

Proposed Technical Specification Pages (retyped)

3.2 POWER DISTRIBUTION LIMITS

3.2.4 Departure From Nucleate Boiling Ratio (DNBR)

LCO 3.2.4 The DNBR shall be maintained by one of the following methods:

- a. Maintaining Core Operating Limit Supervisory System (COLSS) calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR (when COLSS is in service, and either one or both Control Element Assembly Calculators (CEACs) are OPERABLE);
- b. Maintaining COLSS calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR decreased by the allowance specified in the COLR (when COLSS is in service and neither CEAC is OPERABLE);
- c. Operating within the region of acceptable operation specified in the COLR using any OPERABLE Core Protection Calculator (CPC) channel (when COLSS is out of service and either one or both CEACs are OPERABLE); or
- d. Operating within the region of acceptable operation specified in the COLR using any OPERABLE CPC channel (when COLSS is out of service and neither CEAC is OPERABLE).

APPLICABILITY: MODE 1 with THERMAL POWER > 20% RTP. (Before CPC Upgrade)

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. COLSS calculated core power not within limit.	A.1 Restore the DNBR to within limit.	1 hour

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. DNBR outside the region of acceptable operation when COLSS is out of service.	B.1 Determine trend in DNBR. <u>AND</u>	Once per 15 minutes
	B.2.1 With an adverse trend, restore DNBR to within limit. <u>OR</u>	1 hour
	B.2.2 With no adverse trend, restore DNBR to within limit.	4 hours
C. Required Action and associated Completion Time not met.	C.1 Reduce THERMAL POWER to $\leq 20\%$ RTP.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.2.4.1 -----NOTE----- 1. Only applicable when COLSS is out of service. With COLSS in service, this parameter is continuously monitored. 2. Not required to be performed until 2 hours after MODE 1 with THERMAL POWER > 20% RTP. ----- Verify DNBR, as indicated on any OPERABLE DNBR channels, is within the limit of the COLR, as applicable.	2 hours
SR 3.2.4.2 Verify COLSS margin alarm actuates at a THERMAL POWER level equal to or less than the core power operating limit based on DNBR.	31 days

3.2 POWER DISTRIBUTION LIMITS

3.2.4 Departure From Nucleate Boiling Ratio (DNBR)

- LCO 3.2.4 The DNBR shall be maintained by one of the following methods:
- a. Core Operating Limit Supervisory System (COLSS) In Service:
 - 1. Maintaining COLSS calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR when at least one Control Element Assembly Calculator (CEAC) is OPERABLE in each OPERABLE Core Protection Calculator (CPC) channel; or
 - 2. Maintaining COLSS calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR decreased by the allowance specified in the COLR when the CEAC requirements of LCO 3.2.4.a.1 are not met.
 - b. COLSS Out of Service:
 - 1. Operating within the region of acceptable operation specified in the COLR using any OPERABLE Core Protection Calculator (CPC) channel when at least one Control Element Assembly Calculator (CEAC) is OPERABLE in each OPERABLE CPC channel; or
 - 2. Operating within the region of acceptable operation specified in the COLR using any OPERABLE CPC channel (with both CEACs inoperable) when the CEAC requirements of LCO 3.2.4.b.1 are not met.

APPLICABILITY: MODE 1 with THERMAL POWER > 20% RTP. (After CPC Upgrade)

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. COLSS calculated core power not within limit.	A.1 Restore the DNBR to within limit.	1 hour

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. DNBR outside the region of acceptable operation when COLSS is out of service.	B.1 Determine trend in DNBR.	Once per 15 minutes
	<u>AND</u>	
	B.2.1 With an adverse trend, restore DNBR to within limit.	1 hour
	<u>OR</u>	
	B.2.2 With no adverse trend, restore DNBR to within limit.	4 hours
C. Required Action and associated Completion Time not met.	C.1 Reduce THERMAL POWER to \leq 20% RTP.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.2.4.1 -----NOTE----- 1. Only applicable when COLSS is out of service. With COLSS in service, this parameter is continuously monitored. 2. Not required to be performed until 2 hours after MODE 1 with THERMAL POWER > 20% RTP. ----- Verify DNBR, as indicated on any OPERABLE DNBR channels, is within the limit of the COLR, as applicable.	2 hours
SR 3.2.4.2 Verify COLSS margin alarm actuates at a THERMAL POWER level equal to or less than the core power operating limit based on DNBR.	31 days

3.3 INSTRUMENTATION

3.3.1 Reactor Protective System (RPS) Instrumentation – Operating

LCO 3.3.1 Four RPS trip and bypass removal channels for each Function in Table 3.3.1-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.1-1. (Before CPC Upgrade)

ACTIONS

-----NOTE-----
Separate Condition entry is allowed for each RPS Function.

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

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>C. One or more Functions with one automatic bypass removal channel inoperable.</p>	<p>C.1 Disable bypass channel.</p> <p><u>OR</u></p> <p>C.2.1 Place affected automatic trip channel in bypass or trip.</p> <p><u>AND</u></p> <p>C.2.2 Restore bypass removal channel and associated automatic trip channel to OPERABLE status.</p>	<p>1 hour</p> <p>1 hour</p> <p>Prior to entering MODE 2 following next MODE 5 entry</p>
<p>D. One or more Functions with two automatic bypass removal channels inoperable.</p>	<p>-----NOTE----- LCO 3.0.4 is not applicable. -----</p> <p>D.1 Disable bypass channels.</p> <p><u>OR</u></p> <p>D.2 Place one affected automatic trip channel in bypass and place the other in trip.</p>	<p>1 hour</p> <p>1 hour</p>
<p>E. One or more core protection calculator (CPC) channels with a cabinet high temperature alarm.</p>	<p>E.1 Perform CHANNEL FUNCTIONAL TEST on affected CPC.</p>	<p>12 hours</p>

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
F. One or more CPC channels with three or more autorestarts during a 12 hour period.	F.1 Perform CHANNEL FUNCTIONAL TEST on affected CPC.	24 hours
G. Required Action and associated Completion Time not met.	G.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

-----NOTE-----
Refer to Table 3.3.1-1 to determine which SR shall be performed for each RPS Function.

SURVEILLANCE	FREQUENCY
SR 3.3.1.1 Perform a CHANNEL CHECK of each RPS instrument channel.	12 hours

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
<p>SR 3.3.1.2 -----NOTE----- Not required to be performed until 12 hours after THERMAL POWER \geq 70% RTP. -----</p> <p>Verify total Reactor Coolant System (RCS) flow rate as indicated by each CPC is less than or equal to the RCS total flow rate.</p> <p>If necessary, adjust the CPC addressable constant flow coefficients such that each CPC indicated flow is less than or equal to the RCS flow rate.</p>	<p>12 hours</p>
<p>SR 3.3.1.3 Check the CPC autorestart count.</p>	<p>12 hours</p>

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
<p>SR 3.3.1.4 -----NOTES-----</p> <ol style="list-style-type: none"> 1. Not required to be performed until 12 hours after THERMAL POWER \geq 20% RTP. 2. The daily calibration may be suspended during PHYSICS TESTS, provided the calibration is performed upon reaching each major test power plateau and prior to proceeding to the next major test power plateau. <p>-----</p> <p>Perform calibration (heat balance only) and adjust the linear power level signals and the CPC addressable constant multipliers to make the CPC ΔT power and CPC nuclear power calculations agree with the calorimetric, if the absolute difference is \geq 2% when THERMAL POWER is \geq 80% RTP. Between 20% and 80% RTP the maximum difference is -0.5% to 10%.</p>	<p>24 hours</p>
<p>SR 3.3.1.5 -----NOTE-----</p> <p>Not required to be performed until 12 hours after THERMAL POWER \geq 70% RTP.</p> <p>-----</p> <p>Verify total RCS flow rate indicated by each CPC is less than or equal to the RCS flow determined either using the reactor coolant pump differential pressure instrumentation and the ultrasonic flow meter adjusted pump curves or by calorimetric calculations.</p>	<p>31 days</p>

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
<p>SR 3.3.1.6 -----NOTE----- Not required to be performed until 12 hours after THERMAL POWER \geq 15% RTP. ----- Verify linear power subchannel gains of the excore detectors are consistent with the values used to establish the shape annealing matrix elements in the CPCs.</p>	31 days
<p>SR 3.3.1.7 -----NOTES----- 1. The CPC CHANNEL FUNCTIONAL TEST shall include verification that the correct values of addressable constants are installed in each OPERABLE CPC. 2. Not required to be performed for logarithmic power level channels until 2 hours after reducing logarithmic power below 1E-4% NRTP. ----- Perform CHANNEL FUNCTIONAL TEST on each channel.</p>	92 days
<p>SR 3.3.1.8 -----NOTE----- Neutron detectors are excluded from the CHANNEL CALIBRATION. ----- Perform CHANNEL CALIBRATION of the power range neutron flux channels.</p>	92 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
<p>SR 3.3.1.9 -----NOTE----- Neutron detectors are excluded from CHANNEL CALIBRATION. -----</p> <p>Perform CHANNEL CALIBRATION on each channel, including bypass removal functions.</p>	<p>18 months</p>
<p>SR 3.3.1.10 Perform a CHANNEL FUNCTIONAL TEST on each CPC channel.</p>	<p>18 months</p>
<p>SR 3.3.1.11 Using the incore detectors, verify the shape annealing matrix elements to be used by the CPCs.</p>	<p>Once after each refueling prior to exceeding 70% RTP</p>
<p>SR 3.3.1.12 Perform a CHANNEL FUNCTIONAL TEST on each automatic bypass removal function.</p>	<p>Once within 92 days prior to each reactor startup</p>
<p>SR 3.3.1.13 -----NOTE----- Neutron detectors are excluded. -----</p> <p>Verify RPS RESPONSE TIME is within limits.</p>	<p>18 months on a STAGGERED TEST BASIS</p>

RPS Instrumentation – Operating (Before CPC Upgrade)
3.3.1

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

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Variable Over Power	1,2	SR 3.3.1.1 SR 3.3.1.4 SR 3.3.1.6 SR 3.3.1.7 SR 3.3.1.8 SR 3.3.1.9 SR 3.3.1.13	Ceiling \leq 111.0% RTP Band \leq 9.9% RTP Incr. Rate \leq 11.0%/min RTP Decr. Rate $>$ 5%/sec RTP
2. Logarithmic Power Level – High(a)	2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.12 SR 3.3.1.13	\leq 0.011% NRTP
3. Pressurizer Pressure – High	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	\leq 2388 psia
4. Pressurizer Pressure – Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.12 SR 3.3.1.13	\geq 1821 psia
5. Containment Pressure – High	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	\leq 3.2 psig
6. Steam Generator #1 Pressure – Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	\geq 890 psia
7. Steam Generator #2 Pressure – Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	\geq 890 psia

(continued)

(a) Trip may be bypassed when logarithmic power is $>$ 1E-4% NRTP. Bypass shall be automatically removed when logarithmic power is \leq 1E-4% NRTP.

RPS Instrumentation – Operating (Before CPC Upgrade)
3.3.1

Table 3.3.1-1 (page 2 of 3)
Reactor Protective System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
8. Steam Generator #1 Level – Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	≥ 43.7%
9. Steam Generator #2 Level – Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	≥ 43.7%
10. Steam Generator #1 Level – High	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	≤ 91.5%
11. Steam Generator #2 Level – High	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	≤ 91.5%
12. Reactor Coolant Flow, Steam Generator #1-Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	Ramp: ≤ 0.115 psid/sec. Floor: ≥ 12.49 psid Step: ≤ 17.2 psid
13. Reactor Coolant Flow, Steam Generator #2-Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	Ramp: ≤ 0.115 psid/sec. Floor: ≥ 12.49 psid Step: ≤ 17.2 psid

(continued)

RPS Instrumentation – Operating (Before CPC Upgrade)
3.3.1

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

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
14. Local Power Density – High ^(b)	1.2	SR 3.3.1.1 SR 3.3.1.2 SR 3.3.1.3 SR 3.3.1.4 SR 3.3.1.5 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.10 SR 3.3.1.11 SR 3.3.1.12 SR 3.3.1.13	≤ 21.0 kW/ft
15. Departure From Nucleate Boiling Ratio (DNBR) – Low ^(b)	1.2	SR 3.3.1.1 SR 3.3.1.2 SR 3.3.1.3 SR 3.3.1.4 SR 3.3.1.5 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.10 SR 3.3.1.11 SR 3.3.1.12 SR 3.3.1.13	≥ 1.3 (through operating cycle 10) ≥ 1.34 (operating cycle 11 and later)

(b) Trip may be bypassed when logarithmic power is < 1E-4% NRTP. Bypass shall be automatically removed when logarithmic power is ≥ 1E-4% NRTP.

3.3 INSTRUMENTATION

3.3.1 Reactor Protective System (RPS) Instrumentation – Operating

LCO 3.3.1 Four RPS trip and bypass removal channels for each Function in Table 3.3.1-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.1-1. (After CPC Upgrade)

ACTIONS

-----NOTE-----
Separate Condition entry is allowed for each RPS Function.

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

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>C. One or more Functions with one automatic bypass removal channel inoperable.</p>	<p>C.1 Disable bypass channel. <u>OR</u> C.2.1 Place affected automatic trip channel in bypass or trip. <u>AND</u> C.2.2 Restore bypass removal channel and associated automatic trip channel to OPERABLE status.</p>	<p>1 hour 1 hour Prior to entering MODE 2 following next MODE 5 entry</p>
<p>D. One or more Functions with two automatic bypass removal channels inoperable.</p>	<p>-----NOTE----- LCO 3.0.4 is not applicable. ----- D.1 Disable bypass channels. <u>OR</u> D.2 Place one affected automatic trip channel in bypass and place the other in trip.</p>	<p>1 hour 1 hour</p>
<p>E. Required Action and associated Completion Time not met.</p>	<p>E.1 Be in MODE 3</p>	<p>6 hours</p>

(continued)

SURVEILLANCE REQUIREMENTS

-----NOTE-----
Refer to Table 3.3.1-1 to determine which SR shall be performed for each RPS Function.

SURVEILLANCE		FREQUENCY
SR 3.3.1.1	Perform a CHANNEL CHECK of each RPS instrument channel.	12 hours
SR 3.3.1.2	<p>-----NOTE----- Not required to be performed until 12 hours after THERMAL POWER \geq 70% RTP. -----</p> <p>Verify total Reactor Coolant System (RCS) flow rate as indicated by each CPC is less than or equal to the RCS total flow rate.</p> <p>If necessary, adjust the CPC addressable constant flow coefficients such that each CPC indicated flow is less than or equal to the RCS flow rate.</p>	12 hours
SR 3.3.1.3	Check the CPC System Event Log.	12 hours

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
<p>SR 3.3.1.4 -----NOTES-----</p> <ol style="list-style-type: none"> 1. Not required to be performed until 12 hours after THERMAL POWER \geq 20% RTP. 2. The daily calibration may be suspended during PHYSICS TESTS, provided the calibration is performed upon reaching each major test power plateau and prior to proceeding to the next major test power plateau. <p>-----</p> <p>Perform calibration (heat balance only) and adjust the linear power level signals and the CPC addressable constant multipliers to make the CPC ΔT power and CPC nuclear power calculations agree with the calorimetric, if the absolute difference is \geq 2% when THERMAL POWER is \geq 80% RTP. Between 20% and 80% RTP the maximum difference is -0.5% to 10%.</p>	<p>24 hours</p>
<p>SR 3.3.1.5 -----NOTE-----</p> <p>Not required to be performed until 12 hours after THERMAL POWER \geq 70% RTP.</p> <p>-----</p> <p>Verify total RCS flow rate indicated by each CPC is less than or equal to the RCS flow determined either using the reactor coolant pump differential pressure instrumentation and the ultrasonic flow meter adjusted pump curves or by calorimetric calculations.</p>	<p>31 days</p>

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
<p>SR 3.3.1.6 -----NOTE----- Not required to be performed until 12 hours after THERMAL POWER \geq 15% RTP. ----- Verify linear power subchannel gains of the excore detectors are consistent with the values used to establish the shape annealing matrix elements in the CPCs.</p>	31 days
<p>SR 3.3.1.7 -----NOTES----- 1. The CPC CHANNEL FUNCTIONAL TEST shall include verification that the correct values of addressable constants are installed in each OPERABLE CPC. 2. Not required to be performed for logarithmic power level channels until 2 hours after reducing logarithmic power below 1E-4% NRTP. ----- Perform CHANNEL FUNCTIONAL TEST on each channel.</p>	92 days
<p>SR 3.3.1.8 -----NOTE----- Neutron detectors are excluded from the CHANNEL CALIBRATION. ----- Perform CHANNEL CALIBRATION of the power range neutron flux channels.</p>	92 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
<p>SR 3.3.1.9 -----NOTE----- Neutron detectors are excluded from CHANNEL CALIBRATION. -----</p> <p>Perform CHANNEL CALIBRATION on each channel, including bypass removal functions.</p>	<p>18 months</p>
<p>SR 3.3.1.10 Perform a CHANNEL FUNCTIONAL TEST on each CPC channel.</p>	<p>18 months</p>
<p>SR 3.3.1.11 Using the incore detectors, verify the shape annealing matrix elements to be used by the CPCs.</p>	<p>Once after each refueling prior to exceeding 70% RTP</p>
<p>SR 3.3.1.12 Perform a CHANNEL FUNCTIONAL TEST on each automatic bypass removal function.</p>	<p>Once within 92 days prior to each reactor startup</p>
<p>SR 3.3.1.13 -----NOTE----- Neutron detectors are excluded. -----</p> <p>Verify RPS RESPONSE TIME is within limits.</p>	<p>18 months on a STAGGERED TEST BASIS</p>

RPS Instrumentation – Operating (After CPC Upgrade)
3.3.1

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

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Variable Over Power	1,2	SR 3.3.1.1 SR 3.3.1.4 SR 3.3.1.6 SR 3.3.1.7 SR 3.3.1.8 SR 3.3.1.9 SR 3.3.1.13	Ceiling \leq 111.0% RTP Band \leq 9.9% RTP Incr. Rate \leq 11.0%/min RTP Decr. Rate $>$ 5%/sec RTP
2. Logarithmic Power Level – High(a)	2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.12 SR 3.3.1.13	\leq 0.011% NRTP
3. Pressurizer Pressure – High	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	\leq 2388 psia
4. Pressurizer Pressure – Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.12 SR 3.3.1.13	\geq 1821 psia
5. Containment Pressure – High	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	\leq 3.2 psig
6. Steam Generator #1 Pressure – Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	\geq 890 psia
7. Steam Generator #2 Pressure – Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	\geq 890 psia

(continued)

(a) Trip may be bypassed when logarithmic power is $>$ 1E-4% NRTP. Bypass shall be automatically removed when logarithmic power is \leq 1E-4% NRTP.

RPS Instrumentation – Operating (After CPC Upgrade)
3.3.1

Table 3.3.1-1 (page 2 of 3)
Reactor Protective System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
8. Steam Generator #1 Level – Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	≥ 43.7%
9. Steam Generator #2 Level – Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	≥ 43.7%
10. Steam Generator #1 Level – High	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	≤ 91.5%
11. Steam Generator #2 Level – High	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	≤ 91.5%
12. Reactor Coolant Flow, Steam Generator #1-Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	Ramp: ≤ 0.115 psid/sec. Floor: ≥ 12.49 psid Step: ≤ 17.2 psid
13. Reactor Coolant Flow, Steam Generator #2-Low	1,2	SR 3.3.1.1 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.13	Ramp: ≤ 0.115 psid/sec. Floor: ≥ 12.49 psid Step: ≤ 17.2 psid

(continued)

RPS Instrumentation – Operating (After CPC Upgrade)
3.3.1

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

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
14. Local Power Density – High ^(b)	1.2	SR 3.3.1.1 SR 3.3.1.2 SR 3.3.1.3 SR 3.3.1.4 SR 3.3.1.5 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.10 SR 3.3.1.11 SR 3.3.1.12 SR 3.3.1.13	≤ 21.0 kW/ft
15. Departure From Nucleate Boiling Ratio (DNBR) – Low ^(b)	1.2	SR 3.3.1.1 SR 3.3.1.2 SR 3.3.1.3 SR 3.3.1.4 SR 3.3.1.5 SR 3.3.1.7 SR 3.3.1.9 SR 3.3.1.10 SR 3.3.1.11 SR 3.3.1.12 SR 3.3.1.13	≥ 1.3 (through operating cycle 10) ≥ 1.34 (operating cycle 11 and later)

(C) Trip may be bypassed when logarithmic power is < 1E-4% NRTP. Bypass shall be automatically removed when logarithmic power is ≥ 1E-4% NRTP.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. (continued)	B.2 Verify all full length and part length control element assembly (CEA) groups are fully withdrawn and maintained fully withdrawn, except during Surveillance testing pursuant to SR 3.1.5.3 or for control, when CEA group #5 may be inserted to a maximum of 127.5 inches withdrawn.	4 hours
	<u>AND</u>	
	B.3 Verify the "RSPT/CEAC Inoperable" addressable constant in each core protection calculator (CPC) is set to indicate that both CEACs are inoperable.	4 hours
	<u>AND</u>	
	B.4 Verify the Control Element Drive Mechanism Control System is placed in "STANDBY MODE" and maintained in "STANDBY MODE," except during CEA motion permitted by Required Action B.2.	4 hours
<u>AND</u>		
B.5 Perform SR 3.1.5.1.		Once per 4 hours
<u>AND</u>		(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. (continued)	B.6 Disable the Reactor Power Cutback System (RPCS)	4 hours
C. Receipt of a CPC channel B or C cabinet high temperature alarm.	C.1 Perform CHANNEL FUNCTIONAL TEST on affected CEAC(s).	12 hours
D. One or two CEACs with three or more auto restarts during a 12 hour period.	D.1 Perform CHANNEL FUNCTIONAL TEST on affected CEAC.	24 hours
E. Required Action and associated Completion Time of Condition B, C, or D not met.	E.1 Be in MODE 3.	6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.3.3.1 Perform a CHANNEL CHECK.	12 hours
SR 3.3.3.2 Check the CEAC auto restart count.	12 hours
SR 3.3.3.3 Perform a CHANNEL FUNCTIONAL TEST.	92 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
SR 3.3.3.4 Perform a CHANNEL CALIBRATION.	18 months
SR 3.3.3.5 Perform a CHANNEL FUNCTIONAL TEST.	18 months
SR 3.3.3.6 Verify the isolation characteristics of each CEAC isolation amplifier.	18 months

3.3 INSTRUMENTATION

3.3.3 Control Element Assembly Calculators (CEACs)

LCO 3.3.3 Two CEACs shall be OPERABLE in each CPC channel

APPLICABILITY: MODES 1 and 2. (After CPC Upgrade)

ACTIONS

-----NOTE-----
Separate condition entry is allowed for each CPC channel.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One CEAC inoperable in one or more CPC channels.	A.1 Declare the affected CPC channel(s) inoperable.	Immediately
	<u>OR</u>	
	A.2.1 Perform SR 3.1.5.1	Once per 4 hours
	<u>AND</u>	
	A.2.2 Restore CEAC to OPERABLE status.	7 days
B. Required Action and associated Completion Time of Condition A not met. <u>OR</u> Both CEACs inoperable in one or more CPC channels.	B.1 Declare the affected CPC channel(s) inoperable.	Immediately
	<u>OR</u>	(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>B. (continued)</p>	<p>B.2.1 Verify the departure from nucleate boiling ratio requirement of LCO 3.2.4, "Departure from Nucleate Boiling Ratio (DNBR)," is met.</p> <p><u>AND</u></p>	<p>4 hours</p>
	<p>B.2.2 Verify all full length and part length control element assembly (CEA) groups are fully withdrawn and maintained fully withdrawn, except during Surveillance testing pursuant to SR 3.1.5.3 or for control, when CEA group #5 may be inserted to a maximum of 127.5 inches withdrawn.</p> <p><u>AND</u></p>	
	<p>B.2.3 Verify the "RSPT/CEAC Inoperable" addressable constant in each affected core protection calculator (CPC) is set to indicate that both CEACs are inoperable.</p> <p><u>AND</u></p>	<p>4 hours</p> <p>(continued)</p>

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
	<p>B.2.4 Verify the Control Element Drive Mechanism Control System is placed in "STANDBY MODE" and maintained in "STANDBY MODE," except during CEA motion permitted by Required Action B.2.2.</p> <p><u>AND</u></p> <p>B.2.5 Perform SR 3.1.5.1.</p> <p><u>AND</u></p> <p>B.2.6 Disable the Reactor Power Cutback System (RPCS)</p>	<p>4 hours</p> <p>Once per 4 hours</p> <p>4 hours</p>
<p>C. Required Action and associated Completion Time of Condition B not met.</p>	<p>C.1 Be in MODE 3.</p>	<p>6 hours</p>

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.3.1	Perform a CHANNEL CHECK.	12 hours
SR 3.3.3.2	Deleted	
SR 3.3.3.3	Perform a CHANNEL FUNCTIONAL TEST.	92 days
SR 3.3.3.4	Perform a CHANNEL CALIBRATION.	18 months
SR 3.3.3.5	Perform a CHANNEL FUNCTIONAL TEST.	18 months

List of Regulatory Commitments

The following table identified those actions committed to by APS in this document. Please direct questions regarding these commitments to Thomas N. Weber at (623) 393-5764.

REGULATORY COMMITMENT	DUE DATE
1. APS will ensure that all plant specific action items described in Section 6.0 of NRC Safety Evaluation (SE), Acceptance for Referencing of Topical Report CENPD-396-P, Rev. 01, "Common Qualified Platform" and Appendices 1, 2, 3 and 4, Rev. 01 (TAC No. MA1677), dated August 11, 2000, are completed.	Prior to implementation of the Common Q CPCS at PVNGS.

Changes to Technical Specification Bases

(Information Only)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

- b. During a loss of flow accident, there must be at least 95% probability at the 95% confidence level (the 95/95 DNB criterion) that the hot fuel rod in the core does not experience a DNB condition (Ref. 4 ~~B~~);
- c. During an ejected CEA accident, the fission energy input to the fuel must not exceed 280 cal/gm (Ref. 6); and
- d. The control rods (excluding part length rods) must be capable of shutting down the reactor with a minimum required SDM with the highest worth control rod stuck fully withdrawn (Ref. 7).

The power density at any point in the core must be limited to maintain the fuel design criteria (Ref. 4). This is accomplished by maintaining the power distribution and reactor coolant conditions so that the peak LHR and DNB parameters are within operating limits supported by the accident analyses (Ref. 1) with due regard for the correlations between measured quantities, the power distribution, and uncertainties in the determination of power distribution.

Fuel cladding failure during a LOCA is limited by restricting the maximum Linear Heat Generation Rate (LHGR) so that the peak cladding temperature does not exceed 2200°F (Ref. 4). Peak cladding temperatures exceeding 2200°F may cause severe cladding failure by oxidation due to a Zircaloy water reaction.

The LCOs governing LHR, ASI, CEAs, and RCS ensure that these criteria are met as long as the core is operated within the ASI and F_{xy} limits specified in the COLR, and within the T_q limits. The latter are process variables that characterize the three dimensional power distribution of the reactor core. Operation within the limits for these variables ensures that their actual values are within the range used in the accident analyses (Ref. 1)

(continued)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

Fuel cladding damage does not occur from conditions outside the limits of these LCOs during normal operation. However, fuel cladding damage could result if an accident occurs from initial conditions outside the limits of these LCOs. This potential for fuel cladding damage exists because changes in the power distribution can cause increased power peaking and correspondingly increased local LHRs.

DNBR satisfies Criterion 2 of 10 CFR 50.36 (c)(2)(ii).

LCO
*(Before CPC
Upgrade)*

The power distribution LCO limits are based on correlations between power peaking and certain measured variables used as inputs to the LHR and DNBR operating limits. The power distribution LCO limits are provided in the COLR.

With the COLSS in service and one or both of the Control Element Assembly Calculators (CEACs) OPERABLE, the DNBR will be maintained by ensuring that the core power calculated by the COLSS is equal to or less than the permissible core power operating limit based on DNBR calculated by the COLSS. In the event that the COLSS is in service but neither of the two CEACs is OPERABLE, the DNBR is maintained by ensuring that the core power calculated by the COLSS is equal to or less than a reduced value of the permissible core power operating limit calculated by the COLSS. In this condition, the calculated operating limit must be reduced by the allowance specified in the COLR.

In instances for which the COLSS is out of service and either one or both of the CEACs are OPERABLE, the DNBR is maintained by operating within the acceptable region specified in the COLR and using any OPERABLE CPC channel. Alternatively, when the COLSS is out of service and neither of the two CEACs is OPERABLE, the DNBR is maintained by operating within the acceptable region specified in the COLR for this condition and using any OPERABLE CPC channel.

(continued)

BASES

LCO
(Before CPC Upgrade)
(continued)

With the COLSS out of service, the limitation on DNBR as a function of the ASI represents a conservative envelope of operating conditions consistent with the analysis assumptions that have been analytically demonstrated adequate to maintain an acceptable minimum DNBR for all AOOs. Operation of the core with a DNBR at or above this limit ensures that an acceptable minimum DNBR is maintained in the event of the most limiting AOO (i.e., loss of flow transient, CEA misoperation events, or asymmetric SG transient).

LCO
(After CPC Upgrade)

The power distribution LCO limits are based on correlations between power peaking and certain measured variables used as inputs to the LHR and DNBR operating limits. The power distribution LCO limits are provided in the COLR.

With the COLSS in service and **at least one** of the Control Element Assembly Calculators (CEACs) OPERABLE **in each operable CPC Channel**, the DNBR will be maintained by ensuring that the core power calculated by the COLSS is equal to or less than the permissible core power operating limit based on DNBR calculated by the COLSS. In the event that the COLSS is in service but **the above condition is not met**, the DNBR is maintained by ensuring that the core power calculated by the COLSS is equal to or less than a reduced value of the permissible core power operating limit calculated by the COLSS. In this condition, the calculated operating limit must be reduced by the allowance specified in the COLR.

In instances for which the COLSS is out of service and **at least one** of the CEACs are OPERABLE **in each operable CPC Channel**, the DNBR is maintained by operating within the acceptable region specified in the COLR and using any OPERABLE CPC channel. Alternatively, when the COLSS is out of service and **the above condition is not met**, the DNBR is maintained by operating within the acceptable region specified in the COLR for this condition and using any OPERABLE CPC channel **with two inoperable CEACs**.

(continued)

BASES

LCO
(After CPC
Upgrade)
(continued)

With the COLSS out of service, the limitation on DNBR as a function of the ASI represents a conservative envelope of operating conditions consistent with the analysis assumptions that have been analytically demonstrated adequate to maintain an acceptable minimum DNBR for all AOs. Operation of the core with a DNBR at or above this limit ensures that an acceptable minimum DNBR is maintained in the event of the most limiting AO (i.e., loss of flow transient, CEA misoperation events, or asymmetric SG transient).

APPLICABILITY

Power distribution is a concern any time the reactor is critical. The power distribution LCOs, however, are only applicable in MODE 1 above 20% RTP. The reasons these LCOs are not applicable below 20% RTP are:

- a. The incore neutron detectors that provide input to the COLSS, which then calculates the operating limits, are inaccurate due to the poor signal to noise ratio that they experience at relatively low core power levels.
- b. As a result of this inaccuracy, the CPCs assume a minimum core power of 20% RTP when generating the Local Power Density (LPD) and DNBR trip signals. When the core power is below this level, the core is operating well below the thermal limits and the resultant CPC calculated LPD and DNBR trips are highly conservative.

The upgraded CPC system consists of eight total CEACs instead of the two found in the CPC System prior to upgrade. To facilitate the difference in the number of CEACs as well as to support the enhanced features found in the upgraded CPC system, a second 3.2.4 Technical Specification has been developed. The determination on which Specification applies is based on whether or not the unit has received the upgraded CPCs. Each unit shall only use the Specification that reflects the status of their unit's CPC system (i.e., before or after CPC upgrade).

(continued)

BASES

BACKGROUND
(continued)

occurrence. Meeting the acceptable dose limit for an accident category is considered having acceptable consequences for that event.

The RPS is segmented into four interconnected modules. These modules are:

- Measurement channels;
- Bistable trip units;
- RPS Logic; and
- Reactor trip circuit breakers (RTCBs).

This LCO addresses measurement channels and bistable trip units. It also addresses the automatic bypass removal feature for those trips with operating bypasses. The RPS Logic and RTCBs are addressed in LCO 3.3.4, "Reactor Protective System (RPS) Logic and Trip Initiation." The CEACs are addressed in LCO 3.3.3, "Control Element Assembly Calculators (CEACs)."

Measurement Channels *(Before CPC Upgrade)*

Measurement channels, consisting of field transmitters or process sensors and associated instrumentation, provide a measurable electronic signal based upon the physical characteristics of the parameter being measured.

The excore nuclear instrumentation, the core protection calculators (CPCs), and the CEACs, though complex, are considered components in the measurement channels of the Variable Over Power – High, Logarithmic Power Level – High, DNBR – Low, and Local Power Density (LPD) – High trips.

Four identical measurement channels, designated channels A through D, with electrical and physical separation, are provided for each parameter used in the generation of trip signals, with the exception of the control element assembly (CEA) position indication used in the CPCs. Each measurement channel provides input to one or more RPS bistables within the same RPS channel. In addition, some measurement channels may also be used as inputs to Engineered Safety Features Actuation System (ESFAS)

(continued)

BASES

BACKGROUND

Measurement Channels ~~(Before CPC Upgrade)~~ (continued)

bistables, and most provide indication in the control room. Measurement channels used as an input to the RPS are not used for control functions.

When a channel monitoring a parameter exceeds a predetermined setpoint, indicating an unsafe condition, the bistable monitoring the parameter in that channel will trip. Tripping bistables monitoring the same parameter in two or more channels will de-energize Matrix Logic, which in turn de-energizes the Initiation Logic. This causes all four RTCBs to open, interrupting power to the CEAs, allowing them to fall into the core.

Three of the four measurement and bistable channels are necessary to meet the redundancy and testability of 10 CFR 50, Appendix A, GDC 21 (Ref. 1). The fourth channel provides additional flexibility by allowing one channel to be removed from service (trip channel bypass) for maintenance or testing while still maintaining a minimum two-out-of-three logic. Thus, even with a channel inoperable, no single additional failure in the RPS can either cause an inadvertent trip or prevent a required trip from occurring.

Adequate channel to channel independence includes physical and electrical independence of each channel from the others. This allows operation in two-out-of-three logic with one channel removed from service until following the next MODE 5 entry. Since no single failure will either cause or prevent a protective system actuation, and no protective channel feeds a control ~~function~~, this arrangement meets the applicable requirements of standards referenced in the UFSAR Chapter 7 ~~IEEE Standard 279-1971~~ (Ref. 4).

The CPCs perform the calculations required to derive the DNBR and LPD parameters and their associated RPS trips. Four separate CPCs perform the calculations independently, one for each of the four RPS channels. The CPCs provide outputs to drive display indications (DNBR margin, LPD margin, and calibrated neutron flux power levels) and provide DNBR – Low and LPD – High pretrip and trip signals. The CPC channel outputs for the DNBR – Low and LPD – High trips operate contacts in the Matrix Logic in a manner identical to the other RPS trips.

(continued)

BASES

BACKGROUND

Measurement Channels ~~(Before CPC Upgrade)~~ (continued)

Each CPC receives the following inputs:

- Hot leg and cold leg temperatures;
- Pressurizer pressure;
- Reactor coolant pump speed;
- Excore neutron flux levels;
- Target CEA positions; and
- CEAC penalty factors.

Each CPC is programmed with "addressable constants." These are various alignment values, correction factors, etc., that are required for the CPC computations. They can be accessed for display or for the purpose of changing them as necessary.

The CPCs use this constant and variable information to perform a number of calculations. These include the calculation of CEA group and subgroup deviations (and the assignment of conservative penalty factors), correction and calculation of average axial power distribution (APD) (based on excore flux levels and CEA positions), calculation of coolant flow (based on pump speed), and calculation of calibrated average power level (based on excore flux levels and ΔT power).

The DNBR calculation considers primary pressure, inlet temperature, coolant flow, average power, APD, radial peaking factors, and CEA deviation penalty factors from the CEACs to calculate the state of the limiting (hot) coolant channel in the core. A DNBR – Low trip occurs when the calculated value reaches the minimum DNBR trip setpoint.

(continued)

BASES

BACKGROUND

Measurement Channels ~~(Before CPC Upgrade)~~ (continued)

The LPD calculation considers APD, average power, radial peaking factors (based upon target CEA position), and CEAC penalty factors to calculate the current value of compensated peak power density. An LPD – High trip occurs when the calculated value reaches the trip setpoint. The four CPC channels provide input to the four DNBR – Low and four LPD – High RPS trip channels. They effectively act as the sensor (using many inputs) for these trips. The CEACs perform the calculations required to determine the position of CEAs within their subgroups for the CPCs. Two independent CEACs compare the position of each CEA to its subgroup position. If a deviation is detected by either CEAC, an annunciator sounds and appropriate "penalty factors" are transmitted to all CPCs. These penalty factors conservatively adjust the effective operating margins to the DNBR – Low and LPD – High trips. Each CEAC also drives a single cathode ray tube (CRT), which is switchable between CEACs. The CRT displays individual CEA positions from the selected CEAC.

Each CEA has two separate reed switch assemblies mounted outside the RCPB. Each of the two CEACs receives CEA position input from one of the two reed switch position transmitters on each CEA, so that the position of all CEAs is independently monitored by both CEACs.

CEACs are addressed in LCO 3.3.3.

Measurement Channels ~~(After CPC Upgrade)~~

~~Measurement channels, consisting of field transmitters or process sensors and associated instrumentation, provide a measurable electronic signal based upon the physical characteristics of the parameter being measured.~~

~~The excore nuclear instrumentation, the core protection calculators (CPCs) and the CEACs, though complex, are considered components in the measurement channels of the Variable Over Power – High, Logarithmic Power Level – High, DNBR – Low, and Local Power Density (LPD) – High trips.~~

(continued)

BASES

BACKGROUND

Measurement Channels (After CPC Upgrade) (continued)

Four identical measurement channels, designated channels A through D, with electrical and physical separation, are provided for each parameter used in the generation of trip signals, with the exception of the control element assembly (CEA) position indication used in the CPCs. Each measurement channel provides input to one or more RPS bistables within the same RPS channel. In addition, some measurement channels may also be used as inputs to Engineered Safety Features Actuation System (ESFAS) bistables, and most provide indication in the control room. Measurement channels used as an input to the RPS are not used for control functions.

When a channel monitoring a parameter exceeds a predetermined setpoint, indicating an unsafe condition, the bistable monitoring the parameter in that channel will trip. Tripping bistables monitoring the same parameter in two or more channels will de-energize Matrix Logic, which in turn de-energizes the Initiation Logic. This causes all four RTCBs to open, interrupting power to the CEAs, allowing them to fall into the core.

Three of the four measurement and bistable channels are necessary to meet the redundancy and testability of 10 CFR 50, Appendix A, GDC 21 (Ref. 1). The fourth channel provides additional flexibility by allowing one channel to be removed from service (trip channel bypass) for maintenance or testing while still maintaining a minimum two-out-of-three logic. Thus, even with a channel inoperable, no single additional failure in the RPS can either cause an inadvertent trip or prevent a required trip from occurring.

Adequate channel to channel independence includes physical and electrical independence of each channel from the others. This allows operation in two-out-of-three logic with one channel removed from service until following the next MODE 5 entry. Since no single failure will either cause or prevent a protective system actuation, and no protective channel feeds a control *function*, this arrangement meets the *applicable* requirements of *standards referenced in the UFSAR, Chapter 7 IEEE Standard 279-1971 (Ref. 4)*.

(continued)

BASES

BACKGROUND

Measurement Channels (After CPC Upgrade) (continued)

The CPCs perform the calculations required to derive the DNBR and LPD parameters and their associated RPS trips. Four separate CPCs perform the calculations independently, one for each of the four RPS channels. The CPCs provide outputs to drive display indications (DNBR margin, LPD margin, and calibrated neutron flux power levels) and provide DNBR – Low and LPD – High pretrip and trip signals. The CPC channel outputs for the DNBR – Low and LPD – High trips operate contacts in the Matrix Logic in a manner identical to the other RPS trips.

Each CPC receives the following inputs:

- Hot leg and cold leg temperatures;
- Pressurizer pressure;
- Reactor coolant pump speed;
- Excore neutron flux levels;
- Target CEA positions; and
- CEAC penalty factors.

Each CPC is programmed with "addressable constants." These are various alignment values, correction factors, etc., that are required for the CPC computations. They can be accessed for display or for the purpose of changing them as necessary.

The CPCs use this constant and variable information to perform a number of calculations. These include the calculation of CEA group and subgroup deviations (and the assignment of conservative penalty factors), correction and calculation of average axial power distribution (APD) (based on excore flux levels and CEA positions), calculation of coolant flow (based on pump speed), and calculation of calibrated average power level (based on excore flux levels and ΔT power).

(continued)

BASES

BACKGROUND

Measurement Channels (After CPC Upgrade) (continued)

The DNBR calculation considers primary pressure, inlet temperature, coolant flow, average power, APD, radial peaking factors, and CEA deviation penalty factors from the CEACs to calculate the state of the limiting (hot) coolant channel in the core. A DNBR – Low trip occurs when the calculated value reaches the minimum DNBR trip setpoint.

The LPD calculation considers APD, average power, radial peaking factors (based upon target CEA position), and CEAC penalty factors to calculate the current value of compensated peak power density. An LPD – High trip occurs when the calculated value reaches the trip setpoint. The four CPC channels provide input to the four DNBR – Low and four LPD – High RPS trip channels. They effectively act as the sensor *and bistable trip units* (using many inputs) for these trips.

The CEACs perform the calculations required to determine the position of CEAs within their subgroups for the CPCs. Two independent CEACs *within each CPC channel* compare the position of each CEA to its subgroup position. If a deviation is detected by either CEAC, an annunciator sounds and appropriate "penalty factors" are transmitted to all CPCs *the CPC in the affected channel*. These penalty factors conservatively adjust the effective operating margins to the DNBR – Low and LPD – High trips. Each CEAC also drives a single cathode ray tube (CRT), which is switchable between CEACs. The CRT displays individual CEA positions from the selected CEAC.

Each CEA has two separate reed switch assemblies mounted outside the RCPB. Each of the two CEACs receives CEA position input from one of the two reed switch position transmitters on each CEA, so that the position of all CEAs is independently monitored by both CEACs.

Each CEA has two separate reed switch position transmitter (RSPT) assemblies mounted outside the Reactor Coolant Pressure Boundary (RCPB), designated RSPT 1 and RSPT 2. CEA position from the RSPTs is processed by two CEA Position Processors (CPPs) located in each CPC channel.

(continued)

BACKGROUND

Measurement Channels (After CPC Upgrade) (continued)

The CPPs transmit CEA position to the appropriate CEAC in all four CPC channels over optically isolated datalinks, such that CEAC 1 in all channels receives the position of all CEAs based upon RSPT1, and CEAC 2 receives the position of all CEAs based upon RSPT2. Thus the position of all CEAs are independently monitored by both CEACs in each CPC channel

The CPCs display the position of each CEA to the operator on a separate single CEA Position Flat Panel Display. Each CPC channel is connected to the display by means of an optically isolated data link. The operator may select the channel for display. Selecting channel A or B will display CEA position based upon RSPT1 on each CEA, whereas selecting channel C or D will display CEA position based upon RSPT2 on each CEA.

CEACs are addressed in LCO 3.3.3

Bistable Trip Units (Before CPC Upgrade)

Bistable trip units, mounted in the Plant Protection System (PPS) cabinet, receive an analog input from the measurement channels. They compare the analog input to trip setpoints and provide contact output to the Matrix Logic. They also provide local trip indication and remote annunciation.

There are four channels of bistables, designated A, B, C, and D, for each RPS parameter, one for each measurement channel. Bistables de-energize when a trip occurs, in turn de-energizing bistable relays mounted in the PPS relay card racks.

The contacts from these bistable relays are arranged into six coincidence matrices, comprising the Matrix Logic. If bistables monitoring the same parameter in at least two channels trip, the Matrix Logic will generate a reactor trip (two-out-of-four logic).

(continued)

BASES

BACKGROUND

Bistable Trip Units (~~Before CPC Upgrade~~) (continued)

Some measurement channels provide contact outputs to the PPS. In these cases, there is no bistable card, and opening the contact input directly de-energizes the associated bistable relays. These include the CPC generated DNBR – Low and LPD – High trips.

The trip setpoints used in the bistables are based on the analytical limits derived from the accident analysis (Ref. 5). 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 RPS channels that must function in harsh environments as defined by 10 CFR 50.49 (Ref. 6), Allowable Values specified in Table 3.3.1-1, 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 "Plant Protection System Selection of Trip Setpoint Values" (Ref. 7). The nominal trip setpoint entered into the bistable is normally still more conservative than that specified by the Allowable Value to account for changes in random measurement errors detectable by a CHANNEL FUNCTIONAL TEST. One example of such a change in measurement error is drift during the interval between surveillances. A channel is inoperable if its actual setpoint is not within its Allowable Value.

To maintain the margins of safety assumed in the safety analyses, the calculations of the trip variables for the DNBR - Low and Local Power Density - High trips include the measurement, calculational, and processor uncertainties and dynamic allowances as defined in the latest applicable revision of CEN-305-P, "Functional Design Requirements for a Core Protection Calculation" (Ref. 10) and CEN-304-P, "Functional Design Requirements for a Control Element Assembly Calculator," (Ref. 11).

(continued)

BASES

BACKGROUND

Bistable Trip Units ~~(Before CPC Upgrade)~~ (continued)

Setpoints in accordance with the Allowable Value will ensure that SLs of Chapter 2.0, "SAFETY LIMITS (SLs)," are not violated during AOOs, and the consequences of DBAs will be acceptable, providing the plant is operated from within the LCOs at the onset of the AOO or DBA and the equipment functions as designed.

Note that in LCO 3.3.1, the Allowable Values of Table 3.3.1-1 are the LSSS.

Functional testing of the entire RPS, from bistable input through the opening of individual RTCBs, can be performed either at power or shutdown and is normally performed on a quarterly basis. Nuclear instrumentation, the CPCs, and the CEACs can be similarly tested. UFSAR, Section 7.2 (Ref. 8), provides more detail on RPS testing. Processing transmitter calibration is normally performed on a refueling basis.

Bistable Trip Units ~~(After CPC Upgrade)~~

Bistable trip units, mounted in the Plant Protection System (PPS) cabinet, receive an analog input from the measurement channels. They compare the analog input to trip setpoints and provide contact output to the Matrix Logic. They also provide local trip indication and remote annunciation.

There are four channels of bistables, designated A, B, C, and D, for each RPS parameter, one for each measurement channel. Bistables de-energize when a trip occurs, in turn de-energizing bistable relays mounted in the PPS relay card racks.

The contacts from these bistable relays are arranged into six coincidence matrices, comprising the Matrix Logic. If bistables monitoring the same parameter in at least two channels trip, the Matrix Logic will generate a reactor trip (two-out-of-four logic).

(continued)

BASES

BACKGROUND

Bistable Trip Units (After CPC Upgrade) (continued)

Some measurement channels provide contact outputs to the PPS. In these cases, there is no bistable card, and opening the contact input directly de-energizes the associated bistable relays. These include the CPC generated DNBR – Low and LPD – High trips.

The trip setpoints used in the bistables are based on the analytical limits derived from the accident analysis (Ref. 5). 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 RPS channels that must function in harsh environments as defined by 10 CFR 50.49 (Ref. 6), Allowable Values specified in Table 3.3.1-1, 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 "Plant Protection System Selection of Trip Setpoint Values" (Ref. 7). The nominal trip setpoint entered into the bistable is normally still more conservative than that specified by the Allowable Value to account for changes in random measurement errors detectable by a CHANNEL FUNCTIONAL TEST. One example of such a change in measurement error is drift during the interval between surveillances. A channel is inoperable if its actual setpoint is not within its Allowable Value.

To maintain the margins of safety assumed in the safety analyses, the calculations of the trip variables for the DNBR – Low and Local Power Density – High trips include the measurement, calculational, and processor uncertainties and dynamic allowances as defined in the latest applicable revision of *CEN-305-P, "Functional Design Requirements for a Core Protection Calculation"* (Ref. 10) and *CEN-304-P, "Functional Design Requirements for a Control Element Assembly Calculator,"* (Ref. 11)

(continued)

BASES

BACKGROUND

Bistable Trip Units (After CPC Upgrade) (continued)

Setpoints in accordance with the Allowable Value will ensure that SLs of Chapter 2.0, "SAFETY LIMITS (SLs)," are not violated during AOOs, and the consequences of DBAs will be acceptable, providing the plant is operated from within the LCOs at the onset of the AOO or DBA and the equipment functions as designed.

Note that in LCO 3.3.1, the Allowable Values of Table 3.3.1-1 are the LSSS.

Functional testing of the entire RPS, from bistable input through the opening of individual RTCBs, can be performed either at power or shutdown and is normally performed on a quarterly basis. Nuclear instrumentation, the CPCs, and the CEACs can be similarly tested. ***CPC and CEAC functional testing is performed quarterly and during refueling.*** UFSAR, Section 7.2 (Ref. 8), provides more detail on RPS testing. Processing transmitter calibration is normally performed on a refueling basis.

RPS Logic

The RPS Logic, addressed in LCO 3.3.4, consists of both Matrix and Initiation Logic and employs a scheme that provides a reactor trip when bistables in any two of the four channels sense the same input parameter trip. This is called a two-out-of-four trip logic.

Bistable relay contact outputs from the four channels are configured into six logic matrices. Each logic matrix checks for a coincident trip in the same parameter in two bistable channels. The matrices are designated the AB, AC, AD, BC, BD, and CD matrices to reflect the bistable channels being monitored. Each logic matrix contains four normally energized matrix relays. When a coincidence is detected, consisting of a trip in the same Function in the two channels being monitored by the logic matrix, all four matrix relays de-energize.

(continued)

BASES

LCO
(continued)

14. Local Power Density – High ~~(Before CPC Upgrade)~~

This LCO requires four channels of LPD – High to be OPERABLE.

The LCO on the CPCs ensures that the SLs are maintained during all AOOs and the consequences of accidents are acceptable.

A CPC is not considered inoperable if CEAC inputs to the CPC are inoperable. The Required Actions required in the event of CEAC channel failures ensure the CPCs are capable of performing their safety Function.

The CPC channels may be manually bypassed below 1E-4% NRTP, as sensed by the logarithmic nuclear instrumentation. This bypass is enabled manually in all four CPC channels when plant conditions do not warrant the trip protection. The bypass effectively removes the DNBR – Low and LPD – High trips from the RPS Logic circuitry. The operating bypass is automatically removed when enabling bypass conditions are no longer satisfied.

The automatic bypass removal channel is INOPERABLE when the associated Log power channel has failed. The bypass function is manually controlled via station operating procedures and the bypass removal circuitry itself is fully capable of responding to a change in the associated input bistable. Footnotes (a) and (b) in Table 3.3.1-1 and (d) in Table 3.3.2-1 clearly require an "automatic" removal of trip bypasses. A failed Log channel may prevent, depending on the failure mode, the associated input bistable from changing state as power transitions through the automatic bypass removal setpoint. Specifically, when the indicated Log power channel is failed high (above 1E-4%), the automatic Hi-Log power trip bypass removal feature in that channel cannot function. Similarly, when the indicated Log power channel is failed low (below 1E-4%), the automatic DNBR-LPD trip bypass removal feature in that channel cannot function. Although one bypass removal feature is applicable above 1E-4% NRTP and the other is applicable below 1E-4% NRTP, both are affected by a failed Log power channel and should therefore be considered INOPERABLE.

(continued)

BASES

LCO

14. Local Power Density – High (Before CPC Upgrade)
(continued)

When a Log channel is INOPERABLE, both the Hi-Log power and DNBR/LPD automatic trip bypass removal features in that channel are also INOPERABLE, requiring entry into LCO 3.3.1 Condition C or LCO 3.3.2 Condition C depending on plant operating MODE. Required Action C.1 for both LCOs 3.3.1 and 3.3.2 require the bypass channel to be disabled. Compliance with C.1 is met by placing the CR switches in "off" and "normal" for the Hi-Log power and DNBR/LPD bypasses respectively. No further action (key removal, periodic verification, etc.) is required. These CR switches are administratively controlled via station procedure therefore, the requirements of C.1 are continuously met.

This operating bypass is required to perform a plant startup, since both CPC generated trips will be in effect whenever shutdown CEAs are inserted. It also allows system tests at low power with Pressurizer Pressure – Low or RCPs off.

14. Local Power Density – High (After CPC Upgrade)

This LCO requires four channels of LPD – High to be OPERABLE.

The LCO on the CPCs ensures that the SLs are maintained during all AOOs and the consequences of accidents are acceptable.

A CPC is not considered inoperable if CEAC inputs to the CPC are inoperable. The Required Actions required in the event of CEAC channel failures ensure the CPCs are capable of performing their safety function.

The CPC channel has many redundant features designed to improve channel reliability. A minimum subset of features must be functional in order for the CPC to be capable of performing its safety related trip function. Therefore, the channel may remain OPERABLE in the presence of a subset of channel failures, while maintaining the ability to provide the LPD-High trip function.

(continued)

BASES

LCO

14.1. Loca Power Density – High (After CPC Upgrade)
(continued)

On line CPC channel diagnostics make use of redundant features to maintain channel operability to the extent possible, and provide alarm and annunciation of detectable failures.

Those detectable CPC channel failures resulting in a loss of protective function and channel inoperability will result in a CPC Fail indication and associated Low DNBR and High LPD channel trips. Input failures resulting in a sensor out of range affecting one or more CPC process inputs will result in a CPC Sensor Failure indication. In addition, since the CPC software limits the sensor value to the lower or upper range limit value, a CPC channel trip would be generated in most cases due to these extreme values. Detectable failures, whether they result in a channel inoperability or not, are logged in a system event list.

Redundancy is demonstrated as follows:

- a. Each CPC channel redundantly processes analog process and nuclear instrumentation inputs. Only one of the two redundant analog processing modules is required to maintain operability.***
- b. CEA position is redundantly processed by two CEA Position Processors (CPPs) in each CPC channel, and transmitted to the appropriate CEACs in all four CPC channels over one way fiber-optically isolated data links. Only one source of CEA position is required to maintain channel operability.***
- c. Each CPC channel has two redundant operator interface panels, a maintenance test panel (MTP) in the Core Protection Calculator System (CPCS) cabinet, and an Operator's Module (OM) in the control room. Neither is required for the CPC to perform its safety related function. However, one must be functional to assist personnel in performing certain surveillances. Upon failure of the OM, MTP, or both, the CPC channel will remain operable.***

Each CPCS channel contains six processor modules. Failures of these modules are treated as follows:

(continued)

BASES

LCO

14. Local Power Density – High (After CPC Upgrade)
(continued)

- **CPC Processor Module failure - this failure results in a CPC channel inoperability, as addressed by this LCO.**
- **Aux CPC Processor Module failure - this failure does not result in a CPC channel inoperability since this module does not perform any safety related functions.**
- **CEAC 1 Processor Module failure - this failure is addressed in LCO 3.3.3.**
- **CEAC 2 Processor Module failure - this failure is addressed in LCO 3.3.3.**
- **CPP 1 Processor Module failure - this failure is addressed in LCO 3.3.3.**
- **CPP 2 Processor Module failure - this failure is addressed in LCO 3.3.3.**

The CPC channels may be manually bypassed below $1E-4\%$ NRTP, as sensed by the logarithmic nuclear instrumentation. This bypass is enabled manually in all four CPC channels when plant conditions do not warrant the trip protection. The bypass effectively removes the DNBR = Low and LPD = High trips from the RPS Logic circuitry. The operating bypass is automatically removed when enabling bypass conditions are no longer satisfied.

The automatic bypass removal channel is INOPERABLE when the associated Log power channel has failed. The bypass function is manually controlled via station operating procedures and the bypass removal circuitry itself is fully capable of responding to a change in the associated input bistable. Footnotes (a) and (b) in Table 3.3.1-1 and (d) in Table 3.3.2-1 clearly require an "automatic" removal of trip bypasses. A failed Log channel may prevent, depending on the failure mode, the associated input bistable from changing state as power transitions through the automatic bypass removal setpoint. Specifically, when the indicated Log power channel is failed high (above $1E-4\%$), the automatic Hi-Log power trip bypass removal feature in that channel cannot function. Similarly,

(continued)

BASES

LCO

14. Local Power Density – High (After CPC Upgrade)
(continued)

When the indicated Log power channel is failed low (below 1E-4%), the automatic DNBR/LPD trip bypass removal feature in that channel cannot function. Although one bypass removal feature is applicable above 1E-4% NRTP and the other is applicable below 1E-4% NRTP, both are affected by a failed Log power channel and should therefore be considered INOPERABLE.

When a Log channel is INOPERABLE, both the Hi-Log power and DNBR/LPD automatic trip bypass removal features in that channel are also INOPERABLE, requiring entry into LCO 3.3.1 Condition C or LCO 3.3.2 Condition C depending on plant operating MODE. Required Action C.1 for both LCOs 3.3.1 and 3.3.2 require the bypass channel to be disabled. Compliance with C.1 is met by placing the CR switches in "off" and "normal" for the Hi-Log power and DNBR/LPD bypasses respectively. No further action (key removal, periodic verification, etc.) is required. These CR switches are administratively controlled via station procedure therefore, the requirements of C.1 are continuously met.

This operating bypass is required to perform a plant startup, since both CPC generated trips will be in effect whenever shutdown CEAs are inserted. It also allows system tests at low power with Pressurizer Pressure – Low or RCPs off.

15. Departure from Nucleate Boiling Ratio (DNBR) – Low (Before CPC Upgrade)

This LCO requires four channels of DNBR – Low to be OPERABLE.

The LCO on the CPCs ensures that the SLs are maintained during all AOOs and the consequences of accidents are acceptable.

A CPC is not considered inoperable if CEAC inputs to the CPC are inoperable. The Required Actions required in the event of CEAC channel failures ensure the CPCs are capable of performing their safety Function.

The CPC channels may be manually bypassed below 1E-4% NRTP, as sensed by the logarithmic nuclear

(continued)

BASES

LCO

15. Departure from Nucleate Boiling Ratio (DNBR) – Low
(Before CPC Upgrade) (continued)

instrumentation. This bypass is enabled manually in all four CPC channels when plant conditions do not warrant the trip protection. The bypass effectively removes the DNBR – Low and LPD – High trips from the RPS logic circuitry. The operating bypass is automatically removed when enabling bypass conditions are no longer satisfied.

The automatic bypass removal channel is INOPERABLE when the associated Log power channel has failed. The bypass function is manually controlled via station operating procedures and the bypass removal circuitry itself is fully capable of responding to a change in the associated input bistable. Footnotes (a) and (b) in Table 3.3.1-1 and (d) in Table 3.3.2-1 clearly require an "automatic" removal of trip bypasses. A failed Log channel may prevent, depending on the failure mode, the associated input bistable from changing state as power transitions through the automatic bypass removal setpoint. Specifically, when the indicated Log power channel is failed high (above 1E-4%), the automatic Hi-Log power trip bypass removal feature in that channel cannot function. Similarly, when the indicated Log power channel is failed low (below 1E-4%), the automatic DNBR-LPD trip bypass removal feature in that channel cannot function. Although one bypass removal feature is applicable above 1E-4% NRTP and the other is applicable below 1E-4% NRTP, both are affected by a failed Log power channel and should therefore be considered INOPERABLE.

When a Log channel is INOPERABLE, both the Hi-Log power and DNBR/LPD automatic trip bypass removal features in that channel are also INOPERABLE, requiring entry into LCO 3.3.1 Condition C or LCO 3.3.2 Condition C depending on plant operating MODE. Required Action C.1 for both LCOs 3.3.1 and 3.3.2 require the bypass channel to be disabled. Compliance with C.1 is met by placing the CR switches in "off" and "normal" for the Hi-Log power and DNBR/LPD bypasses respectively. No further action (key removal, periodic verification, etc.) is required. These CR switches are administratively controlled via

(continued)

BASES

LCO

15. Departure from Nucleate Boiling Ratio (DNBR) – Low (Before CPC Upgrade) (continued)

station procedure therefore, the requirements of C.1 are continuously met.

This operating bypass is required to perform a plant startup, since both CPC generated trips will be in effect whenever shutdown CEAs are inserted. It also allows system tests at low power with Pressurizer Pressure – Low or RCPs off

15. Departure from Nucleate Boiling Ratio (DNBR) – Low (After CPC Upgrade)

This LCO requires four channels of DNBR – Low to be OPERABLE.

The LCO on the CPCs ensures that the SLs are maintained during all AOOs and the consequences of accidents are acceptable.

A CPC is not considered inoperable if CEAC inputs to the CPC are inoperable. The Required Actions required in the event of CEAC channel failures ensure the CPCs are capable of performing their safety function.

The CPC channel has many redundant features designed to improve channel reliability. A minimum subset of features must be functional in order for the CPC to be capable of performing its safety related trip function. Therefore, the channel may remain OPERABLE in the presence of a subset of channel failures, while maintaining the ability to provide the DNBR-Low trip function. On line CPC channel diagnostics make use of redundant features to maintain channel operability to the extent possible, and provide alarm and annunciation of detectable failures.

Those detectable CPC channel failures resulting in a loss of protective function and channel inoperability will result in a CPC Fail indication and associated Low DNBR and High LPD channel trips. Input failures resulting in a sensor out of range affecting one or more CPC process inputs will result in a CPC Sensor Failure indication. In addition, since the CPC software limits.

(continued)

BASES

LCO

15. Departure from Nucleate Boiling Ratio (DNBR) – Low (After CPC Upgrade) (continued)

the sensor value to the lower or upper range limit value, a CPC channel trip would be generated in most cases due to these extreme values. Detectable failures, whether they result in a channel inoperability or not, are logged in a system event list.

Redundancy is demonstrated as follows:

- a. Each CPC channel redundantly processes analog process and nuclear instrumentation inputs. Only one of the two redundant analog processing modules is required to maintain operability.*
- b. CEA position is redundantly processed by two CEA Position Processors (CPPs) in each CPC channel, and transmitted to the appropriate CEACs in all four CPC channels over one way fiber-optically isolated data links. Only one source of CEA position is required to maintain channel operability.*
- c. Each CPC channel has two redundant operator interface panels, a maintenance test panel (MTP) in the Core Protection Calculator System (CPCS) cabinet, and an Operator's Module (OM) in the control room. Neither is required for the CPC to perform its safety related function. However, one must be functional to assist personnel in performing certain surveillances. Upon failure of the OM, MTP, or both, the CPC channel will remain operable.*

Each CPCS channel contains six processor modules. Failures of these modules are treated as follows:

- CPC Processor Module failure - this failure results in a CPC channel inoperability, as addressed by this LCO.*
- Aux CPC Processor Module failure - this failure does not result in a CPC channel inoperability since this module does not perform any safety related functions.*
- CEAC 1 Processor Module failure - this failure is addressed in LCO 3.3.3.*
- CEAC 2 Processor Module failure - this failure is addressed in LCO 3.3.3.*

(continued)

BASES

LCO

15. Departure from Nucleate Boiling Ratio (DNBR) – Low (After CPC Upgrade) (continued)

- **CPP 1 Processor Module failure - this failure is addressed in LCO 3.3.3.**
- **CPP 2 Processor Module failure - this failure is addressed in LCO 3.3.3**

The CPC channels may be manually bypassed below 1E-4% NRTP, as sensed by the logarithmic nuclear instrumentation. This bypass is enabled manually in all four CPC channels when plant conditions do not warrant the trip protection. The bypass effectively removes the DNBR – Low and LPD – High trips from the RPS logic circuitry. The operating bypass is automatically removed when enabling bypass conditions are no longer satisfied.

The automatic bypass removal channel is INOPERABLE when the associated Log power channel has failed. The bypass function is manually controlled via station operating procedures and the bypass removal circuitry itself is fully capable of responding to a change in the associated input bistable. Footnotes (a) and (b) in Table 3.3.1-1 and (d) in Table 3.3.2-1 clearly require an "automatic" removal of trip bypasses. A failed Log channel may prevent, depending on the failure mode, the associated input bistable from changing state as power transitions through the automatic bypass removal setpoint. Specifically, when the indicated Log power channel is failed high (above 1E-4%), the automatic Hi-Log power trip bypass removal feature in that channel cannot function. Similarly, when the indicated Log power channel is failed low (below 1E-4%), the automatic DNBR-LPD trip bypass removal feature in that channel cannot function. Although one bypass removal feature is applicable above 1E-4% NRTP and the other is applicable below 1E-4% NRTP, both are affected by a failed Log power channel and should therefore be considered INOPERABLE.

When a Log channel is INOPERABLE, both the Hi-Log power and DNBR/LPD automatic trip bypass removal features in that channel are also INOPERABLE, requiring entry into LCO 3.3.1 Condition C or LCO 3.3.2 Condition C depending on plant operating MODE.

(continued)

BASES

LCO

15. Departure from Nucleate Boiling Ratio (DNBR) – Low
(After CPC Upgrade) (continued)

Required Action C.1 for both LCOs 3.3.1 and 3.3.2 require the bypass channel to be disabled. Compliance with C.1 is met by placing the CR switches in "off" and "normal" for the Hi-Log power and DNBR/LPD bypasses respectively. No further action (key removal, periodic verification, etc.) is required. These CR switches are administratively controlled via station procedure therefore, the requirements of C.1 are continuously met.

This operating bypass is required to perform a plant startup, since both CPC generated trips will be in effect whenever shutdown CEAs are inserted. It also allows system tests at low power with Pressurizer Pressure – Low or RCPs off.

Interlocks/Bypasses

The LCO on operating bypass permissive removal channels requires that the automatic operating bypass removal feature of all four operating bypass channels be OPERABLE for each RPS Function with an operating bypass in the MODES addressed in the specific LCO for each Function. All four bypass removal channels must be OPERABLE to ensure that none of the four RPS channels are inadvertently bypassed. Refer also to B 3.3.5 for ESFAS operating bypasses.

This LCO applies to the operating bypass removal feature only. If the bypass enable Function is failed so as to prevent entering a bypass condition, operation may continue. In the case of the Logarithmic Power Level – High trip (Function 2), the absence of a bypass will limit maximum power to below the trip setpoint.

The interlock function Allowable Values are based upon analysis of functional requirements for the bypassed Functions. These are discussed above as part of the LCO discussion for the affected Functions.

APPLICABILITY

This LCO is applicable to the RPS Instrumentation in MODES 1 and 2. LCO 3.3.2 is applicable to the RPS Instrumentation in
(continued)

BASES

APPLICABILITY
(continued)

- The Logarithmic Power Level – High trip, RPS Logic RTCBs, and Manual Trip are required in MODES 3, 4, and 5, with the RTCBs closed, to provide protection for boron dilution and CEA withdrawal events.
- Steam Generator Pressure-Low trip, is required in MODE 3, with the RTCBs closed to provide protection for steam line break events in MODE 3.

The Logarithmic Power Level – High trip, and the Steam Generator Pressure-Low trip in these lower MODES are addressed in LCO 3.3.2. The Logarithmic Power Level – High trip is bypassed prior to MODE 1 entry and is not required in MODE 1.

The upgraded CPC system consists of eight total CEACs instead of the two found in the CPC System prior to upgrade. To facilitate the difference in the number of CEACs as well as to support the enhanced features found in the upgraded CPC system, a second 3.3.1 Technical Specification has been developed. The determination on which Specification applies is based on whether or not the unit has received the upgraded CPCs. Each unit shall only use the Specification that reflects the status of their unit's CPC system (i.e., before or after CPC upgrade).

ACTIONS

The most common causes of channel inoperability are outright failure or drift of the bistable or process module sufficient to exceed the tolerance allowed by the plant specific setpoint analysis. Typically, the drift is found to be small and results in a delay of actuation rather than a total loss of function. This determination is generally made during the performance of a CHANNEL FUNCTIONAL TEST when the process instrument is set up for adjustment to bring it to within specification. If the trip setpoint is less conservative than the Allowable Value in Table 3.3.1-1, the channel is declared inoperable immediately, and the appropriate Condition(s) must be entered immediately.

In the event a channel's trip setpoint is found nonconservative with respect to the Allowable Value, or the transmitter, instrument loop, signal processing electronics, or RPS bistable trip unit is found inoperable, then all affected functions provided by that channel must be declared inoperable, and the unit must enter the Condition for the particular protection Function affected.

(continued)

BASES

ACTIONS

D.1 and D.2 (continued)

The restoration of one affected bypassed automatic trip channel must be completed prior to the next CHANNEL FUNCTIONAL TEST, or the plant must shut down per LCO 3.0.3 as explained in Condition B.

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

E.1 (Before CPC Upgrade)

Condition E applies if any CPC cabinet receives a high temperature alarm. There are redundant temperature sensors in each of the four CPC bays. Since CPC bays B and C also house CEAC calculators 1 and 2, respectively, a high temperature in either of these bays requires entry into LCO 3.3.3, Condition C.

If a CPC cabinet high temperature alarm is received, it is possible for an OPERABLE CPC to be affected and not be completely reliable. Therefore, a CHANNEL FUNCTIONAL TEST must be performed on OPERABLE CPCs within 12 hours. The Completion Time of 12 hours is adequate considering the low probability of undetected failure, the consequences of a single channel failure, and the time required to perform a CHANNEL FUNCTIONAL TEST.

~~G.1~~ E.1 (After CPC Upgrade)

~~Condition G~~ E is entered when the Required Action and associated Completion Time of Condition ~~A, B, C, D, E, or F~~ D are not met.

~~If the Required Actions associated with these Conditions cannot be completed within the required Completion Time, the reactor must be brought to a MODE where the Required Actions do not apply. The allowed Completion Time of 6 hours is reasonable, based on operating experience, for reaching the required MODE from full power conditions in an orderly manner and without challenging plant systems.~~

(continued)

BASES

ACTIONS

F.1 ~~(Before CPC Upgrade)~~

Condition F applies if an OPERABLE CPC has three or more autorestarts in a 12 hour period.

CPCs and CEACs will attempt to autorestart if they detect a fault condition, such as a calculator malfunction or loss of power. A successful autorestart restores the calculator to operation; however, excessive autorestarts might be indicative of a calculator problem. The autorestart periodic test restart (Code 30), and normal system load (Code 33) are not included in the total.

If a nonbypassed CPC has three or more autorestarts, it may not be completely reliable. Therefore, a CHANNEL FUNCTIONAL TEST must be performed on the CPC to ensure it is functioning properly. Based on plant operating experience, the Completion Time of 24 hours is adequate and reasonable to perform the test while still keeping the risk of operating in this condition at an acceptable level, since overt channel failure will most likely be indicated and annunciated in the control room by CPC online diagnostics.

G.1 ~~(Before CPC Upgrade)~~

Condition G is entered when the Required Action and associated Completion Time of Condition A, B, C, D, E, or F are not met.

If the Required Actions associated with these Conditions cannot be completed within the required Completion Time, the reactor must be brought to a MODE where the Required Actions do not apply. The allowed Completion Time of 6 hours is reasonable, based on operating experience, for reaching the required MODE from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE
REQUIREMENTS

The SRs for any particular RPS Function are found in the SR column of Table 3.3.1-1 for that Function. Most Functions are subject to CHANNEL CHECK, CHANNEL FUNCTIONAL TEST, CHANNEL CALIBRATION, and response time testing.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS

SR 3.3.1.2 (continued)

The flow measurement uncertainty may be included in the BERR1 term in the CPC and is equal to or greater than 4%.

SR 3.3.1.3 ~~(Before CPC Upgrade)~~

The CPC autorestart count is checked every 12 hours to monitor the CPC and CEAC for normal operation. If three or more autorestarts of a nonbypassed CPC occur within a 12 hour period, the CPC may not be completely reliable. Therefore, the Required Action of Condition F must be performed. The auto restart periodic tests restart (Code 30) and normal system load (Code 33) are not included in this total. The Frequency is based on operating experience that demonstrates the rarity of more than one channel failing within the same 12 hour interval.

~~SR 3.3.1.3~~ ~~(After CPC Upgrade)~~

~~The CPC autorestart count is checked every 12 hours to monitor the CPC and CEAC for normal operation. If three or more autorestarts of a nonbypassed CPC occur within a 12 hour period, the CPC may not be completely reliable. Therefore, the Required Action of Condition F must be performed. The auto restart periodic tests restart (Code 30) and normal system load (Code 33) are not included in this total. The Frequency is based on operating experience that demonstrates the rarity of more than one channel failing within the same 12 hour interval.~~

~~*The CPC System Event Log is checked every 12 hours to monitor the CPC channel performance, including redundant features not required for the CPC to perform its safety related trip function. The system event log provides a historical record of the last thirty detected CPC channel error conditions. A detected error condition may not render a channel inoperable, unless it is accompanied by a CPC Fail indication.*~~

~~*The Frequency of 12 hours is based upon the nature of the surveillance in detecting many non-critical error conditions, and considers that detectable failures resulting in a channel inoperability will result in a CPC Fail condition.*~~

(continued)

BASES

SURVEILLANCE
REQUIREMENTS

SR 3.3.1.13 (continued)

Response time may be verified by any series of sequential, overlapping or total channel measurements, including allocated sensor response time, such that the response time is verified. Allocations for sensor response times may be obtained from the records of test results, vendor test data, or vendor engineering specifications. Topical Report CE NPSD-1167-A, "Elimination of Pressure Sensor Response Time Testing Requirements." (Ref. 12) 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 Topical Report. Response time verification for other sensor types must be demonstrated by test. The allocation of sensor response times must be verified prior to placing a new component in operation and reverified after maintenance that may adversely affect the sensor response time.

A Note is added to indicate that the neutron detectors are excluded from RPS RESPONSE TIME testing because they are passive devices with minimal drift and because of the difficulty of simulating a meaningful signal. Slow changes in detector sensitivity are compensated for by performing the daily calorimetric calibration (SR 3.3.1.4)

REFERENCES

1. 10 CFR 50, Appendix A, GDC 21
2. 10 CFR 100.
3. NRC Safety Evaluation Report, July 15, 1994.
4. ~~IEEE Standard 279-1971, April 6, 1972~~ UFSAR, Chapter 7
5. UFSAR, Chapters 6 and 15.
6. 10 CFR 50.49.
7. "Calculation of Trip Setpoint Values, Plant Protection System". CEN-286(v), or Calculation 13-JC-SG-203 for the Low Steam Generator Pressure Trip function.
8. UFSAR, Section 7.2.

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BASES

REFERENCES

(continued)

9. CEN-327, June 2, 1986, including Supplement 1, March 3, 1989, and Calculation 13-JC-SB-200.
10. ***CEN-305-P, "Functional Design Requirements for a Core Protection Calculator."***
11. ***CEN-304-P, "Functional Design Requirements for a Control Element Assembly Calculator."***
12. CEQG Topical Report CE NPSD-1167-A, "Elimination of Pressure Sensor Response Time Testing Requirements."

B 3.3 INSTRUMENTATION

B 3.3.3 Control Element Assembly Calculators (CEACs)

BASES

BACKGROUND (Before CPC Upgrade)

The Reactor Protective System (RPS) initiates a reactor trip to protect against violating the core Specified Acceptable Fuel Design Limits (SAFDLs) and breaching the Reactor Coolant Pressure Boundary (RCPB) during Anticipated Operational Occurrences (AOOs). By tripping the reactor, the RPS also assists the Engineered Safety Features Systems in mitigating accidents.

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

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

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 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

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BASES

BACKGROUND
(Before CPC
Upgrade)
(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 RPS is segmented into four interconnected modules. These modules are:

- Measurement channels;
- Bistable trip units;
- RPS Logic; and
- Reactor Trip Circuit Breakers (RTCBs).

This LCO addresses the CEACs. LCO 3.3.1, "Reactor Protective System (RPS) Instrumentation – Operating," provides a description of this equipment in the RPS.

The excore nuclear instrumentation, the Core Protection Calculators (CPCs), and the CEACs are considered components in the measurement channels of the Variable Over Power-High, Logarithmic Power Level – High, DNBR – Low, and Local Power Density (LPD) – High trips. The CEACs are addressed by this Specification.

All four CPCs receive Control Element Assembly (CEA) deviation penalty factors from each CEAC and use the larger of the penalty factors from the two CEACs in the calculation of DNBR and LPD. CPCs are further described in the Background section of LCO 3.3.1.

The CEACs perform the calculations required to determine the position of CEAs within their subgroups for the CPCs. Two independent CEACs compare the position of each CEA to its subgroup position. If a deviation is detected by either CEAC, an annunciator sounds and appropriate "penalty factors" are transmitted to all CPCs. These penalty factors conservatively adjust the effective operating margins to the DNBR – Low and LPD – High trips. Each CEAC also drives a single Cathode Ray Tube (CRT), which is switchable between CEACs. The CRT displays individual CEA positions from the selected CEAC.

(continued)

BASES

BACKGROUND
(Before CPC
Upgrade)
(continued)

Each CEA has two separate reed switch assemblies mounted outside the RCPB. Each of the two CEACs receives CEA position input from one of the two reed switch position transmitters on each CEA, so that the position of all CEAs is independently monitored by both CEACs.

Functional testing of the entire RPS, from bistable input through the opening of individual sets of RTCBs, can be performed either at power or shutdown and is normally performed on a quarterly basis. Nuclear instrumentation, the CPCs, and the CEACs can be similarly tested. UFSAR, Section 7.2 (Ref. 3), provides more detail on RPS testing. Process transmitter calibration is normally performed on a refueling basis.

BACKGROUND
(After CPC
Upgrade)

The Reactor Protective System (RPS) initiates a reactor trip to protect against violating the core Specified Acceptable Fuel Design Limits (SAFDLs) and breaching the Reactor Coolant Pressure Boundary (RCPB) during Anticipated Operational Occurrences (AOOs). By tripping the reactor, the RPS also assists the Engineered Safety Features Systems in mitigating accidents.

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

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

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 pressure SL of 2750 psia shall not be exceeded.

(continued)

BASES

BACKGROUND
(After CPC
Upgrade)
(continued)

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 occurrence. Meeting the acceptable dose limit for an accident category is considered having acceptable consequences for that event.

The RPS is segmented into four interconnected modules. These modules are:

- Measurement channels;
- Bistable trip units;
- RPS Logic; and
- Reactor Trip Circuit Breakers (RTCBs).

This LCO addresses the CEACs. LCO 3.3.1, "Reactor Protective System (RPS) Instrumentation - Operating," provides a description of this equipment in the RPS.

The core nuclear instrumentation, the Core Protection Calculators (CPCs), and the CEACs are considered components in the measurement channels of the Variable Over Power-High, Logarithmic Power Level - High, DNBR - Low, and Local Power Density (LPD) - High trips. The CEACs are addressed by this Specification.

All four *Each* CPCs receives Control Element Assembly (CEA) deviation penalty factors from each *both* CEACs *in that channel* and uses the larger of the penalty factors from the two CEACs in the calculation of DNBR and LPD. CPCs are further described in the Background section of LCO 3.3.1.

The CEACs perform the calculations required to determine the position of CEAs within their subgroups for the CPCs. Two independent CEACs *in each CPC channel* compare the position of each CEA to its subgroup position. If a deviation is detected by either CEAC, an annunciator sounds and

(continued)

BASES

BACKGROUND
(After CPC
Upgrade)
(continued)

appropriate "penalty factors" are transmitted to all CPCs *the CPC Processor in that channel.* These penalty factors conservatively adjust the effective operating margins to the DNBR - Low and LPD - High trips. Each CEAC also drives a single Cathode Ray Tube (CRT), which is switchable between CEACs. The CRT displays individual CEA positions from the selected CEAC.

Each CEA has two separate reed switch assemblies mounted outside the RCPB. Each of the two CEACs receives CEA position input from one of the two reed switch position transmitters on each CEA, so that the position of all CEAs is independently monitored by both CEACs.

Each CEA has two separate reed switch position transmitter (RSPT) assemblies mounted outside the Reactor Coolant Pressure Boundary (RCPB), designated RSPT 1 and RSPT 2. CEA position from the RSPTs is processed by CEA Position Processors (CPPs) located in each CPC channel. The CPPs transmit CEA position to the appropriate CEAC in all four CPC channels over optically isolated datalinks, such that CEAC 1 in all channels receives the position of all CEAs based upon RSPT1, and CEAC 2 receives the position of all CEAs based upon RSPT2. Thus, the position of all CEAs is independently monitored by both CEACs in each CPC channel

The CPCs display the position of each CEA to the operator on a separate single CEA Position Flat Panel Display. Each CPC channel is connected to the display by means of an optically isolated data link. The operator may select the channel for display. Selecting channel A or B will display CEA position based upon RSPT1 on each CEA, whereas selecting channel C or D will display CEA position based upon RSPT 2 on each CEA.

Functional testing of the entire RPS, from bistable input through the opening of individual sets of RTCBs, can be performed either at power or shutdown and is normally performed on a quarterly basis. Nuclear instrumentation, the CPCs, and the CEACs can be similarly tested. *CPC and CEAC functional testing is performed on a Refueling interval basis.* UFSAR, Section 7.2 (Ref. 3), provides more detail on RPS testing. Process transmitter calibration is normally performed on a refueling basis.

APPLICABLE
SAFETY ANALYSES

Each of the analyzed transients and accidents can be detected by one or more RPS Functions.

(continued)

BASES

APPLICABLE
SAFETY ANALYSES

The effect of any misoperated CEA within a subgroup on the core power distribution is assessed by the CEACs, and an appropriately augmented power distribution penalty factor will be supplied as input to the CPCs. As the reactor core responds to the reactivity changes caused by the misoperated CEA and the ensuing reactor coolant and doppler feedback

effects, the CPCs will initiate a DNBR - Low or LPD - High trip signal if SAFDLs are approached. Each CPC also directly monitors one "target CEA" from each subgroup and uses this information to account for excessive radial peaking factors for events involving CEA groups out of sequence and subgroup deviations within a group, without the need for CEACs.

Therefore, although the CEACs do not provide a direct reactor trip function, their input to the CPCs is taken credit for in the CEA misoperation analysis.

The CEACs satisfy Criterion 3 of 10 CFR 50.36 (c)(2)(ii).

LCO
*(Before CPC
Upgrade)*

This LCO on the CEACs ensures that the CPCs are either informed of individual CEA position within each subgroup, using one or both CEACs, or that appropriate conservatism is included in the CPC calculations to account for anticipated CEA deviations. Each CEAC provides an identical input into all four CPC channels. Each CPC uses the higher of the two CEAC transmitted CEA deviation penalty factors. Thus, only one OPERABLE CEAC is required to provide CEA deviation protection. This LCO requires both CEACs to be OPERABLE so that no single CEAC failure can prevent a required reactor trip from occurring.

LCO
*(After CPC
Upgrade)*

This LCO on the CEACs ensures that the CPCs are either informed of individual CEA position within each subgroup, using one or both CEACs *in each channel*, or that appropriate conservatism is included in the CPC calculations to account for anticipated CEA deviations. Each CEAC provides an identical input into all four CPC channels. Each CPC uses the higher of the two CEAC transmitted CEA deviation penalty factors. Thus, only one OPERABLE CEAC is required to provide CEA deviation protection. This LCO requires both CEACs to be OPERABLE so that no single CEAC failure can prevent a required reactor trip from occurring.

(continued)

BASES

LCO
(After CPC
Upgrade)

CEAC 1 in all four CPC channels monitors CEA position based upon RSP1 on all CEAs. CEAC 2 in all four channels monitors CEA position based upon RSP2 on all CEAs. Each CPC uses the higher of the two deviation penalty factors transmitted by the channel CEACs. Thus only one OPERABLE CEAC is required in each channel to provide CEA deviation protection. Because a single RSP1 is used to provide RSP1 input to one CEAC in all four channels, this LCO requires both CEACs to be OPERABLE in each channel so that no sensor failure resulting in CEAC failure in multiple channels can prevent a required trip from occurring.

To increase reliability, each CPC channel contains two CEA Position Processors (CPPs), which redundantly monitor the channel RSP1 inputs, perform analog to digital conversion, and transmit the CEA position to the appropriate CEAC in all four CPC channels over separate one-way fiber optically isolated data links. The receiving CEAC will automatically switch to the backup CPP and associated data link upon failure of the preferred CPP or associated data link. CPPs in CPC channels A and B together process all RSP1 CEA position inputs, and transmit them to CEAC 1 in all four CPC channels. Similarly, CPPs in channels C and D together process all RSP2 position inputs, and transmit them to CEAC 2 in all four CPC channels.

Operation of at least one CPP and associated data links in each CPC channel is therefore required for both CEACs in all CPC channels to receive CEA position information. Failure of both redundant CPPs in a channel or failure of redundant RSP1 power supplies in that channel will cause the associated receiving CEACs in all channels to lose CEA position input on multiple CEAs. Failure of individual RSP1s will result in a subset of CEAs being identified as failed in the associated CEAC in multiple channels.

This LCO therefore addresses both individual channel and multiple channel CEAC inoperabilities.

(continued)

BASES

APPLICABILITY

This LCO is applicable to the CEACs in MODES 1 and 2. The RPS Instrumentation in MODES 1 and 2 is addressed in LCO 3.3.1. The RPS Instrumentation in MODES 3, 4, and 5 with any RTCB closed and any CEA capable of withdrawal is addressed in LCO 3.3.2. The RPS Matrix Logic, Initiation Logic, RTCB, and Manual Trips in Modes 1, 2, 3, 4, and 5 are addressed in LCO 3.3.4.

Most RPS trips are required to be OPERABLE in MODES 1 and 2 because the reactor is critical in these MODES. The trips are designed to take the reactor subcritical, which maintains the SLs during AOOs and assists the Engineered Safety Features Actuation System in providing acceptable consequences during accidents. Most trips are not required to be OPERABLE in MODES 3, 4, and 5. In MODES 3, 4, and 5, the emphasis is placed on return to power events. The reactor is protected in these MODES by ensuring adequate SDM.

Because CEACs provide the inputs to the DNBR – Low and LPD – High trips, they are required to be OPERABLE in MODES 1 and 2 for the same reasons.

The upgraded CPC system consists of eight total CEACs instead of the two found in the CPC System prior to upgrade. To facilitate the difference in the number of CEACs as well as to support the enhanced features found in the upgraded CPC system, a second 3.3.3 Technical Specification has been developed. The determination on which Specification applies is based on whether or not the unit has received the upgraded CPCs. Each unit shall only use the Specification that reflects the status of their unit's CPC system (i.e., before or after CPC upgrade).

(continued)

BASES

ACTIONS
(Before CPC
Upgrade)

A.1 and A.2

Condition A applies to the failure of a single CEAC channel. There are only two CEACs, each providing CEA deviation input into all four CPC channels. The CEACs include complex diagnostic software, making it unlikely that a CEAC will fail without informing the CPCs of its failed status. With one failed CEAC, the CPC will receive CEA deviation penalty factors from the remaining OPERABLE CEAC. If the second CEAC should fail (Condition B), the CPC will use large preassigned penalty factors. The specific Required Actions allowed are as follows:

With one CEAC inoperable, the second CEAC still provides a comprehensive set of comparison checks on individual CEAs within subgroups, as well as outputs to all CPCs, CEA deviation alarms, and position indication for display. Verification every 4 hours that each CEA is within 6.6 inches of the other CEAs in its group provides a check on the position of all CEAs and provides verification of the proper operation of the remaining CEAC. An OPERABLE CEAC will not generate penalty factors until deviations of > 9.0 inches within a subgroup are encountered.

The Completion Time of once per 4 hours is adequate based on operating experience, considering the low probability of an undetected CEA deviation coincident with an undetected failure in the remaining CEAC within this limited time frame.

As long as Required Action A.1 is accomplished as specified, the inoperable CEAC can be restored to OPERABLE status within 7 days. The Completion Time of 7 days is adequate for most repairs, while minimizing risk, considering that dropped CEAs are detectable by the redundant CEAC, and other LCOs specify Required Actions necessary to maintain DNBR and LPD margin.

(continued)

BASES

ACTIONS
(Before CPC
Upgrade)
(continued)B.1, B.2, B.3, B.4, B.5 and B.6

Condition B applies if the Required Action and associated Completion Time of Required Action A are not met, or if both CEACs are inoperable. Actions associated with this Condition involve disabling the Control Element Drive Mechanism Control System (CEDMCS), while providing increased assurance that CEA deviations are not occurring and informing all OPERABLE CPC channels, via a software flag, that both CEACs are failed. This will ensure that the large penalty factor associated with two CEAC failures will be applied to CPC calculations. The penalty factor for two failed CEACs is sufficiently large that power must be maintained significantly < 100% RTP if CPC generated reactor trips are to be avoided. The Completion Time of 4 hours is adequate to accomplish these actions while minimizing risks.

The Required Actions are as follows:

B.1

Meeting the DNBR margin requirements of LCO 3.2.4, "DNBR" ensures that power level is within a conservative region of operation based on actual core conditions.

B.2

This Action requires that the CEAs are maintained fully withdrawn (≥ 144.75 "), except as required for specified testing or flux control via group #5. This verification ensures that undesired perturbations in local fuel burnup are prevented. The Upper Electrical Limit (UEL) CEA reed switches provide an acceptable indication of CEA position.

B.3

The "RSPT/CEAC Inoperable" addressable constant in each of the OPERABLE CPCs is set to indicate that both CEACs are inoperable. This provides a conservative penalty factor to ensure that a conservative effective margin is maintained by the CPCs in the computation of DNBR and LPD trips.

(continued)

BASES

ACTIONS
(Before CPC
Upgrade)
(continued)B.4

The CEDMCS is placed and maintained in "STANDBY MODE," except during CEA motion permitted by Required Action B.2, to prevent inadvertent motion and possible misalignment of the CEAs.

B.5

A comprehensive set of comparison checks on individual CEAs within groups must be made within 4 hours. Verification that each CEA is within 6.6 inches of other CEAs in its group provides a check that no CEA has deviated from its proper position within the group.

B.6

The Reactor Power Cutback (RPCB) System must be disabled. This ensures that CEA position will not be affected by RPCB operation.

C.1

Condition C applies if the CPC channel B or C cabinet receives a high temperature alarm. There are redundant temperature sensors in each of the four CPC bays. A high temperature alarm in any CPC cabinet requires entry into LCO 3.3.1, Condition E. Since CPC bays B and C also house CEAC calculators 1 and 2, respectively, a high temperature in either of these bays may also indicate a problem with the associated CEAC.

If a CPC channel B or C cabinet high temperature alarm is received, it is possible for an OPERABLE CEAC to be affected and not be completely reliable. Therefore, a CHANNEL FUNCTIONAL TEST must be performed on OPERABLE CEACs within 12 hours. The Completion Time of 12 hours is adequate, considering the low probability of undetected failure, the consequences of failure, and the time required to perform a CHANNEL FUNCTIONAL TEST.

(continued)

BASES

ACTIONS
*(Before CPC
Upgrade)*
(continued)

D.1

Condition D applies if an OPERABLE CEAC has three or more auto restarts in a 12 hour period.

CPCs and CEACs will attempt to auto restart if they detect a fault condition such as a calculator malfunction or loss of power. A successful auto restart restores the calculator to operation; however, excessive auto restarts might be indicative of a calculator problem. The auto restart periodic test restart (Code 30), and normal system load (Code 33) are not included in the total.

If an operable CEAC has three or more auto restarts, it may not be completely reliable. Therefore, a CHANNEL FUNCTIONAL TEST must be performed on the CEAC to ensure it is functioning properly. Based on plant operating experience, the Completion Time of 24 hours is adequate and reasonable to perform the test while still keeping the risk of operating in this condition at an acceptable level, since overt channel failure will most likely be indicated and annunciated by CPC online diagnostics.

E.1

Condition E is entered when the Required Action and associated Completion Time of Condition B, C, or D are not met.

If the Required Actions associated with these Conditions cannot be completed within the required Completion Time, the reactor must be brought to a MODE where the Required Actions do not apply. The Completion Time of 6 hours is reasonable, based on operating experience, for reaching the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

(continued)

BASES

**ACTIONS
(After CPC
Upgrade)**

One Note has been added to the ACTIONS. Note 1 has been added to clarify the application of the Completion Time rules. The Conditions of this Specification may be entered independently for each CPC channel. The Completion Times of each inoperable Channel will be tracked separately, starting from the time the Condition was entered for that Channel.

A.1 and A.2

Condition A applies to the failure of a single CEAC channel. There are only two CEACs, each providing CEA deviation input into all four CPC channels. The CEACs include complex diagnostic software, making it unlikely that a CEAC will fail without informing the CPCs of its failed status. With one failed CEAC, the CPC will receive CEA deviation penalty factors from the remaining OPERABLE CEAC. If the second CEAC should fail (Condition B), the CPC will use large preassigned penalty factors. The specific Required Actions allowed are as follows:

A.1, A.2.1 and A.2.2

Condition A applies to the failure of one CEAC in one or more CPC channels. A CEAC failure affecting a single channel could result from failure within a CEAC processor module, whereas a CEAC failure in multiple channels could be caused by failure of redundant CPPs within a CPC channel. Thus, Required Actions address both possibilities.

A.1

Required Action A.1 provides for immediate declaration of affected CPC channel inoperability, and entry into Required Actions associated with LCO 3.3.1 for the DNBR-Low and LPD-High trip functions. This Required Action treats single CEAC failures in one or more channels in a manner consistent with other RPS failures in one or more channels, and might be the preferred action if only one CPC channel is affected. If the failure affects more than two CPC channels, required Actions A.2.1 and A.2.2 would be preferable.

(continued)

BASES

ACTIONS

A.2.1 and A.2.2

(After CPC Upgrade)
(continued)

Actions A.2.1 and A.2.2 accommodate a loss of CEA position monitoring capability by one CEAC in up to all four CPC channels. There are two CEACs per CPC channel, each providing CEA deviation input to the associated channel CPC. The CEACs and CPPs providing CEA position input to the CEACs include complex diagnostic software making it unlikely that a CEAC will fail without informing the CPC of its failed status. With one failed CEAC in one or more channels, the CPC in the affected channels will receive CEA deviation penalty factors from the remaining OPERABLE channel CEAC. If the second CEAC should fail (Condition B), the CPC will use large preassigned penalty factors. The specific Required Actions are as follows:

With one CEAC inoperable *in one or more channels*, the second CEAC still provides a comprehensive set of comparison checks on individual CEAs within subgroups, as well as outputs to all *the affected* CPCs, CEA deviation alarms, and position indication for display. Verification every 4 hours that each CEA is within 6.6 inches of the other CEAs in its group provides a check on the position of all CEAs and provides verification of the proper operation of the remaining CEAC. An OPERABLE CEAC will not generate penalty factors until deviations of > 9.0 inches within a subgroup are encountered.

The Completion Time of once per 4 hours is adequate based on operating experience, considering the low probability of an undetected CEA deviation coincident with an undetected failure in the remaining CEAC within this limited time frame.

As long as Required Action A.1 A.2.1 is accomplished as specified, the inoperable CEAC can be restored to OPERABLE status within 7 days. The Completion Time of 7 days is adequate for most repairs, while minimizing risk, considering that dropped CEAs are detectable by the redundant CEAC, and other LCOs specify Required Actions necessary to maintain DNBR and LPD margin.

(continued)

BASES

ACTIONS
(After CPC
Upgrade)
(continued)

~~B.1, B.2, B.3, B.4, B.5 and B.6~~ **B.2.1, B.2.2, B.2.3, B.2.4,**
B.2.5, and B.2.6

Condition B applies if the Required Action and associated Completion Time of Required Action Condition A are not met, or if both CEACs are inoperable *in one or more CPC channels*. Actions associated with this Condition involve *two choices*:

- **Action B.1 immediately renders the affected CPC channels inoperable, thus requiring entry into the Required Actions associated with LCO 3.3.1.**

- **Action B.2.1 through B.2.6 disable** disabling the Control Element Drive Mechanism Control System (CEDMCS), while providing increased assurance that CEA deviations are not occurring and informing all OPERABLE CPC channels, via a software flag, that both CEACs are failed. This will ensure that the large penalty factor associated with two CEAC failures will be applied to *the* CPC calculations. The penalty factor for two failed CEACs is sufficiently large that power must be maintained significantly < 100% RTP if CPC generated reactor trips are to be avoided. The Completion Time of 4 hours is adequate to accomplish these actions while minimizing risks.

The Required Actions are as follows:

B.1

Required Action B.1 provides for immediate declaration of affected CPC channel inoperability, and entry into Required Actions associated with LCO 3.3.1 for the DNBR-Low and LPD-High trip functions. This Required Action treats failure of both CEACs in one or more channels in a manner consistent with other RPS failures in one or more channels. Similarly, this Required Action permits immediate declaration of channel inoperability and entry in the Required Actions of LCO 3.3.1 if the Required Actions and associated Completion Times of Condition A are not met. Required Action B.1 might be the preferred action if only one CPC channel is affected. If the failure affects more than two CPC channels, required Actions B.2.1 through B.2.6 would be preferable.

(continued)

BASES

ACTIONS

(After CPC Upgrade)
(continued)

~~B.1~~ B.2.1

Meeting the DNBR margin requirements of LCO 3.2.4, "DNBR" ensures that power level is within a conservative region of operation based on actual core conditions.

~~B.2~~ B.2.2

This Action requires that the CEAs are maintained fully withdrawn (≥ 144.75 "), except as required for specified testing or flux control via group #5. This verification ensures that undesired perturbations in local fuel burnup are prevented. The Upper Electrical Limit (UEL) CEA reed switches provide an acceptable indication of CEA position.

~~B.3~~ B.2.3

The "RSPT/CEAC Inoperable" addressable constant in each of the OPERABLE CPCs is set to indicate that both CEACs are inoperable. This provides a conservative penalty factor to ensure that a conservative effective margin is maintained by the CPCs in the computation of DNBR and LPD trips.

~~B.4~~ B.2.4

The CEDMCS is placed and maintained in "STANDBY MODE," except during CEA motion permitted by Required Action B.2, to prevent inadvertent motion and possible misalignment of the CEAs.

~~B.5~~ B.2.5

A comprehensive set of comparison checks on individual CEAs within groups must be made within 4 hours. Verification that each CEA is within 6.6 inches of other CEAs in its group provides a check that no CEA has deviated from its proper position within the group.

~~B.6~~ B.2.6

The Reactor Power Cutback (RPCB) System must be disabled. This ensures that CEA position will not be affected by RPCB operation.

(continued)

ACTIONS
(After CPC
Upgrade)
(continued)

E.1

Condition C applies if the CPC channel B or C cabinet receives a high temperature alarm. There are redundant temperature sensors in each of the four CPC bays. A high temperature alarm in any CPC cabinet requires entry into LGO 3.3.1 Condition E. Since CPC bays B and C also house CEAC calculators 1 and 2, respectively, a high temperature in either of these bays may also indicate a problem with the associated CEAC.

If a CPC channel B or C cabinet high temperature alarm is received, it is possible for an OPERABLE CEAC to be affected and not be completely reliable. Therefore, a CHANNEL FUNCTIONAL TEST must be performed on OPERABLE CEACS within 12 hours. The completion time of 12 hours is adequate, considering the low probability of undetected failure, the consequences of failure, and the time required to perform a CHANNEL FUNCTIONAL TEST.

D.1

Condition D applies if an OPERABLE CEAC has three or more auto restarts in a 12 hour period.

CPCs and CEACS will attempt to auto restart if they detect a fault condition such as a calculator malfunction or loss of power. A successful auto restart restores the calculator to operation. However, excessive auto restarts might be indicative of a calculator problem. The auto restart periodic test restart (Code 30), and normal system load (Code 33), are not included in the total.

If an operable CEAC has three or more auto restarts, it may not be completely reliable. Therefore, a CHANNEL FUNCTIONAL TEST must be performed on the CEAC to ensure it is functioning properly. Based on plant operating experience, the completion time of 24 hours is adequate and reasonable to perform the test while still keeping the risk of operating in this condition at an acceptable level, since overt channel failure will most likely be indicated and announced by CPC online diagnostics.

(continued)

BASES

ACTIONS
(After CPC
Upgrade)
(continued)

E.1 C.1

Condition **E.1 C.1** is entered when the Required Action and associated Completion Time of Condition B, C, or D are **is** not met.

If the Required Actions associated with these **this** Conditions cannot be completed within the required Completion Time, the reactor must be brought to a MODE where the Required Actions do not apply. The Completion Time of 6 hours is reasonable, based on operating experience, for reaching the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE
REQUIREMENTS
(Before CPC
Upgrade)

SR 3.3.3.1

Performance of the CHANNEL CHECK once every 12 hours ensures that gross failure of instrumentation has not occurred. A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on another channel. It is based on the assumption that instrument channels monitoring the same parameter should read approximately the same value.

Significant deviations between the two instrument channels could be an indication of excessive instrument drift in one of the channels or of something even more serious. CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying that the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

Agreement criteria are determined by the plant staff, based on a combination of the channel instrument uncertainties, including indication and readability. If a channel is outside the criteria, it may be an indication that the sensor or the signal processing equipment has drifted outside its limits.

The Frequency, about once every shift, is based on operating experience that demonstrates the rarity of channel failure. Since the probability of two random failures in redundant channels in any 12 hour period is extremely low, the CHANNEL CHECK minimizes the chance of loss of protective function due to failure of redundant channels.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS
(Before CPC
Upgrade)SR 3.3.3.1 (continued)

The CHANNEL CHECK supplements less formal, but more frequent, checks of channel OPERABILITY during normal operational use of the displays associated with the LCO required channels.

SR 3.3.3.2

The CEAC auto restart count is checked every 12 hours to monitor the CPC and CEAC for normal operation. If three or more auto restarts of a nonbypassed CPC occur within a 12 hour period, the CPC may not be completely reliable. The autorestart periodic test restart (code 30) and normal system load (code 33) are not included in the total. Therefore, the Required Action of Condition D must be performed. The Frequency is based on operating experience that demonstrates the rarity of more than one channel failing within the same 12 hour interval.

SR 3.3.3.3

A CHANNEL FUNCTIONAL TEST on each CEAC channel is performed every 92 days to ensure the entire channel will perform its intended function when needed. The quarterly CHANNEL FUNCTIONAL TEST is performed using test software. The Frequency of 92 days is based on the reliability analysis presented in topical report CEN-327, "RPS/ESFAS Extended Test Interval Evaluation" (Ref. 5).

SR 3.3.3.4

SR 3.3.3.4 is the performance of a CHANNEL CALIBRATION every 18 months.

CHANNEL CALIBRATION is a complete check of the instrument channel including the sensor. The Surveillance verifies that the channel responds to a measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drift between successive calibrations to ensure that the channel remains operational between successive surveillance. CHANNEL CALIBRATIONS must be performed consistent with the plant specific setpoint analysis.

(continued)

BASES

**SURVEILLANCE
REQUIREMENTS
(Before CPC
Upgrade)**

SR 3.3.3.4 (continued)

The as found and as left values must also be recorded and reviewed for consistency with the assumptions of the surveillance interval extension analysis. The requirements for this review are outlined in Reference 5.

The Frequency is based upon the assumption of an 18 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis and includes operating experience and consistency with the typical 18 month fuel cycle.

SR 3.3.3.5

Every 18 months, a CHANNEL FUNCTIONAL TEST is performed on the CEACs. The CHANNEL FUNCTIONAL TEST shall include the injection of a signal as close to the sensors as practicable to verify OPERABILITY, including alarm and trip Functions. The basis for the 18 month Frequency is that the CEACs perform a continuous self monitoring function that eliminates the need for frequent CHANNEL FUNCTIONAL TESTS.

This CHANNEL FUNCTIONAL TEST essentially validates the self monitoring function and checks for a small set of failure modes that are undetectable by the self monitoring function. Operating experience has shown that undetected CPC or CEAC failures do not occur in any given 18 month interval.

SR 3.3.3.6

The isolation characteristics of each CEAC CEA position isolation amplifier are verified once per refueling to ensure that a fault in a CEAC or a CPC channel will not render another CEAC or CPC channel inoperable. The CEAC CEA position isolation amplifiers, mounted in CPC cabinets A and D, prevent a CEAC fault from propagating back to CPC A or D.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS
*(Before CPC
Upgrade)*

SR 3.3.3.6 (continued)

The CEA position Isolation amplifier isolation characteristics test shall include the following; 1) with 120 VAC (60 HZ) applied for at least 30 seconds across the output, the reading on the input does not change by more than 0.015 VDC, with an applied input voltage of 5-10 VDC, and 2) with 120 VAC (60 HZ) applied for at least 30 seconds across the input, the reading on the output does not exceed 15 VDC.

The Frequency is based on plant operating experience with regard to channel OPERABILITY, which demonstrates the failure of a channel in any 18 month interval is rare.

SURVEILLANCE
REQUIREMENTS
*(After CPC
Upgrade)*

SR 3.3.3.7

Performance of the CHANNEL CHECK once every 12 hours ensures that gross failure of instrumentation has not occurred. A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on another channel. It is based on the assumption that instrument channels monitoring the same parameter should read approximately the same value.

Significant deviations between the two instrument channels could be an indication of excessive instrument drift in one of the channels or of something even more serious. CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying that the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

Agreement criteria are determined by the plant staff, based on a combination of the channel instrument uncertainties including indication and readability. If a channel is outside the criteria, it may be an indication that the sensor or the signal processing equipment has drifted outside its limits.

The Frequency, about once every shift, is based on operating experience that demonstrates the rarity of channel failure. Since the probability of two random failures in redundant channels in any 12 hour period is extremely low, the CHANNEL CHECK minimizes the chance of loss of protective function due to failure of redundant channels.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS
(After CPC
Upgrade)

SR 3.3.3.1 (continued)

The CHANNEL CHECK supplements less formal, but more frequent, checks of channel OPERABILITY during normal operational use of the displays associated with the LCO required channels.

SR 3.3.3.2

The CEAC auto restart count is checked every 12 hours to monitor the CPC and CEAC for normal operation. If three or more auto restarts of a nonbypassed CPC occur within a 12 hour period, the CPC may not be completely reliable. The autorestart periodic test restart (code 30) and normal system load (code 33) are not included in the total. Therefore, the Required Action of Condition D must be performed. The Frequency is based on operating experience that demonstrates the rarity of more than one channel failing within the same 12 hour interval.

SR 3.3.3.3 SR 3.3.3.2

A CHANNEL FUNCTIONAL TEST on each CEAC channel is performed every 92 days to ensure the entire channel will perform its intended function when needed. The quarterly CHANNEL FUNCTIONAL TEST is performed using test software. The Frequency of 92 days is based on the reliability analysis presented in topical report GEN-327, "RPS/ESF Extended Test Interval Evaluation" (Ref: 5).

SR 3.3.3.4 SR 3.3.3.3

SR 3.3.3.4 3.3.3.3 is the performance of a CHANNEL CALIBRATION every 18 months.

CHANNEL CALIBRATION is a complete check of the instrument channel including the sensor. The Surveillance verifies that the channel responds to a measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drift between successive calibrations to ensure that the channel remains operational between successive surveillance. CHANNEL CALIBRATIONS must be performed consistent with the plant specific setpoint analysis.

(continued)

BASES

**SURVEILLANCE
REQUIREMENTS
(After CPCS
Upgrade)**

~~SR 3.3.3.4~~ SR 3.3.3.3 (continued)

The as found and as left values must also be recorded and reviewed for consistency with the assumptions of the surveillance interval extension analysis. The requirements for this review are outlined in Reference 5.

The Frequency is based upon the assumption of an 18 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis and includes operating experience and consistency with the typical 18 month fuel cycle.

~~SR 3.3.3.5~~ SR 3.3.3.4

Every 18 months, a CHANNEL FUNCTIONAL TEST is performed on the CEACs. The CHANNEL FUNCTIONAL TEST shall include the injection of a signal as close to the sensors as practicable to verify OPERABILITY, including alarm and trip Functions.

The basis for the 18 month Frequency is that the CEACs perform a continuous self monitoring function that eliminates the need for frequent CHANNEL FUNCTIONAL TESTS. This CHANNEL FUNCTIONAL TEST essentially validates the self monitoring function and checks for a small set of failure modes that are undetectable by the self monitoring function. Operating experience has shown that undetected CPC or CEAC failures do not occur in any given 18 month interval.

~~SR 3.3.3.6~~

The isolation characteristics of each CEAC CEA position isolation amplifier are verified once per refueling to ensure that a fault in a CEAC or a CPC channel will not render another CEAC or CPC channel inoperable. The CEAC CEA position isolation amplifiers, mounted in CPC cabinets A and D, prevent a CEAC fault from propagating back to CPC A or D.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS
(After CPC
Upgrade)

SR-3.3.3.6 (continued)

The CEA position Isolation amplifier isolation characteristics test shall include the following: 1) with 120 VAC (60 HZ) applied for at least 30 seconds across the output, the reading on the input does not change by more than 0.015 VDC, with an applied input voltage of 5-10 VDC; and 2) with 120 VAC (60 HZ) applied for at least 30 seconds across the input, the reading on the output does not exceed 15 VDC.

The Frequency is based on plant operating experience with regard to channel OPERABILITY, which demonstrates the failure of a channel in any 18 month interval is rare.

REFERENCES

1. 10 CFR 50.
 2. 10 CFR 100.
 3. UFSAR, Section 7.2.
 4. NRC Safety Evaluation Report, July 15, 1994
 5. CEN-327, June 2, 1986, including Supplement 1, March 3, 1989, and Calculation 13-JC-SB-200.
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