March 24, 2010

TSTF-10-02
PROJ0753

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUBJECT: Transmittal of TSTF-521, Revision 0, "Exclusion of Time Constants from Channel Operation Tests in Specifications 3.3.1 and 3.3.2"

Enclosed for NRC review is TSTF-521, "Exclusion of Time Constants from Channel Operation Tests in Specifications 3.3.1 and 3.3.2."

Any NRC review fees associated with the review of TSTF-521 should be billed to the Pressurized Water Reactor Owners Group.

Should you have any questions, please do not hesitate to contact us.

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Enclosure

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Technical Specification Task Force
Improved Standard Technical Specifications Change Traveler

Exclusion of Time Constants from Channel Operational Tests in Specifications 3.3.1 and 3.3.2

NUREGs Affected: ☐ 1430 ☑ 1431 ☐ 1432 ☐ 1433 ☐ 1434

Classification 1) Technical Change | Recommended for CLIIP?: Yes

Correction or Improvement: Improvement | NRC Fee Status: Not Exempt

Benefit: Reduces Testing

1.0 Description

This change is proposed to clarify that the verification of time constants used in applications covered by Standard Technical Specification (STS) 3.3.1, "Reactor Trip System (RTS) Instrumentation," and STS 3.3.2, "Engineered Safety Feature Actuation System (ESFAS) Instrumentation," is required only during Channel Calibrations and that the time constant settings themselves are calibration surveillance acceptance criteria, not a part of those instrumentation functions' Allowable Values or Nominal Trip Setpoints. This change is a clarification of existing requirements. No relaxation of existing requirements is involved.

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2.0 Proposed Changes

The following Note is added to the Channel Operational Tests (COTs) in SR 3.3.1.7, SR 3.3.1.8, and SR 3.3.2.5: "Verification of time constants is not required."

The following Note is added to the Channel Calibrations in SR 3.3.1.11 and SR 3.3.1.12: "This Surveillance shall include verification that the time constants are adjusted to the prescribed values." SR 3.3.1.10 and SR 3.3.2.9 currently have this Note applied to those Channel Calibration surveillances.

Table 3.3.1-1 and 3.3.2-1 are revised to delete the time constant settings from the Allowable Value and Nominal Trip Setpoint columns (if applicable) and new footnotes are added that apply those time constant settings under the applicable Surveillance Requirement column where the time constant is verified. A new footnote (d) is added to SR 3.3.1.11 in Table 3.3.1-1 for RTS Functions 3.a and 3.b that states, "Rate circuit time constant ≤[2] seconds." Subsequent footnotes are renumbered as a result.

Existing footnote (b) in Table 3.3.2-1 is applied to SR 3.3.2.9 for ESFAS Functions 1.e.(1), 1.g (for the steam line pressure -low portion of that function), 4.d(1). and 4.f (for the steamline pressure -low portion of that function). The Allowable Value and Nominal Trip Setpoint columns are revised to delete the time constant settings. Existing footnote (g) in Table 3.3.2-1 is applied to SR 3.3.2.9 for ESFAS Function 4.d(2). The Allowable Value and Nominal Trip Setpoint columns are revised to delete the time constant setting.

Footnotes are added to Notes 1 and 2 for the τ_1 through τ_7 dynamic compensation time constants of Table 3.3.1-1 for the Overtemperature ΔT and Overpower ΔT RTS functions that state, "Time constants must be met for channel OPERABILITY; however, they are not part of the Allowable Value [or Nominal Trip Setpoint]."

Finally. an editorial correction is made to the indicated ΔT at RTP for Notes 1 and 2 in Table 3.3.1-1 such that T_Q is replaced with ΔT_0.

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3.0 Background

Dynamic modules in selected RTS and ESFAS functions are used to provide a faster response to a change in a plant process parameter than would be available from a system without dynamic compensation. For example, a dynamic module may be designed to add a compensation proportional to the rate of change of the input variable. Since most real-life transients do not change abruptly in slope, an increasing variable can be expected to continue to increase in the short term. Leading compensation can predict near future trends and compensate for process lags. The lead/lag and derivative (or rate/lag) functions of Westinghouse 7300 Process Protection System NLL cards are examples of dynamic modules that provide this compensation.

Another type of dynamic module is designed to filter out spurious signals (noise). The concept behind these filter (or lag) modules recognizes that if a signal is changing too rapidly, the rate of change is probably spurious. These modules are used alone or in conjunction with rate-of-change compensation because leading compensation exaggerates the effect of noise. The lag function of Westinghouse 7300 Process Protection System NLL cards is an example of dynamic modules that provide this compensation.

Lead/lag and lag cards are used in the Overtemperature ΔT RTS function. Lead, lag, and derivative (rate/lag) cards are used in the Overpower ΔT RTS function. Lead/lag cards are used in the ESFAS Safety Injection and Steamline Isolation functions that use low steamline pressure signals as an input. Derivative (rate/lag) cards are used in ESFAS Steamline Isolation functions that use high negative pressure rate signals as an input.

Another example of a different type of dynamic module is the rate circuit used in the Nuclear Instrumentation System neutron flux rate trips (both positive and negative rate trips).

The values associated with the time constants for these dynamic compensation modules are factored into the transient analysis input assumptions for those transients crediting these particular RTS and ESFAS functions. However, these time constant values are not derived from the setpoint calculations and are not associated with the Allowable Values or Nominal Trip Setpoints for these RTS and ESFAS functions.

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4.0 Technical Analysis

Time Constant Surveillance Frequency

One of the effects of the proposed change is to clarify that the time constants are tested as part of the [18] month Channel Calibrations and not during the more frequent Channel Operational Tests. This section demonstrates that [18] months is the intended Surveillance Frequency for the time constants.

Section 4.0 of WCAP-14036-P-A (Reference 1) states the following:
"The time response of dynamic function (i.e., lead-lag, etc.) cards is verified during periodic calibration testing and, therefore, these cards were not included in the program."

Section 8.0 of WCAP-14036-P-A states the following:
"As noted in Section 4.0, the dynamic response of lead-lag functions are [sic] tested (i.e., calibrated) as part of the periodic channel surveillance calibration and, therefore, the card response time does not have to be verified independently by other tests. Since the lead/lag cards are dynamically calibrated, no allowance is included in Table 8-1 for these cards. If a lead-lag card is used in a channel with the lead-lag set to zero and is not dynamically calibrated, a bounding response time contribution for the card would have to be determined by the utility or the card would have to be tested periodically."

Plant-specific implementation of WCAP-14036-P-A has been consistent with these statements. For example, AmerenUE's adoption of Reference 1 added the following statements to the SR 3.3.1.16 and SR 3.3.2.10 Bases per References 2 and 6:
"Time constants are verified during the performance of SR 3.3.1.10 and SR 3.3.1.11."
and
"Time constants are verified during the performance of SR 3.3.2.9."

Reference 3 documented AmerenUE's commitment regarding the WCAP-14036-P-A Section 8.0 caveat on lead/lag cards with zero time constants to response time test the affected 7300 card strings at the Frequency established by SR 3.3.1.16 and SR 3.3.2.10. Sections 3.0 and 4.0 of the NRC Safety Evaluation attached to Reference 4 acknowledge and approve of the verification of time constant values during the 18-month Channel Calibrations.

SR 3.3.1.10 and SR 3.3.2.9 (both Channel Calibrations) currently contain Notes stating, "This Surveillance shall include verification that the time constants are adjusted to the prescribed values." The proposed changes to SR 3.3.1.7, SR 3.3.1.8, SR 3.3.1.11, SR 3.3.1.12, and SR 3.3.2.5 make these Surveillances consistent with SR 3.3.1.10 and SR 3.3.2.9.

The SR 3.3.1.16 and SR 3.3.2.10 Bases also note that time constant verifications on an 18-month Frequency are acceptable. Those RTS and ESFAS functions that contain cards with dynamic compensation (such as lag, lead/lag, and rate/lag cards in the 7300 Process Protection System or rate circuits in the Nuclear Instrumentation System) will continue to have their time constants verified on an 18-month Frequency during the Channel Calibrations performed per SR 3.3.1.10, SR 3.3.1.11, SR 3.3.1.12, and SR 3.3.2.9.

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Setpoint Methodology

There are three values typically defined under Westinghouse setpoint methodologies:

a. Safety analysis limit

b. Allowable value

c. Nominal trip setpoint.

The safety analysis limit (SAL) is the value assumed in the accident analysis. The nominal trip setpoint (NTS) is the value set into the equipment and is obtained by adding or subtracting the channel statistical allowance (CSA) to/from the SAL. The NTS allows for the normal expected rack drift.

Older vintage Westinghouse setpoint studies specified an allowance from the NTS to the AV that accounted for drift when measured at the rack during periodic testing, rack calibration accuracy, and rack comparator setting accuracy. The difference between the NTS and the SAL included the following items: a) the inaccuracy of the instrument (sensor temperature and pressure effects, sensor reference accuracy, sensor drift), b) process measurement accuracy, c) uncertainties in the sensor calibration, d) primary element accuracy (when applicable), e) environmental effects on equipment accuracy caused by postulated or limiting postulated events (only for those systems required to mitigate consequences of an accident), f) rack temperature error, g) rack and sensor M&TE errors, and h) the rack error terms discussed above (between the NTS and AV).

Recent vintage Westinghouse setpoint studies specify an allowance from the NTS to the AV that accounts only for rack calibration accuracy. This is the same basic square root sum of the squares (SRSS) methodology used in older studies, but with the inclusion of refinements to better reflect plant calibration practices and equipment performance. These refinements include the incorporation of a sensor reference accuracy term to address repeatability effects when performing a single pass calibration (i.e., one up and one down pass at several points verifies linearity and hysteresis, but not repeatability). In addition, sensor and rack error terms for calibration accuracy and drift are grouped in the CSA equation with their dependent M&TE terms, then combined with the other independent error terms using the SRSS methodology.

Neither the older or more recent setpoint studies address time constants. The values of the time constants are transient analysis inputs, but they they do not affect the setpoint studies. As such, these values represent Channel Calibration surveillance acceptance criteria only and should be specified under the Surveillance Requirement column in Tables 3.3.1-1 and 3.3.2-1.

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5.0 Regulatory Analysis

5.1 No Significant Hazards Considerations Determination

The TSTF has evaluated whether or not a significant hazards consideration is involved with the proposed generic change by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The proposed change clarifies that verification of time constants is performed during the Channel Calibration test and not during the Channel Operational Test. Overall protection system performance will remain within the bounds of the previously performed accident analyses since there are no hardware changes. The design of the RTS and ESFAS instrumentation will be unaffected. These protection systems will continue to function in a manner consistent with the plant design basis. All design, material. and construction standards that were applicable prior to the request are maintained.

   Performance of Surveillances is not an initiator to any accident previously evaluated. As a result, the proposed change will not affect the probability of any accident. There will be no degradation in the performance of, or an increase in the number of challenges imposed on, safety-related equipment assumed to function during an accident situation. There will be no change to normal plant operating parameters or accident mitigation performance for any accident previously evaluated.

   The time response allocation and modeling assumptions in the accident analyses remain the same. The proposed change will not modify any system interface and will not increase the likelihood of an accident since the occurrence of these events is independent of this change. The proposed activity will not change, degrade or prevent actions or alter any assumptions previously made in evaluating the radiological consequences of any accident.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The proposed change clarifies that verification of time constants is performed during the Channel Calibration test and not during the Channel Operational Test. There are no hardware changes nor are there any changes in the method by which any safety-related plant system performs its safety function. This change will not affect the normal method of plant operation or change any operating parameters. No performance requirements will be affected.

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No new accident scenarios, transient precursors, failure mechanisms, or limiting single failures are introduced as a result of this change. There will be no adverse effect or challenges imposed on any safety-related system as a result of the proposed change.

The proposed change does not alter the design or performance of the [7300] Process Protection System, Nuclear Instrumentation System, or [Solid State Protection System] used in the plant protection systems. The continued verification of RTS and ESFAS time constants on an 18-month Frequency will not create any new accident initiators or scenarios. Periodic surveillance of these systems will continue and will detect any system degradation.

Therefore, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No.

   The proposed change clarifies that verification of time constants is performed during the Channel Calibration test and not during the Channel Operational Test. There will be no effect on the manner in which safety limits or limiting safety system settings are determined nor will there be any effect on those plant systems necessary to assure the accomplishment of protection functions. There will be no impact on the overpower limit, departure from nucleate boiling ratio (DNBR) limits, heat flux hot channel factor (F_Q), nuclear enthalpy rise hot channel factor ($F_{\Delta H}$), loss of coolant accident peak cladding temperature (LOCA PCT), peak local power density, or any other margin of safety. The radiological dose consequence acceptance criteria will continue to be met.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, the TSTF concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

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5.2 Applicable Regulatory Requirements / Criteria

The following NRC requirements and guidance document are applicable to the review of the proposed change.

GDC-13 requires that instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety, including those variables and systems that can affect the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems.

GDC-20 requires that the protection system(s) shall be designed (1) to initiate automatically the operation of appropriate systems including the reactivity control systems, to assure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences and (2) to sense accident conditions and to initiate the operation of systems and components important to safety.

GDC-21 requires that the protection system(s) shall be designed for high functional reliability and testability.

GDC-22 through GDC-25 and GDC-29 require various design attributes for the protection system(s), including independence, safe failure modes, separation from control systems, requirements for reactivity control malfunctions. and protection against anticipated operational occurrences.

Regulatory Guide 1.22 discusses an acceptable method of satisfying GDC-20 and GDC-21 regarding the periodic testing of protection system actuation functions. These periodic tests should duplicate, as closely as practicable, the performance that is required of the actuation devices in the event of an accident.

10 CFR 50.55a(h) requires that the protection systems meet IEEE 279-1971. Sections 4.9 - 4.11 of IEEE 279-1971 discuss testing provisions for protection systems. Regulatory Guide 1.118, Revision 2 discusses acceptable methods for testing protection systems, including Section 6.3.4 of IEEE 338-1977 for response time testing.

The proposed change does not affect the RTS or ESFAS instrumentation design such that conformance with any of the regulatory requirements and guidance documents above would come into question. The evaluations performed above confirm that compliance with be maintained with all applicable regulatory requirements.

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the approval of the proposed change will not be inimical to the common defense and security or to the health and safety of the public.

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6.0 Environmental Consideration

A review has determined that the proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

7.0 References

1. WCAP-14036-P-A. Revision 1, "Elimination of Periodic Protection Channel Response Time Tests," October 1998.

2. Union Electric Letter to NRC, ULNRC-04159 dated December 3, 1999.

3. Union Electric Letter to NRC. ULNRC-04189 dated February 24, 2000.

4. NRC Letter to Union Electric, "Application of WCAP-14036-P-A for Response Time Testing Elimination at Callaway Plant Unit 1 (TAC No. MA7283)," dated March 3, 2000.

5. Union Electric Letter to NRC, ULNRC-04638 dated April 16, 2002.

6. Union Electric Letter to NRC, ULNRC-04684 dated June 17, 2002.

7. NRC Letter to Union Electric, "Response Time Testing Elimination for Positive Flux Rate Trip Function for Callaway Plant. Unit 1 (TAC No. MB4796)," dated May 21, 2002.

8. NRC Letter to Union Electric, "Callaway Plant, Unit 1 -Issuance of Amendment RE: Reactor Trip System Instrumentation (TAC No. MB5421)," dated September 3, 2002.

Revision History

OG Revision 0 **Revision Status: Active**

Revision Proposed by: Callaway

Revision Description:
Original Issue

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OG Revision 0 **Revision Status: Active**

Owners Group Review Information

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Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 26-Feb-10

TSTF Review Information

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OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

TSTF Comments:

(No Comments)

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NRC Review Information

NRC Received Date: 24-Mar-10

Affected Technical Specifications

Bkgnd 3.3.1 Bases	RTS Instrumentation
S/A 3.3.1 Bases	RTS Instrumentation
LCO 3.3.1	RTS Instrumentation Change Description: Table 3.3.1-1
SR 3.3.1.7	RTS Instrumentation
SR 3.3.1.7 Bases	RTS Instrumentation
SR 3.3.1.8	RTS Instrumentation
SR 3.3.1.8 Bases	RTS Instrumentation
SR 3.3.1.11	RTS Instrumentation
SR 3.3.1.11 Bases	RTS Instrumentation
SR 3.3.1.12	RTS Instrumentation
SR 3.3.1.12 Bases	RTS Instrumentation

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SR 3.3.1.16 Bases	RTS Instrumentation
Bkgnd 3.3.2 Bases	ESFAS Instrumentation
S/A 3.3.2 Bases	ESFAS Instrumentation
LCO 3.3.2	ESFAS Instrumentation Change Description: Table 3.3.2-1
SR 3.3.2.5	ESFAS Instrumentation
SR 3.3.2.5 Bases	ESFAS Instrumentation
SR 3.3.2.10 Bases	ESFAS Instrumentation

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SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.3.1.6	-----------------------------NOTE------------------------------ Not required to be performed until [24] hours after THERMAL POWER is ≥ 50% RTP. --- Calibrate excore channels to agree with incore detector measurements.	[92] EFPD
SR 3.3.1.7	-----------------------------NOTES---------------------------- 1. Not required to be performed for source range instrumentation prior to entering MODE 3 from MODE 2 until 4 hours after entry into MODE 3. 2. Verification of time constants is not required. --- Perform COT.	184 days

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.3.1.8	-----------------------------NOTES---------------------------- 1. This Surveillance shall include verification that interlocks P-6 and P-10 are in their required state for existing unit conditions. 2. Verification of time constants is not required. --- Perform COT.	--------NOTE-------- Only required when not performed within previous 184 days ------------------------ Prior to reactor startup <u>AND</u> Four hours after reducing power below P-6 for source range instrumentation <u>AND</u> [Twelve] hours after reducing power below P-10 for power and intermediate range instrumentation <u>AND</u> Every 184 days thereafter

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.3.1.9	-----------------------------NOTE------------------------------ Verification of setpoint is not required. --- Perform TADOT.	[92] days
SR 3.3.1.10	-----------------------------NOTE------------------------------ This Surveillance shall include verification that the time constants are adjusted to the prescribed values. --- Perform CHANNEL CALIBRATION.	[18] months
SR 3.3.1.11	-----------------------------NOTES--------------------------- 1. Neutron detectors are excluded from CHANNEL CALIBRATION. 2. This Surveillance shall include verification that the time constants are adjusted to the prescribed values. --- Perform CHANNEL CALIBRATION.	[18] months
SR 3.3.1.12	-----------------------------NOTES--------------------------- 1. This Surveillance shall include verification of Reactor Coolant System resistance temperature detector bypass loop flow rate. 2. This Surveillance shall include verification that the time constants are adjusted to the prescribed values. --- Perform CHANNEL CALIBRATION.	[18] months
SR 3.3.1.13	Perform COT.	18 months
SR 3.3.1.14	-----------------------------NOTE------------------------------ Verification of setpoint is not required.	

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

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL[(k~~j~~)] TRIP SETPOINT
1. Manual Reactor Trip	1,2	2	B	SR 3.3.1.14	NA	NA
	3[(a)], 4[(a)], 5[(a)]	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[(b)],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[(d)]	≤ [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[(d)] 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[(b)], 2[(c)]	2	F,G	SR 3.3.1.1 SR 3.3.1.8 SR 3.3.1.11	≤ [31]% RTP	[25]% RTP

(a) With Rod Control System capable of rod withdrawal or one or more rods not fully insert.

(b) Below the P-10 (Power Range Neutron Flux) interlocks.

(c) Above the P-6 (Intermediate Range Neutron Flux) interlocks.

(d) Rate circuit time constant ≥ [2] seconds.

---REVIEWER'S NOTE---

~~(j)~~(k) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

Table 3.3.1-1 (page 2 of 7)
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL~~(j)~~(k) TRIP SETPOINT
5. Source Range Neutron Flux	2~~(d)~~(e)	2	H,I	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(a), 4(a), 5(a)	2	I,J	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
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 3.3.1-19)	Refer to Note 1 (Page 3.3.1-19)
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 3.3.1-20)	Refer to Note 2 (Page 3.3.1-20)
8. Pressurizer Pressure						
a. Low	1~~(f)~~(g)	[4]	K	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10 SR 3.3.1.16	≥ [1886] psig	[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	[2385] psig
9. Pressurizer Water Level - High	1~~(e)~~(f)	3	K	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10	≤ [93.8]%	[92]%
10. Reactor Coolant Flow - Low	1~~(f)~~(g)	3 per loop	K	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.10 SR 3.3.1.16	≥ [89.2]%	[90]%

(a) With Rod Control System capable of rod withdrawal or one or more rods not fully insert.

~~(d)~~(e) Below the P-6 (Intermediate Range Neutron Flux) interlocks.

~~(e)~~(f) Above the P-7 (Low Power Reactor Trips Block) interlock.

~~(f)~~(g) Above the P-8 (Power Range Neutron Flux) interlock.

--REVIEWER'S NOTE--

~~(j)~~(k) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

Table 3.3.1-1 (page 3 of 7)
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL~~(j)~~(k) TRIP SETPOINT
11. Reactor Coolant Pump (RCP) BreakerPosition						
a. Single Loop	1~~(f)~~(g)	1 per RCP	L	SR 3.3.1.14	NA	NA
b. Two Loops	1~~(g)~~(h)	1 per RCP	M	SR 3.3.1.14	NA	NA
12. Undervoltage RCPs	1~~(e)~~(f)	[3] per bus	K	SR 3.3.1.9 SR 3.3.1.10 SR 3.3.1.16	≥ [4760] V	[4830] V
13. Underfrequency RCPs	1~~(e)~~(f)	[3] per bus	K	SR 3.3.1.9 SR 3.3.1.10 SR 3.3.1.16	≥ [57.1] Hz	[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]%	[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]%	[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	[40]% full steam flow at RTP
16. Turbine Trip						
a. Low Fluid Oil Pressure	1~~(h)~~(i)	3	N	SR 3.3.1.10 SR 3.3.1.15	≥ [750] psig	[800] psig
b. Turbine Stop Valve Closure	1~~(h)~~(i)	4	N	SR 3.3.1.10 SR 3.3.1.15	≥ [1]% open	[1]% open

~~(e)~~(f) Above the P-7 (Low Power Reactor Trips Block) interlock.

~~(f)~~(g) Above the P-8 (Power Range Neutron Flux) interlock.

~~(g)~~(h) Above the P-7 (Low Power Reactor Trips Block) interlock and below the P-8 (Power Range Neutron Flux) Interlock

~~(h)~~(i) Above the P-9 (Power Range Neutron Flux) interlock.

--REVIEWER'S NOTE--

~~(j)~~(k) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

Table 3.3.1-1 (page 4 of 7)
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL~~(j)~~(k) TRIP SETPOINT
17. Safety Injection (SI) Input from Engineered Safety Feature Actuation System (ESFAS)	1,2	2 trains	O	SR 3.3.1.14	NA	NA
18. Reactor Trip System Interlocks						
a. Intermediate Range Neutron Flux, P-6	2~~(d)~~(e)	2	Q	SR 3.3.1.11 SR 3.3.1.13	≥ [6E-11] amp	[1E-10] amp
b. Low Power Reactor Trips Block, P-7	1	1 per train	R	SR 3.3.1.5	NA	NA
c. Power Range Neutron Flux, P-8	1	4	R	SR 3.3.1.11 SR 3.3.1.13	≤ [50.2]% RTP	[48]% RTP
d. Power Range Neutron Flux, P-9	1	4	R	SR 3.3.1.11 SR 3.3.1.13	≤ [52.2]% RTP	[50]% RTP
e. Power Range Neutron Flux, P-10	1,2	4	Q	SR 3.3.1.11 SR 3.3.1.13	≥ [7.8]% RTP and ≤ [12.2]% RTP	[10]% RTP
f. Turbine Impulse Pressure, P-13	1	2	R	[SR 3.3.1.1] SR 3.3.1.10 SR 3.3.1.13	≤ [12.2]% turbine power	10]% turbine power
19. Reactor Trip Breakers~~(i)~~(j) (RTBs)	1,2	2 trains	P	SR 3.3.1.4	NA	NA
	3(b), 4(b), 5(b)	2 trains	C	SR 3.3.1.4	NA	NA

(b) With Rod Control System capable of rod withdrawal or one or more rods not fully inserted.

~~(d)~~(e) Below the P-6 (Intermediate Range Neutron Flux) interlocks.

~~(i)~~(j) Including any reactor trip bypass breakers that are racked in and closed for bypassing an RTB.

--REVIEWER'S NOTE--

~~(j)~~(k) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

Table 3.3.1-1 (page 5 of 7)
Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL[j](k) TRIP SETPOINT
20. Reactor Trip Breaker Undervoltage and Shunt Trip Mechanisms	1,2	1 each per RTB	S	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	O	SR 3.3.1.5	NA	NA
	3[(b)], 4[(b)], 5[(b)]	2 trains	C	SR 3.3.1.5	NA	NA

---REVIEWER'S NOTE---

(b) With Rod Control System capable of rod withdrawal or one or more rods not fully inserted.

~~(j)~~(k) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

Table 3.3.1-1 (page 6 of 7)
Reactor Trip System Instrumentation

Note 1: Overtemperature ΔT

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

$$\Delta T \frac{(1+T_1 S)}{(1+T_2 S)}\left(\frac{1}{1+T_3 S}\right) \leq \Delta T_0 \left\{K_1 - K_2 \frac{(1+T_4 S)}{(1+T_5 S)}\left[T \frac{1}{(1+T_6 S)} - T'\right] + K_3 (P - P') - f_1(\Delta I)\right\}$$

Where: ΔT is measured RCS ΔT,°F.
ΔT_{0Q} 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, ≤ [*]°F.

P is the measured pressurizer pressure, psig
P' is the nominal RCS operating pressure, ≥ [*] psig

K_1 ≤ [*]	K_2 ≥ [*]/°F	K_3 ≥ [*]/psig
T_1 ≥ [*] sec**	T_2 ≤ [*] sec**	T_3 ≤ [*] sec**
T_4 ≥ [*] sec**	T_5 ≤ [*] sec**	T_6 ≤ [*] sec**

$f_1(\Delta I)$ = [*] {[*] - (q_t - q_b)}	when q_t - q_b ≤ [*]% RTP
0% of RTP	when [*]% RTP < q_t - q_b ≤ [*]% RTP
[*] {(q_t - q_b) - [*]}	when q_t - q_b > [*]% 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.

*These values denoted with [*] are specified in the COLR.

** Time constants must be met for channel OPERABILITY; however, they are not part of the Allowable Value [or Nominal Trip Setpoint.]

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

Note 2: Overpower ΔT

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

$$\Delta T \frac{(1+T_1 S)}{(1+T_2 S)}\left(\frac{1}{1+T_3 S}\right) \leq \Delta T_0 \left\{K_4 - K_5 \frac{T_7 S}{1+T_7 S}\left(\frac{1}{1+T_6 S}\right)T - K_6\left[T\frac{1}{1+T_6 S} - T''\right] - f_2(\Delta I)\right\}$$

Where: ΔT is measured RCS ΔT,°F.
ΔT_{0Q} 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, ≤ [*]°F.

K_4 ≤ [*]
K_5 ≥ [*]/°F for increasing T_{avg}
[*]/°F for decreasing T_{avg}
K_6 ≥ [*]/°F when $T > T''$
[*]/°F when $T \leq T''$

T_1 ≥ [*] sec**
T_2 ≤ [*] sec**
T_3 ≤ [*] sec**
T_6 ≤ [*] sec**
T_7 ≥ [*] sec**

$f_2(\Delta I)$ = [*]

*These values denoted with [*] are specified in the COLR.

** Time constants must be met for channel OPERABILITY; however, they are not part of the Allowable Value [or Nominal Trip Setpoint.]

SURVEILLANCE REQUIREMENTS

--NOTE--
Refer to Table 3.3.2-1 to determine which SRs apply for each ESFAS Function.

SURVEILLANCE		FREQUENCY
SR 3.3.2.1	Perform CHANNEL CHECK.	12 hours
SR 3.3.2.2	Perform ACTUATION LOGIC TEST.	92 days on a STAGGERED TEST BASIS
SR 3.3.2.3	-----------------------------NOTE------------------------------ The continuity check may be excluded. --- Perform ACTUATION LOGIC TEST.	31 days on a STAGGERED TEST BASIS
--------------------------------REVIEWER'S NOTE-------------------------------- The Frequency remains at 31 days on a STAGGERED TEST BASIS for plants with a Relay Protection System. -- SR 3.3.2.4	Perform MASTER RELAY TEST.	92 days on a STAGGERED TEST BASIS
SR 3.3.2.5	-----------------------------NOTE------------------------------ Verification of time constants is not required. --- Perform COT.	184 days
SR 3.3.2.6	Perform SLAVE RELAY TEST.	[92] days
SR 3.3.2.7	-----------------------------NOTE------------------------------ Verification of relay setpoints not required. --- Perform TADOT.	[92] days

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

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	NOMINAL[(j)] TRIP SETPOINT
1. Safety Injection						
a. Manual Initiation	1,2,3,4	2	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 1	1,2,3	3	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≤ [3.86] psig	[3.6] psig
d. Pressurizer Pressure - Low	1,2,3[(a)]	[3]	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9 SR 3.3.2.10	≥ [1839] psig	[1850] psig
e. Steam Line Pressure						
(1) Low	1,2,3[[(a)]]	3 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9(b) SR 3.3.2.10	≥ [635](b) psig	[675](b) psig
(2) High Differential Pressure Between Steam Lines	1,2,3	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	≤ [106] psig	[97] psig

(a) Above the P-11 (Pressurizer Pressure) interlock.

(b) Time constants used in the lead/lag controller are $t_1 \geq [50]$ seconds and $t_2 \leq [5]$ seconds.

------------------------------------REVIEWER'S NOTE------------------------------------

(j) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

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	NOMINAL[(j)] TRIP SETPOINT
1. Safety Injection						
f. High Steam Flow in Two Steam Lines	1,2,3 [(c)]	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	(d)	(e)
Coincident with T_{avg} - Low Low	1,2,3 [(c)]	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	[553]°F
g. High Steam Flow in Two Steam Lines	1,2,3 [(c)]	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	(d)	(e)
Coincident with Steam Line Pressure - Low	1,2,3 [(c)]	1 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9[(b)] SR 3.3.2.10	≥ [635][(b)] psig	[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	[12.05] psig

(b) Time constants used in the lead/lag controller are $t_1 \geq [50]$ seconds and $t_2 \leq [5]$ seconds.

(c) Above the P-12 (T_{avg} - Low Low) interlock.

(d) 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.

(e) 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.

---REVIEWER'S NOTE---

(j) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

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	NOMINAL[j] TRIP SETPOINT
4. Steam Line Isolation						
a. Manual Initiation	1,2[h],3[h]	2	F	SR 3.3.2.8	NA	NA
b. Automatic Actuation Logic and Actuation Relays	1,2[h],3[h]	2 trains	G	SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.6	NA	NA
c. Containment Pressure - High 2	1, 2[h], 3[h]	[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	[6.35] psig
d. Steam Line Pressure						
(1) Low	1, 2[h], 3[a][h]	3 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9[b] SR 3.3.2.10	≥ [635][b] psig	[675][b] psig
(2) Negative Rate - High	3[f][h]	3 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9[g] SR 3.3.2.10	≤ [121.6][g] psi	[110][g] psi

(a) Above the P-11 (Pressurizer Pressure) interlock.

(b) Time constants used in the lead/lag controller are $t_1 \geq [50]$ seconds and $t_2 \leq [5]$ seconds.

(f) Below the P-11 (Pressurizer Pressure) interlock.

(g) Time constant utilized in the rate/lag controller is ≥ [50] seconds.

(h) Except when all MSIVs are closed and [de-activated].

--REVIEWER'S NOTE--

(j) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

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	NOMINAL[(j)] TRIP SETPOINT
4. Steam Line Isolation						
e. High Steam Flow in Two Steam Lines	1, 2 [(h)], 3 [(h)]	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	(d)	(e)
Coincident with T_{avg} - Low Low	1, 2 [(h)], 3 [(c) (h)]	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	[553]°F
f. High Steam Flow in Two Steam Lines	1, 2 [(h)], 3 [(h)]	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	(d)	(e)
Coincident with Steam Line Pressure - Low	1,2,[(h)] 3 [(h)]	1 per steam line	D	SR 3.3.2.1 SR 3.3.2.5 SR 3.3.2.9[(b)] SR 3.3.2.10	≥ [635]~~[(b)]~~ psig	[675]~~[(b)]~~ psig
g. High Steam Flow	1,2 [(h)], 3 [(h)]	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_{avg} - Low Low	1,2 [(h)], 3 [(c) (h)]	[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

(b) Time constants used in the lead/lag controller are $t_1 \geq$ [50] seconds and $t_2 \leq$ [5] seconds.

(c) Above the P-12 (T_{avg} - Low Low) interlock.

(d) 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.

(e) 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.

(h) Except when all MSIVs are closed and [de-activated].

----------REVIEWER'S NOTE----------

(j) Unit specific implementations may contain only Allowable Value depending on Setpoint Study methodology used by the unit.

BASES

BACKGROUND (continued)

Allowable Values and RTS Setpoints

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 RTS channels that must function in harsh environments as defined by 10 CFR 50.49 (Ref. 6), the Allowable Values specified in Table 3.3.1-1 in the accompanying LCO are conservative with respect to the analytical limits. A detailed description of the methodology used to calculate the Allowable Values and trip setpoints, including their explicit uncertainties, is provided in the "RTS/ESFAS Setpoint Methodology Study" (Ref. 7) 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. Time constants are verified to be adjusted to their prescribed values during CHANNEL CALIBRATIONS. 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., ± 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.

Trip setpoints consistent with the requirements of 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).

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

- pressurizer pressure - the Trip Setpoint is varied to correct for changes in system pressure, and

- axial power distribution - f(ΔI), the Trip Setpoint is varied to account for imbalances in the axial power distribution as detected by the NIS upper and lower power range detectors. If axial peaks are greater than the design limit, as indicated by the difference between the upper and lower NIS power range detectors, the Trip Setpoint is reduced in accordance with Note 1 of Table 3.3.1-1.

Dynamic compensation is included for system piping delays from the core to the temperature measurement system. Time constants are verified to be adjusted to their prescribed values during CHANNEL CALIBRATIONS.

The Overtemperature ΔT trip Function is calculated for each loop as described in Note 1 of Table 3.3.1-1. Trip occurs if Overtemperature ΔT is indicated in two loops. At some units, the pressure and temperature signals are used for other control functions. For those units, the actuation logic must be able to withstand 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. Note that this Function also provides a signal to generate a turbine runback prior to reaching the Trip Setpoint. A turbine runback will reduce turbine power and reactor power. A reduction in power will normally alleviate the Overtemperature ΔT condition and may prevent a reactor trip.

The LCO requires all four channels of the Overtemperature ΔT trip Function to be OPERABLE for two and four loop units (the LCO requires all three channels on the Overtemperature ΔT trip Function to be OPERABLE for three loop units). Note that the Overtemperature ΔT Function receives input from channels shared with other RTS Functions. Failures that affect multiple Functions require entry into the Conditions applicable to all affected Functions.

In MODE 1 or 2, the Overtemperature ΔT trip must be OPERABLE to prevent DNB. In MODE 3, 4, 5, or 6, this trip Function does not have to be OPERABLE because the reactor is not operating and there is insufficient heat production to be concerned about DNB.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

7. Overpower ΔT

The Overpower ΔT trip Function ensures that protection is provided to ensure the integrity of the fuel (i.e., no fuel pellet melting and less than 1% cladding strain) under all possible overpower conditions. This trip Function also limits the required range of the Overtemperature ΔT trip Function and provides a backup to the Power Range Neutron Flux - High Setpoint trip. The Overpower ΔT trip Function ensures that the allowable heat generation rate (kW/ft) of the fuel is not exceeded. It uses the ΔT of each loop as a measure of reactor power with a setpoint that is automatically varied with the following parameters:

- reactor coolant average temperature - the Trip Setpoint is varied to correct for changes in coolant density and specific heat capacity with changes in coolant temperature, and
- rate of change of reactor coolant average temperature - including dynamic compensation for the delays between the core and the temperature measurement system. Time constants are verified to be adjusted to their prescribed values during CHANNEL CALIBRATIONS.

The Overpower ΔT trip Function is calculated for each loop as per Note 2 of Table 3.3.1-1. Trip occurs if Overpower ΔT is indicated in two loops. At some units, the temperature signals are used for other control functions. At those units, the actuation logic must be able to withstand an input failure to the control system, which may then require the protection function actuation and a single failure in the remaining channels providing the protection function actuation. Note that this Function also provides a signal to generate a turbine runback prior to reaching the Allowable Value. A turbine runback will reduce turbine power and reactor power. A reduction in power will normally alleviate the Overpower ΔT condition and may prevent a reactor trip.

The LCO requires four channels for two and four loop units (three channels for three loop units) of the Overpower ΔT trip Function to be OPERABLE. Note that the Overpower ΔT trip Function receives input from channels shared with other RTS Functions. Failures that affect multiple Functions require entry into the Conditions applicable to all affected Functions.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.7

SR 3.3.1.7 is the performance of a COT every 184 days.

A COT is performed on each required channel to ensure the entire channel will perform the intended Function. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable COT of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications and non-Technical Specifications tests at least once per refueling interval with applicable extensions.

Setpoints must be within the Allowable Values specified in Table 3.3.1-1.

The difference between the current "as found" values and the previous test "as left" values must be consistent with the drift allowance used in the setpoint methodology. The setpoint shall be left set consistent with the assumptions of the current unit specific setpoint methodology.

The "as found" and "as left" values must also be recorded and reviewed for consistency with the assumptions of Reference 9.

SR 3.3.1.7 is modified by twoa Notes. Note 1 that provides a 4 hours delay in the requirement to perform this Surveillance for source range instrumentation when entering MODE 3 from MODE 2. This Note allows a normal shutdown to proceed without a delay for testing in MODE 2 and for a short time in MODE 3 until the RTBs are open and SR 3.3.1.7 is no longer required to be performed. If the unit is to be in MODE 3 with the RTBs closed for > 4 hours this Surveillance must be performed prior to 4 hours after entry into MODE 3. Note 2 excludes verification of time constants from the COT.

The Frequency of 184 days is justified in Reference 9.

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.8

SR 3.3.1.8 is the performance of a COT as described in SR 3.3.1.7, except it is modified by two Notes. a Note 1 states that this test shall include verification that the P-6 and P-10 interlocks are in their required state for the existing unit condition. Note 2 excludes verification of time constants from the COT. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable COT of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications and non-Technical Specifications tests at least once per refueling interval with applicable extensions. The Frequency is modified by a Note that allows this surveillance to be satisfied if it has been performed within 184 days of the Frequencies prior to reactor startup and four hours after reducing power below P-10 and P-6. The Frequency of "prior to startup" ensures this surveillance is performed prior to critical operations and applies to the source, intermediate and power range low instrument channels. The Frequency of [12] hours after reducing power below P-10 (applicable to intermediate and power range low channels) and 4 hours after reducing power below P-6 (applicable to source range channels) allows a normal shutdown to be completed and the unit removed from the MODE of Applicability for this surveillance without a delay to perform the testing required by this surveillance. The Frequency of every 92 days thereafter applies if the plant remains in the MODE of Applicability after the initial performances of prior to reactor startup and [12] and four hours after reducing power below P-10 or P-6, respectively. The MODE of Applicability for this surveillance is < P-10 for the power range low and intermediate range channels and < P-6 for the source range channels. Once the unit is in MODE 3, this surveillance is no longer required. If power is to be maintained < P-10 for more than [12] hours or < P-6 for more than 4 hours, then the testing required by this surveillance must be performed prior to the expiration of the time limit. [Twelve] hours and four hours are reasonable times to complete the required testing or place the unit in a MODE where this surveillance is no longer required. This test ensures that the NIS source, intermediate, and power range low channels are OPERABLE prior to taking the reactor critical and after reducing power into the applicable MODE (< P-10 or < P-6) for periods > [12] and 4 hours, respectively. The Frequency of 184 days is justified in Reference 13.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.11

SR 3.3.1.11 is the performance of a CHANNEL CALIBRATION, as described in SR 3.3.1.10, every [18] months. This SR is modified by two Notes. a Note 1 statesing that neutron detectors are excluded from the CHANNEL CALIBRATION. The CHANNEL CALIBRATION for the power range neutron detectors consists of a normalization of the detectors based on a power calorimetric and flux map performed above 15% RTP. Note 2 states that this test shall include verification that the time constants are adjusted to the prescribed values where applicable. The CHANNEL CALIBRATION for the source range and intermediate range neutron detectors consists of obtaining the detector plateau or preamp discriminator curves, evaluating those curves, and comparing the curves to the manufacturer's data. This Surveillance is not required for the NIS power range detectors for entry into MODE 2 or 1, and is not required for the NIS intermediate range detectors for entry into MODE 2, because the unit must be in at least MODE 2 to perform the test for the intermediate range detectors and MODE 1 for the power range detectors. The [18] month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. Operating experience has shown these components usually pass the Surveillance when performed on the [18] month Frequency.

SR 3.3.1.12

SR 3.3.1.12 is the performance of a CHANNEL CALIBRATION, as described in SR 3.3.1.10, every [18] months. This SR is modified by two Notes. a Note 1 statesing that this test shall include verification of the RCS resistance temperature detector (RTD) bypass loop flow rate. Note 2 states that this test shall include verification that the time constants are adjusted to the prescribed values where applicable. Whenever a sensing element is replaced, the next required CHANNEL CALIBRATION of the resistance temperature detectors (RTD) sensors is accomplished by an inplace cross calibration that compares the other sensing elements with the recently installed sensing element.

This test will verify the rate lag compensation for flow from the core to the RTDs.

The Frequency is justified by the assumption of an 18 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.15

SR 3.3.1.15 is the performance of a TADOT of Turbine Trip Functions. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable TADOT of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications and non-Technical Specifications tests at least once per refueling interval with applicable extensions. This TADOT is as described in SR 3.3.1.4, except that this test is performed prior to exceeding the [P-9] interlock whenever the unit has been in MODE 3. This Surveillance is not required if it has been performed within the previous 31 days. Verification of the Trip Setpoint does not have to be performed for this Surveillance. Performance of this test will ensure that the turbine trip Function is OPERABLE prior to exceeding the [P-9] interlock.

SR 3.3.1.16

SR 3.3.1.16 verifies that the individual channel/train actuation response times are less than or equal to the maximum values assumed in the accident analysis. Response time testing acceptance criteria are included in Technical Requirements Manual, Section 15 (Ref. 14). Individual component response times are not modeled in the analyses.

The analyses model the overall or total elapsed time, from the point at which the parameter exceeds the trip setpoint value at the sensor to the point at which the equipment reaches the required functional state (i.e., control and shutdown rods fully inserted in the reactor core).

For channels that include dynamic transfer Functions (e.g., lag, lead/lag, rate/lag, etc.), the response time test may be performed with the transfer Function set to one, with the resulting measured response time compared to the appropriate FSAR response time. Alternately, the response time test can be performed with the time constants set to their nominal value, provided the required response time is analytically calculated assuming the time constants are set at their nominal values. The response time may be measured by a series of overlapping tests such that the entire response time is measured. See also the Bases for SR 3.3.1.10, SR 3.3.1.11, and SR 3.3.1.12.

-----------------------------------REVIEWER'S NOTE-----------------------------------
Applicable portions of the following Bases are applicable for plants adopting WCAP-13632-P-A and/or WCAP-14036-P.

BASES

BACKGROUND (continued)

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 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.

Allowable Values and ESFAS Setpoints

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 Allowable Values specified in Table 3.3.2-1 in the accompanying LCO are conservative with respect to the analytical limits. A detailed description of the methodology used to calculate the Allowable Values 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. Time constants are verified to be adjusted to their prescribed values during CHANNEL CALIBRATIONS. 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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

e. Safety Injection - Steam Line Pressure

(1) Steam Line Pressure – Low

Steam Line Pressure - Low provides protection against the following accidents:

- SLB,
- Feed line break, and
- Inadvertent opening of an SG relief or an SG safety valve.

Steam Line Pressure - Low provides no input to any control functions. Thus, three OPERABLE channels on each steam line are sufficient to satisfy the protective requirements with a two-out-of-three logic on each steam line.

With the transmitters typically located inside the steam tunnels, it is possible for them to experience adverse environmental conditions during a secondary side break. Therefore, the Trip Setpoint reflects both steady state and adverse environmental instrument uncertainties.

This Function is anticipatory in nature and has a typical lead/lag ratio of 50/5. Time constants are verified to be adjusted to their prescribed values during CHANNEL CALIBRATIONS.

Steam Line Pressure - Low must be OPERABLE in MODES 1, 2, and 3 (above P-11) when a secondary side break or stuck open valve could result in the rapid depressurization of the steam lines. This signal may be manually blocked by the operator below the P-11 setpoint. Below P-11, feed line break is not a concern. Inside containment SLB will be terminated by automatic SI actuation via Containment Pressure - High 1, and outside containment SLB will be terminated by the Steam Line Pressure - Negative Rate - High signal for steam line isolation. This Function is not required to be OPERABLE in MODE 4, 5, or 6 because there is insufficient energy in the secondary side of the unit to cause an accident.

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.4

SR 3.3.2.4 is the performance of a MASTER RELAY TEST. The MASTER RELAY TEST is the energizing of the master relay, verifying contact operation and a low voltage continuity check of the slave relay coil. Upon master relay contact operation, a low voltage is injected to the slave relay coil. This voltage is insufficient to pick up the slave relay, but large enough to demonstrate signal path continuity. This test is performed every 92 days on a STAGGERED TEST BASIS. The time allowed for the testing (4 hours) is justified in Reference 11. The Frequency of 92 days is justified in Reference 9.

SR 3.3.2.5

SR 3.3.2.5 is the performance of a COT.

A COT is performed on each required channel to ensure the entire channel will perform the intended Function. Setpoints must be found within the Allowable Values specified in Table 3.3.1-1. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable COT of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications and non-Technical Specifications tests at least once per refueling interval with applicable extensions.

The difference between the current "as found" values and the previous test "as left" values must be consistent with the drift allowance used in the setpoint methodology. The setpoint shall be left set consistent with the assumptions of the current unit specific setpoint methodology.

The "as found" and "as left" values must also be recorded and reviewed for consistency with the assumptions of Reference 6.

SR 3.3.2.5 is modified by a Note that excludes verification of time constants from the COT.

The Frequency of 184 days is justified in Reference 11.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.10

This SR ensures the individual channel ESF RESPONSE TIMES are less than or equal to the maximum values assumed in the accident analysis. Response Time testing acceptance criteria are included in the Technical Requirements Manual, Section 15 (Ref. 12). Individual component response times are not modeled in the analyses. The analyses model the overall or total elapsed time, from the point at which the parameter exceeds the Trip Setpoint value at the sensor, to the point at which the equipment in both trains reaches the required functional state (e.g., pumps at rated discharge pressure, valves in full open or closed position).

For channels that include dynamic transfer functions (e.g., lag, lead/lag, rate/lag, etc.), the response time test may be performed with the transfer functions set to one with the resulting measured response time compared to the appropriate FSAR response time. Alternately, the response time test can be performed with the time constants set to their nominal value provided the required response time is analytically calculated assuming the time constants are set at their nominal values. The response time may be measured by a series of overlapping tests such that the entire response time is measured. See also the Bases for SR 3.3.2.9.

-----------------------------REVIEWER'S NOTE---
Applicable portions of the following Bases are applicable for plants adopting WCAP-13632-P-A (Ref. 9). and/or WCAP-14036-P (Ref. 10).

Response time may be verified by actual response time tests in any series of sequential, overlapping or total channel measurements, or by the summation of allocated sensor, signal processing and actuation logic response times with actual response time tests on the remainder of the channel. Allocations for sensor response times may be obtained from: (1) historical records based on acceptable response time tests (hydraulic, noise, or power interrupt tests), (2) in place, onsite, or offsite (e.g., vendor) test measurements, or (3) utilizing vendor engineering specifications. WCAP-13632-P-A, Revision 2, "Elimination of Pressure Sensor Response Time Testing Requirements," (Ref. 13) dated January 1996, provides the basis and methodology for using allocated sensor response times in the overall verification of the channel response time for specific sensors identified in the WCAP. Response time verification for other sensor types must be demonstrated by test.