SUPPLEMENTAL 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.:	**301-8280**
SRP Section:	**07.01 – Instrumentation and Controls-Introduction**
Application Section:	**7.1**
Date of RAI Issue:	**11/10/2015**

Question No. 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.

Response

To clearly describe the periodic test error band and its relation with calculating the draft trip setpoint (DTSP) as well as the effect on the DTSP, AV, and TSP of having a PPS Cabinet Periodic Test Error Band with a value of zero, the last paragraph of Section 2.1, “Basic Description” of TeR APR1400-Z-J-NR-14005 will be revised to state the following:

> The total instrument channel uncertainty between the AL and the DTSP includes all uncertainty factors existing on the PPS channel which consists of the sensor, the APC-S, and the PPS cabinet. The total instrument channel uncertainty is generally determined by the algebraic summation of the termination and splicing effect, the static pressure effect, the reference leg error, the dynamic flow error, and the square-root-sum-of-squares (SRSS) combination of the reference accuracy, the drift, the temperature effect, the power supply effect, the radiation effect, the seismic effect, and the measurement test error. The detailed method to combine all uncertainty factors to calculate the total instrument channel uncertainty is described in Section 2.3.3 and Section III, “Measurement Channel Uncertainties” of each appendix. Only the PPS cabinet periodic test error, which is based on a monthly testing interval, is used to determine the AV since the surveillance test for the PPS cabinet is required during normal plant operation. However, the transmitter and the APC-S errors are each individually verified every refueling period to be within their respective calibration error bands and periodic test error bands.
>
> When the PPS cabinet periodic test error band has a value of zero, the DTSP is equal to the AV. When the PPS cabinet periodic test error band has a value of zero, the AV is most conservative due to the difference in value between the AL and the DTSP not being reduced by the value of the PPS cabinet periodic test error band to establish the AV. If the PPS cabinet periodic test error band is greater than zero, the AV will be less conservative than the DTSP by the value of the PPS cabinet periodic test error band, as shown in Figure 1.
>
> The final TSP is offset in a conservative direction from the calculated AV by approximately 0.5% of the channel span, which is sufficiently greater than the PPS cabinet periodic test error. This approach can reduce the possibility of a licensee event report being required when a periodic test result exceeds the AV.
>
> The calibration error band shown in Figure 1 is the as-left limit of a parameter. The

calibration error band represents the transmitter, the APC-S, or the PPS cabinet calibration error band. The transmitter, the APC-S, and the PPS cabinet errors after calibration are each individually verified to be within their respective calibration error bands. The calibration error band is determined by the SRSS combination of the reference accuracy, the power supply effect, and the measurement test error.

The periodic test error band shown in Figure 1 is the as-found limit of a parameter. The periodic test error band represents the transmitter, the APC-S, or the PPS cabinet periodic test error band. The transmitter, the APC-S, and the PPS cabinet errors before calibration are each individually verified to be within their respective periodic test error bands. The periodic test error band is determined by the SRSS combination of the reference accuracy, the drift, the temperature effect, the power supply effect, the radiation effect, and the measurement test error. The uncertainty factors to determine the band are selected from those used to determine the total instrument channel uncertainty.

For the sensors and the APC-S, the calibration error band and periodic test error band serve as error limits during a periodic test. If the instrument reading is within the calibration error 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 source of the anomaly is to be investigated and the operability is also to be evaluated since the instrumentation is not behaving as expected.

For the PPS cabinet, if the instrument reading is within the calibration error 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 but is conservative with respect to the AV, the source of the anomaly and the possibility of exceeding the AV are to be investigated since the instrumentation is not behaving as expected. Only a violation of the AV is a reportable incident.

When the periodic test error band or the AV is exceeded, an appropriate action contains adjustment of testing frequency, setpoint revision in the conservative direction, reevaluation of the trip setpoint or acceptance criterion, evaluation of equipment installation and environment, evaluation of calibration, repair or replacement of the device, or procedure change to implement supplemental action.

Supplemental Response

Reference to reducing the possibility of “a licensee event report” will be changed to reducing the possibility that a periodic test result exceeds the allowable value to focus on the setpoint methodology rather than the administrative result.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

Technical report APR1400-Z-J-NR-14005-P/NP, Rev.0 will be revised as indicated in the attachment associated with this response.

RAI 301-8280 - Question 07.01-41

Supplemental RAI 301-8280 - Question 07.01-41

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.

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~~ that a periodic test result exceeds the AV. 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.

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The total instrument channel uncertainty between the AL and the DTSP includes all uncertainty factors existing on the PPS channel which consists of the sensor, the APC-S, and the PPS cabinet. The total instrument channel uncertainty is generally determined by the algebraic summation of the termination and splicing effect, the static pressure effect, the reference leg error, the dynamic flow error, and the square-root-sum-of-squares (SRSS) combination of the reference accuracy, the drift, the temperature effect, the power supply effect, the radiation effect, the seismic effect, and the measurement test error. The detailed method to combine all uncertainty factors to calculate the total instrument channel uncertainty is described in Section 2.3.3 and Section III, "Measurement Channel Uncertainties" of each appendix. Only the PPS cabinet periodic test error, which is based on a monthly testing interval, is used to determine the AV since the surveillance test for the PPS cabinet is required during normal plant operation. However, the transmitter and the APC-S errors are each individually verified every refueling period to be within their respective calibration error bands and periodic test error bands.

When the PPS cabinet periodic test error band has a value of zero, the DTSP is equal to the AV. When the PPS cabinet periodic test error band has a value of zero, the AV is most conservative due to the difference in value between the AL and the DTSP not being reduced by the value of the PPS cabinet periodic test error band to establish the AV. If the PPS cabinet periodic test error band is greater than zero, the AV will be less conservative than the DTSP by the value of the PPS cabinet periodic test error band, as shown in Figure 1.

The final TSP is offset in a conservative direction from the calculated AV by approximately 0.5% of the channel span, which is sufficiently greater than the PPS cabinet periodic test error. This approach can reduce the possibility ~~of a licensee event report being required when~~ a periodic test result exceeds the AV.

that

The calibration error band shown in Figure 1 is the as-left limit of a parameter. The calibration error band represents the transmitter, the APC-S, or the PPS cabinet calibration error band. The transmitter, the APC-S, and the PPS cabinet errors after calibration are each individually verified to be within their respective calibration error bands. The calibration error band is determined by the SRSS combination of the reference accuracy, the power supply effect, and the measurement test error.

The periodic test error band shown in Figure 1 is the as-found limit of a parameter. The periodic test error band represents the transmitter, the APC-S, or the PPS cabinet periodic test error band. The transmitter, the APC-S, and the PPS cabinet errors before calibration are each individually verified to be within their respective periodic test error bands. The periodic test error band is determined by the SRSS combination of the reference accuracy, the drift, the temperature effect, the power supply effect, the radiation effect, and the measurement test error. The uncertainty factors to determine the band are selected from those used to determine the total instrument channel uncertainty.

For the sensors and the APC-S, the calibration error band and periodic test error band serve as error limits during a periodic test. If the instrument reading is within the calibration error 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 source of the anomaly is to be investigated and the operability is also to be evaluated since the instrumentation is not behaving as expected.

For the PPS cabinet, if the instrument reading is within the calibration error 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 but is conservative with respect to the AV, the source of the anomaly and the possibility of exceeding the AV are to be investigated since the instrumentation is not behaving as expected. ~~Only a violation of the AV is a reportable incident.~~

When the periodic test error band or the AV is exceeded, an appropriate action contains adjustment of testing frequency, setpoint revision in the conservative direction, reevaluation of the trip setpoint or acceptance criterion, evaluation of equipment installation and environment, evaluation of calibration, repair or replacement of the device, or procedure change to implement supplemental action.

Supplemental RAI 301-8280 - Question 07.01-41

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

Trip Setpoint = Analytical Limit (AL2) - Total Channel AC Error
= TSP2

Allowable Value = TSP1 or TSP2 + PPS Cabinet PTE

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. that a periodic test result exceeds the 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

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

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

Allowable Value = TSP1 or TSP2 - PPS Cabinet PTE

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. that a periodic test result exceeds the 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

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

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

Allowable Value = TSP1 or TSP2 - PPS Cabinet PTE

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. that a periodic test result exceeds the 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

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

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. that a periodic test result exceeds the 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)

Supplemental RAI 301-8280 - Question 07.01-41

APPENDIX E

STEAM GENERATOR PRESSURE - LOW

TRIP SETPOINT CALCULATION

[ ]TS

VI.TRIP SETPOINT, ALLOWABLE VALUE, PRETRIP SETPOINT

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

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

Allowable Value = TSP1 or TSP2 - PPS Cabinet PTE

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. that a periodic test result exceeds the 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

Supplemental RAI 301-8280 - Question 07.01-41

APPENDIX F

CONTAINMENT PRESSURE - HIGH

TRIP SETPOINT CALCULATION

To reduce the possibility ~~of a licensee event report~~, the trip setpoint is offset from the calculated allowable value. that a periodic test result exceeds the 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 + D (For RPS)
A + C + E (For ESFAS)

The actual RPS channel delay time is less than the total analysis response time.

The actual ESFAS channel delay time is less than the total analysis response time.

Supplemental RAI 301-8280 - Question 07.01-41

APPENDIX G

VARIABLE OVERPOWER - HIGH

TRIP SETPOINT CALCULATION

V. SETPOINT, ALLOWABLE VALUE, PRETRIP OFFSET

1. CEILING :

Setpoint = Analytical Limit (AL1) - Total Channel Error

= SP1

Allowable Value = SP1 + PPS Cabinet PTE

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

Supplemental RAI 301-8280 - Question 07.01-41

APPENDIX H

LOGARITHMIC POWER LEVEL - HIGH

TRIP SETPOINT CALCULATION

To reduce the possibility ~~of a licensee event report~~, the final trip setpoint is offset from the calculated allowable value. that a periodic test result exceeds the allowable value

The pretrip setpoint may be determined by engineering judgment.

VI.PPS CHANNEL RESPONSE TIMES

A. Process Equipment
B. PPS Cabinet (RPS)
C. Reactor Trip Switchgear

TOTAL CHANNEL RESPONSE TIME

A + B + C (For RPS)

The actual RPS channel delay time is less than the total analysis response time.

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

Allowable Value = TSP + PPS Cabinet PTE

Final Trip Setpoint = Allowable Value - Offset

that a periodic test result exceeds the allowable value

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

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. that a periodic test result exceeds the 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.

Supplemental RAI 301-8280 - Question 07.01-41

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

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. that a periodic test result exceeds the 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

Supplemental RAI 301-8280 - Question 07.01-41

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

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. that a periodic test result exceeds the 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

Supplemental RAI 301-8280 - Question 07.01-41

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

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

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. that a periodic test result exceeds the 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.

SUPPLEMENTAL 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.:	**301-8280**
SRP Section:	**07.01 – Instrumentation and Controls-Introduction**
Application Section:	**7.1**
Date of RAI Issue:	**11/10/2015**

Question No. 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.

Response

To describe the basis for the stated offset, Section 2.5.4, “Drift Allowance” of TeR APR1400-Z-J-NR-14005 will be revised as follows:

> To prevent a licensee event report, the TSP is offset in a conservative direction from the calculated AV by a drift allowance of about 0.5% of the channel span, which is sufficiently greater than the PPS cabinet periodic test error. Since the PPS cabinet periodic test error is used in determining the AV from the DTSP, the drift allowance does not consider the sensor and the APC-S periodic test errors, which are individually verified to be within their respective periodic test error bands. Historically, the 0.5% of channel span value is larger than the value of the PPS cabinet periodic test error. Because the PPS cabinet periodic test error is the difference of the DTSP and the AV, the approach results in a TSP which is reasonable. This approach does not negatively affect safety since the TSP is moved in the conservative direction by reducing the plant operating margin.

Supplemental Response

To clarify the purpose of a margin between the AV and the TSP, reference to preventing “a licensee event report” will be changed to reducing the possibility that a periodic test result exceeds the allowable value.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

Technical report APR1400-Z-J-NR-14005-P/NP, Rev. 0 will be revised as indicated in the attachment associated with this response.

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 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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To reduce the possibility that a periodic test result exceeds the AV

~~To prevent a licensee event report,~~ the TSP is offset in a conservative direction from the calculated AV by a drift allowance of about 0.5% of the channel span, which is sufficiently greater than the PPS cabinet periodic test error. Since the PPS cabinet periodic test error is used in determining the AV from the DTSP, the drift allowance does not consider the sensor and the APC-S periodic test errors, which are individually verified to be within their respective periodic test error bands. Historically, the 0.5% of channel span value is larger than the value of the PPS cabinet periodic test error. Because the PPS cabinet periodic test error is the difference of the DTSP and the AV, the approach results in a TSP which is reasonable. This approach does not negatively affect safety since the TSP is moved in the conservative direction by reducing the plant operating margin.

RAI 301-8280 - Question 07.01-50

Supplemental RAI 301-8280 - Question 07.01-50