

Industry/TSTF Standard Technical Specification Change Traveler

Make changes to RTS and ESF Tables

Classification: 1) Correct Specifications

NUREGs Affected: 1430 1431 1432 1433 1434

Description:

Modify Table 3.3.1-1, Reactor Trip System Instrumentation, and Table 3.3.2-1, Engineered Safety Feature Actuation Instrumentation, to replace the requirement for a Trip Setpoint with a requirement for a Nominal Trip Setpoint. Additionally, a note is added to the Bases which allows (1) the actual trip setpoint to be set more conservative than the Nominal Trip Setpoint specified in the ITS in response to plant conditions, and (2) states an "as-found" trip setpoint is operable when it is outside the calibration tolerance band if the as-found value has not exceeded the associated TS Allowable Value and the channel is readjusted to within the established calibration tolerances. The Bases discussion is revised to provide conforming discussion to the LCO changes and to more clearly and accurately discuss the relation between the nominal trip setpoint, the allowable value, and the plant approved setpoint methodology. Also, the Allowable Value is clarified to be the Limiting Safety System Setting required by 10 CFR 50.36.

Modify the Bases for the RPS Instrumentation specification for the BWOG, CEOG, BWR/4 and BWR/6 ITS NUREGs to clearly document the basis for the use of allowable values rather than the trip setpoint as the Limiting Safety System Setting.

Justification:

This change clarifies the use of limiting safety system settings and standardizes the RTS and ESFAS TS Tables with other STS NUREGs.

Industry Contact:	Buschbaum, Denny	(254) 897-5851	dbuschbl@tuelectric.com
NRC Contact:	Schulten, Carl	301-314-1192	css1@nrc.gov

Revision History

OG Revision 0

Revision Status: Closed

Revision Proposed by: NRC

Revision Description:
Original Issue

TSTF Review Information

TSTF Received Date: 21-May-99 Date Distributed for Review 21-May-99

OG Review Completed: BWOG WOG CEOG BWROG

TSTF Comments:
(No Comments)

TSTF Resolution: Superseded Date: 28-Sep-99

OG Revision 1

Revision Status: Active

Next Action: NRC

Revision Proposed by: TSTF

Revision Description:
Based on discussions with the NRC, changes have been made to TSB-20 and incorporated into TSTF-355.

Reactor Trip System (RTS) Instrumentation, LCO 3.3.1 (NUREG-1431)Insert 1

A channel is OPERABLE with a trip setpoint value outside its calibration tolerance band provided the trip setpoint "as-found" value does not exceed its associated Allowable Value and provided the trip setpoint "as-left" value is adjusted to a value within the "as-left" calibration tolerance band of the Nominal Trip Setpoint. A trip setpoint may be set more conservative than the Nominal Trip Setpoint as necessary in response to plant conditions.

Engineered Safety Feature Actuation System (ESFAS) Instrumentation, LCO 3.3.2 (NUREG-1431)Insert 2

A channel is OPERABLE with a trip setpoint value outside its calibration tolerance band provided the trip setpoint "as-found" value does not exceed its associated Allowable Value and provided the trip setpoint "as-left" value is adjusted to a value within the calibration tolerance band of the Nominal Trip Setpoint. A trip setpoint may be set more conservative than the Nominal Trip Setpoint as necessary in response to plant conditions.

B 3.3.1 Reactor Trip System (RTS) Instrumentation BASES (NUREG-1431)Insert 3

Technical specifications are required by IOCFR50.36 to contain LSSS defined by the regulation as "... settings for automatic protective devices . . . so chosen that automatic protective action will correct the abnormal situation before a Safety Limit (SL) is exceeded." The Analytic 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 protection action that occurs on reaching the Analytic Limit therefore ensures that the SL is not exceeded. However, in practice, the actual settings for automatic protective devices must be chosen to be more conservative than the Analytic Limit to account for instrument loop uncertainties related to the setting at which the automatic protective action would actually occur.

The Trip Setpoint is a predetermined setting for a protective device chosen to ensure automatic actuation prior to the process variable reaching the Analytic Limit and thus ensuring that the SL would not be exceeded. As such, the Trip Setpoint accounts for uncertainties in setting the device (e.g. calibration), uncertainties in how the device might actually perform (e.g., repeatability), changes in the point of action of the device 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 Trip Setpoint plays an important role in ensuring that SLs are not exceeded. As such, the Trip Setpoint meets the definition of an LSSS (Ref. 10) and could be used to meet the requirement that they be contained in the technical specifications.

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)." For automatic protective devices, the required safety function is to ensure that a SL is not exceeded and therefore the LSSS as defined by 10 CFR 50.36 is the same as the OPERABILITY limit for these devices. However, use of the Trip Setpoint to define OPERABILITY in technical specifications and its corresponding designation as the LSSS required by 10 CFR 50.36 would be an overly restrictive requirement if it were applied as an OPERABILITY limit for the "as found" value of a protective device 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 protective device with a setting that has been found to be different from the Trip Setpoint due to some drift of the setting may still be OPERABLE since drift is to be expected. This expected drift would have been specifically accounted for in the setpoint methodology for calculating the Trip Setpoint and thus the automatic protective action would still have ensured that the SL would not be exceeded with the "as found" setting of the protective device. Therefore, the device would still be OPERABLE since it would have performed its safety function and the only corrective action required would be to reset the device to the Trip Setpoint to account for further drift during the next surveillance interval.

Use of the Trip Setpoint to define "as found" OPERABILITY and its designation as the LSSS under the expected circumstances described above would result in actions required by both the rule and technical specifications that are clearly not warranted. However, there is also some point beyond which the device would have not been able to perform its function due, for example, to greater than expected drift. This value needs to be specified in the technical specifications in order to define OPERABILITY of the devices and is designated as the Allowable Value which, as stated above, is the same as the LSSS.

The Allowable Value specified in Table 3.3.1-1 serves as the LSSS such that a channel is OPERABLE if the trip setpoint is found not to exceed the Allowable Value during the CHANNEL OPERATIONAL TEST (COT). As such, the Allowable Value differs from the Trip Setpoint by an amount primarily equal to the expected instrument loop uncertainties, such as drift, during the surveillance interval. In this manner, the actual setting of the device will still meet the LSSS definition and ensure that a Safety Limit is not exceeded at any given point of time as long as the device has not drifted beyond that expected during the surveillance interval. If the actual setting of the device is found to have exceeded the Allowable Value the device would be considered inoperable from a technical specification perspective. This requires corrective action including those actions required by 10 CFR 50.36 when automatic protective devices do

not function as required. Note that, although the channel is "OPERABLE" under these circumstances, the trip setpoint should be left adjusted to a value within the established trip setpoint calibration tolerance band, 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.

[Note: Alternatively, a TS format incorporating an Allowable Value only column may be proposed by a licensee. In this case the trip setpoint value of Table 3.3.1-1 is located in the TS Bases or in a licensee-controlled document outside the TS. Changes to the trip setpoint value would be controlled by 10 CFR 50.59 or administratively as appropriate, and adjusted per the setpoint methodology and applicable surveillance requirements. At their option, the licensee may include the trip setpoint in Table 3.3.1-1 as shown, or as suggested by the licensees' setpoint methodology or license.]

B 3.3.1 Reactor Trip System (RTS) Instrumentation BASES (NUREG-1431)

Insert 4

is determined by either "as-found" calibration data evaluated during the CHANNEL CALIBRATION or by qualitative assessment of field transmitter or sensor as related to the channel behavior observed during performance of the CHANNEL CHECK.

B 3.3.1 Reactor Trip System (RTS) Instrumentation BASES (NUREG-1431)

Insert 5

which incorporates all of the known uncertainties applicable to each channel. The magnitudes of these uncertainties are factored into the determination of each trip setpoint and corresponding Allowable Value. The trip setpoint entered into the bistable is more conservative than that specified by the Allowable Value (LSSS) to account for measurement errors detectable by the COT. The Allowable Value serves as the Technical Specification OPERABILITY limit for the purpose of the COT. One example of such a change in measurement error is drift during the surveillance interval. If the measured setpoint does not exceed the Allowable Value, the bistable is considered OPERABLE.

The trip setpoint is the value at which the bistable is set and is the expected value to be achieved during calibration. The trip setpoint value ensures the LSSS and the safety analysis limits are met for surveillance interval selected when a channel is adjusted based on stated channel uncertainties. Any bistable is considered to be properly adjusted when the "as left" setpoint value is within the band for CHANNEL CALIBRATION uncertainty allowance' (i.e., \pm rack calibration + comparator setting uncertainties). The trip setpoint value is therefore considered a

“nominal” value (i.e., expressed as a value without inequalities) for the purposes of COT and CHANNEL CALIBRATION.

B 3.3.2, Engineered Safety Feature Actuation System (ESFAS) Instrumentation BASES (NUREG-1431)

Insert 6

The Allowable Value in conjunction with the trip setpoint and LCO establishes the threshold for ESFAS action to prevent exceeding acceptable limits such that the consequences of Design Basis Accidents (DBAs) will be acceptable. The Allowable Value is considered a limiting value such that a channel is OPERABLE if the setpoint is found not to exceed the Allowable Value during the CHANNEL OPERATIONAL TEST (COT). Note that, although a channel is “OPERABLE” under these circumstances, the ESFAS setpoint must be left adjusted to within the established calibration tolerance band of the ESFAS setpoint in accordance with the 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.

B 3.3.2, Engineered Safety Feature Actuation System (ESFAS) Instrumentation BASES (NUREG-1431)

Insert 7

is determined by either “as-found” calibration data evaluated during the CHANNEL CALIBRATION or by qualitative assessment of field transmitter or sensor, as related to the channel behavior observed during performance of the CHANNEL CHECK.

B 3.3.2, Engineered Safety Feature Actuation System (ESFAS) Instrumentation BASES (NUREG-1431)

Insert 8

A detailed description of the methodology used to calculate the Allowable Value and ESFAS setpoints including their explicit uncertainties, is provided in the plant specific setpoint methodology study (Ref. 6) which incorporates all of the known uncertainties applicable to each channel. The magnitudes of these uncertainties are factored into the determination of each ESFAS setpoint and corresponding Allowable Value. The nominal ESFAS setpoint entered into the bistable is more conservative than that specified by the Allowable Value to account for measurement errors detectable by the COT. The Allowable Value serves as the Technical Specification OPERABILITY limit for the purpose of the COT. One example of such a change in measurement error is drift during the surveillance interval. If the measured setpoint does not

exceed the Allowable Value, the bistable is considered OPERABLE.

The ESFAS setpoints are the values at which the bistables are set and is the expected value to be achieved during calibration. The ESFAS setpoint value ensures the safety analysis limits are met for the surveillance interval selected when a channel is adjusted based on stated channel uncertainties. Any bistable is considered to be properly adjusted when the “as-left” setpoint value is within the band for CHANNEL CALIBRATION uncertainty allowance (i.e. calibration tolerance uncertainties). The ESFAS setpoint value is therefore considered a “nominal value (i.e., expressed as a value without inequalities) for the purposes of the COT and CHANNEL CALIBRATION.

B 3.3.1 Reactor Protection System (RPS) Instrumentation BASES (NUREG-1430); B 3.3.1.1 Reactor Protection System (RPS) instrumentation BASES(NUREG-1433, NUREG-1434); B 3.3.1 Reactor Protective System (RPS) Instrumentation BASES (NUREG-1432)

Insert 9

Technical specifications are required by IOCFR50.36 to contain LSSS defined by the regulation as “... settings for automatic protective devices . . . so chosen that automatic protective action will correct the abnormal situation before a Safety Limit (SL) is exceeded.” The Analytic 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 protection action that occurs on reaching the Analytic Limit therefore ensures that the SL is not exceeded. However, in practice, the actual settings for automatic protective devices must be chosen to be more conservative than the Analytic Limit to account for instrument loop uncertainties related to the setting at which the automatic protective action would actually occur.

The Trip Setpoint is a predetermined setting for a protective device chosen to ensure automatic actuation prior to the process variable reaching the Analytic Limit and thus ensuring that the SL would not be exceeded. As such, the Trip Setpoint accounts for uncertainties in setting the device (e.g. calibration), uncertainties in how the device might actually perform (e.g., repeatability), changes in the point of action of the device 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 Trip Setpoint plays an important role in ensuring that SLs are not exceeded. As such, the Trip Setpoint meets the definition of an LSSS (Ref. 10) and could be used to meet the requirement that they be contained in the technical specifications.

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).” For automatic protective devices, the required safety

function is to ensure that a SL is not exceeded and therefore the LSSS as defined by 10 CFR 50.36 is the same as the OPERABILITY limit for these devices. However, use of the Trip Setpoint to define OPERABILITY in technical specifications and its corresponding designation as the LSSS required by 10 CFR 50.36 would be an overly restrictive requirement if it were applied as an OPERABILITY limit for the "as found" value of a protective device 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 protective device with a setting that has been found to be different from the Trip Setpoint due to some drift of the setting may still be OPERABLE since drift is to be expected. This expected drift would have been specifically accounted for in the setpoint methodology for calculating the Trip Setpoint and thus the automatic protective action would still have ensured that the SL would not be exceeded with the "as found" setting of the protective device. Therefore, the device would still be OPERABLE since it would have performed its safety function and the only corrective action required would be to reset the device to the Trip Setpoint to account for further drift during the next surveillance interval.

Use of the Trip Setpoint to define "as found" OPERABILITY and its designation as the LSSS under the expected circumstances described above would result in actions required by both the rule and technical specifications that are clearly not warranted. However, there is also some point beyond which the device would have not been able to perform its function due, for example, to greater than expected drift. This value needs to be specified in the technical specifications in order to define OPERABILITY of the devices and is designated as the Allowable Value which, as stated above, is the same as the LSSS.

The Allowable Value specified in Table 3.3.1-1 {Table 3.3.1.1-1 for NUREG-1433 and NUREG-1434} serves as the LSSS such that a channel is OPERABLE if the trip setpoint is found not to exceed the Allowable Value during the CHANNEL FUNCTIONAL TEST (CFT). As such, the Allowable Value differs from the Trip Setpoint by an amount primarily equal to the expected instrument loop uncertainties, such as drift, during the surveillance interval. In this manner, the actual setting of the device will still meet the LSSS definition and ensure that a Safety Limit is not exceeded at any given point of time as long as the device has not drifted beyond that expected during the surveillance interval. If the actual setting of the device is found to have exceeded the Allowable Value the device would be considered inoperable from a technical specification perspective. This requires corrective action including those actions required by 10 CFR 50.36 when automatic protective devices do not function as required. Note that, although the channel is "OPERABLE" under these circumstances, the trip setpoint should be left adjusted to a value within the established trip setpoint calibration tolerance band, 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.

Table 3.3.1-1 (page 1 of 8)
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL
						TRIP SETPOINT (a)
1. Manual Reactor Trip	1,2	2	B	SR 3.3.1.14	NA	NA
	3(b), 4(b), 5(b)	2	C	SR 3.3.1.14	NA	NA
2. Power Range Neutron Flux						
a. High	1,2	4	D	SR 3.3.1.1 SR 3.3.1.2 SR 3.3.1.7 SR 3.3.1.11 SR 3.3.1.16	≤ [111.2]% RTP	⊕ [109]% RTP
b. Low	1(c), 2	4	E	SR 3.3.1.1 SR 3.3.1.8 SR 3.3.1.11 SR 3.3.1.16	≤ [27.2]% RTP	⊕ [25]% RTP
3. Power Range Neutron Flux Rate						
a. High Positive Rate	1,2	4	E	SR 3.3.1.7 SR 3.3.1.11	≤ [6.8]% RTP with time constant ≥ [2] sec	⊕ [5]% RTP with time constant ≥ [2] sec
b. High Negative Rate	1,2	4	E	SR 3.3.1.7 SR 3.3.1.11 SR 3.3.1.16	≤ [6.8]% RTP with time constant ≥ [2] sec	⊕ [5]% RTP with time constant ≥ [2] sec
4. Intermediate Range Neutron Flux	1(c), 2(d)	2	F,G	SR 3.3.1.1 SR 3.3.1.8 SR 3.3.1.11	≤ [31]% RTP	⊕ [25]% RTP
	2(e)	2	H	SR 3.3.1.1 SR 3.3.1.8 SR 3.3.1.11	≤ [31]% RTP	⊕ [25]% RTP

(continued)

- (a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
- (b) With Reactor Trip Breakers (RTBs) closed and Rod Control System capable of rod withdrawal.
- (c) Below the P-10 (Power Range Neutron Flux) interlocks.
- (d) Above the P-6 (Intermediate Range Neutron Flux) interlocks.
- (e) Below the P-6 (Intermediate Range Neutron Flux) interlocks.

Table 3.3.1-1 (page 2 of 8)
 Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	<u>NOMINAL</u> TRIP SETPOINT ^(a)
5. Source Range Neutron Flux	2(e)	2	I, J	SR 3.3.1.1 SR 3.3.1.8 SR 3.3.1.11 SR 3.3.1.16	≤ [1.4 E5] cps	Ⓢ [1.0 E5] cps
	3(b), 4(b), 5(b)	2	J, K	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.11 SR 3.3.1.16	≤ [1.4 E5] cps	Ⓢ [1.0 E5] cps
	3(f), 4(f), 5(f)	[1]	L	SR 3.3.1.1 SR 3.3.1.11	N/A	N/A
6. Overtemperature ΔT	1, 2	[4]	E	SR 3.3.1.1 SR 3.3.1.3 SR 3.3.1.6 SR 3.3.1.7 SR 3.3.1.12 SR 3.3.1.16	Refer to Note 1 (Page 3.3-21)	Refer to Note 1 (Page 3.3-21)
7. Overpower ΔT	1, 2	[4]	E	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.12 SR 3.3.1.16	Refer to Note 2 (Page 3.3-22)	Refer to Note 2 (Page 3.3-22)

(continued)

- (a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
- (b) With RTBs closed and Rod Control System capable of rod withdrawal.
- (c) Below the P-6 (Intermediate Range Neutron Flux) interlocks.
- (f) With the RTBs open. In this condition, source range Function does not provide reactor trip but does provide [input to the Boron Dilution Protection System (LCD 3.3.9), and] indication.

Table 3.3.1-1 (page 3 of 8)
 Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL TRIP SETPOINT (a)
8. Pressurizer Pressure						
a. Low	1(g)	[4]	M	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10 SR 3.3.1.16	≥ [1886] psig	② [1900] psig
b. High	1,2	[4]	E	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10 SR 3.3.1.16	≤ [2396] psig	② [2385] psig
9. Pressurizer Water Level - High	1(g)	3	M	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10	≤ [93.8]%	② [92]%
10. Reactor Coolant Flow - Low						
a. Single Loop	1(h)	3 per loop	N	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10 SR 3.3.1.16	≥ [89.2]%	② [90]%
b. Two Loops	1(i)	3 per loop	M	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10 SR 3.3.1.16	≥ [89.2]%	② [90]%

(continued)

- (a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
- (g) Above the P-7 (Low Power Reactor Trips Block) interlock.
- (h) Above the P-8 (Power Range Neutron Flux) interlock.
- (i) Above the P-7 (Low Power Reactor Trips Block) interlock and below the P-8 (Power Range Neutron Flux) interlock.

Table 3.3.1-1 (page 4 of 8)
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL
						TRIP- SETPOINT (a)
11. Reactor Coolant Pump (RCP) Breaker Position						
a. Single Loop	1(h)	1 per RCP	O	SR 3.3.1.14	NA	NA
b. Two Loops	1(i)	1 per RCP	M	SR 3.3.1.14	NA	NA
12. Undervoltage RCPs	1(g)	[3] per bus	M	SR 3.3.1.9 SR 3.3.1.10 SR 3.3.1.16	≥ [4760] V	2 [4830] V
13. Underfrequency RCPs	1(g)	[3] per bus	M	SR 3.3.1.9 SR 3.3.1.10 SR 3.3.1.16	≥ [57.1] Hz	2 [57.5] Hz
14. Steam Generator (SG) Water Level - Low Low	1,2	[4 per SG]	E	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10 SR 3.3.1.16	≥ [30.4]%	2 [32.3]%
15. SG Water Level - Low	1,2	2 per SG	E	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10 SR 3.3.1.16	≥ [30.4]%	2 [32.3]%
Coincident with Steam Flow/ Feedwater Flow Mismatch	1,2	2 per SG	E	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10 SR 3.3.1.16	≤ [42.5]% full steam flow at RTP	3 [40]% full steam flow at RTP

(continued)

- (a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
- (g) Above the P-7 (Low Power Reactor Trips Block) interlock.
- (h) Above the P-8 (Power Range Neutron Flux) interlock.
- (i) Above the P-7 (Low Power Reactor Trips Block) interlock and below the P-8 (Power Range Neutron Flux) interlock.

Table 3.3.1-1 (page 5 of 8)
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL
						TRIP SETPOINT(a)
16. Turbine Trip						
a. Low Fluid Oil Pressure	1(j)	3	P	SR 3.3.1.10 SR 3.3.1.15	≥ [750] psig	② [800] psig
b. Turbine Stop Valve Closure	1(j)	4	P	SR 3.3.1.10 SR 3.3.1.15	≥ [1] % open	② [1] % open
17. Safety Injection (SI) Input from Engineered Safety Feature Actuation System (ESFAS)	1,2	2 trains	Q	SR 3.3.1.14	NA	NA
18. Reactor Trip System Interlocks						
a. Intermediate Range Neutron Flux, P-6	2(e)	2	S	SR 3.3.1.11 SR 3.3.1.13	≥ [6E-11] amp	② [1E-10] amp
b. Low Power Reactor Trips Block, P-7	1	1 per train	T	SR 3.3.1.11 SR 3.3.1.13	NA	NA
c. Power Range Neutron Flux, P-8	1	4	T	SR 3.3.1.11 SR 3.3.1.13	≤ [50.2] % RTP	② [48] % RTP
d. Power Range Neutron Flux, P-9	1	4	T	SR 3.3.1.11 SR 3.3.1.13	≤ [52.2] % RTP	② [50] % RTP
e. Power Range Neutron Flux, P-10	1,2	4	S	SR 3.3.1.11 SR 3.3.1.13	≥ [7.8] % RTP and ≤ [12.2] % RTP	② [10] % RTP
f. Turbine Impulse Pressure, P-13	1	2	T	[SR 3.3.1.11] SR 3.3.1.10 SR 3.3.1.13	≤ [12.2] % turbine power	② [10] % turbine power

(continued)

- (a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
- (e) Below the P-6 (Intermediate Range Neutron Flux) interlocks.
- (j) Above the P-9 (Power Range Neutron Flux) interlock.

Table 3.3.1-1 (page 6 of 8)
 Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL
						TRIP - SETPOINT(a)
19. Reactor Trip Breakers (k)	1,2	2 trains	R	SR 3.3.1.4	NA	NA
	3(b), 4(b), 5(b)	2 trains	C	SR 3.3.1.4	NA	NA
20. Reactor Trip Breaker Undervoltage and Shunt Trip Mechanisms	1,2	1 each per RTB	U	SR 3.3.1.4	NA	NA
	3(b), 4(b), 5(b)	1 each per RTB	C	SR 3.3.1.4	NA	NA
21. Automatic Trip Logic	1,2	2 trains	Q	SR 3.3.1.5	NA	NA
	3(b), 4(b), 5(b)	2 trains	C	SR 3.3.1.5	NA	NA

- (a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
- (b) With RTBs closed and Rod Control System capable of rod withdrawal.
- (k) Including any reactor trip bypass breakers that are racked in and closed for bypassing an RTB.

Table 3.3.1-1 (page 7 of 8)
 Reactor Trip System Instrumentation

Note 1: Overtemperature ΔT

Nominal

The Overtemperature ΔT Function Allowable Value shall not exceed the following Trip Setpoint by more than [3.8]% of ΔT span.

$$\Delta T \frac{(1+\tau_1 s)}{(1+\tau_2 s)} \left(\frac{1}{1+\tau_3 s} \right) \leq \Delta T_0 \left\{ K_1 - K_2 \frac{(1+\tau_4 s)}{(1+\tau_5 s)} \left[T \frac{1}{(1+\tau_6 s)} - T' \right] + K_3 (P - P') - f_1(\Delta I) \right\}$$

Where: ΔT is measured RCS ΔT , °F.
 ΔT_0 is the indicated ΔT at RTP, °F.
 s is the Laplace transform operator, sec⁻¹.
 T is the measured RCS average temperature, °F.
 T' is the nominal T_{avg} at RTP, \leq [588]°F.

P is the measured pressurizer pressure, psig
 P' is the nominal RCS operating pressure, \leq [2235] psig

$K_1 \leq$ [1.09] $K_2 \geq$ [0.0138]/°F $K_3 =$ [0.000671]/psig
 $\tau_1 \geq$ [8] sec $\tau_2 \leq$ [3] sec $\tau_3 \leq$ [2] sec
 $\tau_4 \geq$ [33] sec $\tau_5 \leq$ [4] sec $\tau_6 \leq$ [2] sec

$f_1(\Delta I) = 1.26\{35 + (q_t - q_b)\}$ when $q_t - q_b \leq - [35]\%$ RTP
 0% of RTP when $-[35]\%$ RTP $< q_t - q_b \leq [7]\%$ RTP
 $-1.05\{(q_t - q_b) - 7\}$ when $q_t - q_b > [7]\%$ RTP

Where q_t and q_b are percent RTP in the upper and lower halves of the core, respectively, and $q_t + q_b$ is the total THERMAL POWER in percent RTP.

Table 3.3.1-1 (page 8 of 8)
 Reactor Trip System Instrumentation

Note 2: Overpower ΔT

nominal

The Overpower ΔT Function Allowable Value shall not exceed the following Trip Setpoint by more than [3]% of ΔT span.

$$\Delta T \frac{(1+\tau_1 s)}{(1+\tau_2 s)} \left(\frac{1}{1+\tau_3 s} \right) \leq \Delta T_0 \left\{ K_4 - K_5 \frac{\tau_4 s}{1+\tau_4 s} \left(\frac{1}{1+\tau_5 s} \right) T - K_6 \left[T \frac{1}{1+\tau_6 s} - T'' \right] - f_2(\Delta I) \right\}$$

Where: ΔT is measured RCS ΔT , °F.
 ΔT_0 is the indicated ΔT at RTP, °F.
 s is the Laplace transform operator, sec⁻¹.
 T is the measured RCS average temperature, °F.
 T'' is the nominal T_{avg} at RTP, $\leq [588]$ °F.

$K_4 \leq [1.09]$	$K_5 \geq [0.02]/^\circ\text{F}$ for increasing T_{avg}	$K_6 \geq [0.00128]/^\circ\text{F}$ when $T > T''$
	$[0]/^\circ\text{F}$ for decreasing T_{avg}	$[0]/^\circ\text{F}$ when $T \leq T''$
$\tau_1 \geq [8]$ sec	$\tau_2 \leq [3]$ sec	$\tau_3 \leq [2]$ sec
$\tau_6 \leq [2]$ sec	$\tau_7 \geq [10]$ sec	

$f_2(\Delta I) = 0\%$ RTP for all ΔI .

Table 3.3.1-1 (page 8 of 8)
 Reactor Trip System Instrumentation

Note 2: Overpower ΔT

nominal

The Overpower ΔT Function Allowable Value shall not exceed the following Trip Setpoint by more than [3]% of ΔT span.

$$\Delta T \frac{(1+\tau_1 s)}{(1+\tau_2 s)} \left(\frac{1}{1+\tau_3 s} \right) \leq \Delta T_0 \left\{ K_4 - K_5 \frac{\tau_7 s}{1+\tau_7 s} \left(\frac{1}{1+\tau_6 s} \right) T - K_6 \left[T \frac{1}{1+\tau_6 s} - T'' \right] - f_2(\Delta I) \right\}$$

Where: ΔT is measured RCS ΔT , °F.
 ΔT_0 is the indicated ΔT at RTP, °F.
 s is the Laplace transform operator, sec⁻¹.
 T is the measured RCS average temperature, °F.
 T'' is the nominal T_{avg} at RTP, \leq [588]°F.

$K_4 \leq [1.09]$	$K_5 \geq [0.02]/^\circ\text{F}$ for increasing T_{avg}	$K_6 \geq [0.00128]/^\circ\text{F}$ when $T > T''$
	$[0]/^\circ\text{F}$ for decreasing T_{avg}	$[0]/^\circ\text{F}$ when $T \leq T''$
$\tau_1 \geq [8]$ sec	$\tau_2 \leq [3]$ sec	$\tau_3 \leq [2]$ sec
$\tau_6 \leq [2]$ sec	$\tau_7 \geq [10]$ sec	

$f_2(\Delta I) = 0\%$ RTP for all ΔI .

Table 3.3.2-1 (page 2 of 8)
 Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	TRIP SETPOINT ^(a)
1. Safety Injection (continued)						
g. High Steam Flow in Two Steam Lines	1,2,3 ^(d)	2 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	(e)	(f)
Coincident with Steam Line Pressure - Low	1,2,3 ^(d)	1 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≥ [635] ^(c) psig	2 [675] psig
2. Containment Spray						
a. Manual Initiation	1,2,3,4	2 per train, 2 trains	B	SR 3.3.2.8	NA	NA
b. Automatic Actuation Logic and Actuation Relays	1,2,3,4	2 trains	C	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA	NA
c. Containment Pressure						
High - 3 (High High)	1,2,3	4	E	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≤ [12.31] psig	2 [12.05] psig
High - 3 (Two Loop Plants)	1,2,3	[3] sets of [2]	E	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≤ [12.31] psig	2 [12.05] psig

NOMINAL

2 [12.05] psig
 2 [12.05] psig

(continued)

- (a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
- (c) Time constants used in the lead/lag controller are $t_1 \geq [50]$ seconds and $t_2 \leq [5]$ seconds.
- (d) Above the P-12 (T_{avg} - Low Low) interlock.
- (e) Less than or equal to a function defined as ΔP corresponding to [44]% full steam flow below [20]% load, and ΔP increasing linearly from [44]% full steam flow at [20]% load to [114]% full steam flow at [100]% load, and ΔP corresponding to [114]% full steam flow above 100% load.
- (f) Less than or equal to a function defined as ΔP corresponding to [40]% full steam flow between [0]% and [20]% load and then a ΔP increasing linearly from [40]% steam flow at [20]% load to [110]% full steam flow at [100]% load.

Table 3.3.2-1 (page 3 of 8)
Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	TRIP SETPOINT (a)
NOMINAL						
3. Containment Isolation						
a. Phase A Isolation						
(1) Manual Initiation	1,2,3,4	2	B	SR 3.3.2.8	NA	NA
(2) Automatic Actuation Logic and Actuation Relays	1,2,3,4	2 trains	C	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA	NA
(3) Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					
b. Phase B Isolation						
(1) Manual Initiation	1,2,3,4	2 per train, 2 trains	B	SR 3.3.2.8	NA	NA
(2) Automatic Actuation Logic and Actuation Relays	1,2,3,4	2 trains	C	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA	NA
(3) Containment Pressure						
High - 3 (High High)	1,2,3	[4]	E	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≤ [12.31] psig	[12.05] psig
4. Steam Line Isolation						
a. Manual Initiation	1,2 ⁽ⁱ⁾ ,3 ⁽ⁱ⁾	2	F	SR 3.3.2.8	NA	NA
b. Automatic Actuation Logic and Actuation Relays	1,2 ⁽ⁱ⁾ ,3 ⁽ⁱ⁾	2 trains	G	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA	NA

(continued)

(a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
(i) Except when all MSIVs are closed and [de-activated].

Table 3.3.2-1 (page 4 of 8)
 Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	<u>NOMINAL</u> TRIP SETPOINT ^(a)
4. Steam Line Isolation (continued)						
c. Containment Pressure - High 2	1,2 ⁽ⁱ⁾ , 3 ⁽ⁱ⁾	[4]	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≤ [6.61] psig	2 [6.35] psig
d. Steam Line Pressure						
(1) Low	1,2 ⁽ⁱ⁾ , 3 ^{(b)(i)}	3 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≥ [635] ^(c) psig	2 [675] ^(c) psig
(2) Negative Rate - High	3 ^{(g)(i)}	3 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≤ [121.6] ^(h) psi/sec	2 [110] ^(h) psi/sec
e. High Steam Flow in Two Steam Lines	1,2 ⁽ⁱ⁾ , 3 ⁽ⁱ⁾	2 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	(e)	(f)
Coincident with T _{avg} - Low Low	1,2 ⁽ⁱ⁾ , 3 ^{(d)(i)}	1 per loop	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≥ [550.6] ^(f)	2 [553] ^(f)

(continued)

- (a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
- (b) Above the P-11 (Pressurizer Pressure) interlock.
- (c) Time constants used in the lead/lag controller are $t_r \geq [50]$ seconds and $t_l \leq [5]$ seconds.
- (d) Above the P-12 (T_{avg} - Low Low) interlock.
- (e) Less than or equal to a function defined as ΔP corresponding to [44]% full steam flow below [20]% load, ΔP increasing linearly from [44]% full steam flow at [20]% load to [114]% full steam flow at [100]% load, and ΔP corresponding to [114]% full steam flow above 100% load.
- (f) Less than or equal to a function defined as ΔP corresponding to [40]% full steam flow between [0]% and [20]% load and then a ΔP increasing linearly from [40]% steam flow at [20]% load to [110]% full steam flow at [100]% load.
- (g) Below the P-11 (Pressurizer Pressure) interlock.
- (h) Time constant utilized in the rate/lag controller is $\leq [50]$ seconds.
- (i) Except when all MSIVs are closed and [de-activated].

Table 3.3.2-1 (page 5 of 8)
 Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	TRIP SETPOINT (a)
NOMINAL						
4. Steam Line Isolation (continued)						
f. High Steam Flow in Two Steam Lines	1,2(i), 3(i)	2 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	(e)	(f)
Coincident with Steam Line Pressure - Low	1,2, (i) 3(i)	1 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≥ [635] (c) psig	[675] (c) psig
g. High Steam Flow	1,2(i), 3(i)	2 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≤ [25]% of full steam flow at no load steam pressure	[] full steam flow at no load steam pressure
Coincident with Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					
and						
Coincident with T _{low} - Low Low	1,2(i), 3(d)(i)	[2] per loop	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≥ [550.6] °F	[553] °F
h. High High Steam Flow	1,2(i), 3(i)	2 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≤ [130]% of full steam flow at full load steam pressure	[] of full steam flow at full load steam pressure
Coincident with Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					

(continued)

- (a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
- (d) Above the P-12 (T_{low} - Low Low) interlock.
- (i) Except when all MSIVs are closed and [de-activated].

Table 3.3.2-1 (page 6 of 8)
 Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL TRIP SETPOINT (a)	
5. Turbine Trip and Feedwater Isolation							
a. Automatic Actuation Logic and Actuation Relays	1,2(j), [3](j)	2 trains	HIG	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA		NA
b. SG Water Level - High High (P-14)	1,2(j), [3](j)	[3] per SG	I(D)	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≤ [84.21%]		② [82.41%]
c. Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.						
6. Auxiliary Feedwater							
a. Automatic Actuation Logic and Actuation Relays (Solid State Protection System)	1,2,3	2 trains	G	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA		NA
b. Automatic Actuation Logic and Actuation Relays (Balance of Plant ESFAS)	1,2,3	2 trains	G	SR 3.3.2.3	NA		NA
c. SG Water Level - Low Low	1,2,3	[3] per SG	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≥ [30.4%]		② [32.21%]

(continued)

(a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.
 (j) Except when all MFIVs, MFRVs, [and associated bypass valves] are closed and [de-activated] [or isolated by a closed manual valve].

Table 3.3.2-1 (page 7 of 8)
 Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL
						TRIP SETPOINT(a)
6. Auxiliary Feedwater (continued)						
d. Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					
e. Loss of Offsite Power	1,2,3	[3] per bus	F	SR 3.3.2.7 SR 3.3.2.9 SR 3.3.2.10	≥ [2912] V with ≤ 0.8 sec time delay	② [2975] V with ≤ 0.8 sec time delay
f. Undervoltage Reactor Coolant Pump	1,2	[3] per bus	I	SR 3.3.2.7 SR 3.3.2.9 SR 3.3.2.10	≥ [69]% bus voltage	② [70]% bus voltage
g. Trip of all Main Feedwater Pumps	1,2	[2] per pump	J	SR 3.3.2.8 SR 3.3.2.9 SR 3.3.2.10	≥ [] psig	② [] psig
h. Auxiliary Feedwater Pump Suction Transfer on Suction Pressure - Low	1,2,3	[2]	F	SR 3.3.2.1 SR 3.3.2.7 SR 3.3.2.9	≥ [20.53] [psia]	② [] [psia]
7. Automatic Switchover to Containment Sump						
a. Automatic Actuation Logic and Actuation Relays	1,2,3,4	2 trains	C	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA	NA
b. Refueling Water Storage Tank (RWST) Level - Low	1,2,3,4	4	K	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≥ [15]% and ≤ [] %	② [] and []
Coincident with Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					

(continued)

(a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

Table 3.3.2-1 (page 8 of 8)
 Engineered Safety Feature Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	<u>NOMINAL</u> TRIP SETPOINT (a)
7. Automatic Switchover to Containment Sump (continued)						
c. RWST Level - Low Low	1,2,3,4	4	K	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≥ [15]%	Ⓢ [18]%
Coincident with Safety Injection	Refer to Function 1 (Safety Injection) for all initiation functions and requirements.					
and						
Coincident with Containment Sump Level - High	1,2,3,4	4	K	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≥ [30] in. above el. [703] ft	Ⓢ [] in. above el. [] ft
8. ESFAS Interlocks						
a. Reactor Trip, P-4	1,2,3	1 per train, 2 trains	F	SR 3.3.2.11	NA	NA
b. Pressurizer Pressure, P-11	1,2,3	3	L	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9	≤ [1996] psig	Ⓢ [] psig
c. T _{avg} - Low Low, P-12	1,2,3	[1] per loop	L	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9	≥ [550.6] °F	Ⓢ [553] °F

(a) Reviewer's Note: Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

B 3.3 INSTRUMENTATION

B 3.3.1 Reactor Trip System (RTS) Instrumentation

BASES

BACKGROUND

The RTS initiates a unit shutdown, based on the values of selected unit parameters, to protect against violating the core fuel design limits and Reactor Coolant System (RCS) pressure boundary during anticipated operational occurrences (AOOs) and to assist the Engineered Safety Features (ESF) Systems in mitigating accidents.

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

Insert 3

~~The LSSS, defined in this specification as the [Trip Setpoints], in conjunction with the LCOs, establish the threshold for protective system action to prevent exceeding acceptable limits during Design Basis Accidents (DBAs).~~

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

1. The Departure from Nucleate Boiling Ratio (DNBR) shall be maintained above the Safety Limit (SL) value to prevent departure from nucleate boiling (DNB);
2. Fuel centerline melt shall not occur; and
3. The RCS pressure SL of 2750 psia shall not be exceeded.

Operation within the SLs of Specification 2.0, "Safety Limits (SLs)," also maintains the above values and assures that offsite dose will be within the 10 CFR 50 and 10 CFR 100 criteria during AOOs.

Accidents are events that are analyzed even though they are not expected to occur during the unit life. The acceptable limit during accidents is that offsite dose shall be maintained within an acceptable fraction of 10 CFR 100 limits. Different accident categories are allowed a

(continued)

BASES

BACKGROUND (continued)

different fraction of these limits, based on probability of occurrence. Meeting the acceptable dose limit for an accident category is considered having acceptable consequences for that event.

The RTS instrumentation is segmented into four distinct but interconnected modules as illustrated in Figure [], FSAR, Chapter [7] (Ref. 1), and as identified below:

1. Field transmitters or process sensors: provide a measurable electronic signal based upon the physical characteristics of the parameter being measured;
2. Signal Process Control and Protection System, including Analog Protection System, Nuclear Instrumentation System (NIS), field contacts, and protection channel sets: provides signal conditioning, bistable setpoint comparison, process algorithm actuation, compatible electrical signal output to protection system devices, and control board/control room/miscellaneous indications;
3. Solid State Protection System (SSPS), including input, logic, and output bays: initiates proper unit shutdown and/or ESF actuation in accordance with the defined logic, which is based on the bistable outputs from the signal process control and protection system; and
4. Reactor trip switchgear, including reactor trip breakers (RTBs) and bypass breakers: provides the means to interrupt power to the control rod drive mechanisms (CRDMs) and allows the rod cluster control assemblies (RCCAs), or "rods," to fall into the core and shut down the reactor. The bypass breakers allow testing of the RTBs at power.

Field Transmitters or Sensors

To meet the design demands for redundancy and reliability, more than one, and often as many as four, field transmitters or sensors are used to measure unit parameters. To account for the calibration tolerances and instrument drift, which are assumed to occur between calibrations, statistical allowances are provided in the Trip Setpoint and Allowable

(continued)

BASES

BACKGROUND

Field Transmitters or Sensors (continued)

Insert 4

Values. The OPERABILITY of each transmitter or sensor can be evaluated when its "as found" calibration data are compared against its documented acceptance criteria.

Signal Process Control and Protection System

Generally, three or four channels of process control equipment are used for the signal processing of unit parameters measured by the field instruments. The process control equipment provides signal conditioning, comparable output signals for instruments located on the main control board, and comparison of measured input signals with setpoints established by safety analyses. These setpoints are defined in FSAR, Chapter [7] (Ref. 1), Chapter [6] (Ref. 2), and Chapter [15] (Ref. 3). If the measured value of a unit parameter exceeds the predetermined setpoint, an output from a bistable is forwarded to the SSPS for decision evaluation. Channel separation is maintained up to and through the input bays. However, not all unit parameters require four channels of sensor measurement and signal processing. Some unit parameters provide input only to the SSPS, while others provide input to the SSPS, the main control board, the unit computer, and one or more control systems.

Generally, if a parameter is used only for input to the protection circuits, three channels with a two-out-of-three logic are sufficient to provide the required reliability and redundancy. If one channel fails in a direction that would not result in a partial Function trip, the Function is still OPERABLE with a two-out-of-two logic. If one channel fails, such that a partial Function trip occurs, a trip will not occur and the Function is still OPERABLE with a one-out-of-two logic.

Generally, if a parameter is used for input to the SSPS and a control function, four channels with a two-out-of-four logic are sufficient to provide the required reliability and redundancy. The circuit must be able to withstand both an input failure to the control system, which may then require the protection function actuation, and a single failure in the other channels providing the protection function actuation. Again, a single failure will neither cause nor

(continued)

BASES

BACKGROUND

Signal Process Control and Protection System (continued)

prevent the protection function actuation. These requirements are described in IEEE-279-1971 (Ref. 4). The actual number of channels required for each unit parameter is specified in Reference 1.

Two logic channels are required to ensure no single random failure of a logic channel will disable the RTS. The logic channels are designed such that testing required while the reactor is at power may be accomplished without causing trip. Provisions to allow removing logic channels from service during maintenance are unnecessary because of the logic system's designed reliability.

and RTS Setpoints

Trip Setpoints and Allowable Values

The Trip Setpoints are the nominal values at which the bistables are set. Any bistable is considered to be properly adjusted when the "as left" value is within the band for CHANNEL CALIBRATION accuracy (i.e., \pm rack calibration + comparator setting accuracy).

The Trip Setpoints used in the bistables are based on the analytical limits stated in Reference 1. The selection of these Trip Setpoints is such that adequate protection is provided when all sensor and processing time delays are taken into account. To allow for calibration tolerances, instrumentation uncertainties, instrument drift, and severe environment errors for those RTS channels that must function in harsh environments as defined by 10 CFR 50.49 (Ref. 5), the Trip Setpoints and Allowable Values specified in Table 3.3.1-1 in the accompanying LCO are conservative ~~adjusted~~ with respect to the analytical limits. A detailed description of the methodology used to calculate the Trip Setpoints, including their explicit uncertainties, is provided in the "RTS/ESFAS Setpoint Methodology Study" (Ref. 6).

Allowed Value and

Inser + 5

The actual nominal Trip Setpoint entered into the bistable is more conservative than that specified by the Allowable Value to account for changes in random measurement errors detectable by a COT. One example of such a change in measurement error is drift during the surveillance interval. If the measured setpoint does not exceed the Allowable Value, the bistable is considered OPERABLE.

(continued)

requirements of the

and RTS Setpoints

BASES

BACKGROUND

~~Trip Setpoints and Allowable Values~~ (continued)

Consistent Trip

Setpoints in accordance with the Allowable Value ensure that SLs are not violated during AOOs (and that the consequences of DBAs will be acceptable, providing the unit is operated from within the LCOs at the onset of the AOO or DBA and the equipment functions as designed). Note that in the accompanying LCO 3.3.1, the Trip Setpoints of Table 3.3.1-1 are the LSSS.

Each channel of the process control equipment can be tested on line to verify that the signal or setpoint accuracy is within the specified allowance requirements of Reference 2. Once a designated channel is taken out of service for testing, a simulated signal is injected in place of the field instrument signal. The process equipment for the channel in test is then tested, verified, and calibrated. SRs for the channels are specified in the SRs section.

The Trip Setpoints and Allowable Values listed in Table 3.3.1-1 are based on the methodology described in Reference 6, which incorporates all of the known uncertainties applicable for each channel. The magnitudes of these uncertainties are factored into the determination of each Trip Setpoint. All field sensors and signal processing equipment for these channels are assumed to operate within the allowances of these uncertainty magnitudes.

Solid State Protection System

The SSPS equipment is used for the decision logic processing of outputs from the signal processing equipment bistables. To meet the redundancy requirements, two trains of SSPS, each performing the same functions, are provided. If one train is taken out of service for maintenance or test purposes, the second train will provide reactor trip and/or ESF actuation for the unit. If both trains are taken out of service or placed in test, a reactor trip will result. Each train is packaged in its own cabinet for physical and electrical separation to satisfy separation and independence requirements. The system has been designed to trip in the event of a loss of power, directing the unit to a safe shutdown condition.

(continued)

BASES

BACKGROUND

Reactor Trip Switchgear (continued)

the reactor trip or ESF, these diagrams also describe the various "permissive interlocks" that are associated with unit conditions. Each train has a built in testing device that can automatically test the decision logic matrix Functions and the actuation devices while the unit is at power. When any one train is taken out of service for testing, the other train is capable of providing unit monitoring and protection until the testing has been completed. The testing device is semiautomatic to minimize testing time.

APPLICABLE
SAFETY ANALYSES,
LCO, and
APPLICABILITY

The RTS functions to maintain the SLs during all AOOs and mitigates the consequences of DBAs in all MODES in which the RTBs are closed.

Each of the analyzed accidents and transients can be detected by one or more RTS Functions. The accident analysis described in Reference 3 takes credit for most RTS trip Functions. RTS trip Functions not specifically credited in the accident analysis are qualitatively credited in the safety analysis and the NRC staff approved licensing basis for the unit. These RTS trip Functions may provide protection for conditions that do not require dynamic transient analysis to demonstrate Function performance. They may also serve as backups to RTS trip Functions that were credited in the accident analysis.

The LCO requires all instrumentation performing an RTS Function, listed in Table 3.3.1-1 in the accompanying LCO, to be OPERABLE. Failure of any instrument renders the affected channel(s) inoperable and reduces the reliability of the affected Functions.

Insert 1

The LCO generally requires OPERABILITY of four or three channels in each instrumentation Function, two channels of Manual Reactor Trip in each logic Function, and two trains in each Automatic Trip Logic Function. Four OPERABLE instrumentation channels in a two-out-of-four configuration are required when one RTS channel is also used as a control system input. This configuration accounts for the possibility of the shared channel failing in such a manner that it creates a transient that requires RTS action. In

(continued)

B 3.3 INSTRUMENTATION

B 3.3.2 Engineered Safety Feature Actuation System (ESFAS) Instrumentation

BASES

BACKGROUND

The ESFAS initiates necessary safety systems, based on the values of selected unit parameters, to protect against violating core design limits and the Reactor Coolant System (RCS) pressure boundary, and to mitigate accidents.

The ESFAS instrumentation is segmented into three distinct but interconnected modules as identified below:

- Field transmitters or process sensors and instrumentation: provide a measurable electronic signal based on the physical characteristics of the parameter being measured;
- Signal processing equipment including analog protection system, field contacts, and protection channel sets: provide signal conditioning, bistable setpoint comparison, process algorithm actuation, compatible electrical signal output to protection system devices, and control board/control room/miscellaneous indications; and
- Solid State Protection System (SSPS) including input, logic, and output bays: initiates the proper unit shutdown or engineered safety feature (ESF) actuation in accordance with the defined logic and based on the bistable outputs from the signal process control and protection system.

Insert 6 →

Field Transmitters or Sensors

To meet the design demands for redundancy and reliability, more than one, and often as many as four, field transmitters or sensors are used to measure unit parameters. In many cases, field transmitters or sensors that input to the ESFAS are shared with the Reactor Trip System (RTS). In some cases, the same channels also provide control system inputs. To account for calibration tolerances and instrument drift, which are assumed to occur between calibrations, statistical allowances are provided in the Trip Setpoint and Allowable

(continued)

BASES

BACKGROUND

Field Transmitters or Sensors (continued)

Insert 7

~~Values. The OPERABILITY of each transmitter or sensor can be evaluated when its "as found" calibration data are compared against its documented acceptance criteria.~~

Signal Processing Equipment

Generally, three or four channels of process control equipment are used for the signal processing of unit parameters measured by the field instruments. The process control equipment provides signal conditioning, comparable output signals for instruments located on the main control board, and comparison of measured input signals with setpoints established by safety analyses. These setpoints are defined in FSAR, Chapter [6] (Ref. 1), Chapter [7] (Ref. 2), and Chapter [15] (Ref. 3). If the measured value of a unit parameter exceeds the predetermined setpoint, an output from a bistable is forwarded to the SSPS for decision evaluation. Channel separation is maintained up to and through the input bays. However, not all unit parameters require four channels of sensor measurement and signal processing. Some unit parameters provide input only to the SSPS, while others provide input to the SSPS, the main control board, the unit computer, and one or more control systems.

Generally, if a parameter is used only for input to the protection circuits, three channels with a two-out-of-three logic are sufficient to provide the required reliability and redundancy. If one channel fails in a direction that would not result in a partial Function trip, the Function is still OPERABLE with a two-out-of-two logic. If one channel fails such that a partial Function trip occurs, a trip will not occur and the Function is still OPERABLE with a one-out-of-two logic.

Generally, if a parameter is used for input to the SSPS and a control function, four channels with a two-out-of-four logic are sufficient to provide the required reliability and redundancy. The circuit must be able to withstand both an input failure to the control system, which may then require the protection function actuation, and a single failure in the other channels providing the protection function

(continued)

BASES

BACKGROUND

Signal Processing Equipment (continued)

actuation. Again, a single failure will neither cause nor prevent the protection function actuation.

These requirements are described in IEEE-279-1971 (Ref. 4). The actual number of channels required for each unit parameter is specified in Reference 2.

Trip Setpoints and Allowable Values

and ESFAS setpoints

The Trip Setpoints are the nominal values at which the bistables are set. Any bistable is considered to be properly adjusted when the "as left" value is within the band for CHANNEL CALIBRATION accuracy.

The Trip Setpoints used in the bistables are based on the analytical limits stated in Reference 2. The selection of these Trip Setpoints is such that adequate protection is provided when all sensor and processing time delays are taken into account. To allow for calibration tolerances, instrumentation uncertainties, instrument drift, and severe environment errors for those ESFAS channels that must function in harsh environments as defined by 10 CFR 50.49 (Ref. 5), the Trip Setpoints and Allowable Values specified in Table 3.3.2-1 in the accompanying LCO are conservatively adjusted with respect to the analytical limits. A detailed description of the methodology used to calculate the Trip Setpoints, including their explicit uncertainties, is provided in the "RTS/ESFAS Setpoint Methodology Study" (Ref. 6). The actual nominal Trip Setpoint entered into the bistable is more conservative than that specified by the Allowable Value to account for changes in random measurement errors detectable by a COT. One example of such a change in measurement error is drift during the surveillance interval. If the measured setpoint does not exceed the Allowable Value, the bistable is considered OPERABLE.

Insert B

adjusted consistent with the requirements of the

Setpoints in accordance with the Allowable Value ensure that the consequences of Design Basis Accidents (DBAs) will be acceptable, providing the unit is operated from within the LCOs at the onset of the DBA and the equipment functions as designed.

(continued)

BASES

and ESFAS Setpoints

BACKGROUND

Trip Setpoints and Allowable Values (continued)

Each channel can be tested on line to verify that the signal processing equipment and setpoint accuracy is within the specified allowance requirements of Reference 2. Once a designated channel is taken out of service for testing, a simulated signal is injected in place of the field instrument signal. The process equipment for the channel in test is then tested, verified, and calibrated. SRs for the channels are specified in the SR section.

The Trip Setpoints and Allowable Values listed in Table 3.3.2-1 are based on the methodology described in Reference 6, which incorporates all of the known uncertainties applicable for each channel. The magnitudes of these uncertainties are factored into the determination of each Trip Setpoint. All field sensors and signal processing equipment for these channels are assumed to operate within the allowances of these uncertainty magnitudes.

Solid State Protection System

The SSPS equipment is used for the decision logic processing of outputs from the signal processing equipment bistables. To meet the redundancy requirements, two trains of SSPS, each performing the same functions, are provided. If one train is taken out of service for maintenance or test purposes, the second train will provide ESF actuation for the unit. If both trains are taken out of service or placed in test, a reactor trip will result. Each train is packaged in its own cabinet for physical and electrical separation to satisfy separation and independence requirements.

The SSPS performs the decision logic for most ESF equipment actuation; generates the electrical output signals that initiate the required actuation; and provides the status, permissive, and annunciator output signals to the main control room of the unit.

The bistable outputs from the signal processing equipment are sensed by the SSPS equipment and combined into logic matrices that represent combinations indicative of various

(continued)

BASES (continued)

APPLICABLE
SAFETY ANALYSES,
LCO, AND
APPLICABILITY

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 may be the primary actuation signal for more than one type of accident. An ESFAS Function may also be a secondary, or backup, actuation signal for one or more other accidents. For example, Pressurizer Pressure—Low is a primary actuation signal for small loss of coolant accidents (LOCAs) and a backup actuation signal for steam line breaks (SLBs) outside containment. Functions such as manual initiation, not specifically credited in the accident safety analysis, are qualitatively credited in the safety analysis and the NRC staff approved licensing basis for the unit. These Functions may provide protection for conditions that do not require dynamic transient analysis to demonstrate Function performance. These Functions may also serve as backups to Functions that were credited in the accident analysis (Ref. 3).

Insert 2

The LCO requires all instrumentation performing an ESFAS Function to be OPERABLE. Failure of any instrument renders the affected channel(s) inoperable and reduces the reliability of the affected Functions.

The LCO generally requires OPERABILITY of four or three channels in each instrumentation function and two channels in each logic and manual initiation function. The two-out-of-three and the two-out-of-four configurations allow one channel to be tripped during maintenance or testing without causing an ESFAS initiation. Two logic or manual initiation channels are required to ensure no single random failure disables the ESFAS.

The required channels of ESFAS instrumentation provide unit protection in the event of any of the analyzed accidents. ESFAS protection functions are as follows:

1. Safety Injection

Safety Injection (SI) provides two primary functions:

1. Primary side water addition to ensure maintenance or recovery of reactor vessel water level (coverage of the active fuel for heat removal, clad integrity, and for limiting peak clad temperature to < 2200°F); and

(continued)

TSTF-355

BASES

SURVEILLANCE
REQUIREMENTS

SR 3.3.2.11 (continued)

Trip Interlock, and the Frequency is once per RTB cycle. This Frequency is based on operating experience demonstrating that undetected failure of the P-4 interlock sometimes occurs when the RTB is cycled.

The SR is modified by a Note that excludes verification of setpoints during the TADOT. The Function tested has no associated setpoint.

REFERENCES

1. FSAR, Chapter [6].
2. FSAR, Chapter [7].
3. FSAR, Chapter [15].
4. IEEE-279-1971.
5. 10 CFR 50.49. *Plant-specific*
6. ~~RTS/ESFAS~~ Setpoint Methodology Study.
7. NUREG-1218, April 1988.
8. WCAP-10271-P-A, Supplement 2, Rev. 1, June 1990.
9. Technical Requirements Manual, Section 15, "Response Times."

10. Regulatory Guide 1.105, Revision 3, "Setpoints for Safety-Related Instrumentation."

TSTF-355

B 3.3 INSTRUMENTATION

B 3.3.1 Reactor Protection System (RPS) Instrumentation

BASES

BACKGROUND

The RPS initiates a reactor trip to protect against violating the core fuel design limits and the Reactor Coolant System (RCS) pressure boundary during anticipated operational occurrences (AOOs). By tripping the reactor, the RPS also assists the Engineered Safety Feature (ESF) Systems in mitigating accidents.

The protection and monitoring systems have been designed to assure 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 the LCOs on other reactor system parameters and equipment performance.

Insert 9

The LSSS, defined in this Specification as the Allowable Value, in conjunction with the LCOs, establishes the threshold for protective system action to prevent exceeding acceptable limits during Design Basis Accidents (DBAs).

During AOOs, which are those events expected to occur one or more times during the unit's life, the acceptable limit is:

- a. The departure from nucleate boiling ratio (DNBR) shall be maintained above the Safety Limit (SL) value;
- b. Fuel centerline melt shall not occur; and
- c. The RCS pressure SL of 2750 psia shall not be exceeded.

Maintaining the parameters within the above values ensures that the offsite dose will be within the 10 CFR 20 and 10 CFR 100 criteria during AOOs.

Accidents are events that are analyzed even though they are not expected to occur during the unit's life. The acceptable limit during accidents is that the offsite dose shall be maintained within 10 CFR 100 limits. Meeting the acceptable dose limit for an accident category is considered having acceptable consequences for that event.

(continued)

B 3.3 INSTRUMENTATION

TSTF-355

B 3.3.1 Reactor Protective System (RPS) Instrumentation—Operating (Analog)

BASES

BACKGROUND

The RPS initiates a reactor trip to protect against violating the core specified acceptable fuel design limits and breaching the reactor coolant pressure boundary during anticipated operational occurrences (AOOs). By tripping the reactor, the RPS also assists the Engineered Safety Features 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.

Insert 9 →

The LSSS, defined in this Specification as the Allowable Value, in conjunction with the LCOs, establish the threshold for protective system action to prevent exceeding acceptable limits during Design Basis Accidents (DBAs).

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

- The departure from nucleate boiling ratio (DNBR) shall be maintained above the Safety Limit (SL) value to prevent departure from nucleate boiling;
- Fuel centerline melting shall not occur; and
- The Reactor Coolant System (RCS) pressure SL of 2750 psia shall not be exceeded.

Maintaining the parameters within the above values ensures that the offsite dose will be within the 10 CFR 50 (Ref. 1) and 10 CFR 100 (Ref. 2) criteria during AOOs.

Accidents are events that are analyzed even though they are not expected to occur during the plant life. The acceptable limit during accidents is that the offsite dose shall be maintained within an acceptable fraction of 10 CFR 100 (Ref. 2) limits. Different accident categories allow a different fraction of these limits based on probability of

(continued)

TSTF-355

B 3.3 INSTRUMENTATION

B 3.3.1 Reactor Protective System (RPS) Instrumentation—Operating (Digital)

BASES

BACKGROUND

The RPS initiates a reactor trip to protect against violating the core specified acceptable fuel design limits and breaching the reactor coolant pressure boundary (RCPB) during anticipated operational occurrences (A00s). 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.

Insert 9

~~The LSSS, defined in this Specification as the Allowable Value, in conjunction with the LCOs, establish the threshold for protective system action to prevent exceeding acceptable limits during Design Basis Accidents (DBAs).~~

During A00s, which are those events expected to occur one or more times during the plant life, the acceptable limits are:

- The departure from nucleate boiling ratio (DNBR) shall be maintained above the Safety Limit (SL) value to prevent departure from nucleate boiling (DNB);
- Fuel centerline melting shall not occur; and
- The Reactor Coolant System (RCS) pressure SL of 2750 psia shall not be exceeded.

Maintaining the parameters within the above values ensures that the offsite dose will be within the 10 CFR 50 (Ref. 1) and 10 CFR 100 (Ref. 2) criteria during A00s.

Accidents are events that are analyzed even though they are not expected to occur during the plant life. The acceptable limit during accidents is that the offsite dose shall be maintained within an acceptable fraction of 10 CFR 100 (Ref. 2) limits. Different accident categories allow a different fraction of these limits based on probability of

(continued)

TSTF-355

B 3.3 INSTRUMENTATION

B 3.3.1.1 Reactor Protection System (RPS) Instrumentation

BASES

BACKGROUND

The RPS initiates a reactor scram when one or more monitored parameters exceed their specified limits, to preserve the integrity of the fuel cladding and the Reactor Coolant System (RCS) and minimize the energy that must be absorbed following a loss of coolant accident (LOCA). This can be accomplished either automatically or manually.

The protection and monitoring functions of the RPS 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 are defined in this

Insert 9

Specification as the Allowable Values, which, in conjunction with the LCOs, establish the threshold for protective system action to prevent exceeding acceptable limits, including Safety Limits (SLs) during Design Basis Accidents (DBAs).

The RPS, as shown in the FSAR, Figure [] (Ref. 1), includes sensors, relays, bypass circuits, and switches that are necessary to cause initiation of a reactor scram. Functional diversity is provided by monitoring a wide range of dependent and independent parameters. The input parameters to the scram logic are from instrumentation that monitors reactor vessel water level, reactor vessel pressure, neutron flux, main steam line isolation valve position, turbine control valve (TCV) fast closure, trip oil pressure, turbine stop valve (TSV) position, drywell pressure, and scram discharge volume (SDV) water level, as well as reactor mode switch in shutdown position and manual scram signals. There are at least four redundant sensor input signals from each of these parameters (with the exception of the reactor mode switch in shutdown scram signal). Most channels include electronic equipment (e.g., trip units) that compares measured input signals with pre-established setpoints. When the setpoint is exceeded, the channel output relay actuates, which then outputs an RPS trip signal to the trip logic. Table B 3.3.1.1-1 summarizes the diversity of sensors capable of initiating scrams during anticipated operating transients typically analyzed.

(continued)

TSTF-355

B 3.3 INSTRUMENTATION

B 3.3.1.1 Reactor Protection System (RPS) Instrumentation

BASES

BACKGROUND

The RPS initiates a reactor scram when one or more monitored parameters exceed their specified limit, to preserve the integrity of the fuel cladding and the Reactor Coolant System (RCS), and minimize the energy that must be absorbed following a loss of coolant accident (LOCA). This can be accomplished either automatically or manually.

The protection and monitoring functions of the RPS 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 are defined in this

Insert 9 → Specification as the Allowable Values, which, in conjunction with the LCOs, establish the threshold for protective system action to prevent exceeding acceptable limits, including Safety Limits (SLs), during Design Basis Accidents (DBAs).

The RPS, as shown in the FSAR, Figure [] (Ref. 1), includes sensors, relays, bypass circuits, and switches that are necessary to cause initiation of a reactor scram. Functional diversity is provided by monitoring a wide range of dependent and independent parameters. The input parameters to the scram logic are from instrumentation that monitors reactor vessel water level; reactor vessel pressure; neutron flux main steam line isolation valve position; turbine control valve (TCV) fast closure, trip oil pressure low; turbine stop valve (TSV) trip oil pressure, low; drywell pressure and scram discharge volume (SDV) water level; as well as reactor mode switch in shutdown position and manual scram signals. There are at least four redundant sensor input signals from each of these parameters (with the exception of the reactor mode switch in shutdown scram signal). Most channels include electronic equipment (e.g., trip units) that compares measured input signals with pre-established setpoints. When a setpoint is exceeded, the channel output relay actuates, which then outputs an RPS trip signal to the trip logic. Table B 3.3.1.1-1 summarizes the diversity of sensors capable of initiating scrams during anticipated operating transients typically analyzed.

(continued)

NRC FORM 8C
(7-94)
NRCMD 3.57

COVER SHEET FOR CORRESPONDENCE
USE THIS COVER SHEET TO PROTECT ORIGINALS OF
MULTI-PAGE CORRESPONDENCE