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.: **295-8263**

SRP Section: **16 – Technical Specifications**

Application Section: **16.3.3**

Date of RAI Issued: **11/05/2015**

Question No. 16-110

The applicant is requested to consider the following suggested clarifications and corrections to the “Background” section of the Bases for generic TS 3.3.1:

1. Though the acronym (RPS) “Reactor Protection System” is defined in the subsection title, the STS convention is to also define it when the phrase is first used in the subsection. Replace “The RPS” in the first sentence with “The Reactor Protection System (RPS)”; also append SAFDL with a lower case letter s, since it is a singular acronym.

2. The beginning of the third paragraph on Page B 3.3.1-1 omits the following generally-applicable text which is included the STS. The applicant is requested to insert this passage, and revise the existing sentences consistent with the indicated markup:

   Technical Specifications are required by 10 CFR 50.36 (Reference 7) to include LSSS for variables that have significant safety functions. LSSS are defined by the regulation as “Where a LSSS is specified for a variable on which a safety limit has been placed, the setting must be chosen so that automatic protective actions will correct the abnormal situation before a Safety Limit (SL) is exceeded.” The Analytical Limit is the limit of the process variable at which a safety action is initiated, as established by the safety analysis, to ensure that a SL is not exceeded. Any automatic protective action that occurs on reaching the Analytical Limit therefore ensures that the SL is not exceeded. However, in practice, the actual settings for automatic protection channels must be chosen to be more conservative than the Analytical Limit to account for channel uncertainties related to the setting at which the automatic protective action would actually occur. <<*Begin markup*>> ~~The LSSS for variable of the significant safety functions is required by 10 CFR 50.36 (Reference 7).~~ The LSSS~~,~~ values are identified and maintained in a document required by Specification 5.5.19, ~~the setpoint control program~~ Setpoint Control Program (SCP), which specifies that the changes to LSSS values (and related limits) shall be controlled by 10 CFR 50.59 and the NRC-approved setpoint methodology referenced in Specification 5.5.19 (the SCP). In ~~in~~ conjunction with the LCOs, the LSSS establish~~es~~ the thresholds for protection system actuation ~~action~~ to prevent exceeding acceptable limits during design basis events (DBEs).

In the next (fourth) paragraph, in list item ‘a’ change ‘safety limit’ to ‘Safety Limit’ and in item ‘c’ change ‘reactor coolant system (RCS)’ to just ‘RCS.’

3. Following the fifth paragraph, the STS includes a Reviewer’s Note. The applicant is requested to describe how the calculated trip setpoints described in the proposed setpoint methodology TeR (allowable value, draft trip setpoint, final trip setpoint, calibration tolerance, and periodic test acceptance criteria) are consistent with the guidance in the Reviewer’s Note and the quantities described in the Note (limiting trip setpoint, nominal trip setpoint) or required by the SCP (allowable value, nominal trip setpoint, as-left tolerance, and as-found tolerance).

4. Following the Reviewer’s Note, on page B 3.3.1-2, the Bases omits the following generally-applicable text which is included in STS B 3.3.1B, and would precede the fourth paragraph that begins, "During AOOs . . ." on generic TS page B 3.3.1-1. See STS pages B 3.3.1B-2 and B 3.3.1B-3. The applicant is requested to insert this passage:

> The [Limiting Trip Setpoint (LTSP)] specified in the SCP is a predetermined setting for a protective channel chosen to ensure automatic actuation prior to the process variable reaching the Analytical Limit and thus ensuring that the SL would not be exceeded. As such, the [LTSP] accounts for uncertainties in setting the channel (e.g., calibration), uncertainties in how the channel might actually perform (e.g., repeatability), changes in the point of action of the channel over time (e.g., drift during surveillance intervals), and any other factors which may influence its actual performance (e.g., harsh accident environments). In this manner, the [LTSP] ensures that SLs are not exceeded. As such, the [LTSP] meets the definition of a LSSS (Ref. 1).
>
> Technical Specifications contain values related to the OPERABILITY of equipment required for safe operation of the facility. OPERABLE is defined in Technical Specifications as "...being capable of performing its safety function(s)." Relying solely on the [LTSP] to define OPERABILITY in Technical Specifications would be an overly restrictive requirement if it were applied as an OPERABILITY limit for the "as-found" value of a protection channel setting during a Surveillance. This would result in Technical Specification compliance problems, as well as reports and corrective actions required by the rule which are not necessary to ensure safety. For example, an automatic protection channel device with a setting that has been found to be different from the [LTSP] due to some drift of the setting may still be OPERABLE because drift is to be expected. This expected drift would have been specifically accounted for in the setpoint methodology for calculating the [LTSP] and thus the automatic protective action would still have ensured that the SL would not be exceeded with the "as-found" setting of the protection channel. Therefore, the channel would still be OPERABLE because it would have performed its safety function and the only corrective action required would be to reset the channel within the established as-left tolerance around the [LTSP] to account for further drift during the next surveillance interval.
>
> Note that, although the channel is OPERABLE under these circumstances, the trip setpoint must be left adjusted to a value within the as-left tolerance, in accordance with uncertainty assumptions stated in the referenced setpoint methodology (as-left criteria), and confirmed to be operating within the statistical allowances of the uncertainty terms assigned (as-found criteria).
>
> However, there is also some point beyond which the channel may not be able to perform its function due to, for example, greater than expected drift. This value needs to be specified in

the Technical Specifications in order to define OPERABILITY of the channels and is designated as the Allowable Value.

If the actual setting (as-found setpoint) of the channel is found to be conservative with respect to the Allowable Value but is beyond the as-found tolerance band, the channel is OPERABLE, but degraded. The degraded condition will be further evaluated during performance of the SR. This evaluation will consist of resetting the channel setpoint to the [Nominal Trip Setpoint (NTSP)] (within the allowed tolerance), and evaluating the channel response. If the channel is functioning as required and is expected to pass the next surveillance, then the channel is OPERABLE and can be restored to service at the completion of the surveillance. After the surveillance is completed, the channel as-found condition will be entered into the Corrective Action Program for further evaluation.

The applicant should replace the items in square brackets with terms that are consistent with the terms in the SCP and omit the brackets.

Response

The following changes will be made to DCD Tier 2 TS Bases 3.3.1 to be consistent with the information provided in NUREG-1432 Rev. 4:

1. The acronym “RPS” will be spelled out as “Reactor Protection System (RPS)” when first used in the Background section of the Bases. Also in that same Bases section, the acronym “SAFDL” will be changed to “SAFDLs” since it is an abbreviation of a plural noun.

2. The requested passage will be inserted and the existing sentences will also be revised to be consistent with the proposed markup.

   The phrase “safety limit” will be changed to just “SL” since the inserted passage includes the phrase and its acronym. The phrase “reactor coolant system (RCS)” will be maintained since the phrase is the first instance it is used in the subsection.

3. The proposed setpoint methodology TeR states that the terms “draft trip setpoint,” “final trip setpoint,” “calibration error,” and “periodic test error” are synonymous with “limiting trip setpoint,” “nominal trip setpoint,” “as-left limit,” and “as-found limit,” respectively. The term “Nominal Trip Setpoint” instead of “limiting trip setpoint” will be used in the Bases for generic TS 3.3.1 as provided in the Bases change associated with item 4 below. Therefore, this approach is consistent with the generic TS 5.5.19, “Setpoint Control Program” which uses the terms “allowable value,” “nominal trip setpoint,” “as-left tolerance,” and “as-found tolerance.”

4. The requested passage will be inserted into generic TS page B 3.3.1-1 with the term Nominal Trip Setpoint used instead of the bracketed term Limiting Trip Setpoint to be consistent with the terms in the SCP.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

The TS Bases for TS 3.3.1 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

B 3.3 INSTRUMENTATION

B 3.3.1 Reactor Protection System (RPS) Instrumentation – Operating

Reactor Protection System (RPS)

SAFDLs

BASES

BACKGROUND

The ~~RPS~~ initiates a reactor trip to protect against violating the core specified acceptable fuel design limits (~~SAFDL~~) and breaching the reactor coolant pressure boundary (RCPB) during anticipated operational occurrences (AOOs). By tripping the reactor, the RPS also assists the engineered safety features (ESF) systems in mitigating accidents.

The protection and monitoring systems have been designed to ensure safe operation of the reactor. This is achieved by specifying limiting safety system settings (LSSS) in terms of parameters directly monitored by the RPS, as well as LCOs on other reactor system parameters and equipment performance.

~~The LSSS for variable of the significant safety functions is required by 10 CFR 50.36 (Reference 7). The LSSS, identified and maintained in the setpoint control program (SCP) controlled by 10 CFR 50.59 in conjunction with the LCOs, establishes the threshold for protection system action to prevent exceeding acceptable limits during design basis events (DBEs).~~

Replace with the markups on the next two pages

During AOOs, which are those events expected to occur one or more times during the plant life, the acceptable limits are:

a. The departure from nucleate boiling ratio (DNBR) shall be maintained above the ~~safety limit (SL)~~ value to prevent departure from nucleate boiling (DNB).

SL

b. Fuel centerline melting shall not occur.

c. The reactor coolant system (RCS) pressure SL of 193.3 kg/cm^{2}A (2,750 psia) shall not be exceeded.

Maintaining the parameters within the above values ensures that offsite dose will be within the 10 CFR Part 50, Appendix A, GDC 21 (Reference 1) and 10 CFR 50.34 (Reference 2) criteria during AOOs.

Technical Specifications are required by 10 CFR 50.36 (Reference 7) to include LSSS for variables that have significant safety functions. LSSS are defined by the regulation as “Where a LSSS is specified for a variable on which a safety limit has been placed, the setting must be chosen so that automatic protective actions will correct the abnormal situation before a Safety Limit (SL) is exceeded.” The Analytical Limit is the limit of the process variable at which a safety action is initiated, as established by the safety analysis, to ensure that a SL is not exceeded. Any automatic protective action that occurs on reaching the Analytical Limit therefore ensures that the SL is not exceeded. However, in practice, the actual settings for automatic protection channels must be chosen to be more conservative than the Analytical Limit to account for channel uncertainties related to the setting at which the automatic protective action would actually occur. The LSSS values are identified and maintained in a document required by Specification 5.5.19, Setpoint Control Program (SCP), which specifies that the changes to LSSS values (and related limits) shall be controlled by 10 CFR 50.59 and the NRC-approved setpoint methodology referenced in Specification 5.5.19 (the SCP). In conjunction with the LCOs, the LSSS establish the thresholds for protection system actuation to prevent exceeding acceptable limits during design basis events (DBEs).

The Nominal Trip Setpoint (NTSP) specified in the SCP is a predetermined setting for a protective channel chosen to ensure automatic actuation prior to the process variable reaching the Analytical Limit and thus ensuring that the SL would not be exceeded. As such, the NTSP accounts for uncertainties in setting the channel (e.g., calibration), uncertainties in how the channel might actually perform (e.g., repeatability), changes in the point of action of the channel over time (e.g., drift during surveillance intervals), and any other factors which may influence its actual performance (e.g., harsh accident environments). In this manner, the NTSP ensures that SLs are not exceeded. As such, the NTSP meets the definition of a LSSS (Ref. 7).

Technical Specifications contain values related to the OPERABILITY of equipment required for safe operation of the facility. OPERABLE is defined in Technical Specifications as "...being capable of performing its safety function(s)." Relying solely on the NTSP to define OPERABILITY in Technical Specifications would be an overly restrictive requirement if it were applied as an OPERABILITY limit for the "as-found" value of a protection channel setting during a Surveillance. This would result in Technical Specification compliance problems, as well as reports and corrective actions required by the rule which are not necessary to ensure safety. For example, an automatic protection channel device with a setting that has been found to be different from the NTSP due to some drift of the setting may still be OPERABLE because drift is to be expected. This expected drift would have been specifically accounted for in the setpoint methodology for calculating the NTSP and thus the automatic protective action would still have ensured that the SL would not be exceeded with the "as-found" setting of the protection channel. Therefore, the channel would still be OPERABLE because it would have performed its safety function and the only corrective action required would be to reset the channel within the established as-left tolerance around the NTSP to account for further drift during the next surveillance interval.

Note that, although the channel is OPERABLE under these circumstances, the trip setpoint must be left adjusted to a value within the as-left tolerance, in accordance with uncertainty assumptions stated in the referenced setpoint methodology (as-left criteria), and confirmed to be operating within the statistical allowances of the uncertainty terms assigned (as-found criteria).

However, there is also some point beyond which the channel may not be able to perform its function due to, for example, greater than expected drift. This value needs to be specified in the Technical Specifications in order to define OPERABILITY of the channels and is designated as the Allowable Value.

If the actual setting (as-found setpoint) of the channel is found to be conservative with respect to the Allowable Value but is beyond the as-found tolerance band, the channel is OPERABLE, but degraded. The degraded condition will be further evaluated during performance of the SR. This evaluation will consist of resetting the channel setpoint to the NTSP (within the allowed tolerance), and evaluating the channel response. If the channel is functioning as required and is expected to pass the next surveillance, then the channel is OPERABLE and can be restored to service at the completion of the surveillance. After the surveillance is completed, the channel as-found condition will be entered into the Corrective Action Program for further evaluation.

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Application Section: 16.3.3

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Question No. 16-111

The proposed ACTIONS Table and SR Table and Table 3.3.5-1 for generic TS 3.3.5 contains the following differences from STS 3.3.5B that do not appear to be justified or self consistent. The applicant is requested to conform to the STS phrasing and provisions, and suggested consistency changes, or justify the difference:

1. Suggest inserting "automatic" before "operating bypass removal channel" in Required Action C.2.2.

2. Completion Time for generic TS 3.3.5 Required Actions A.2 and C.2.2 should match STS ("Prior to entering MODE 2 following next MODE 5 entry");

3. Condition B should match STS and include "automatic ESFAS" before "trip channels inoperable."

4. The Required Action Note in Condition E and Condition F should say "Functions" instead of "function."

5. The Note in the Required Action column of Condition B, that states "LCO 3.0.4 is not applicable" with the unit in Condition B, is unnecessary, since the ACTIONS will permit operation to continue indefinitely with one automatic ESFAS trip channel in trip and one automatic ESFAS trip channel in bypass for affected RPS Function(s).

6. The logical connector between Required Actions C.2.1 and C.2.2 should align with the period before the last digit of the labels C.2.1 and C.2.2;

7. The Note in the Required Action column of Condition D, that states "LCO 3.0.4 is not applicable" with the unit in Condition D, is unnecessary, since the ACTIONS will permit operation to continue indefinitely with bypass removal channels disabled, or one affected automatic ESFAS trip channel in trip and one affected trip channel in bypass for affected RPS Function(s).

8. Required Actions C.1 and D.1, which say “Disable [automatic operating] bypass [removal] channel(s).” are unclear. Since the function being disabled is to automatically remove the bypass and enable the associated ESFAS trip channel, unbypassing the ESFAS trip channel would need to be done manually before reaching the reset setting. The applicant is requested to clarify the meaning of these action requirements.

9. In generic TS SR 3.3.5.2 and SR 3.3.5.3, insert “the” before “Setpoint Control Program.” In SR 3.3.5.3 insert “associated automatic operating” before “bypass removal function.”

10. In generic TS Table 3.3.5-1 in the second column heading (APPLICABLE MODES or OTHER SPECIFIED CONDITIONS), “or” should be “OR”; also, the Applicability should be stated for each ESFAS trip instrument Function (trip signal from each bistable processor), and not for the ESFAS signal from coincidence logic, and processed through initiation logic and actuation logic, which is covered by LCO 3.3.6.

11. Justify not including Mode 4 in the Applicability of generic TS Table 3.3.5-1 Functions 3a, Containment Isolation Actuation Signal (CIAS) on Containment Pressure – High and 3b, CIAS on Pressurizer Pressure – Low; else add Mode 4 and revise the Required Action Notes for ACTIONS E and F and associated Bases discussions accordingly.

12. The Required Action Notes for ACTIONS E and F should appear above Required Action E.1 and F.1, respectively, and span the width of the Required Action column. (See Writer’s Guide Section 5.1.8.) Alternatively, these Notes may be moved to the Condition column to be in line with the Condition letter and should span the width of the Condition statement.

Response

The following changes will be made to TS 3.3.5 to be consistent with STS 3.3.5:

1. The word “automatic” will be inserted before “operating bypass removal channel” in Required Action C.2.2 and included in the associated Bases paragraph.

2. The completion time for Required Actions A.2 and C.2.2 will be changed to “Prior to entering MODE 2 following next MODE 5 entry” and the Bases will be changed to be consistent with the wording.

3. The phrase “automatic ESFAS” will be added to Condition B.

4. The word “functions” in the Required Action Note in Condition E and Condition F will be changed to “Functions.”

5. The Note in the Required Action column of Condition B will be deleted.

6. The logical connector “AND” between Required Actions C.2.1 and C.2.2 will be aligned with the period before the last digit of the labels C.2.1 and C.2.2.

7. The Note in the Required Action column of Condition D will be deleted.

8. Required Actions C.1, which states “Disable bypass channel” means that if the inoperable bypass removal function for any bypass channel cannot be restored to an OPERABLE status within 1 hour (except for the case that the bypass is not in effect), the associated trip channel

must be declared inoperable as stated in Condition A. Required Action D.1, which states "Disable bypass channels" means that if the inoperable bypass removal function for two bypass channels cannot be restored to OPERABLE status within 1 hour (except for the case that the bypass is not in effect), the associated trip channels must be declared inoperable as stated in Condition B.

9. The word "the" in generic TS SR 3.3.5.2 and SR 3.3.5.3 will be inserted before "Setpoint Control Program." The phrase "automatic operating" will be inserted before "bypass removal function" described in SR 3.3.5.3 to be consistent with RAI 239-8076, Question 16-90.

10. The word "or" described in the second column heading of generic TS Table 3.3.5-1 will be changed to "OR." Since the scheme to state the Applicability is consistent with that applied in NUREG-1432, Rev. 4, and is also the same as Table 3.3.1 in the generic TS and with NUREG-1432, Rev. 4, the current description to state the applicability will be maintained.

11. Applicable Modes for ESFAS functions such as SIAS, CSAS, and MSIS in generic TS Table 3.3.5-1 are extended from Modes 1, 2, and 3 to Modes 1, 2, 3, and 4 in order to enhance the safety of nuclear power plants. This approach is more conservative than NUREG-1432, Rev. 4; however, it is not necessary to add Mode 4 to CIAS based on operating experience from the Korean operating fleet. Therefore, no revision pertaining to Applicable Modes is necessary.

12. The required Action Notes for ACTIONS E and F will be moved to above Required Actions E.1 and F.1. The width of the Note in the Required Action column will be extended to span the entire column.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

Technical Specification 3.3.5 and Bases will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

3.3 INSTRUMENTATION

3.3.5 Engineered Safety Features Actuation System (ESFAS) Instrumentation

LCO 3.3.5 Four ESFAS trip channels and associated operating bypass removal channels for each Function in Table 3.3.5-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.5-1.

ACTIONS

----- NOTE -----

1. Separate Condition entry is allowed for each ESFAS Function.
2. When one channel is bypassed and the bypassed condition exceeds 7 days duration, it shall be reviewed in 24 hours whether to maintain the operation in bypassed condition within the specified Completion Time of the Required Action A.2 or administrative controls.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more Functions with one automatic ESFAS trip channel inoperable.	A.1 Place trip channel in bypass or trip.	1 hour
	AND	
	A.2 Restore trip channel to OPERABLE status.	~~Prior to next entry into MODE 2 following entry into MODE 5~~ Prior to entering MODE 2 following next MODE 5 entry
B. One or more Functions with two [automatic ESFAS] trip channels inoperable.	~~----- NOTE ----- LCO 3.0.4 is not applicable. -----~~	
	B.1 Place one trip channel in bypass and the other in trip.	1 hour

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One or more Functions with one automatic operating bypass removal channel inoperable.	C.1 Disable bypass channel.	1 hour
	OR	
	C.2.1 Place affected automatic trip channel in bypass or trip.	1 hour
	AND	
	C.2.2 Restore automatic operating bypass removal channel and associated automatic trip channel to OPERABLE status.	~~Prior to next entry into MODE 2 following entry into MODE 5~~ Prior to entering MODE 2 following next MODE 5 entry
D. One or more Functions with two automatic operating bypass removal channels inoperable.	~~NOTE~~ ~~LCO 3.0.4 is not applicable.~~	
	D.1 Disable bypass channels.	1 hour
	OR	
	D.2 Place one affected automatic trip channel in bypass and place the other in trip.	1 hour

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. Required Action and associated Completion Time not met.	E.1 ------------ NOTE ------------ Only applicable to ~~functions~~ 3, 5, and 6 of Table 3.3.5-1. ----------------------------------	
	Be in MODE 3.	6 hours
	AND	
	E.2 Be in MODE 4.	12 hours
F. Required Action and associated Completion Time not met.	E.1 ------------ NOTE ------------ Only applicable to ~~functions~~ 1, 2, and 4 of Table 3.3.5-1. ----------------------------------	
	Be in MODE 3.	6 hours
	AND	
	F.2 Be in MODE 5.	36 hours

Delete

E.1

Functions

Expand the width to fit the cell

Delete

F.1

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.5.1	Perform CHANNEL CHECK of each ESFAS channel.	12 hours
SR 3.3.5.2	Perform CHANNEL FUNCTIONAL TEST of each ESFAS channel in accordance with the Setpoint Control Program.	31 days
SR 3.3.5.3	Perform CHANNEL CALIBRATION of each ESFAS channel, including automatic operating bypass removal function in accordance with the Setpoint Control Program.	18 months
SR 3.3.5.4	Verify ESFAS RESPONSE TIME is within limits.	18 months on a STAGGERED TEST BASIS
SR 3.3.5.5	Perform CHANNEL FUNCTIONAL TEST on each automatic operating bypass removal channel.	Once within 31 days prior to each reactor startup

Table 3.3.5-1 (Page 1 of 1)
Engineered Safety Features Actuation System Instrumentation

FUNCTION	APPLICABLE MODES ~~or~~ OR OTHER SPECIFIED CONDITIONS
1. Safety Injection Actuation Signal a. Containment Pressure – High b. Pressurizer Pressure – Low[a]	1, 2, 3, 4
2. Containment Spray Actuation Signal a. Containment Pressure – High High	1, 2, 3, 4
3. Containment Isolation Actuation Signal a. Containment Pressure – High b. Pressurizer Pressure – Low[a]	1, 2, 3
4. Main Steam Isolation Signal a. Steam Generator Pressure – Low[c] b. Containment Pressure – High c. Steam Generator Level – High	1, 2[b], 3[b], 4
5. Auxiliary Feedwater Actuation Signal SG #1 (AFAS-1) a. Steam Generator Level – Low	1, 2, 3
6. Auxiliary Feedwater Actuation Signal SG #2 (AFAS-2) a. Steam Generator Level – Low	1, 2, 3

(1) The setpoint may be manually decreased to a minimum value of 7.0 kg/cm^2A (100 psia), as pressurizer pressure is reduced, provided the margin between pressurizer pressure and the setpoint is maintained ≤ 28.1 kg/cm^2 (400 psi). Trips may be bypassed when pressurizer pressure is < 28.1 kg/cm^2A (400 psia). Bypass shall be automatically removed when pressurizer pressure is ≥ 35.2 kg/cm^2A (500 psia). The setpoint shall be automatically increased to the normal setpoint as pressurizer pressure is increased.

(2) Main Steam Isolation Signal (MSIS) Function (Steam Generator Pressure – Low, Containment Pressure – High, and Steam Generator Level – High signals) is not required to be OPERABLE when all associated valves isolated by the MSIS Function are closed and deactivated.

(3) The setpoint may be decreased as steam pressure is reduced, provided the margin between steam pressure and the setpoint is maintained ≤ 14.1 kg/cm^2 (200 psi). The setpoint shall be automatically increased to the normal setpoint as steam pressure is increased.

BASES

ACTIONS (continued)

3. CIAS

Containment Pressure – High
Pressurizer Pressure – Low

4. MSIS

Steam Generator Pressure – Low
Containment Pressure – High
Steam Generator Level – High

5. AFAS-1

Steam Generator #1 Level – Low

6. AFAS-2

Steam Generator #2 Level – Low

automatic ESFAS trip

ESFAS coincidence logic is normally two-out-of-four.

If one ~~ESFAS~~ channel is inoperable, startup or power operation is allowed to continue providing the inoperable channel is placed in bypass or trip within 1 hour (Required Action A.1).

The Completion Time of 1 hour allotted to restore, bypass, or trip the channel is sufficient to allow the operator to take all appropriate actions for the failed channel and still ensures that the risk involved in operating with the failed channel is acceptable.

The failed channel is restored to OPERABLE status prior to ~~next~~ entry into MODE 2 following entry into MODE 5. With a channel bypassed, the coincidence logic is in a two-out-of-three configuration. In this configuration, common cause failure of dependent channels cannot prevent trip.

next

The Completion Time of prior to ~~next~~ entry into MODE 2 following entry into MODE 5 is based on adequate channel to channel independence, which allows a two-out-of-three channel operation, since no single failure will prevent a ESFAS initiation.

BASES

ACTIONS (continued)

B.1

The Required Action is modified by a Note stating that LCO 3.0.4 is not applicable. The Note was added to allow the changing of MODES even though two channels are inoperable, with one channel bypassed and one tripped. In this configuration, the protection system is in a one-out-of-two logic, which is adequate to ensure that no random failure will prevent protection system operation.

Condition B applies to the failure of two channels of one or more input parameters in any ~~AFAS~~ ESFAS automatic trip Function as following:

1. SIAS

   Containment Pressure – High
   Pressurizer Pressure – Low

2. CSAS

   Containment Pressure – High High

3. CIAS

   Containment Pressure – High
   Pressurizer Pressure – Low

4. MSIS

   Steam Generator Pressure – Low
   Containment Pressure – High
   Steam Generator Level – High

5. AFAS-1

   Steam Generator #1 Level – Low

6. AFAS-2

   Steam Generator #2 Level – Low

automatic ESFAS trip

BASES

ACTIONS (continued)

With two inoperable channels, power operation may continue, provided one inoperable channel is placed in bypass and the other channel is placed in trip within 1 hour. With one channel of protection instrumentation bypassed, the ESFAS Function is in two-out-of-three logic in the bypassed input parameter, but with another channel failed, the ESFAS could be operating with a two-out-of-two logic. This is outside the assumptions made in the analyses and should be corrected. To correct the problem, the second channel is placed in trip. This places the ESFAS Function in a one-out-of-two logic. If any of the other OPERABLE channels receives a trip signal, ESFAS actuation will occur.

automatic ESFAS trip

One of the two inoperable channels will need to be restored to OPERABLE status prior to the next required CHANNEL FUNCTIONAL TEST because channel surveillance testing on an OPERABLE channel requires that the OPERABLE channel be placed in bypass. However, it is not possible to bypass more than one ESFAS channel, and placing a second channel in trip will result in an ESFAS actuation. Therefore, if one ESFAS channel is in trip and a second channel is in bypass, a third inoperable channel would place the unit in LCO 3.0.3.

<u>C.1, C.2.1 and C.2.2.</u>

Condition C applies to one automatic operating bypass removal function inoperable. The only automatic operating bypass removal on an ESFAS is on the Pressurizer Pressure – Low signal. This bypass removal is shared with the RPS Pressurizer Pressure – Low bypass removal.

If the bypass removal function for any operating bypass cannot be restored to OPERABLE, the associated ESFAS channel may be considered OPERABLE only if the operating bypass is not in effect. Otherwise the affected ESFAS channel must be declared inoperable, as in Condition A, and the bypass either removed, or the operating bypass removal channel repaired. The Bases for the Required Actions and required Completion Times are consistent with Condition A.

automatic

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Date of RAI Issued: **11/05/2015**

Question No. 16-112

The applicant is requested to consider the following suggested clarifications and corrections to the "Background" section of the Bases for generic TS 3.3.5:

1. On page B 3.3.5-4, second paragraph under the heading "ESFAS Logic", the fourth sentence should end with the phrase "coincidence logic state" not "coincidence logics state." The applicant is requested to remove the letter "s" from "logics" for clarity, or otherwise revise the sentence to clarify the intended meaning.

2. On page B 3.3.5-5, the applicant is requested to revise the first two paragraphs consistent with the following suggested markup by the staff:

   The actuation logic in each channel of ESF-CCS takes part in actuating the equipment of the corresponding ESF~~AS~~ train. Each ESFAS Function has individual actuation logic in each channel of the ESF-CCS.

   The initiation logic performs the ~~logical "OR" of~~ selective 2-out-of-4 logic (logical "OR"; channel A or C AND channel B or D; but not channels A and C OR channels B and D) on the LCL outputs for each ESFAS Function, to generate the ESF actuation signal ~~and sends the ESFAS signal~~ to the ESF-CCS component control logic.

3. On page B 3.3.5-5, the third paragraph uses the phrase "serial data link for group and loop controllers." A word search of DCD Chapter 16 found no other instances of the use of the terms "group controller(s)" and "loop controller(s)."

   Staff understands that, for each channel (Division A, B, C, or D) of an ESFAS Function, the Engineered Safety Features Component Control System (ESF-CCS) includes:

- Two redundant Group Controllers (GC1 and GC2) that independently perform the “initiation logic” function—the ″selective 2-out-of-4 logic” processing of the coincidence logic output signals received from the Local Coincidence Logic (LCL) processors in all four Plant Protection System (PPS) channels. For example, for ESFAS Division A, the coincidence logic trip signals received from the four PPS channels are labeled A1, B1, C1, and D1, and for ESFAS Division B, they are labeled A2, B2, C2, and D2. The selective 2-out-of-4 logic in Division A is “A1 or C1 AND B1 or D1”; and in Division B, it is “A2 or C2 AND B2 or D2.”

- A Loop Controller (LC), with a primary and a backup processor module (PM1 and PM2), that processes the GC1 and GC2 ESF actuation signals, respectively, with the ESF component control logic to generate and send component control signals to the component interface module (CIM) of each actuated device in the respective ESF train.

a. The applicant is requested to verify the accuracy of the above description of the LCL for coincidence logic, the GC for initiation logic, and the LC for actuation logic; the actuation logic is apparently considered by Table 3.3.6-1 to include the ESFAS Division’s component control logic.

b. The applicant is requested to describe the functions and purposes of the equipment listed in the subject paragraph by expanding the subject Bases paragraph, which confusingly states:

> The ESF-CCS comprises power supply, manual switch, latching logic and serial data link for group and loop controllers.

4. The fourth paragraph on page B 3.3.5-5 is confusing and appears to be inaccurate. It states:

> Each ESFAS Function has sub groups and each sub group is in charge of one- or more ESFAS Functions. The initiation and actuation logics to the sub groups are identified in LCO 3.3.6.

The “ESFAS function sub groups” do not appear to be listed or defined in any kind of detail anywhere in the DCD, the Safety I&C TeR, or the Bases for generic TS 3.3.6. Therefore, the applicant is requested to (1) add this information to the APR1400 DC application; and (2) revise the above paragraph so it is accurate, clear, and informative regarding ESFAS function sub groups.

5. The applicant is requested to revise the fifth paragraph on page B 3.3.5-5 for clarity beginning with the fourth sentence, consistent with the following markup:

> Bypassing the same parameter in more than one channel is restricted by ~~the~~ administrative procedure. The coincidence logic becomes 2-out-of-3 coincidence logic. ~~All-bypass~~ The all-bypass function for bypassing all parameters in ~~the~~ an ESFAS channel is interlocked in the LCL algorithm to prevent simultaneous bypass of more than one channel. The all-bypass function interlock is implemented ~~based on~~ with an analog circuit ~~through~~ and hardwired cable between the LCLs in all channels.

The purpose of the all-bypass function is to support testing and maintenance of the BP, whereas the trip channel bypass is used ~~against~~ in case of sensor failure.

6. The applicant is requested to revise the seventh paragraph on page B 3.3.5-5 for clarity, consistent with the following markup:

   An enabled operating ~~Operating~~ bypass function does not block ~~protects~~ the output of trip and alarm signals from the bistable processor to the IPS and QIAS-N. The Pressurizer Pressure – Low input to the SIAS shares an operating bypass with the Pressurizer Pressure – Low reactor trip.

Response

The following changes will be made to the "Background" section of the Bases for generic TS 3.3.5:

1. The phrase "coincidence logics state" described on page B 3.3.5-4 will be changed to "coincidence logic state" along with those on pages B 3.3.1-8, B 3.3.4-3, and B 3.3.6-2.

2. The local coincidence logic (LCL) and initiation logic are sequentially located in the LCL processor. The LCL performs the 2-out-of-4 logic and then the initiation logic receiving the LCL outputs performs the "OR" logic to generate the ESF actuation signal to the ESF-CCS actuation logic. Therefore, the first two paragraphs on page B 3.3.5-5 will be changed as follows:

   "The actuation logic in each channel of ESF-CCS takes part in actuating the equipment of the corresponding ESF train. Each ESFAS Function has individual actuation logic in each channel of the ESF-CCS.

   The initiation logic performs the logical "OR" of LCL outputs for each ESFAS Function, to generate the ESF actuation signal to the ESF-CCS actuation logic.

3.a Two redundant Group Controllers (GC1 and GC2) located in each ESF-CCS cabinet independently perform the "actuation logic" function that processes the "selective 2-out-of-4 logic" using the initiation logic output signals from the LCL processors in all four PPS channels. The description pertaining to the Loop Controller (LC) is correct. The additional detailed information regarding the ESF-CCS is described in DCD Tier 2, Section 7.3, "Engineered safety Features Systems."

3.b Since the detailed ESF-CCS configuration is described in DCD Tier 2, Section 7.3 and is not directly related to the safety functions covered in Technical Specification, the third paragraph will be deleted.

4. The information regarding the ESFAS subgroups is stated in Section 7.3.2.5 of DCD Tier 2 and Section 4.4.2 of the Safety I&C TeR.

   The fourth paragraph on page B 3.3.5-5 will be revised to be consistent with the information stated in Section 7.3.2.5 of DCD Tier 2 and Section 4.4.2 of the Safety I&C TeR as follows:

Each ESFAS Function has an associated group of outputs. Each group of outputs is divided into subgroups. Outputs within a subgroup are tested concurrently and are selectively arranged so that concurrent actuation does not adversely affect plant operations. The initiation and actuation logics to the subgroups are addressed in LCO 3.3.6.

5. The fifth paragraph on page B 3.3.5-5 will be revised to be consistent with the proposed markup provided in the request.

6. Since an enabled operating bypass function does block the output of trip and alarm signals from the bistable processor, the seventh paragraph on page B 3.3.5-5 will be revised as follows:

   An enabled operating bypass function blocks the output of trip and alarm signals from the bistable processor to the LCL, IPS, and QIAS-N. The Pressurizer Pressure – Low input to the SIAS shares an operating bypass with the Pressurizer Pressure – Low reactor trip.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

The TS Bases for TS 3.3.5 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

BASES

BACKGROUND (continued)

logic

Each LCL receives four trip signals, one from its associated bistable logic in the channel and one from each of the equivalent bistable logic located in the other three channels. The LCL also receives the trip channel bypass status signals associated with each of the above mentioned bistables. The function of the LCL is to generate a coincidence signal whenever two or more like bistables are in a tripped condition. The LCL takes into consideration the trip bypass input state when determining the coincidence ~~logics~~ state. Designating the protection channels as A, B, C, and D, with no trip bypass present, the LCL will produce a coincidence signal for any of the following trip inputs: AB, AC, AD, BC, BD, CD, ABC, ABD, ACD, BCD, and ABCD. These represent all possible two or more trip combinations of the four protection channels. Should a trip bypass be present, the logic will provide a coincidence signal when two or more of the three un-bypassed bistables are in a tripped condition.

On a system basis, a coincidence signal is generated in all four protection channels whenever a coincidence of two or more like bistables of the four channels are in a tripped state.

In addition to a coincidence signal, each LCL also provides bypass status outputs. The bypass status is provided to verify that a bypass has actually been entered into the logic either locally or remotely via the maintenance and test panel or the operator's module.

The inputs to the initiation logic are the LCL outputs from the appropriate LCLs. The LCL outputs are arranged in the initiation circuit to provide two-out-of-four coincidence. This configuration will avoid spurious channel initiation in the event of a single LCL processor or digital output module failure. The RPS initiation logic consists of an "OR" circuit for each undervoltage and shunt trip relay and de-energizes interposing relays. Each interposing relay opens one switchgear in RTSG in turn.

Each trip path is responsible for opening two of eight RTSGs. The PPS interfaces with the undervoltage trip device of RTSS breakers. The DPS interfaces with the shunt trip device of the RTSS breakers. The actuation of either the undervoltage or the shunt trip device interrupts power from the motor generator (MG) sets to the control element drive mechanisms (CEDMs).

BASES

BACKGROUND (continued)

logic

The LCL takes into consideration the trip bypass input state when determining the coincidence ~~logics~~ state. Designating the protection channels as A, B, C, D, with no trip bypass present, the LCL will produce a coincidence signal for any of the following trip inputs: AB, AC, AD, BC, BD, CD, ABC, ABD, ACD, BCD, ABCD. These represent all possible two- or more out-of-four trip combinations of the four protection channels. Should a trip bypass be present, the logic will provide a coincidence signal when two or more of the three un-bypassed bistables are in a tripped condition.

On a system basis, a coincidence signal is generated in all four protection channels whenever a coincidence of two or more like bistables of the four channels are in a tripped state.

In addition to a coincidence signal, each LCL also provides bypass status outputs. The bypass status is provided to verify that a bypass has actually been entered into the logic either locally or remotely via the maintenance and test panel or the operator's module.

The inputs to the initiation logic are the LCL outputs from the appropriate LCLs. The LCL outputs are arranged in the initiation circuit to provide selective two-out-of-four coincidence. This configuration will avoid spurious channel initiation in the event of a single LCL processor or digital output module failure.

The RPS initiation logic consists of an "OR" circuit for each undervoltage and de-energizes interposing relays. Each interposing relay opens one switchgear in RTSG in turn.

It is possible to change the two-out-of-four RPS logic to a two-out-of-three logic for a given input parameter in one channel at a time by trip channel bypassing.

BASES

BACKGROUND (continued)

Setpoints in accordance with the Allowable Value will ensure that Safety Limits (SLs) are not violated during AOOs and the consequences of design basis accidents (DBAs) will be acceptable, providing the plant is operated from within the LCOs at the onset of the AOO or DBA and the equipment functions as designed.

Functional testing of the ESFAS, from the bistable input through the output to the ESFAS actuation logic, can be performed either at power or shut down, and is normally performed on a monthly basis (31 days). DCD Tier 2, Section 7.2 (Reference 6) provides more detail on ESFAS testing. Process transmitter calibration is normally performed on a refueling basis. SRs for the channels are specified in the Surveillance Requirements section.

ESFAS Logic

The ESFAS logic, consisting of initiation logic channel and actuation logic, employs a scheme that provides an ESF actuation of all trains when bistables in any two of the four channels sensing the same input parameter trip. This is called a two-out-of-four trip logic.

Each LCL receives four trip signals, one for its associated bistable logic in the channel and one from each of the equivalent bistable logic located in the other three channels. The LCL receives the trip channel bypass status associated with each of the above mentioned bistables. The function of the LCL is to generate a coincidence signal whenever two or more like bistables are in a tripped condition. The LCL takes into consideration the trip bypass input state when determining the coincidence ~~logics~~ logic state. Designating the protection channels as A, B, C, D, with no trip bypass present, the LCL will produce a coincidence signal for any of the following trip inputs: AB, AC, AD, BC, BD, CD, ABC, ABD, ACD, BCD, ABCD. These represent all possible two- or more out-of-four trip combinations of the four protection channels. Should a trip bypass be present, the logic will provide a coincidence signal when two or more of the three un-bypassed bistables are in a tripped condition.

On a system basis, a coincidence signal is generated in all four protection channels whenever a coincidence of two or more like bistables of the four channels are in a tripped state. The local coincidence trip output in coincidence logic is used as an input to the initiation logic. This signal is sent to actuation logic in each channel of ESF-CCS.

BASES

BACKGROUND (continued)

The ESFAS function is performed through the below portions in the ESF system.

a. Measurement channels

b. Bistable logic

c. ESFAS logic:

- Coincidence Logic
- Initiation Logic (trip paths)
- Actuation Logic

This LCO addresses ESFAS logic. Bistable logic and measurement channel are addressed in LCO 3.3.5, "Engineered Safety Features Actuation System (ESFAS) Instrumentation."

The role of the measurement channel and bistable logic is described in LCO 3.3.5. The role of the ESFAS logic is described below.

<u>ESFAS Logic</u>

The ESFAS logic, consisting of coincidence, initiation and actuation logic, employs a scheme that provides an ESF actuation of four divisions when bistables in any two of the four channels sense the same input parameter trip. This is called a two-out-of-four trip logic.

<u>Coincidence Logic</u>

There is one local coincidence logic (LCL) associated with each trip bistable logic of each channel. Each LCL receives four trip signals, one for its associated bistable logic in the channel and one from each of the equivalent bistable logic located in the other three channels. The LCL receives the trip channel bypass status associated with each of the above mentioned bistables. The function of the LCL is to generate a coincidence logic trip whenever two or more like bistables are in a tripped condition. The LCL takes into consideration the trip bypass input state when determining the coincidence ~~logics~~ logic state.

The actuation logic in each channel of ESF−CCS takes part in actuating the equipment of the corresponding ESF train. Each ESFAS Function has individual actuation logic in each channel of the ESF−CCS.

The initiation logic performs the logical "OR" of LCL outputs for each ESFAS Function, to generate the ESF actuation signal to the ESF−CCS actuation logic.

The actuation logic in each channel of ESF-CCS takes part in corresponding ESFAS train. Each ESF Function has individual actuation logic in each channel of ESF-CCS.

The initiation logic performs the logical "OR" of LCL outputs for each ESFAS signal and sends the ESFAS signal to ESF-CCS

~~The ESF-CCS comprises power supply, manual switch, latching logic and serial data link for group and loop controllers.~~

Each ESFAS Function has an associated group of outputs. Each group of outputs is divided into subgroups. Outputs within a subgroup are tested concurrently and are selectively arranged so that concurrent actuation does not adversely affect plant operations. The initiation and actuation logics to the subgroups are addressed in LCO 3.3.6.

Each ESFAS Function has sub groups and each sub group is in charge of one- or more ESFAS Functions. The initiation and actuation logics to the sub groups are identified in LCO 3.3.6.

By trip channel bypassing one input parameter for a channel, the two-out-of-four ESFAS coincidence logic shall be converted to two-out-of-three. Though the bypass produces trip indication and alarm in the bistable processor, the LCL does not accept the corresponding input signal as an input for actuation. Different parameters may be simultaneously bypassed, either in one channel or in different channels. Bypassing the same parameter in more than one channel is restricted by ~~the~~ administrative procedure. The coincidence logic becomes 2-out-of-3 coincidence logic. The all-bypass ~~All-bypass~~ function for bypassing all parameters in an ESFAS ~~the~~ channel is interlocked in the LCL algorithm to prevent simultaneous bypass of more than one channel. The all-bypass function interlock is implemented ~~based on~~ with an analog circuit and ~~through~~ hardwired cable between the LCLs in all channels. The purpose of all-bypass function is to support testing and maintenance of the BP whereas the trip channel bypass is used ~~against~~ in case of sensor failure.

In addition to the trip channel bypasses, there are also operating bypasses for ESFAS actuation trip. These bypasses are enabled manually, in all four channels, when plant conditions do not warrant the specific trip protection. All operating bypasses are automatically removed when enabling bypass conditions are no longer satisfied.

An enabled operating bypass function blocks the output of trip and alarm signals from the bistable processor to the LCL, IPS, and QIAS−N. ~~Operating bypass protects the output of trip and alarm signals from bistable processor.~~ The Pressurizer Pressure – Low input to the SIAS shares an operating bypass with the Pressurizer Pressure – Low reactor trip.

When necessary, the operator can manually actuate the ESFAS in the MCR and local panel.

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.:	**295-8263**
SRP Section:	**16 – Technical Specifications**
Application Section:	**16.3.3**
Date of RAI Issue:	**11/05/2015**

Question No. 16-114

The proposed ACTIONS Table and SR Table and Table 3.3.6-1 for generic TS 3.3.6 contain the following differences from STS 3.3.6B that do not appear to be justified or self consistent. The applicant is requested to conform to the STS phrasing and provisions, and suggested consistency changes, or justify the difference:

1. Justify not including Mode 4 in the Applicability of generic TS Table 3.3.6-1 Functions 3a, Containment Isolation Actuation Signal (CIAS) Coincidence Logic, and 3b, CIAS Initiation Logic; else add Mode 4 and revise the Required Action Notes for ACTIONS E and F and associated Bases discussions accordingly.

2. The Required Action Notes for ACTIONS E and F should appear above Required Action E.1 and F.1, respectively, and span the width of the Required Action column. (See Writer's Guide Section 5.1.8.) Alternatively, these Notes may be moved to the Condition column to be in line with the Condition letter designator and should span the width of the Condition statement. In addition, neither Note includes Function 2, Containment Spray Actuation Signal, and Function 7, Diverse Manual ESF Actuation Signal (Switch on MCR Safety Console). The applicant is requested to explain this omission, or correct the error. Finally, staff suggest clarifying Conditions E and F to say:

   E. Required Action and associated Completion Time **of Condition A, B, or C** not met.

   F. Required Action and associated Completion Time **of Condition A, B, C, or D** not met.

3. The applicant is requested to explain the following concerning the Diverse Manual ESF Actuation Signal Function:

   a. Why does LCO 3.3.6 not explicitly refer to Diverse Manual ESF Actuation Signal

channels, Functions 7a through 7f? The "LCO" section of the Bases for generic TS 3.3.6 says "This LCO requires two channels of safety injection, containment spray, auxiliary feedwater, and one channel for each main steam isolation valve and one channel for containment isolation to be OPERABLE in MODES 1, 2, 3, and 4." But LCO 3.3.6 says, "Four channels of ESFAS Coincidence Logic, four channels of ESFAS Initiation Logic, four channels of Actuation Logic, and four channels of Manual Trip shall be OPERABLE for each Function in Table 3.3.6-1." The applicant is requested to consider revising Table 3.3.6-1 to include a "REQUIRED CHANNELS" column, and to revise LCO 3.3.6 to say: "The ESFAS Coincidence Logic, Initiation Logic, Actuation Logic, Manual Trip, and Diverse Manual ESF Actuation channels required for each Function in Table 3.3.6-1 shall be OPERABLE."

b. The last sentence of the Bases for Required Action D.1 needs clarification, and should say: "If the inoperable **Diverse Manual ESF Actuation** channel is not restored to OPERABLE status within 72 hours, ~~it~~ **Condition F** is entered ~~to the Condition F~~.

c. The applicant is requested to make the following corrections or justify the currently proposed text: Condition D should say: "One or more **Diverse Manual ESF Actuation** Functions with one ~~Diverse Manual ESF Actuation Channels~~ channel inoperable." Required Action D.1 should say: "Restore channels to OPERABLE ~~S~~status." Because separate condition entry is *apparently* allowed by the ACTIONS Table Note, for each Diverse Manual ESF Actuation Function. So, the ACTIONS Table Note should say: "Separate Condition entry is allowed for each ESFAS Function **and for each Diverse Manual ESF Actuation Function**.

d. Since only one Diverse Manual ESF Actuation channel is provided for each main steam isolation valve and only one Diverse Manual ESF Actuation channel is provided for containment isolation, the proposed rationale (in the Bases for Action D of generic TS 3.3.6) for the proposed 72 hour Completion Time to restore an inoperable channel to operable status is not acceptable for these two Diverse Manual ESF Actuation Functions. The applicant is requested to propose and justify a more restrictive restoration action Completion Time for these two Diverse Manual ESF Actuation Functions.

4. The applicant is requested to revise as indicated the first sentence of the Bases for Required Actions E.1 and E.2, and for Required Actions F.1 and F.2 of generic TS 3.3.6 to say "If ~~the~~ **any** Required Actions and associated Completion Time~~s for the~~ **of** Condition **A, B,** [**or C**] [**C, or D**] cannot be met, the plant must be brought to a MODE in which the LCO does not apply." Also, these Bases paragraphs should address the Required Action Note (or Condition Note if the Note is moved) and state which of the six sets of ESFAS Logic and Manual Trip Functions apply to each Action (E or F) and why; also, the Bases for Action F should say why only Action F applies to Functions 7a through 7f, Diverse Manual ESF Actuation Functions a. Safety Injection; b. Containment Spray; c. Auxiliary Feedwater (SG #1); d. Auxiliary Feedwater (SG #2); e. Main Steam Isolation per MSIV; and f. Containment Isolation.

5. For consistency in terminology, the applicant is requested to revise the surveillance column Note for SR 3.3.6.1, as indicated by the markup, to say: "Testing of Actuation Logic shall include the verification of proper operation of each actuation **circuit** ~~signal~~." Also for clarity,

the applicant is requested to revise the surveillance column Notes for SR 3.3.6.2, as indicated by the markup, to say:

-------------------------------NOTE**S**-----------------------------
1. Components exempt from testing during operation shall be tested once every 18 month**s** (MODE 6) or in MODE 5 if not tested ~~until~~ **within** the previous 62 days.
2. Subgroup of Actuation Logic channel A, C and B, D shall be tested on a staggered basis.

Response

The following changes will be made to TS 3.3.6 to be consistent with STS 3.3.5B:

1. Regarding the coincidence logic and initiation logic located in the PPS, applicable MODES for ESFAS functions such as SIAS, CSAS, and MSIS in generic TS Table 3.3.6-1 are extended from MODES 1, 2, and 3 to MODES 1, 2, 3, and 4 in order to enhance the safety of nuclear power plants. This approach is consistent with applicable MODES for ESFAS functions such as SIAS, CSAS, and MSIS in generic TS Table 3.3.5-1. Therefore, no revision pertaining to applicable MODES is necessary.

2. The Required Action Notes for ACTIONS E and F will be moved to above Required Actions E.1 and F.1. The width of the Note in the Required Action column will be extended to span the entire column.

   The Required Action Notes for ACTIONS E and F will be changed to “Applies to Functions 3, 5, and 6 of Table 3.3.6-1” and “Applies to Functions 1, 2, 4, and 7 of Table 3.3.6-1,” respectively.

   Conditions E and F will be revised to include the associated Conditions.

3.a LCO 3.3.6 will be changed to state “The ESFAS Coincidence Logic, Initiation Logic, Actuation Logic, Manual Trip, and Diverse Manual ESF Actuation channels required for each Function in Table 3.3.6-1 shall be OPERABLE.” In addition, Table 3.3.6-1 will be revised to include a “REQUIRED CHANNELS” column.

3.b The last sentence of the Bases for Required Action D will be changed to state “If the inoperable Diverse Manual ESF Actuation channel is not restored to OPERABLE status within 72 hours, Condition F is entered.

3.c The Condition D will be changed to state “One or more Diverse Manual ESF Actuation Functions with one channel inoperable.” The Required Action D will be changed to state “Restore inoperable channel to OPERABLE status.” The ACTIONS Table Note will be changed to state “Separate Condition entry is allowed for each ESFAS Function and for each Diverse Manual ESF Actuation Function.”

3.d The Diverse Manual ESF Actuation Function requires that the operator manually actuate ESF systems from the MCR after a postulated common cause failure of the PPS and ESF-CCS. The probability for a multiple failure in the automatic ESFAS actuation logic and other manual controls within the 72 hour duration is low. Therefore, the proposed 72 hour Completion Time to restore an inoperable channel to operable status is reasonable based on operating experience for the repair and restoration of the diverse manual ESF equipment.

4. The first sentence of the Bases for Required Actions E.1 and E.2, and for Required Actions F.1 and F.2 of generic TS 3.3.6 will be changed to state “If any Required Actions and associated Completion Time of Condition A, B, or C cannot be met, the plant must be brought to a MODE in which the LCO does not apply,” and “If any Required Actions and associated Completion Time of Condition A, B, C, or D cannot be met, the plant must be brought to a MODE in which the LCO does not apply,” respectively.

   The following sentence will be added to the Bases for Required Action E.1 and E.2.

   “A Note to the Required Action indicates that Functions 3, 5, and 6 of Table 3.3.6-1 are applicable.”

   The following sentence will be added to the Bases for Required Action F.1 and F.2.

   “A Note to the Required Action indicates that Functions 1, 2, 4, and 7 of Table 3.3.6-1 are applicable. Since the applicable MODES for the Diverse Manual ESF Actuation Function are 1, 2, 3, and 4, Action F applies to Function 7 in Table 3.3.6-1. This takes the plant out of the applicable MODES and restores the plant to operation within the bounds of the safety analyses.”

5. The surveillance column Note for SR 3.3.6.1 will be revised to change the word ‘signal’ to ‘circuit’.

   The surveillance column Notes for SR 3.3.6.2 will be revised as follows:

   -------------------------------NOTES-----------------------------
   1. Components exempt from testing during operation shall be tested once every 18 months (MODE 6) or in MODE 5 if not tested within the previous 62 days.
   2. Subgroup of Actuation Logic channel A, C and B, D shall be tested on a staggered basis.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

Technical Specifications 3.3.6 and the associated Bases will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

3.3 INSTRUMENTATION

3.3.6 Engineered Safety Features Actuation System (ESFAS) Logic and Manual Trip

LCO 3.3.6 ~~Four channels of ESFAS Coincidence Logic, four channels of ESFAS Initiation Logic, four channels of Actuation Logic, and four channels of Manual Trip shall be OPERABLE for each Function in Table 3.3.6-1.~~

The ESFAS Coincidence Logic, Initiation Logic, Actuation Logic, Manual Trip, and Diverse Manual ESF Actuation channels required for each Function in Table 3.3.6−1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.6-1.

ACTIONS

-- NOTE --

~~Separate Condition entry is allowed for each ESFAS Function.~~

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more Functions with one Coincidence Logic channel, Initiation Logic channel, or Manual Trip channel inoperable.	A.1 Restore channel to OPERABLE status.	48 hours
B. One or more Functions with two Initiation Logic channels affecting the same trip leg inoperable.	B.1 Open at least one contact in affected trip leg of both ESFAS Actuation Logic channels. AND B.2 Restore channels to OPERABLE status.	Immediately 48 hours

Separate Condition entry is allowed for each ESFAS Function and for each Diverse Manual ESF Actuation Function.

One or more Diverse Manual ESF Actuation Functions with one channel inoperable.

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One or more Functions with one Actuation Logic channel inoperable.	~~C.~~ ------------ NOTE ------------ One channel of Actuation Logic may be bypassed for up to 1 hour for Surveillances, provided the other channel is OPERABLE. ------------------------------ [Expand the width to fit the cell]	
	C.1 Restore inoperable channel to OPERABLE status.	48 hours
D. ~~One or more Functions with one Diverse Manual ESF Actuation Channels inoperable~~	D. ~~Restore channels to OPERABLE Status.~~ Restore inoperable channel to OPERABLE status.	72 hours
E. Required Action and associated Completion Time of Condition A, B, or C not met.	~~E.~~ ------------ NOTE ------------ Applies ~~only~~ to Functions 3, ~~5~~ 5, and 6 of Table 3.3.6-1 ------------------------------ [Expand the width to fit the cell]	
	E.1 Be in MODE 3.	6 hours
	AND	
	E.2 Be in MODE 4.	12 hours
F. Required Action and associated Completion Time of Condition A, B, C, or D not met.	~~F.1~~ ------------ NOTE ------------ ~~Applies only to Functions 1 and 4 of Table 3.3.6-1.~~ Applies to Functions 1, 2, 4, and 7 of Table 3.3.6−1. ------------------------------	
	F.1 Be in MODE 3.	6 hours
	AND	
	F.2 Be in MODE 5.	36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.6.1	------------------ NOTE ------------------ Testing of Actuation Logic shall include the verification of proper operation of each actuation ~~signal~~. [circuit] -- Perform CHANNEL FUNCTIONAL TEST on each ESFAS logic channel and Manual ESF Actuation channel.	31 days
SR 3.3.6.2	~~------------------ NOTE ------------------ Components exempt from testing during operation shall be tested once every 18 month(MODE 6) or in MODE 5 if not tested until the previous 62 days. Subgroup of Actuation Logic channel A, C and B, D shall be tested on a staggered basis. --~~ Perform a verification of the OPERABILITY of subgroup for Actuation signal of each Actuation Logic channel	31 days on a STAGGERED TEST BASIS
SR 3.3.6.3	Perform CHANNEL FUNCTIONAL TEST on each Diverse Manual ESF Actuation channel	18 months

------------------ NOTES ------------------
1. Components exempt from testing during operation shall be tested once every 18 months (MODE 6) or in MODE 5 if not tested within the previous 62 days.
2. Subgroup of Actuation Logic channel A, C and B, D shall be tested on a staggered basis.

Table 3.3.6-1 (Page 1 of 2)
Engineered Safety Features Actuation System Logic and Manual Trip Applicability

FUNCTION	APPLICABLE MODES
1. Safety Injection Actuation Signal	
a. Coincidence Logic	1, 2, 3, 4
b. Initiation Logic	1, 2, 3, 4
c. Actuation Logic	1, 2, 3, 4
d. Manual Trip	1, 2, 3, 4
2. Containment Spray Actuation Signal	
a. Coincidence Logic	1, 2, 3, 4
b. Initiation Logic	1, 2, 3, 4
c. Actuation Logic	1, 2, 3, 4
d. Manual Trip	1, 2, 3, 4
3. Containment Isolation Actuation Signal	
a. Coincidence Logic	1, 2, 3
b. Initiation Logic	1, 2, 3
c. Actuation Logic	1, 2, 3, 4
d. Manual Trip	1, 2, 3, 4
4. Main Steam Isolation Signal	
a. Coincidence Logic	1, 2, 3, 4
b. Initiation Logic	1, 2, 3, 4
c. Actuation Logic	1, 2, 3, 4
d. Manual Trip	1, 2, 3, 4
5. Auxiliary Feedwater Actuation Signal SG #1 (AFAS-1)	
a. Coincidence Logic	1, 2, 3
b. Initiation Logic	1, 2, 3
c. Actuation Logic	1, 2, 3, 4
d. Manual Trip	1, 2, 3, 4

Replace with the markup on the next page

FUNCTION	REQUIRED CHANNELS	APPLICABLE MODES
1. Safety Injection Actuation Signal		
a. Coincidence Logic	4	1, 2, 3, 4
b. Initiation Logic	4	1, 2, 3, 4
c. Actuation Logic	4	1, 2, 3, 4
d. Manual Trip	4	1, 2, 3, 4
2. Containment Spray Actuation Signal		
a. Coincidence Logic	4	1, 2, 3, 4
b. Initiation Logic	4	1, 2, 3, 4
c. Actuation Logic	4	1, 2, 3, 4
d. Manual Trip	4	1, 2, 3, 4
3. Containment Isolation Actuation Signal		
a. Coincidence Logic	4	1, 2, 3
b. Initiation Logic	4	1, 2, 3
c. Actuation Logic	4	1, 2, 3, 4
d. Manual Trip	4	1, 2, 3, 4
4. Main Steam Isolation Signal		
a. Coincidence Logic	4	1, 2, 3, 4
b. Initiation Logic	4	1, 2, 3, 4
c. Actuation Logic	4	1, 2, 3, 4
d. Manual Trip	4	1, 2, 3, 4
5. Auxiliary Feedwater Actuation Signal SG #1 (AFAS-1)		
a. Coincidence Logic	4	1, 2, 3
b. Initiation Logic	4	1, 2, 3
c. Actuation Logic	4	1, 2, 3, 4
d. Manual Trip	4	1, 2, 3, 4

Table 3.3.6-1 (Page 2 of 2)
Engineered Safety Features Actuation System Logic and Manual Trip Applicability

FUNCTION	APPLICABLE MODES
6. Auxiliary Feedwater Actuation Signal SG #2 (AFAS-2)	
a. Coincidence Logic	1, 2, 3
b. Initiation Logic	1, 2, 3
c. Actuation Logic	1, 2, 3, 4
d. Manual Trip	1, 2, 3, 4
7. Diverse Manual ESF Actuation Signal	
a. Safety Injection	1, 2, 3, 4
b. Containment Spray	1, 2, 3, 4
c. Auxiliary Feedwater (SG #1)	1, 2, 3, 4
d. Auxiliary Feedwater (SG #2)	1, 2, 3, 4
e. Main Steam Isolation per MSIV	1, 2, 3, 4
f. Containment Isolation	1, 2, 3, 4

Replace with the markup on the next page

FUNCTION	REQUIRED CHANNELS	APPLICABLE MODES
6. Auxiliary Feedwater Actuation Signal SG #1 (AFAS-2)		
a. Coincidence Logic	4	1, 2, 3
b. Initiation Logic	4	1, 2, 3
c. Actuation Logic	4	1, 2, 3, 4
d. Manual Trip	4	1, 2, 3, 4
7. Diverse Manual ESF Actuation Signal		
a. Safety Injection	2	1, 2, 3, 4
b. Containment Spray	2	1, 2, 3, 4
c. Auxiliary Feedwater (SG #1)	2	1, 2, 3, 4
d. Auxiliary Feedwater (SG #2)	2	1, 2, 3, 4
e. Main Steam Isolation per MSIV	1	1, 2, 3, 4
f. Containment Isolation	1	1, 2, 3, 4

BASES

ACTIONS (continued)

D

D.1

The Required Action D applies to the diverse manual ESF Actuation equipment.

The associated Completion Time and LCO are reasonable based on operating experience for repair and restoration of this type of diverse manual ESF equipment In addition, it is assumed that a low probability for a multiple failures in the automatic ESFAS actuation logic and other manual controls within 72 hours will occur. If the inoperable channel is not restored to OPERABLE status within 72 hours, it is entered to the Condition F.

If the inoperable Diverse Manual ESF Actuation channel is not restored to OPERABLE status within 72 hours, Condition F is entered.

E.1 and E.2

If the Required Actions and associated Completion Times for the Condition cannot be met, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 4 within 12 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

If any Required Actions and associated Completion Time of Condition A, B, or C cannot be met, the plant must be brought to a MODE in which the LCO does not apply.

A Note to the Required Action indicates that Functions 3, 5, and 6 of Table 3.3.6−1 are applicable.

F.1 and F.2

If the Required Actions and associated Completion Times for the Condition are not met, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

If any Required Actions and associated Completion Time of Condition A, B, C, or D cannot be met, the plant must be brought to a MODE in which the LCO does not apply.

A Note to the Required Action indicates that Functions 1, 2, 4, and 7 of Table 3.3.6−1 are applicable. Since the applicable MODES for the Diverse Manual ESF Actuation Function are 1, 2, 3, and 4, Action F applies to Function 7 in Table 3.3.6−1. This takes the plant out of the applicable MODES and restores the plant to operation within the bounds of the safety analyses.

BASES

SURVEILLANCE REQUIREMENTS (continued)

Manual ESF Actuation Testing

Manual ESF actuation testing is tested every 31 days to verify that manual pushbutton can actuate the actuation logic as designed.

The 31-day Surveillance period is determined by operating experience and shows that equipment can meet the Surveillance requirement condition when equipment is tested as this Surveillance period.

SR 3.3.6.2

Individual subgroup must also be tested, one at a time, to verify the individual ESFAS components will actuate when required.

The 31-day Frequency on a staggered test basis complies with the operating experience and ensures the problems of individual logic signal can be detected within this time frame.

Some components cannot be tested at power operation since their actuation may lead to plant trip or equipment damage. Actuation logic subgroups not tested at power operation must be tested in accordance with the ~~Note~~ Notes to this SR.

SR 3.3.6.3

A CHANNEL FUNCTIONAL TEST for diverse ESF manual actuation channel performs the diverse manual ESF actuation circuit by manual actuation of each Function. This testing is performed every 18 months to verify that the trip pushbutton can actuate the actuation logic as designed.

REFERENCES

1. DCD Tier 2, Section 7.3.

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.:	**295-8263**
SRP Section:	**16 – Technical Specifications**
Application Section:	**16.3.3**
Date of RAI Issue:	**11/05/2015**

Question No. 16-117

DCD Tier 2 Section 7.3.1.3 Actuation Logic, below the heading "ESFAS Function" beginning on page 7.3-5, makes the following statements:

> The SIAS is also initiated by a loss of power to two PPS divisions. The SIAS also actuates the EDG.
>
> The CSAS is also initiated by a loss of power to two PPS divisions.
>
> The CIAS is also initiated by a loss of power to two PPS divisions. The MSIS is also initiated by a loss of power to two PPS divisions.
>
> The AFAS-1 or AFAS-2 is also initiated by a loss of power to two PPS divisions.

ESFAS Functional Logic, as depicted in DCD Figure 7.3-4 SIAS, Figure 7.3-5 CSAS, Figure 7.3-6 CIAS, Figure 7.3-7 MSIS, and Figure 7.3-8 AFAS, does not appear to illustrate the effect of a loss of vital ac power to two PPS divisions on the coincidence logic, initiation logic, and actuation logic for these EFSAS Functions. In addition to an SIAS coincidence logic output signal, the EDG of the associated Class 1E electrical safety train also gets a start signal from the CSAS, AFAS-1, and AFAS-2 coincidence logic output signals, according to Figure 7.3-21 EDG Loading Sequencer – Control logic Diagram. The applicant is requested to:

(1) Describe how loss of (vital ac) electrical power to two PPS divisions generates ESF actuation signals to all ESF trains of equipment;

(2) Describe how loss of (vital ac) electrical power to two PPS divisions would affect an enabled operating bypass, including when the operating bypass is in a denergized PPS division, and when it is in an unaffected PPS division;

(3) Revise the Bases for generic TS subsection 3.3.6 ESFAS Logic and Manual Trip, and DCD Tier 2 Chapters 7 and 8, to explain how a loss of (vital ac) electrical power to two PPS divisions generates ESF actuation signals to all ESF trains of equipment, in terms of the ESFAS Functional Logic design;

(4) Revise the Bases for generic TS subsection 3.3.6 ESFAS Logic and Manual Trip and subsection 3.3.7 EDG ─ LOVS to clarify how SIAS, CSAS, and AFAS signals initiate an EDG start, and that this actuation logic is required by LCO 3.3.6 and tested by a Channel Functional Test surveillance; and

(5) Revise as appropriate the operating bypass discussions in the generic TS Section 3.3 Bases to clarify how an enabled operating bypass is affected when its associated PPS division loses ac electrical power.

Response

The following responses are provided regarding the loss of (vital ac) electrical power to two PPS divisions:

(1) Each ESF-CCS division receives an NSSS ESF initiation signal from all four divisions of the PPS and generates ESF actuation signals by means of the selective 2-out-of-4 coincidence logic. The loss of (vital ac) electrical power to two PPS divisions causes the inputs from both PPS divisions to go to a failed (i.e., safe) state. The ESF-CCS recognizes the failed input signals as actuated state in the group controllers (GCs). Accordingly, the selective 2-out-of 4 coincidence logic in the ESF-CCS GC generates the ESF actuation signals to all ESF trains of equipment.

(2) The operating bypass inhibits the trip and pre-trip outputs from the trip and pre-trip algorithms in the bistable processor. The loss of (vital ac) electrical power to two PPS divisions generates ESF actuation signals to all ESF trains of equipment due to the ESF-CCS receiving two failed state NSSS ESF initiation signals from the two PPS divisions. At that time, the enabled operating bypass in the deenergized PPS division returns to normal (disabled). An enabled operating bypass in an unaffected PPS division (power remains) will stay in the bypassed state. In both cases, the plant will be in a safe condition since it will have tripped due to deenergization of one PPS division level output.

(3) The statements regarding the generation of ESF actuation signals to all ESF trains of equipment on a loss of (vital ac) electrical power to two PPS divisions will be inserted into the Bases for TS 3.3.6, Actions Section for B.1 and B.2 and also in DCD Section 7.3. The statements are not related to Chapter 8.

(4) The statements to clarify how SIAS, CSAS, and AFAS signals initiate an EDG start will be inserted into the Bases for TS 3.3.6 and 3.3.7, including that it is tested by a Channel Functional Test in SR 3.3.6.2.

(5) The statements regarding the effect of an enabled operating bypass caused by PPS division’s ac electrical power will be inserted into the Background section of Bases for TS 3.3.1 RPS Instrumentation and 3.3.5 ESFAS Instrumentation.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

The Bases for TS 3.3.1, 3.3.5, 3.3.6 and 3.3.7 and DCD Tier 2 Section 7.3 7 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

logic conditions are satisfied. The selective 2-out-of-4 coincidence logic is performed in

The loss of (vital ac) electrical power to two PPS divisions causes the inputs from both PPS divisions to go to a failed (i.e., safe) state. The ESF-CCS recognizes the failed input signals as actuated state in the GCs. Accordingly, the selective 2-out-of-4 coincidence logic in the ESF-CCS GC generates the ESF actuation signals to all ESF trains of equipment.

within each ESF-CCS division.

The selective 2-out-of-4 coincidence logic in the GC processors enhances the fault tolerance to maintain system-level availability and minimize the consequences of single failures. A failure of a processor in the PPS or data communication between the PPS and ESF-CCS is tolerated by the signal quality checking logic and the coincidence logic in the GC.

The redundant GCs provide ESF actuation signals to the redundant LCs in the respective division via SDLs. Each LC receives the ESF actuation signals from the GCs. There is no additional coincidence logic downstream of the GCs. See Figure 7.3-1 for a simplified functional diagram of the ESF-CCS.

All ESF actuation signals can be initiated using manual ESF system-level actuation switches on the safety console. In the ESF actuation logic, each signal also sets a latch to provide reasonable assurance that the system-level signal is not automatically reset once it has been initiated, as shown in Figure 7.3-3. Each ESF actuation signal, excluding the cycling portion of the AFAS, can be manually reset to restore the initiation logic to the non-actuated state from the OM or MTP when ESF actuation condition is cleared.

The BOP ESFAS receives process variable signals from the safety portion of the RMS, manual ESF system-level actuation switches, and manual channel bypass switches. The BOP ESFAS consists of 1-out-of-2 logics taken twice except the FHEVAS, which has one 1-out-of-2 logic.

<u>ESFAS Function</u>

The ESFAS consists of six NSSS ESFAS signals and three BOP ESFAS signals. Manual ESF system-level actuation switches are provided on the safety console. The manual MSIS actuation switches are also provided on the remote shutdown console in the RSR.

a. SIAS

BASES

ACTIONS (continued)

A.1

Condition A applies to one manual trip, coincidence logic, or initiation logic channel inoperable.

The channel must be restored to OPERABLE status within 48 hours. Operating experience has demonstrated that the probability of a random failure in a second channel is low during any given 48-hour period.

Failure of a single initiation logic channel affects one leg of two-out-of-four actuation logic channel. In this case, according to the purpose of operation Technical Specification, actuation logic is not inoperable status. When initiation logic channel is failure, LCO 3.0.3 may be not entered. This Action is different from Required Action related to the RPS Manual channel inoperable because open contact of reactor trip switchgear is implemented and confirmed easily in RPS. If the channel cannot be restored to OPERABLE status with 48 hours, Condition E or F is entered.

B.1 and B.2

Condition B applies to the failure of both initiation logic channels affecting the same trip leg.

In this case, the actuation logic channels are not inoperable, since they are in one-out-of-two logic and capable of performing as required. This obviates the need to enter LCO 3.0.3 in the event of a coincidence logic or vital bus power failure.

If a LCL power supply or vital instrument bus is lost, the initiation logic channels in the same trip leg will generate the initiation signal. This will open the actuation logic contacts, satisfying the Required Action to generate at least the actuation logic signal in the affected trip leg from actuation logic.

The channel must be restored to OPERABLE status within 48 hours. This provides the operator with time to take appropriate actions and still ensures that any risk involved in operating with a failed channel is acceptable. Operating experience has demonstrated that the probability of a random failure of a second initiation logic is low during any given 48 hour period.

The failure of vital electrical power to two PPS divisions which exclude the same trip leg of the selective 2-out-of 4 actuation logic causes the inputs from both PPS divisions to go to a failed (i.e., safe) state. The ESF-CCS recognizes the failed input signals as actuated state in the actuation logic. Therefore, a loss of vital electrical power to two PPS divisions generates ESF actuation signals to all ESF trains of equipment.

BASES

APPLICABLE SAFETY ANALYSES

Each of the analyzed accidents can be detected by one or more ESFAS Functions. One of the ESFAS Functions is the primary actuation signal for that accident. An ESFAS Function can be the primary actuation signal for more than one type of accident. An ESFAS Function can also be a secondary, or backup, actuation signal for one or more other accidents.

ESFAS Functions are as follows:

1. Safety Injection Actuation Signal

   SIAS ensures acceptable consequences during large break loss of coolant accidents (LOCAs), small break LOCAs, control element assembly ejection accidents, and main steam line breaks (MSLBs) inside containment. To provide the required protection, either a high containment pressure or a low pressurizer pressure signal will initiate SIAS. The SIAS initiates the safety injection system and actuates the ~~emergency diesel generator~~ EDG.

2. Containment Spray Actuation Signal

   CSAS actuates containment spray, preventing containment overpressurization during large break LOCAs, small break LOCAs, and MSLBs or FWLBs inside containment. CSAS is initiated by high-high containment pressure and a SIAS. This configuration reduces the likelihood of inadvertent containment spray. The CSAS actuates the EDG.

3. Containment Isolation Actuation Signal

   CIAS ensures acceptable mitigating actions during large and small break LOCAs and during MSLBs or feedwater line breaks (FWLBs) either inside or outside containment. CIAS is initiated by low pressurizer pressure or high containment pressure.

4. Main Steam Isolation Signal

   MSIS ensures acceptable consequences during a MSLB or FWLB (between the steam generator and the main feedwater check valve) either inside or outside containment. MSIS isolates both steam generators if either generator indicates a low pressure condition or if a high containment pressure condition exists. This prevents an excessive rate of heat extraction and subsequent cooldown of the RCS during these events.

The AFAS actuates the EDG.

BASES

APPLICABLE SAFETY ANALYSES (continued)

5, 6. Auxiliary Feedwater Actuation Signal

AFAS consists of two steam generator specific signals (AFAS-1 and AFAS-2). AFAS-1 initiates auxiliary feed to SG #1 and AFAS-2 initiates auxiliary feed to SG #2.

AFAS maintains a steam generator heat sink during a small LOCA event, steam generator tube rupture event, MSLB, or FWLB event either inside or outside containment.

The ESFAS satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires all channel components necessary to provide an ESFAS actuation to be OPERABLE.

The requirements for each Function are listed below. The reasons for the applicable MODES for each Function are addressed under APPLICABILITY.

1. Safety Injection Actuation Signal

Automatic SIAS occurs in Pressurizer Pressure – Low or Containment Pressure – High and is explained in Bases 3.3.5.

a. Coincidence Logic

This LCO requires four channels of SIAS coincidence logic to be OPERABLE in MODES 1, 2, 3, and 4.

b. Initiation Logic

This LCO requires four channels of SIAS initiation logic to be OPERABLE in MODES 1, 2, 3, and 4.

c. Actuation Logic

This LCO requires four channels of SIAS actuation logic to be OPERABLE in MODES 1, 2, 3, and 4.

d. Manual Trip

This LCO requires four channels of SIAS manual trip to be OPERABLE in MODES 1, 2, 3, and 4.

BASES

SURVEILLANCE REQUIREMENTS (continued)

Manual ESF Actuation Testing

Manual ESF actuation testing is tested every 31 days to verify that manual pushbutton can actuate the actuation logic as designed.

The 31-day Surveillance period is determined by operating experience and shows that equipment can meet the Surveillance requirement condition when equipment is tested as this Surveillance period.

SR 3.3.6.2

Individual subgroup must also be tested, one at a time, to verify the individual ESFAS components will actuate when required.

The 31-day Frequency on a staggered test basis complies with the operating experience and ensures the problems of individual logic signal can be detected within this time frame.

Some components cannot be tested at power operation since their actuation may lead to plant trip or equipment damage. Actuation logic subgroups not tested at power operation must be tested in accordance with the Note to this SR.

SR 3.3.6.3

A CHANNEL FUNCTIONAL TEST for diverse ESF manual actuation channel performs the diverse manual ESF actuation circuit by manual actuation of each Function. This testing is performed every 18 months to verify that the trip pushbutton can actuate the actuation logic as designed.

REFERENCES

1. DCD Tier 2, Section 7.3.

A CHANNEL FUNCTION TEST performs to verify a EDG start is actuated by SIAS, CSAS, and AFAS signals.

BASES

BACKGROUND (continued)

The undervoltage protection scheme has been designed to protect the plant from spurious trips caused by the offsite power source. This is made possible by the inverse voltage time characteristics of the relays used. A complete loss of offsite power will result in approximately a 1-second delay in LOVS actuation. The EDG starts and is available to accept loads within a 17-second time interval on the engineered safety features actuation system (ESFAS) or LOVS. Emergency power is established within the maximum time delay assumed for each event analyzed in the accident analysis (Reference 2).

Since there are four protective channels in a two-out-of-four trip logic for each train of the 4.16 kV power supply, no single failure will cause or prevent protective system actuation. This arrangement meets IEEE Std 603 criteria (Reference 3).

APPLICABLE SAFETY ANALYSES

The EDG – LOVS is required for engineered safety features (ESF) systems to function in any accident with a loss of offsite power. Its design basis is that of the ESFAS.

Accident analyses credit the loading of the EDG based on a loss of offsite power during a loss of coolant accident. The actual EDG start has historically been associated with the ESFAS actuation. The diesel loading has been included in the delay time associated with each safety system component requiring EDG supplied power following a loss of offsite power. The analysis assumes a non-mechanistic EDG loading, which does not explicitly account for each individual component of the loss of power detection and subsequent actions. This delay time includes contributions from the EDG start, EDG loading, and safety injection system component actuation. The response of the EDG to a loss of power must be demonstrated to fall within this analysis response time when including the contributions of all portions of the delay.

The required channels of LOVS, in conjunction with the ESF systems powered from the EDGs, provide plant protection in the event of any of the analyzed accidents discussed in Reference 2, in which a loss of offsite power is assumed. LOVS channels are required to meet the redundancy and testability requirements of 10 CFR Part 50, Appendix A, GDC 21 (Reference 4).

The SIAS, CSAS, or AFAS automatically starts the EDG, but the EDG breaker is not connected to the ESF buses, if preferred offsite AC power is available.

BASES

BACKGROUND (continued)

It is possible to change the two-out-of-four RPS logic to a two-out-of-three logic for a given input parameter in one channel at a time by trip channel bypassing. Thus, the bistable logic will function normally, producing normal trip indication and annunciation, but a reactor trip will not occur unless two additional channels indicate a trip condition. Trip channel bypassing can be simultaneously performed on any number of parameters in any number of channels, providing each parameter is bypassed in only one channel at a time. Trip channel bypassing is normally employed during maintenance or testing.

Two-out-of-three logic also prevents inadvertent trips caused by any single channel failure in a trip condition. In addition to the trip channel bypasses, there are also operating bypasses on select RPS trips. These bypasses are enabled manually in all four RPS channels when plant conditions do not warrant the specific trip protection. All operating bypasses are automatically removed when enabling bypass conditions are no longer satisfied.

Operating bypasses are implemented in the bistable logic, so that normal trip indication is also disabled. Trips with operating bypasses include Pressurizer Pressure – Low, Logarithmic Power Level – High, and CPC (DNBR – Low and LPD – High).

The operating bypass inhibits the trip and pre-trip outputs from trip and pre-trip algorithms in a bistable processor. An enabled operating bypass is removed since the loss of vital electrical power to a PPS division deenergizes the bistable processor.

Reactor Trip Switchgear (RTSG)

The reactor trip switchgear, addressed in LCO 3.3.4, consists of eight RTSGs. Power input to the reactor trip switchgear comes from two full capacity MG sets operated in parallel, such that the loss of either MG set does not de-energize the CEDMs.

There are two separate CEDM power supply buses, each bus powering half of the CEDMs. The RTSS consists of one set of four RTSGs (RTSS 1) and another set of four RTSGs (RTSS 2). Each RTSS channel consists of two reactor trip switchgears (RTSGs). The eight RTSGs are connected with 2-out-of-4 configuration.

BASES

BACKGROUND (continued)

The actuation logic in each channel of ESF-CCS takes part in corresponding ESFAS train. Each ESF Function has individual actuation logic in each channel of ESF-CCS.

The initiation logic performs the logical “OR” of LCL outputs for each ESFAS signal and sends the ESFAS signal to ESF-CCS

The ESF-CCS comprises power supply, manual switch, latching logic and serial data link for group and loop controllers.

Each ESFAS Function has sub groups and each sub group is in charge of one- or more ESFAS Functions. The initiation and actuation logics to the sub groups are identified in LCO 3.3.6.

By trip channel bypassing one input parameter for a channel, the two-out-of-four ESFAS coincidence logic shall be converted to two-out-of-three. Though the bypass produces trip indication and alarm in the bistable processor, the LCL does not accept the corresponding input signal as an input for actuation. Different parameters may be simultaneously bypassed, either in one channel or in different channels. Bypassing the same parameter in more than one channel is restricted by the administrative procedure. The coincidence logic becomes 2-out-of-3 coincidence logic. All-bypass function for bypassing all parameters in the channel is interlocked in LCL algorithm to prevent simultaneous bypass of more than one channel. The all-bypass interlock is implemented based on analog circuit through hardwired cable between LCLs in all channels. The purpose of all-bypass function is to support testing and maintenance of BP whereas the trip channel bypass is used against sensor failure.

In addition to the trip channel bypasses, there are also operating bypasses for ESFAS actuation trip. These bypasses are enabled manually, in all four channels, when plant conditions do not warrant the specific trip protection. All operating bypasses are automatically removed when enabling bypass conditions are no longer satisfied.

Operating bypass protects the output of trip and alarm signals from bistable processor. The Pressurizer Pressure – Low input to the SIAS shares an operating bypass with the Pressurizer Pressure – Low reactor trip.

The operating bypass inhibits the trip and pre-trip outputs from the trip and pre-trip algorithms in the bistable processor. The loss of (vital ac) electrical power to two PPS divisions generates ESF actuation signals to all ESF trains of equipment due to the ESF-CCS receiving two failed state NSSS ESF initiation signals from the two PPS divisions. At that time, the enabled operating bypass in the deenergized PPS division returns to normal (disabled). An enabled operating bypass in an unaffected PPS division (power remains) will stay in the bypassed state. In both cases, the plant will be in a safe condition since it will have tripped due to deenergization of one PPS division level output.

When necessary, the operator can manually actuate the ESFAS in the MCR and local panel.

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.: **295-8263**

SRP Section: **16 – Technical Specifications**

Application Section: **16.3.3**

Date of RAI Issued: **11/05/2015**

Question No. 16-118

The applicant is requested to consider incorporating the following clarifications to the "Background" section of the Bases for generic TS 3.3.4, to improve the usability of the Bases.

1. On page B 3.3.4-4 under the heading "RTSG" revise the first sentence to be consistent with the STS, as indicated; please identify and correct any errors in the suggested changes:

> The reactor trip switchgear **system (RTSS)** consists of **two sets of four RTSS circuit breakers (RTSGs), RTSS-1 and RTSS-2, connected in series** ~~of eight RTSGs~~ **(i.e., eight RTSS circuit breakers in total), which are operated in four sets (i.e., channels A, B, C, and D) of two RTSS circuit breakers each**. **RTSS-1 contains four RTSS circuit breakers designated A1, B1, C1, and D1 arranged in two parallel trip legs (A1 and B1; C1 and D1) (a trip leg contains two RTSS circuit breakers in series); RTSS-2 contains four RTSS circuit breakers designated A2, B2, C2, and D2 also arranged in two parallel trip legs (A2 and C2; B2 and D2). Opening one RTSS circuit breaker in each trip leg of RTSS-1 or RTSS-2 interrupts power to all control element drive mechanisms (CEDMs)**.
>
> Power input to the **CEDMs by way of** ~~RTSG~~ **RTSS-1 and RTSS-2 and the Digital Rod Control System (DRCS)** comes from two full capacity **motor generator** (MG**)** sets operated in parallel, such that the loss of either MG set does not de-energize the CEDMs. **Power is supplied from the MG sets to the CEDMs via two trip legs (redundant paths) in RTSS-1 and two trip legs in RTSS-2, with RTSS-1 and RTSS-2 connected in series. This arrangment of the eight RTSS circuit breakers ensures that a fault, or the opening of an RTSS-1 circuit breaker in one trip leg (i.e., for testing purposes) coincident with a fault, or the**

opening of an RTSS-2 circuit breaker in one trip leg will not interrupt power to the CEDMs. ~~Both trip legs shall be interrupted to drop CEAs.~~ **With two channels in trip for the same RPS Function, at least one RTSS circuit breaker will be opened in both trip legs of either RTSS-1 or RTSS-2.** ~~and two~~ **Two** separate methods for **opening each RTSS circuit breaker are** ~~shall be~~ provided, **the undervoltage trip device and the shunt trip device.** ~~because each power is connected to only one of two RTSGs connected in serial.~~ The two **RTSS circuit breakers** ~~RTSGs~~ within a trip leg are actuated by separate **RPS** initiation **logic** circuits. When **electrical power to the** two CEDM power supply buses **is** ~~are~~ lost, all CEAs will fall into the core by gravity. The PPS interfaces with the undervoltage trip device of **the** RTSS **circuit** breakers. The **Diverse Protection System (DPS)** ~~DPS~~ interfaces with the shunt trip device of the RTSS **circuit** breakers. The actuation of either the undervoltage or the shunt trip device interrupts power from the ~~motor generator (~~MG~~)~~ sets to the ~~control element drive mechanisms (~~CEDMs~~)~~.

Response

The first paragraph under the heading "RTSG" in the Background Section of the Bases for LCO 3.3.4 will be revised to be consistent with the proposed wording provided. However, since the APR1400 uses the terminology reactor trip circuit breaker (RTCBs) rather than reactor trip switchgears (RTSGs), the proposed markup includes the APR1400 specific terminology where appropriate.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

The TS Bases for TS 3.3.4 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

BASES

BACKGROUND (continued)

Thus, the bistable logic will function normally, producing normal trip indication and annunciation, but a reactor trip will not occur unless two additional channels indicate a trip condition. Trip channel bypassing can be simultaneously performed on any number of parameters in any number of channels, providing each parameter is bypassed in only one channel at a time. Bypassing the same parameter in more than one channel is restricted by the administrative procedure. The coincidence logic becomes 2-out-of-3 coincidence logic. All-bypass function for bypassing all parameters in the channel is interlocked in LCL algorithm to prevent simultaneous bypass of more than one channel. The all-bypass interlock is implemented based on analog circuit through hardwired cable between LCLs in all channels. The purpose of all-bypass function is to support testing and maintenance of BP whereas the trip channel bypass is used for sensor failure.

Replace with the markup on the next page

RTSG

The reactor trip switchgear consists of eight RTSGs. Power input to the RTSG comes from two full capacity MG sets operated in parallel, such that the loss of either MG set does not de-energize the CEDMs. Both trip legs shall be interrupted to drop CEAs and two separate methods shall be provided because each power is connected to only one of two RTSGs connected in serial. The two RTSGs within a trip leg are actuated by separate initiation circuits. When two CEDM power supply buses are lost, all CEAs will fall into the core by gravity. The PPS interfaces with the undervoltage trip device of RTSS breakers. The DPS interfaces with the shunt trip device of the RTSS breakers. The actuation of either the undervoltage or the shunt trip device interrupts power from the motor generator (MG) sets to the control element drive mechanisms (CEDMs).

Each set of RTSG is operated by either a manual reactor trip switch or an interposing relay actuated by RPS. There are four manual trip switches, arranged in two sets of two. Depressing both switches in either set will result in a reactor trip. When a manual trip is initiated using manual switches in MCR, the RPS trip paths and relays are bypassed, and the RTSG undervoltage and shunt trip devices are actuated independent of the RPS.

Manual trip circuitry includes the switches and interconnecting wiring to both RTSGs necessary to actuate both the undervoltage and shunt trip devices but excludes the interposing relay contacts and their interconnecting wiring to the RTSGs, which are considered part of the initiation circuit.

The reactor trip switchgear system (RTSS) consists of two sets of four reactor trip circuit breakers (RTCBs), RTSS-1 and RTSS-2, connected in series (i.e., eight RTCBs in total), which are operated in four sets (i.e., channels A, B, C, and D) of two RTCBs each RTSS-1 contains four RTCBs designated A1, B1, C1, and D1 arranged in two parallel trip legs (A1 and B1; C1 and D1) (a trip leg contains two RTSS circuit breakers in series); RTSS-2 contains four RTCBs designated A2, B2, C2, and D2 also arranged in two parallel trip legs (A2 and C2; B2 and D2). Opening one RTCB in each trip leg of RTSS-1 or RTSS-2 interrupts power to all control element drive mechanisms (CEDMs).

Power input to the CEDMs by way of RTSS-1 and RTSS-2 and the Digital Rod Control System (DRCS) comes from two full capacity motor generator (MG) sets operated in parallel, such that the loss of either MG set does not de-energize the CEDMs. Power is supplied from the MG sets to the CEDMs via two trip legs (redundant paths) in RTSS-1 and two trip legs in RTSS-2, with RTSS-1 and RTSS-2 connected in series. This arrangement of the eight RTCBs ensures that a fault, or the opening of an RTSS-1 RTCB in one trip leg (i.e., for testing purposes) coincident with a fault, or the opening of an RTSS-2 RTCB in one trip leg will not interrupt power to the CEDMs. With two channels in trip for the same RPS Function, at least one RTCB will be opened in both trip legs of either RTSS-1 or RTSS-2. Two separate methods for opening each RTSS circuit breaker are provided, the undervoltage trip device and the shunt trip device. The two RTCBs within a trip leg are actuated by separate RPS initiation logic circuits. When electrical power to the two CEDM power supply buses is lost, all CEAs will fall into the core by gravity. The PPS interfaces with the undervoltage trip device of the RTCBs. The Diverse Protection System (DPS) interfaces with the shunt trip device of the RTCBs. The actuation of either the undervoltage or the shunt trip device interrupts power from the MG sets to the CEDMs.

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.:	**295-8263**
SRP Section:	**16 – Technical Specifications**
Application Section:	**16.3.3**
Date of RAI Issue:	**11/05/2015**

Question No. 16-119

In the "Applicable Safety Analyses" section of the Bases for generic TS 3.3.6, under the discussion of AFAS, the second paragraph (page B 3.6.6-5) states

> AFAS maintains a steam generator heat sink during a small LOCA event, steam generator tube rupture event, MSLB, or FWLB event either inside or outside containment.

In the "Applicable Safety Analyses" section of the Bases for STS 3.3.6, under the discussion of Emergency Feedwater Actuation Signal (EFAS), the second paragraph (page B 3.6.6-6) states

> EFAS maintains a steam generator heat sink during a steam generator tube rupture event and a MSLB or FWLB event either inside or outside containment.

- The applicant is requested to explain including "small LOCA event" in the list of events during which the AFAS maintains a SG heat sink, since neither the STS Bases nor Sys 80+ Bases includes this event.

- The applicant is also requested to clarify the paragraph, consistent with the STS, to say:

> AFAS maintains a steam generator heat sink during a small **break** LOCA event, **a** steam generator tube rupture event, **and a** ~~MSLB,~~ **MSLB** or FWLB event either inside or outside **of** containment.

- The applicant is requested to explain why it did not propose to include an additional sentence at the end of the paragraph, which is included in the "Applicable Safety Analyses" section of the Bases for CE System 80+ generic TS 3.3.6, under the discussion of Emergency Feedwater Actuation Signal (EFAS), the second paragraph (page B 3.3-133) that states (emphasis added)

> EFAS maintains a steam generator heat sink during a loss of MFW event, steam generator tube rupture event, MSLB, or FWLB event either inside or outside containment, or any event where normal AC power or the MFW system is unavailable. *EFAS is also initiated by a loss of power to two or more measurement channels.*

•The applicant is requested to explain not including "loss of MFW event" or "any event where normal AC power or the MFW system is unavailable" in the list of events during which the AFAS maintains a SG heat sink, since the Sys 80+ Bases paragraph quoted above includes these events, and since the "Applicable Safety Analyses" section of the Bases for generic TS 3.7.5, AFWS, states,

> The AF system mitigates the consequences of any event with a loss of normal feedwater.
>
> The limiting design basis accidents (DBAs) and transients for the AFWS are as follows:
>
> a. Feedwater line break (FWLB)
>
> b. Loss of normal feedwater
>
> In addition, the minimum available AFW flow and system characteristics are serious considerations in the analysis of a small break loss of coolant accident.

Response

The use of the term small LOCA will be corrected to small break LOCA. The SG level will decrease due to a loss of MFW and MSSV opening if a small break LOCA with a loss of offsite power occurs. Thus, the small break LOCA event is necessary to be included in the AFAS in order to remove the decay heat and other residual heat.

Since a loss of power to two or more measurement channels causes all ESFAS functions to be initiated, this condition is not specifically applicable to the AFAS. Therefore, the related statement is not necessary to be added to the AFAS. This approach is consistent with the STS.

The sentence "any event where normal AC power or the MFW system is unavailable" will be inserted in the list of events during which the AFAS maintains a SG heat sink.

In conclusion, to be consistent with the STS and CE system 80+, the second paragraph on page B 3.3.6-5 in the Applicable Safety Analysis section will be revised as follows:

> AFAS maintains a steam generator heat sink during a small break LOCA event, a steam generator tube rupture event, and a MSLB or FWLB event either inside or outside of containment, or any event where normal AC power or the MFW system is unavailable.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

The TS Bases for TS 3.3.6 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

BASES

APPLICABLE SAFETY ANALYSES (continued)

AFAS maintains a steam generator heat sink during a small break LOCA event, a steam generator tube rupture event, and a MSLB, or FWLB event either inside or outside of containment, or any event where normal AC power or the MFW system is unavailable.

, 6. Auxiliary Feedwater Actuation Signal

AFAS consists of two steam generator specific signals (AFAS-1 and AFAS-2). AFAS-1 initiates auxiliary feed to SG #1 and AFAS-2 initiates auxiliary feed to SG #2.

~~AFAS maintains a steam generator heat sink during a small LOCA event, steam generator tube rupture event, MSLB, or FWLB event either inside or outside containment.~~

The ESFAS satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires all channel components necessary to provide an ESFAS actuation to be OPERABLE.

The requirements for each Function are listed below. The reasons for the applicable MODES for each Function are addressed under APPLICABILITY.

1. Safety Injection Actuation Signal

Automatic SIAS occurs in Pressurizer Pressure – Low or Containment Pressure – High and is explained in Bases 3.3.5.

a. Coincidence Logic

This LCO requires four channels of SIAS coincidence logic to be OPERABLE in MODES 1, 2, 3, and 4.

b. Initiation Logic

This LCO requires four channels of SIAS initiation logic to be OPERABLE in MODES 1, 2, 3, and 4.

c. Actuation Logic

This LCO requires four channels of SIAS actuation logic to be OPERABLE in MODES 1, 2, 3, and 4.

d. Manual Trip

This LCO requires four channels of SIAS manual trip to be OPERABLE in MODES 1, 2, 3, and 4.

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.: **295-8263**

SRP Section: **16 – Technical Specifications**

Application Section: **16.3.3**

Date of RAI Issued: **11/05/2015**

Question No. 16-120

The applicant is requested to correct an error in the "LCO" section of the Bases for generic TS 3.3.6, page B 3.3.6-8, under the discussion of Coincidence Logic for Auxiliary Feedwater Actuation Signal SG #2 (AFAS-2). Paragraph 6.a should say

> This LCO requires ~~six~~ **four** channels of coincidence logic to be OPERABLE in MODES 1, 2, and 3.

Response

The sentence below Coincidence Logic for Auxiliary Feedwater Actuation Signal SG #2 (AFAS-2) stated in the "LCO" section of the Bases for generic TS 3.3.6, page B 3.3.6-8 will be revised to change the number of required channels from six to four as recommended.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

The TS Bases for TS 3.3.6 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

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

BASES

LCO (continued)

5. Auxiliary Feedwater Actuation Signal SG #1 (AFAS-1)

AFAS-1 occurs on a Steam Generator Level – Low in Steam Generator #1.

a. Coincidence Logic

This LCO requires four channels of coincidence logic to be OPERABLE in MODES 1, 2, and 3.

b. Initiation Logic

This LCO requires four channels of initiation logic to be OPERABLE in MODES 1, 2, and 3.

c. Actuation Logic

This LCO requires four channel of actuation logic to be OPERABLE in MODES 1, 2, 3, and 4.

d. Manual Trip

This LCO requires four channels of manual trip to be OPERABLE in MODES 1, 2, 3, and 4.

6. Auxiliary Feedwater Actuation Signal SG #2 (AFAS-2)

AFAS-2 occurs on a Steam Generator Level – Low in Steam Generator #2.

a. Coincidence Logic

This LCO requires ~~six~~ four channels of coincidence logic to be OPERABLE in MODES 1, 2, and 3.

b. Initiation Logic

This LCO requires four channels of initiation logic to be OPERABLE in MODES 1, 2, and 3.

c. Actuation Logic

This LCO requires four channel of actuation logic to be OPERABLE in MODES 1, 2, 3, and 4.

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.: **295-8263**

SRP Section: **16 – Technical Specifications**

Application Section: **16.3.3**

Date of RAI Issue: **11/05/2015**

Question No. 16-121

The "Applicability" section of the Bases for generic TS 3.3.6 appears to be inconsistent regarding whether any automatic ESFAS logic functions are required to be operable in Mode 4. The contents of the Applicability section of the Bases for generic TS 3.3.6, STS 3.3.6, and CE System 80+ generic TS 3.3.6 are presented in the following table for comparison:

Applicability Section of Bsaes for:		
APR1400 generic TS 3.3.6	STS 3.3.6	CE System 80+ generic TS 3.3.6
In MODES 1, 2, 3 and **4**, there is sufficient energy in the primary and secondary systems to warrant automatic ESF System responses to:	In MODES 1, 2, and 3 there is sufficient energy in the primary and secondary systems to warrant automatic ESF System responses to:	In MODES 1, 2, and 3, there is sufficient energy in the primary and secondary systems to warrant automatic ESF System responses to:
a. Close the main steam isolation valves to preclude a positive reactivity addition. b. Actuate auxiliary feedwater to preclude the loss of the steam generators as a heat sink (in the event the normal feedwater system is not available). c. Actuate ESF systems to prevent or limit the release of fission product radioactivity to the environment by isolating containment and limiting the containment pressure from exceeding the containment design pressure during a design basis LOCA or MSLB. d. Actuate ESF systems to ensure sufficient borated inventory to permit adequate core cooling and reactivity control during a design basis LOCA or MSLB accident.	• Close the main steam isolation valves to preclude a positive reactivity addition, • Actuate auxiliary feedwater to preclude the loss of the steam generators as a heat sink (in the event the normal feedwater system is not available), • Actuate ESF systems to prevent or limit the release of fission product radioactivity to the environment by isolating containment and limiting the containment pressure from exceeding the containment design pressure during a design basis LOCA or MSLB, and • Actuate ESF systems to ensure sufficient borated inventory to permit adequate core cooling and reactivity control during a design basis LOCA or MSLB accident.	• Close the main steam isolation valves to preclude a positive reactivity addition, • Actuate auxiliary feedwater to preclude the loss of the steam generators as a heat sink (in the event the normal feedwater system is not available), • Actuate ESF systems to prevent or limit the release of fission product radioactivity to the environment by isolating containment and limiting the containment pressure from exceeding the containment design pressure during a design basis LOCA or MSLB, and • Actuate ESF systems to ensure sufficient borated inventory to permit adequate core cooling and reactivity control during a design basis LOCA or MSLB accident.

Applicability Section of Bsaes for:		
APR1400 generic TS 3.3.6	STS 3.3.6	CE System 80+ generic TS 3.3.6
No text corresponding to Sys 80+	No text corresponding to Sys 80+	All the following ESF functions are required to be operable in these MODES: 1. Safety Injection Actuation – SIAS 2. Containment Spray Actuation - CSAS 3. Containment Isolation - CIAS 4. Main Steam Line Isolation – MSIS 5. Emergency Feedwater - EFAS-1 6. Emergency Feedwater - EFAS-2 7. Diverse Manual ESF Actuation Interface to ESF Components.
No text corresponding to Sys 80+	No text corresponding to Sys 80+	For MODE 4 there is sufficient energy and potential in the primary and secondary systems to warrant 1) the automatic actuation of all components to mitigate the consequences of a large break LOCA or Main Steam Line Break (MSLB) and 2) prevent or limit the release of fission product radioactivity to the environment. ESF functions which apply to MODE 4 operation follow: 1. Safety Injection Actuation - SIAS 2. Containment Spray Actuation - CSAS 3. Containment Isolation - CIAS
In MODES 4, 5, and 6, automatic actuation of these Functions is not required because adequate time is available to evaluate plant conditions and respond by manually operating the ESF components if required.	In MODES 4, 5, and 6, automatic actuation of these Functions is not required because adequate time is available to evaluate plant conditions and respond by manually operating the ESF components if required.	In MODES 5 and 6 these functions are not required because adequate time is available to evaluate plant conditions and respond by manually operating the ESF components if required. In most cases, the equipment actuated by these ESFAS functions need not be operable.

Applicability Section of Bsaes for:		
APR1400 generic TS 3.3.6	STS 3.3.6	CE System 80+ generic TS 3.3.6
No text corresponding to STS	CSAS, MSIS, and EFAS have relatively few components, which can be actuated individually if required in MODE 4, and the systems may be disabled or reconfigured, making system level Manual Trip impossible and unnecessary.	No text corresponding to STS
The ESFAS logic must be OPERABLE in the same MODES as the automatic and manual trip. In MODE 4, only the portion of the ESFAS logic responsible for the required manual trip must be OPERABLE.	The ESFAS logic must be OPERABLE in the same MODES as the automatic and Manual Trip. In MODE 4, only the portion of the ESFAS logic responsible for the required Manual Trip must be OPERABLE.	No text corresponding to STS
In MODES 5 and 6, the systems initiated by ESFAS are either reconfigured or disabled for shutdown cooling operation. Accidents in these MODES are slow to develop and would be mitigated by manual operation of individual components.	In MODES 5 and 6, the systems initiated by ESFAS are either reconfigured or disabled for shutdown cooling operation. Accidents in these MODES are slow to develop and would be mitigated by manual operation of individual components.	No text corresponding to STS

- The applicant is requested to resolve the apparent conflicts in the Bases regarding which automatic ESFAS logic Functions are required to be operable in Mode 4. Generic TS 3.3.6 Table 3.3.6-1 indicates that CIAS and AFAS coincidence logic and initiation logic functions arenot required to be operable in Mode 4, but that CIAS and AFAS actuation logic and manual trip functions are required to be operable in Mode 4.

- The applicant is requested to explain why CIAS and AFAS Actuation Logic Function must be operable to support operability of CIAS and AFAS Manual Trip Function in Mode 4.

Response

- In order to support operability of the CIAS and AFAS manual trip functions, the CIAS and AFAS actuation logic functions shall be operable in the same Mode because each manual ESF actuation signal is sent to its own actuation logic located in an engineered safety features-component control system (ESF-CCS) group controller. In case of a common cause failure in computerized ESF-CCS group controllers, the diverse manual ESF actuation functions are required to perform the associated safety functions since the manual ESF actuation functions would be inoperable. Therefore, the CIAS and AFAS actuation logic functions are required to be operable in Mode 4 since the Applicable Modes of the CIAS and AFAS manual trip functions are Mode 4.

- Since all ESFAS manual trip signals are transmitted to their own Actuation Logics, the Applicable Modes of all ESFAS Actuation Logic Functions should be the same as those of the ESFAS Manual Trip Functions. Therefore, the CIAS and AFAS Actuation Logic Functions must be operable to support operability of CIAS and AFAS Manual Trip Function in Mode 4.

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

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