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

3. Errors may have both random and non-random components. When this occurs, the notation A+A', B+B', C+C', …, N+N' is used to indicate the combination of the two error types.

2.4.11 Measurement Test Error

Measurement test error is taken twice in the calculation of periodic test error because it must be reapplied at the end of the test interval.

2.5 Setpoint Determination

2.5.1 Limiting Safety System Setting (LSSS)

Where an LSSS 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 (Reference 4.3). LSSS for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions.

The LSSS, which is maintained in the TS, establishes the AV.

~~The LSSS may be TSP, AV, or both according to Reference 4.1.~~ The TSP is described in the DCD Sections 7.2 and 7.3 and the AV is required part of the TS.

2.5.2 Trip Setpoint

The TSP is established to provide the sufficient margin from the safety limit by adding/subtracting, in the conservative direction, the event-specific total instrument channel uncertainty to the corresponding AL. The most conservative event-specific value is then used as the TSP for a PPS function.

The high containment pressure TSP is determined by two methods. Starting from 0.0 cmH_2O, the lowest possible TSP is calculated that will not interfere with normal plant operation. This conforms to the containment isolation dependability requirements of NUREG-0737 (Reference 4.4). Starting from the AL, the highest possible TSP is calculated that will guarantee reactor trip and ESF actuation when required. The more conservative of the two values is chosen as the final TSP.

2.5.3 Allowable Value

The AV is less conservative than the TSP, by the amount of the PPS cabinet periodic test error. This uncertainty accommodates the maximum anticipated drift of the PPS cabinet equipment between calibrations. The TS requires that, if upon checking a setpoint, the value set in the PPS is less conservative than the AV, the channel must be declared inoperable until the PPS setpoint is reevaluated to a conservative value.

2.5.4 Drift Allowance

In general, the PPS cabinet periodic test error is very small. To prevent a licensee event report, the TSP is offset in a conservative direction from the calculated AV by a drift allowance that is greater than the PPS cabinet periodic test error. By calculating the TSP and AV in this manner, setpoint drifts that are inconsistent with the safety analysis are virtually eliminated. The TSP is also far enough away from the process, so spurious trips during normal operation are minimized.

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Question No. 07.01-6

Provide consistent use of setpoint terminology.

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.” TeR APR1400-Z-J-NR-14005-P, Rev.0, describes the setpoint methodology applied to the PPS and DPS for the APR1400 and states conformance to Regulatory Guide 1.105, Rev.3, BTP 7-12, and Regulatory Issue Summary 2006-17. Section 5 of the TeR defines the setpoint-related terminology used. For clarity, staff requests applicant to cite the source, if relevant, for the definitions. For example, “Analytical Limit (AL), Limit of a measured or calculated variable established by the safety analysis to ensure that a safety limit is not exceeded. (ANSI/ISA S67.04-1994).” Appendix A of the TeR, “Pressurizer Pressure – High Trip Setpoint Calculation,” Section VI, “TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT,” uses the terms Trip Setpoint, Allowable Value, and Final Trip Setpoint. It is not clear if “Trip Setpoint” is referring to the “Draft Setpoint” in Figure 1 of the technical report. Staff requests applicant to use consistent terminology between the technical report and its appendices. Also, the Staff requests applicant to unambiguously state how the terms (e.g., AV, NTSP, As-Left Tolerance [ALT], As-Found Tolerance [AFT]) used in Tier 2, Chapter 16, Section 5.5.19, "Setpoint Control Program" (SCP), correspond to the terms used in the setpoint methodology technical report (e.g., AV, TSP, Calibration Error Band [as-left limit], Periodic Test Error Band [as-found limit]). Provide consistent use of terminology and update the FSAR accordingly.

Response

The setpoint-related terminologies defined in Section 5 of the TeR are synonymous with those of RG 1.105, ANSI/ISA-S67.04-1994, and RIS 2006-17 and also unique to APR1400

documentation.

The term of “Trip Setpoint” described in Section VI of Appendix A of the TeR means the “Draft Trip Setpoint” in Figure 1 of the technical report. To use consistent terminology between the technical report and its appendices “Draft” will be added to corresponding wordings in all Appendices of the TeR as shown in Attachment 1.

Nominal Trip Setpoint (NTSP), As-Left Tolerance [ALT], As-Found Tolerance [AFT] used in Tier 2, Chapter 16, Section 5.5.19 correspond, respectively, to final TSP, Calibration Error Band, and Periodic Test Error Band used in the setpoint methodology technical report. The relationship between NTSP and final TSP is described in Section 2.1 of the TeR. The definitions of Calibration Error and Periodic Test Error provided in Section 5 of the TeR are synonymous with the “region of calibration tolerance,” as shown in Figure 1 of RG 1.105, and “as-found LSSS,” as used in RIS 2006-17, respectively.

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 the DCD Tier 2, since terms such as Calibration Error, TSP, and Periodic Test Error have been used in place of the terminologies used in the regulations and industry standards to facilitate the understanding of values with regards to the operation of the APR1400.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical/Environmental Reports

Technical Report APR1400-Z-J-NR-14005-P, Rev.0 will be revised as indicated in Attachment 1.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

APPENDIX A

PRESSURIZER PRESSURE - HIGH

TRIP SETPOINT CALCULATION

VI. TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

~~Trip Setpoint~~ = Analytical Limit (AL1) - Total Channel WCN Error

= ~~TSP1~~

Draft Trip Setpoint

DTSP1

~~Trip Setpoint~~ = Analytical Limit (AL2) - Total Channel AC Error

= ~~TSP2~~

DTSP2

Allowable Value = ~~TSP1~~ or ~~TSP2~~ + PPS Cabinet PTE

DTSP1 DTSP2

More conservative trip setpoint should be selected to calculate allowable value.

Final Trip Setpoint = Allowable Value - Offset

To reduce the possibility of a licensee event report, the final trip setpoint is offset from the calculated allowable value.

The pretrip setpoint may be determined by engineering judgment.

VII. PPS CHANNEL RESPONSE TIMES

A. Transmitter
B. APC-S
C. PPS Cabinet (RPS)
D. Reactor Trip Switchgear

TOTAL CHANNEL RESPONSE TIME :

A + B + C + D (For RPS)

APPENDIX B

PRESSURIZER PRESSURE - LOW

TRIP SETPOINT CALCULATION

( )TS

VI.TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

Draft Trip Setpoint

~~Trip Setpoint~~ = Analytical Limit (AL1) + Total Channel WCN Error = ~~TSP1~~ DTSP1

~~Trip Setpoint~~ = Analytical Limit (AL2) + Total Channel AC Error = ~~TSP2~~ DTSP2

Allowable Value = ~~TSP1~~ or ~~TSP2~~ - PPS Cabinet PTE

DTSP1 DTSP2

More conservative trip setpoint should be selected to calculate allowable value.

Final Trip Setpoint = Allowable Value + Offset

To reduce the possibility of a licensee event report, the trip setpoint is offset from the calculated allowable value.

The pretrip setpoint may be determined by engineering judgment.

VII. PPS CHANNEL RESPONSE TIMES

A. Transmitter
B. APC-S
C. PPS Cabinet (RPS)
D. PPS Cabinet (ESFAS)
E. Reactor Trip Switchgear
F. ESFAS Cabinet Delay Time

TOTAL CHANNEL RESPONSE TIME

APPENDIX C

STEAM GENERATOR LEVEL - LOW

TRIP SETPOINT CALCULATION

Draft Trip Setpoint

~~Trip Setpoint~~ = Analytical Limit (AL1) + Total Channel WCN Error = ~~TSP1~~ DTSP1

~~Trip Setpoint~~ = Analytical Limit (AL2) + Total Channel AC Error = ~~TSP2~~ DTSP2

Allowable Value = ~~TSP1~~ or ~~TSP2~~ - PPS Cabinet PTE

DTSP1 DTSP2

More conservative trip setpoint should be selected to calculate allowable value.

Final Trip Setpoint = Allowable Value - Offset

To reduce the possibility of a licensee event report, the final trip setpoint is offset from the calculated allowable value.

The more conservative value between the final trip setpoint and the analysis nominal trip setpoint should be determined as the new trip setpoint.

In case the analysis nominal trip setpoint is determined as the new trip setpoint, the new allowable value is determined by subtracting offset from the new trip setpoint.

B. For AFAS

Trip Setpoint = Analytical Limit (AL3) + Total Channel WCN Error

Trip Setpoint = Analytical Limit (AL4) + Total Channel AC Error

Allowable Value = AL3 or AL4 - PPS Cabinet PTE

More conservative trip setpoint should be selected to calculate allowable value.

APPENDIX D

STEAM GENERATOR LEVEL - HIGH

TRIP SETPOINT CALCULATION

PPS Cabinet WCN Error : CU(WCN)

Measurement Channel WCN Error : MCU(WCN)

[ ]TS

V. TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

Draft Trip Setpoint

DTSP

~~Trip Setpoint~~ = Analytical Limit (AL) - Total Channel WCN Error = ~~TSP~~

Allowable Value = ~~TSP~~ + PPS Cabinet PTE

DTSP

Final Trip Setpoint = Allowable Value - Offset

To reduce the possibility of a licensee event report, the trip setpoint is offset from the calculated allowable value.

The pretrip setpoint may be determined by engineering judgment.

VI. PPS CHANNEL RESPONSE TIMES

A. Transmitter
B. PPS Cabinet (RPS)
C. PPS Cabinet (ESFAS)
D. Reactor Trip Switchgear
E. ESFAS Cabinet Delay Time

TOTAL CHANNEL RESPONSE TIME

A + B + E (For RPS)

APPENDIX E

STEAM GENERATOR PRESSURE - LOW

TRIP SETPOINT CALCULATION

[ ]TS

VI.TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

Draft Trip Setpoint

~~Trip Setpoint~~ = Analytical Limit (AL1) + Total Channel WCN Error = ~~TSP1~~ DTSP1

~~Trip Setpoint~~ = Analytical Limit (AL2) + Total Channel AC Error = ~~TSP2~~ DTSP2

Allowable Value = ~~TSP1~~ or ~~TSP2~~ - PPS Cabinet PTE

DTSP1 DTSP2

More conservative trip setpoint should be selected to calculate allowable value.

Final Trip Setpoint = Allowable Value + Offset

To reduce the possibility of a licensee event report, the trip setpoint is offset from the calculated allowable value.

The pretrip setpoint may set by engineering judgment.

VII. PPS CHANNEL RESPONSE TIMES

A. Transmitter
B. APC-S
C. PPS Cabinet (RPS)
D. PPS Cabinet (ESFAS)
E. Reactor Trip Switchgear
F. ESFAS Cabinet Delay Time

TOTAL CHANNEL RESPONSE TIME

APPENDIX F

CONTAINMENT PRESSURE - HIGH

TRIP SETPOINT CALCULATION

A. Starting from 0.0 cm H_20, the lowest possible value that would not interfere with operation unnecessarily is calculated.

a. Analytical Limit: 0.0 cm H_20
b. Positive Containment Pressure Limit
c. Containment Pressure Spike:
d. Total Channel Error:

DTSP1

~~Low Trip Setpoint Limit~~ = a + b + c + d = ~~TSP1~~

Low Draft Trip Setpoint Limit

The above method is used additionally to satisfy the early actuation requirements of NUREC-0737.

B. Starting from AL, the highest possible value that will guarantee a reactor trip when required is calculated.

a. Analytical Limit
b. Negative Containment Pressure Limit
c. Total Channel Error

High Draft Trip Setpoint Limit

DTSP2

~~High Trip Setpoint Limit~~ = a + b + c = ~~TSP2~~

DTSP1

Allowable Value = ~~TSP1~~ or ~~TSP2~~ + PPS Cabinet PTE

DTSP2

More conservative trip setpoint should be selected to calculate allowable value.

Final Trip Setpoint = Allowable Value + Offset

APPENDIX G

VARIABLE OVERPOWER - HIGH

TRIP SETPOINT CALCULATION

V.SETPOINT, ALLOWABLE VALUE, PRETRIP OFFSET

1. CEILING :

~~Setpoint~~ = Analytical Limit (AL1) - Total Channel Error

= ~~SP1~~ ← DSP1

Draft Setpoint

Allowable Value = ~~SP1~~ + PPS Cabinet PTE

final

To reduce the possibility of a licensee event report, the ~~trip~~ setpoint is offset from the calculated allowable value.

The pretrip offset may be determined by engineering judgment.

2. RATE :

Setpoint = Analytical Limit (AL2)

= SP2

Allowable Value = SP2

3. STEP :

Setpoint = Analytical Limit (AL3) - PPS Cabinet PTE

= SP3

Allowable Value = SP3 + PPS Cabinet PTE

VI. PPS CHANNEL RESPONSE TIMES

APPENDIX H

LOGARITHMIC POWER LEVEL - HIGH

TRIP SETPOINT CALCULATION

[ ]TS

WORST CASE NORMAL (WCN) ERROR

[ ]TS

The factors which are considered in process equipment uncertainties may change according to the process equipment applied.

IV.TOTAL CHANNEL ERROR

Combine:

A. PPS Cabinet WCN Error : CU(WCN)

B. Process Equipment WCN Error : MCU(WCN)

[ ]TS

V.TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

~~Trip Setpoint~~ = Analytical Limit(AL) - Total Channel Error

= ~~TSP~~

Draft Trip Setpoint

DTSP

Allowable Value = ~~TSP~~ + PPS Cabinet PTE

Final Trip Setpoint = Allowable Value - Offset

APPENDIX I

CONTAINMENT PRESSURE HIGH - HIGH

TRIP SETPOINT CALCULATION

MEASUREMENT CHANNEL PERIODIC TEST ERROR

[ ]TS

MEASUREMENT CHANNEL WORST CASE NORMAL (WCN) ERROR

[ ]TS

IV. TOTAL CHANNEL WORST CASE NORMAL (WCN) ERROR WITH SEISMIC

Combine:

PPS Cabinet WCN Error : CU(WCN)

Measurement Channel WCN Error : MCU(WCN)

[ ]TS

V.TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

~~Trip Setpoint~~ = Analytical Limit (AL) - Total Channel Error

= ~~TSP~~

Draft Trip Setpoint

DTSP

Allowable Value = ~~TSP~~ + PPS Cabinet PTE

Final Trip Setpoint = Allowable Value - Offset

To reduce the possibility of a licensee event report, the trip setpoint is offset from the calculated allowable value by about 0.5 percent of span.

APPENDIX J

DIVERSE PROTECTION SYSTEM

PRESSURIZER PRESSURE - HIGH

TRIP SETPOINT CALCULATION

IV. TOTAL CHANNEL WORST CASE NORMAL (WCN) ERROR WITH SEISMIC

Combine:

DPS Cabinet WCN Error : CU(WCN)

Measurement Channel WCN Error : MCU(WCN)

[ ]TS

V. TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

~~Trip Setpoint~~ = Analytical Limit (AL) - Total Channel WCN Error

= ~~TSP~~

Draft Trip Setpoint

DTSP

Allowable Value = ~~TSP~~ + DPS Cabinet PTE

Final Trip Setpoint = Allowable Value - Offset

To reduce the possibility of a licensee event report, the trip setpoint is offset from the calculated allowable value.

The pretrip setpoint may be determined by engineering judgment.

The analysis nominal trip setpoint used conservatively in the safety analysis report is determined as the new trip setpoint to reduce the possibility that the DPS trip setpoint is lower than that of the PPS. The new allowable value is determined by adding offset from the new trip setpoint.

APPENDIX K

DIVERSE PROTECTION SYSTEM

STEAM GENERATOR LEVEL - LOW

TRIP SETPOINT CALCULATION

IV. TOTAL CHANNEL WORST CASE NORMAL (WCN) ERROR WITH SEISMIC

Combine:

DPS Cabinet WCN Error : CU(WCN)

Measurement Channel WCN Error : MCU(WCN)

[ ]TS

V. TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

~~Trip Setpoint~~ = Analytical Limit (AL) + Total Channel WCN Error

= ~~TSP~~

Draft Trip Setpoint

DTSP

Allowable Value = ~~TSP~~ - DPS Cabinet PTE

Final Trip Setpoint = Allowable Value + Offset

To reduce the possibility of a licensee event report, the trip setpoint is offset from the calculated allowable value.

The pretrip setpoint may be determined by engineering judgment.

VI. DPS CHANNEL RESPONSE TIMES

A. Transmitter

B. DPS Cabinet

TOTAL CHANNEL RESPONSE TIME

APPENDIX L

DIVERSE PROTECTION SYSTEM

CONTAINMENT PRESSURE - HIGH

TRIP SETPOINT CALCULATION

Combine:

DPS Cabinet WCN Error : CU(WCN)

Measurement Channel WCN Error : MCU(WCN)

[ ]**TS**

V. TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

~~Trip Setpoint~~ = Analytical Limit (AL) - Total Channel WCN Error

= ~~TSP~~

Draft Trip Setpoint

DTSP

Allowable Value = ~~TSP~~ + DPS Cabinet PTE

Final Trip Setpoint = Allowable Value – Offset

To reduce the possibility of a licensee event report, the final trip setpoint is offset from the calculated allowable value.

The pretrip setpoint may be determined by engineering judgment.

VI. DPS CHANNEL RESPONSE TIMES

A. Transmitter

B. DPS Cabinet

C. Reactor Trip Switch Gear

TOTAL CHANNEL RESPONSE TIME

APPENDIX M

DIVERSE PROTECTION SYSTEM

PRESSURIZER PRESSURE - LOW

TRIP SETPOINT CALCULATION

[ ]TS

VI. TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

~~Trip Setpoint~~ = Analytical Limit (AL1) + Total Channel WCN Error

= ~~TSP~~

Draft Trip Setpoint

DTSP1

~~Trip Setpoint~~ = Analytical Limit (AL2) + Total Channel AC Error

= ~~TSP2~~

DTSP2

DTSP1

DTSP2

Allowable Value = ~~TSP1~~ or ~~TSP2~~ - DPS Cabinet PTE

Final Trip Setpoint = Allowable Value + Offset

To reduce the possibility of a licensee event report, the trip setpoint is offset from the calculated allowable value.

The pretrip setpoint may be determined by engineering judgment.

VII. DPS CHANNEL RESPONSE TIMES

A. Transmitter

B. DPS Cabinet

TOTAL CHANNEL RESPONSE TIME

A + B (For DPS)

The actual DPS channel delay time is less than the total Analysis Response Time.

APPENDIX N

REACTOR COOLANT FLOW - LOW

TRIP SETPOINT CALCULATION

increased by a factor of two. Consequently, the error used is twice the process equipment accuracy.

IV. TOTAL CHANNEL ERROR FOR FLOOR AND STEP

Combine:

A. PPS Cabinet Worst Case Normal Error: CU(WCN)

B. PE Worst Case Normal Error : MCU(WCN)

[ ]TS

V.SETPOINT, ALLOWABLE VALUE, PRETRIP BAND

1. FLOOR :

Draft Setpoint

~~Setpoint~~ = Derived Setpoint (DSP1) + Total Channel Error

= ~~SP1~~ ← DS1

Allowable Value = ~~SP1~~ - PPS Cabinet PTE

Final Setpoint = Allowable Value + Offset

2. RATE :

Setpoint = Derived Setpoint (DSP2)

= SP2

Allowable Value = SP2

ACRONYMS AND ABBREVIATIONS

AC	accident condition
AFAS	auxiliary feedwater actuation signal
AL	analytical limit
ANSI	American National Standards Institute
ANTS	analysis nominal trip setpoint
APC-S	auxiliary process cabinet – safety
AV	allowable value
BTP	branch technical position
CFR	code of federal regulations
CIAS	containment isolation actuation signal
CPC	core protection calculator
CSAS	containment spray actuation signal
CU	cabinet uncertainty
COLSS	core operating limit supervisory system
DBE	design basis event
DCD	design control document
DNBR	departure from nucleate boiling ratio
DPS	diverse protection system
DRT	derived response time
DS	draft setpoint
DSP	derived setpoint
DTSP	draft trip setpoint
ESF	engineered safety features
ESFAS	engineered safety features actuation system
ESF-CCS	engineered safety feature - component control system
HE	harsh environment
ISA	Instrument Society of America
KEPCO	Korea Electric Power Corporation
KHNP	Korea Hydro & Nuclear Power Co., Ltd.
LOCA	loss of coolant accident
LPD	local power density
LRCF	low reactor coolant flow
LSSS	limiting safety system setting
MCU	measurement channel uncertainty
MSIS	main steam isolation signal

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.: **34-7870**

SRP Section: **07.01 – Instrumentation and Controls – Introduction**

Application Section: **07.01**

Date of RAI Issued: **06/16/2015**

Question No. 07.01-7

Clarify what is meant by "previous errors" in TeR APR1400-Z-J-NR-14005-P, Rev.0, “Setpoint Methodology for Plant Protection System.”

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.” TeR APR1400-Z-J-NR-14005-P, Rev.0, describes the setpoint methodology applied to the plant protection system and diverse protection system for the APR1400, and states conformance to Regulatory Guide 1.105, Rev.3, BTP 7-12, and Regulatory Issue Summary (RIS) 2006- 17. Section 2.3.2.1 of the TeR states, “As with the previous errors, the measurement channel calibration errors is determined from tests and from the information supplied by the manufacturer.” Staff requests applicant to describe what is meant by “previous errors" and to update the FSAR accordingly.

Response

In the draft version of the TeR, Sections 2.3.2.5 thru 2.3.2.7 regarding the PPS cabinet errors were initially located in front of the Sections 2.3.2.1 thru 2.3.2.4 covering measurement channel errors. The wording of “previous errors” described in Section 2.3.2.1 was used to indicate the PPS cabinet calibration error and PPS cabinet periodic test error. However, the wording is not necessary to be used in the TeR, Rev.0.

Therefore, “As with the previous errors” described in Section 2.3.2.1 will be deleted as shown in Attachment 1.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical/Environmental Reports

Technical Report APR1400-Z-J-NR-14005-P, Rev.0 will be revised as indicated in Attachment 1.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

2.3 Equipment Errors

2.3.1 General

Good engineering practice and current setpoint requirements dictate that all factors that can affect the operation of equipment be considered in the setpoint calculation. In this setpoint methodology, uncertainty components are determined separately and combined by a statistically valid method to arrive at a total instrument channel uncertainty. Those uncertainties that are both random and independent are combined by the square-root-sum–of-squares (SRSS) technique, a standard method of combining random uncertainties. Those uncertainties that are non-random and dependent are combined by algebraic summation.

For means of setpoint calculation, the PPS is divided into two major regions. The first region is the measurement channel portion of the instrument loop and it consists of the sensor, transmitter, power supply, and signal processing equipment - all equipment up to the PPS cabinet. This region is susceptible to four individual errors. These individual elements are specific to plant and equipment.

- Measurement Channel Calibration Error
- Measurement Channel Periodic Test Error
- Measurement Channel Worst Case Normal Error
- Measurement Channel Accident Condition Error

The second region is the PPS cabinet itself, which is susceptible to three errors. These individual elements are specific to plant and equipment.

- PPS Cabinet Calibration Error
- PPS Cabinet Periodic Test Error
- PPS Cabinet Worst Case Normal Error

2.3.2 Individual Errors

2.3.2.1 Measurement Channel Calibration Error

The measurement channel calibration error accounts for the uncertainties introduced in the transmitter and/or the auxiliary process cabinet – safety (APC-S) during the calibration process that must be accommodated if the instrumentation is required for protective action immediately after calibration. ~~As with the previous errors, the~~ measurement channel calibration error is determined from tests and from the information supplied by the manufacturer. The measurement channel calibration error band uses the SRSS combination of the reference accuracy, power supply effect, and measurement test error. The combination method for each trip parameter is described in appendices.

The

2.3.2.2 Measurement Channel Periodic Test Error

The measurement channel periodic test error for the transmitter and/or the APC-S accounts for the expected, measurable process equipment drift that might accumulate in the maximum allowable calibration interval that is 25% greater than the interval required by the TS. The measurement channel periodic test error band uses the SRSS combination of the reference accuracy, drift, temperature effect, power supply effect, radiation effect, and measurement test error. In this case the measurement test error

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.: **34-7870**

SRP Section: **07.01 – Instrumentation and Controls – Introduction**

Application Section: **07.01**

Date of RAI Issued: **06/16/2015**

Question No. 07.01-8

Describe how surveillance testing and maintenance are used to determine setpoints.

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.” 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 and diverse protection system for the APR1400, and states conformance to Regulatory Guide 1.105, Rev.3, BTP 7-12, and Regulatory Issue Summary (RIS) 2006-17. APR1400 FSAR, Tier 1, Section 2.5.1.1, Item 10, states, “Accuracy, response time testing, surveillance testing, and maintenance are applied to determine setpoints for variables of RT and ESF initiation.” It is not clear to the staff how surveillance testing and maintenance are used to determined setpoints as described in the TeR. Describe how surveillance testing and maintenance are used to determined setpoints and update the FSAR accordingly.

Response

Section 2.1 of the TeR APR1400-Z-J-NR-14005-P, Rev.0, states “The calibration error band serves as an error limit during a periodic test. If the instrument reading is within this tolerance band, no recalibration is necessary. If the instrument reading is outside the calibration error band, but within the periodic test error band, the channel segment is functioning as intended although recalibration is required.”

Surveillance testing is a periodic test required by the TS, and is to be performed at an appropriate test interval to ensure that an instrument channel is functioning in compliance with the safety analysis and to verify that trip setpoints remain within their established limits during

operation. If as-found data from surveillance testing indicates that the calibration error band was exceeded, appropriate maintenance, such as calibration, will be performed. Therefore, APR1400 DCD Tier 1, Section 2.5.1.1, Item 10 will be revised, as shown in Attachment 1, to state that surveillance testing and maintenance are used to determine if setpoints for variables of RT and ESF initiation are within acceptable limits.

Impact on DCD

APR1400 DCD Tier 1, Section 2.5.1.1, Item 10 will be revised as indicated in Attachment 1.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical/Environmental Reports

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

Impact on Technical Specifications

There is no impact on the Technical Specifications.

7.c The PPS provides indications of the bypassed or inoperable status indication (BISI) on the OM in the MCR for the variables identified in Tables 2.5.1-2 and 2.5.1-3 for RT and ESF initiation.

8. Each PPS division is controlled from either the MCR or the RSR as selected from master transfer switches.

9. The PPS utilizes a 2-out-of-4 coincidence logic when no channels are in trip channel bypass. The PPS converts to a 2-out-of-3 coincidence logic whenever a trip channel bypass is present.

10. Accuracy, response time testing, surveillance testing, and maintenance are applied to determine ~~setpoints for variables of RT and ESF initiation.~~ if setpoints for variables of RT and ESF initiation are within acceptable limits.

11. RTS and ESF initiation software is implemented according to the software life cycle process.

12. The cabinets listed in Table 2.5.1-1 have key locks and door open alarms, and are located in a vital area of the facility.

13. The RT logic of the PPS is designed to fail to a safe state such that loss of electrical power to a division of PPS results in a trip condition for that division but the ESFAS logic of the PPS is designed to fail to a safe state such that loss of electrical power to a division of PPS does not result in ESF initiation for that division.

14. Redundant safety equipment listed in Table 2.5.1-1 is provided with means of identification.

15. The input signals of PPS through APC-S or ENFMS are derived from RT and ESF measurement instrumentation that measures monitored variables identified in Tables 2.5.1-2 and 2.5.1-3.

16. The PPS provides RT and ESF initiation signals to meet the required response time for trip and initiation conditions identified in Tables 2.5.1-2 and 2.5.1-3.

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.: **34-7870**

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Question No. 07.01-9

Describe 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 is this new setpoint is consistent with the more restrictive setpoint.

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.” 10 CFR 50.55a(h)(3) requires safety systems to meet the requirements of IEEE Std 603-1991. IEEE Std 603-1991, Clause 6.8.2, states, in part, "Where it is necessary to provide multiple setpoints for adequate protection for a particular mode of operation or set of operating conditions, the design shall provide positive means of ensuring that the more restrictive setpoint is used when required. The devices used to prevent improper use of less restrictive setpoints shall be part of the sense and command features."

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 and diverse protection system for the APR1400, and states conformance to Regulatory Guide 1.105, Rev.3, BTP 7-12, and Regulatory Issue Summary (RIS) 2006-17. TeR APR1400-Z-J-NR-14001-P, Rev. 0, “Safety I&C System,” Section 4.2.1, states, in part, “The PPS … receives manually entered inputs for limited operator intervention in the automatic RT [reactor trip] and ESF [engineered safety features] actuation such as an operating bypass and setpoint reset,” and Section 4.2.1.1, states, in part, that low pressurizer pressure and low steam generator pressure reactor trips have manual reset setpoints. APR1400 FSAR, Tier 2, Chapter 7, Page 7.2-11, states, in part, “The design permits manually initiated automatic decrementing of the setpoint. Decrementing of the setpoint can be initiated by setpoint reset switches on the safety console and remote shutdown console (RSC). When the signal decreases, the setpoint resets itself to a fixed value less than the actual input signal that exists at that time.”

Describe when the reset setpoints would be used for these reactor trip functions and the basis for manually changing the setpoint value. In addition, describe how the new “fixed value” setpoint is determined, and how is this new setpoint is consistent with "the more restrictive setpoint" discussed in
IEEE Std 603-1991, Clause 6.8.2. Tier 2, Chapter 7, Section 7.2.3.4, states "Restrictive setpoints are not used for the RPS." It is not clear to the staff if the more restrictive setpoint is used. Clarify and describe the use of reset setpoints, fixed value setpoints, and more restrictive setpoints in the APR1400 design and update the FSAR accordingly.

Response

APR1400 DCD Tier 2, Chapter 7, Section 7.2.1.4, specifies, in part, “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 DCD 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/cm^2 (400 psi) for pressurizer pressure and 14 kg/cm^2 (200 psi) for steam generator pressure.”

According to APR1400 DCD Tier 2, Chapter 7, Section 7.2.1.4 and Table 7.2-4, low pressurizer pressure and low steam generator pressure reactor trip parameters have the function of manually resetting setpoints that should be used to shut down the nuclear power plant without the initiation of any unnecessary protective actions during plant cooldown for refueling or urgent maintenance. The purpose of the manual reset setpoints is not to provide multiple setpoints for adequate protection for a particular mode of operation or set of operating conditions but to shut down the plant without any unnecessary protective actions when plant cooldown is necessary. Therefore, as described in Section 7.2.3.4, it is correct that restrictive setpoints are not used for the RPS.

In the APR1400 design, when a plant operator manually resets the predetermined reset setpoint in service, the new reset setpoint is determined as a setpoint that is lower than the existing pressurizer pressure or steam generator pressure by its own fixed value. 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 the DCD Tier 2, since the detailed information related to the reset setpoints are specified in Section 7.2.1.4 and Table 7.2-4 of APR1400 DCD Tier 2, Chapter 7.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical/Environmental Reports

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

Impact on Technical Specifications

There is no impact on the Technical Specifications.