

BASES

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ACTIONS  
(continued)

W.1 and W.2

Condition W applies to the Seismic Trip, in MODES 1 and 2. With one of the channels inoperable, START UP and/or POWER OPERATION may proceed provided the inoperable channel is placed in trip within the next 6 hours. If a direction is inoperable, then the channel must be considered inoperable. Placing the channel in the tripped condition creates a partial trip condition requiring only one out of two logic from the remaining locations for reactor trip actuation.

The Required Actions have been modified by a Note that allows placing the inoperable channel in the bypassed condition for up to 72 hours while performing surveillance testing or maintenance. The allowed 72 hour bypass time is reasonable based on the low probability of an event occurring while the channel is bypassed and on the time required to perform the required surveillance testing.

X.1, X.2 and X.3

Condition X applies to the Trip Time Delay (TTD) circuitry for the SG Water Level-Low Low trip function in MODES 1 and 2. With one or more TTD circuitry delay timers inoperable or the RSC delta-T equivalent power input inoperable, 6 hours are allowed to adjust the threshold power level for no time delay to 0% RTP. This sets the TTD timer to zero seconds and effectively removes its input from the SG water level circuit. If the TTD timer cannot be set to zero seconds for a single SG water level control, then the affected SG water level low-low channel must be placed in trip. Only one SG water level low-low channel can be placed in the trip position without tripping the plant. The Completion Time of 6 hours is reasonable considering the nature of these functions and the low probability of an event occurring during this interval as justified in Reference 7.

If the TTD threshold power for no time delay cannot be adjusted to 0% RTP (zero seconds time delay) or the single SG water level channel cannot be placed in the trip condition within the specified Completion Time, the unit must be placed in a MODE where these Functions are not required OPERABLE. The 12 hour allowed to place the unit in MODE 3 is a reasonable time, based on operating experience, to place the unit in MODE 3 from full power in an orderly manner and without challenging unit systems.

The Required Actions have been modified by a note that allows placing the SG water level channel or one additional channel in the bypassed condition for up to 4 hours while performing routine surveillance testing of the other channels.

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(continued)

BASES (continued)

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**SURVEILLANCE  
REQUIREMENTS**

The SRs for each RTS Function are identified by the SRs column of Table 3.3.1-1 for that Function.

A note has been added to the SR Table stating that Table 3.3.1-1 determines which SRs apply to which RTS Functions.

Note that each channel of process protection supplies both trains of the RTS. When testing Channel I, Train A and Train B must be examined. Similarly, Train A and Train B must be examined when testing Channel II, Channel III, and Channel IV (if applicable). The CHANNEL CALIBRATION and COTs are performed in a manner that is consistent with the assumptions used in analytically calculating the required channel accuracies.

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 other channels. 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. A 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 unit 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 limit.

SR 3.3.1.1

The Frequency is based on operating experience that demonstrates channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the LCO required channels.

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(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS  
(continued)

SR 3.3.1.2

SR 3.3.1.2 compares the calorimetric heat balance calculation to the NIS power indications every 24 hours. If the calorimetric exceeds the NIS power indications by  $> 2\%$  RTP, the NIS is not declared inoperable, but the excore channel gains, must be adjusted consistent with the calorimetric power. If the NIS power indications cannot be properly adjusted, the channel is declared inoperable.

Two Notes modify SR 3.3.1.2. The first Note indicates that the NIS power indications shall be adjusted consistent with the calorimetric results if the absolute difference between the NIS power indications and the calorimetric is  $> 2\%$  RTP. The second Note clarifies that this Surveillance is required only if reactor power is  $\geq 15\%$  RTP and that 24 hours is allowed for performing the first Surveillance after reaching 15% RTP but prior to exceeding 30% RTP. At lower power levels, calorimetric data are inaccurate. The 24-hour allowance after increasing THERMAL POWER above 15% RTP provides a reasonable time to attain a scheduled power plateau, establish the requisite conditions, perform the required calorimetric measurement, and make any required adjustments in a controlled, orderly manner and without introducing the potential for extended operation at high power levels with instrumentation that has not been verified to be acceptable for subsequent use.

The Frequency of every 24 hours is adequate. It is based on unit operating experience, considering instrument reliability and operating history data for instrument drift. Together these factors demonstrate the change in the absolute difference between NIS and heat balance calculated powers rarely exceeds 2% in any 24 hour period.

In addition, control room operators periodically monitor redundant indications and alarms to detect deviations in channel outputs.

SR 3.3.1.3

SR 3.3.1.3 compares the incore system to the NIS channel output every 31 EFPD. If the absolute difference is  $\geq 3\%$ , the NIS channel is still OPERABLE, but must be readjusted. The comparison checks for differences due to changes in core power distribution since the last calibration.

If the NIS channel cannot be properly readjusted, the channel is declared inoperable. This Surveillance is performed to verify the  $f(\Delta I)$  input to the overtemperature  $\Delta T$  Function.

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(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS

SR 3.3.1.3 (continued)

Two Notes modify SR 3.3.1.3. Note 1 indicates that the excore NIS channel shall be adjusted if the absolute difference between the incore and excore AFD is  $\geq 3\%$ . Note 2 clarifies that the Surveillance is required only if reactor power is  $\geq 50\%$  RTP and that 24 hours is allowed for performing the first Surveillance after reaching 50% RTP. Note 2 allows power ascensions and associated testing to be conducted in a controlled and orderly manner, at conditions that provide acceptable results and without introducing the potential for extended operation at high power levels with instrumentation that has not been verified to be acceptable for subsequent use. Due to such effects as shadowing from the relatively deep control rod insertion and, to a lesser extent, the dependency of the axially-dependent radial leakage on the power level, the relationship between the incore and excore indications of axial flux difference (AFD) at lower power levels is variable. Thus, it is prudent to defer the calibration of the excore AFD against the incore AFD until more stable conditions are attained (i.e., withdrawn control rods and higher power level). The AFD is used as an input to the Overtemperature  $\Delta T$  reactor trip function and for assessing compliance with ITS LCO 3.2.3, "AXIAL FLUX DIFFERENCE." Due to the DNB benefits gained by administratively restricting the power level to 50% RTP, no limits on AFD are imposed below 50% RTP by LCO 3.2.3; thus, the proposed change is consistent with LCO 3.2.3. requirements below 50% RTP. Similarly, sufficient DNB margins are realized through operation below 50% RTP that the intended function of the Overtemperature  $\Delta T$  reactor trip function is maintained, even though the excore AFD indication may not exactly match the incore AFD indication. Based on plant operating experience, 24 hours is a reasonable time frame to limit operation above 50% RTP while completing the procedural steps associated with the surveillance in an orderly manner.

The Frequency of every 31 EFPD is adequate. It is based on unit operating experience, considering instrument reliability and operating history data for instrument drift. Also, since the changes in neutron flux are slow during the fuel cycle, the expected change in the absolute difference between the incore and excore AFD will be less than 3 percent AFD during this interval.

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SURVEILLANCE  
REQUIREMENTS

SR 3.3.1.4

SR 3.3.1.4 is the performance of a TADOT every 31 days on a STAGGERED TEST BASIS. This test shall verify OPERABILITY by actuation of the end devices.

The RTB test shall include separate verification of the undervoltage and shunt trip mechanisms. Independent verification of RTB undervoltage and shunt trip Function is not required for the bypass breakers. No capability is provided for performing such a test at power. The independent test for bypass breakers is included in SR 3.3.1.14. The bypass breaker test shall include a local manual shunt trip only. A Note has been added to indicate that this test must be performed on the bypass breaker prior to placing it in service.

The Frequency of every 31 days on a STAGGERED TEST BASIS is adequate. It is based on industry operating experience, considering instrument reliability and operating history data.

SR 3.3.1.5

SR 3.3.1.5 is the performance of an ACTUATION LOGIC TEST. The seismic trip is tested every 31 days on a STAGGERED TEST BASIS. The SSPS is tested every 31 days on a STAGGERED TEST BASIS, using the semiautomatic tester. The train being tested is placed in the bypass condition with the RTB bypass breaker installed, thus preventing inadvertent actuation. Through the semiautomatic tester, all possible logic combinations, with and without applicable permissives, are tested for each protection function including operation of the P-7 permissive which is a logic function only. The P-7 alarm circuit is excluded from this testing since it only mimics the actions of the SSPS and cannot prevent the permissive from performing its function. The Frequency of every 31 days on a STAGGERED TEST BASIS is adequate. It is based on industry operating experience, considering instrument reliability and operating history data.

SR 3.3.1.6

SR 3.3.1.6 is a calibration of the excore channels to the incore channels. If the measurements do not agree, the excore channels are not declared inoperable but must be calibrated to agree with the incore detector measurements. If the excore channels cannot be adjusted, the channels are declared inoperable. This Surveillance is performed to verify the  $f(\Delta I)$  input to the overtemperature  $\Delta T$  Function.

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS

SR 3.3.1.6 (continued)

A Note modifies SR 3.3.1.6. The Note states that this Surveillance is required only if reactor power is  $\geq 75\%$  RTP and that 72 hours after thermal power is  $\geq 75\%$  RTP is allowed for performing the first surveillance after reaching 75% RTP. The SR is deferred until a scheduled testing plateau above 75% RTP is attained during the post-outage power ascension. During a typical post-refueling power ascension, it is usually necessary to control the axial flux difference at lower power levels through control rod insertion. After equilibrium conditions are achieved at the specified power plateau, a flux map must be taken and the required data collected. The data is typically analyzed and the appropriate excore calibrations completed within 48 hours after achieving equilibrium conditions. An additional time allowance of 24 hours is provided during which the effects of equipment failures may be remedied and any required re-testing may be performed.

The allowance of 72 hours after equilibrium conditions are attained at the testing plateau provides sufficient time to allow power ascensions and associated testing to be conducted in a controlled and orderly manner at conditions that provide acceptable results and without introducing the potential for extended operation at high power levels with instrumentation that has not been verified to be acceptable for subsequent use.

The Frequency of 92 EFPD is adequate. It is based on industry operating experience, considering instrument reliability and operating history data for instrument drift.

SR 3.3.1.7

SR 3.3.1.7 is the performance of a COT every 92 days.

A COT is performed on each required channel to ensure the entire channel will perform the intended Function.

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(continued)

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REQUIREMENTS

SR 3.3.1.7 (continued)

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

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

The "as found" and "as left" values must also be recorded and reviewed for consistency with the assumptions of Reference 7.

SR 3.3.1.7 is modified by two notes. Note 1 provides a 4 hour delay in the requirement to perform this Surveillance for source range instrumentation when entering MODE 3 from MODE 2. This Note allows a normal shutdown to proceed without a delay for testing in MODE 2 and for a short time in MODE 3 until the RTBs are open and SR 3.3.1.7 is no longer required to be performed. If the unit is to be in MODE 3 with the RTBs closed for > 4 hours this Surveillance must be performed prior to 4 hours after entry into MODE 3. Note 2 requires that the quarterly COT for the source range instrumentation shall include verification by observation of the associated permissive annunciator window that the P-6 and P-10 interlocks are in their required state for the existing unit conditions. If this surveillance or if SR 3.3.1.8 has been performed within the previous 92 days, the requirements of this surveillance are satisfied.

The Frequency of 92 days is justified in Reference 7.

SR 3.3.1.8

SR 3.3.1.8 is the performance of a COT as described in SR 3.3.1.7 it is modified by the same Note that this test shall include verification that the P-6 and P-10 interlocks are in their required state for the existing unit conditions by observation of the associated permissive annunciator window. The Frequency is modified by a Note that allows this surveillance to be satisfied if it has been performed within 92 days of the Frequencies prior to reactor startup, 12 hours after reducing power below P-10, and four hours after reducing power below P-6, as discussed below. The Frequency of "prior to startup" ensures this surveillance is performed prior to critical operations and applies to the source, intermediate and power range low instrument channels. The Frequency of "12 hours after reducing power below P-10" (applicable to intermediate and power range low channels) and "4 hours after reducing power below P-6" (applicable to source range channels)

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SURVEILLANCE  
REQUIREMENTS

SR 3.3.1.8 (continued)

allows a normal shutdown to be completed and the unit removed from the MODE of Applicability for this surveillance without a delay to perform the testing required by this surveillance. The Frequency of every 92 days thereafter applies if the plant remains in the MODE of Applicability after the initial performances of prior to reactor startup, 12 hours after reducing power below P-10, and four hours after reducing power below P-6. The MODE of Applicability for this surveillance is < P-10 for the power range low and intermediate range channels and < P-6 for the source range channels. Once the unit is in MODE 3, this surveillance is no longer required. If power is to be maintained < P-10 for more than 12 hours or < P-6 for more than 4 hours, then the testing required by this surveillance must be performed prior to the expiration of the 12 hour or 4 hour limit, as applicable. These time limits are reasonable, based on operating experience, to complete the required testing or place the unit in a MODE where this surveillance is no longer required. This test ensures that the NIS source, intermediate, and power range low channels are OPERABLE prior to taking the reactor critical and after reducing power into the applicable MODE (< P-10 or < P-6) for the periods discussed above.

SR 3.3.1.9

SR 3.3.1.9 is the performance of a TADOT and is performed every 92 days, as justified in Reference 7.

The SR is modified by a Note that excludes verification of setpoints from the TADOT. Since this SR applies to RCP undervoltage and underfrequency relays, setpoint verification requires elaborate bench calibration and is accomplished during the CHANNEL CALIBRATION.

SR 3.3.1.10

A CHANNEL CALIBRATION is performed every 24 months, or approximately at every refueling. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor. The test verifies that the channel responds to a measured parameter within the necessary range and accuracy.

CHANNEL CALIBRATIONS must be performed consistent with the assumptions of the DCPD setpoint methodology. The difference between the current "as found" values and the previous test "as left" values must be consistent with the drift allowance used in the setpoint methodology.

Whenever an RTD is replaced in Functions 6, 7, or 14, the next required CHANNEL CALIBRATION of the RTDs is accomplished by an in-place cross calibration that compares the other sensing elements with the recently installed sensing element.

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SR 3.3.1.10 (continued)

The Frequency of 24 months is based on the assumed calibration interval in the determination of the magnitude of equipment drift in the setpoint methodology.

SR 3.3.1.10 is modified by a Note stating that this test shall include verification that the time constants are adjusted to the prescribed values where applicable.

SR 3.3.1.11

SR 3.3.1.11 is the performance of a CHANNEL CALIBRATION, as described in SR 3.3.1.10, every 24 months. The CHANNEL CALIBRATION for the power range nuclear instruments includes a normalization of the detectors based on a power calorimetric and flux map performed above 15% RTP, and a test that shows allowed variances of detector voltage do not effect detector operation. The CHANNEL CALIBRATION for the intermediate range nuclear instruments includes a test that shows allowed variances of detector voltage do not effect detector operation. The CHANNEL CALIBRATION for the source range nuclear instruments includes obtaining detector high voltage and discriminator bias curves and using this data to evaluate detector and channel settings based on manufacturers' recommendations and industry operating experience.

This SR is modified by three Notes. Note 1 state that neutron detectors are excluded from the CHANNEL CALIBRATION. Note 2 states that the test shall include verification that the time constants are adjusted to the prescribed values where applicable. Note 3 states that, prior to entry into MODE 2 or 1, the power and intermediate range detector plateau voltage verification (as described above) is not required to be current until 72 hours after achieving equilibrium conditions with THERMAL POWER  $\geq$  95% RTP. Equilibrium conditions are achieved when the core is sufficiently stable at intended operating conditions to perform a meaningful detector plateau voltage verification. The allowance of 72 hours after equilibrium conditions are attained at the testing plateau provides sufficient time to allow power

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SURVEILLANCE  
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SR 3.3.1.11 (Continued)

ascension testing to be conducted in a controlled and orderly manner at conditions that provide acceptable results and without introducing the potential for extended operation at high power levels with instrumentation that has not been verified to be OPERABLE for subsequent use. The source range curves are obtained under the conditions that apply during a plant outage.

The 24 month Frequency is based on past operating experience, which has shown these components usually pass the Surveillance when performed on the 24 month Frequency. The conditions for obtaining the source range curves and for verifying the power and intermediate range detector operation are described above. The other remaining portions of the CHANNEL CALIBRATIONS may be performed either during a plant outage or during plant operation.

SR 3.3.1.12

SR 3.3.1.12 is the performance of a CHANNEL CALIBRATION of the seismic trip, every 24 months. For function 22, Seismic Trip, the calibration shall encompass, as a minimum, the sensor relays, the SSPS, and associated required alarms. Since it is impractical to routinely remove and ship the seismic trigger packages to an offsite facility to verify calibration on a shaker table, the sensors shall be verified by introducing a known acceleration to voltage relationship to the sensor and verifying the proper action, in accordance with the manufacturers recommendations.

The Frequency is justified by the assumption of an 24 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.

SR 3.3.1.13

SR 3.3.1.13 is the performance of a COT of RTS interlocks every 24 months.

The Frequency is based on the known reliability of the interlocks and the multichannel redundancy available, and has been shown to be acceptable through operating experience.

SR 3.3.1.14

SR 3.3.1.14 is the performance of a TADOT of the Manual Reactor Trip, RCP Breaker Position, Seismic Trip and the SI Input from ESFAS. This TADOT is performed every 24 months. The Manual Reactor Trip

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SURVEILLANCE  
REQUIREMENTS

SR 3.3.1.14 (Continued)

test shall independently verify the OPERABILITY of the undervoltage and shunt trip mechanisms for the Reactor Trip Breakers and Reactor Trip Bypass Breakers. Breaker actuation is verified using the local indicator since physical verification of the main contacts is not practical. This is acceptable based on breaker design and industry operating and maintenance experience. The Seismic Trip TADOT shall, as a minimum, verify the OPERABILITY of the channel from the seismic sensor relays to the input logic of the SSPS. The remainder of the channel is tested under the SR 3.3.1.5 or 3.3.1.12 requirements.

The Frequency is based on the known reliability of the Functions and the multichannel redundancy available, and has been shown to be acceptable through operating experience.

The SR is modified by a Note that excludes verification of setpoints from the TADOT. The Functions affected have no setpoints associated with them except for the Seismic Trip that is calibrated by SR 3.3.1.12 at the same 24 month frequency.

SR 3.3.1.15

SR 3.3.1.15 is the performance of a TADOT of Turbine Trip Functions. This TADOT is performed prior to exceeding the P-9 interlock whenever the unit has been in MODE 3. This Surveillance is not required if it has been performed within the previous 31 days. Verification of the Trip Setpoint does not have to be performed for this Surveillance. Performance of this test will ensure that the turbine trip Function is OPERABLE prior to exceeding the P-9 interlock.

SR 3.3.1.16

SR 3.3.1.16 verifies that the individual channel/train actuation response times are less than or equal to the maximum values assumed in the accident analysis. Response time testing acceptance criteria and the individual functions requiring RESPONSE TIME verification are included in Equipment Control Guideline (ECG) 38.1. Individual component response times are not modeled in the analyses.

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

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SURVEILLANCE  
REQUIREMENTS

SR 3.3.1.16 (Continued)

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

The response time testing for the SG water level low-low does not include trip time delays. Response times include the transmitters, Eagle-21 process protection cabinets, solid state protection system cabinets, and actuation devices only. This reflects the response times necessary for THERMAL POWER in excess of 50 percent RTP. For those functions without a specified response time, SR 3.3.1.16 is not applicable.

Response time may be verified by actual response time tests in any series of sequential, overlapping or total channel measurements, or by the summation of allocated sensor response times with actual response time tests on the remainder of the channel. Allocations for sensor response times may be obtained from: (1) historical records based on acceptable response time tests (hydraulic, noise, or power interrupt tests), (2) inplace, onsite, or offsite (e.g. vendor) test measurements, or (3) utilizing vendor engineering specifications. WCAP-13632-P-A Revision 2, "Elimination of Pressure Sensor Response Time Testing Requirements" (Ref. 8) provides the basis and methodology for using allocated sensor response times in the overall verification of the channel response time for specific sensors identified in the WCAP. Response time verification for other sensor types must be demonstrated by test.

The allocations for sensor response times must be verified prior to placing the component in initial operational service and re-verified following maintenance that may adversely affect response time. In general, electrical repair work does not impact response time provided the parts used for repair are of the same type and value. One example where response time could be affected is replacing the sensing assembly of a transmitter.

As appropriate, each channel's response time must be verified every 24 months on a STAGGERED TEST BASIS. Each verification shall

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SR 3.3.1.16 (Continued)

include at least one train such that both trains are verified at least once per 48 months and one channel per function such that all channels are tested at least once every N times 24 months where N is the total number of redundant channels in a specific RT function. Testing of the final actuation devices is included in the verification. Response times cannot be determined during unit operation because equipment operation is required to measure response times. Experience has shown that these components usually pass this surveillance when performed at the 24 month Frequency. Therefore, the Frequency was concluded to be acceptable from a reliability standpoint.

SR 3.3.1.16 is modified by a Note stating that neutron detectors are excluded from RTS RESPONSE TIME testing. This Note is necessary because of the difficulty in generating an appropriate detector input signal. Excluding the detectors is acceptable because the principles of detector operation ensure a virtually instantaneous response. The source range preamplifiers are also excluded. This is acceptable because the principles of operation of the preamplifier have been evaluated and a determination made that there are no credible failure mechanisms that could affect response time that would not be detected during routine testing. Response time of the neutron flux signal portion of the channel shall be measured from detector output or input to the first electronic component in the channel, exclusive of the preamplifier.

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REFERENCES

1. FSAR, Chapter 7.
2. FSAR, Chapter 6.
3. FSAR, Chapter 15.
4. IEEE-279-1971.
5. 10 CFR 50.49.
6. Blank
7. WCAP-10271-P-A, Supplement 2, Rev. 1, June 1990.

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REFERENCES  
(Continued)

8. WCAP 13632 - PA-1, Rev. 2 "Elimination of Pressure Sensor Response Time Testing Requirements."
  9. FSAR, Chapter 9.2.7 & 9.2.2.
  10. FSAR, Chapter 10.3 & 10.4
  11. FSAR, Chapter 8.3.
  12. DCM S-38A, "Plant Protection System"
  13. WCAP-13878, "Reliability of Potter & Brumfield MDR Relays", June 1994.
  14. WCAP-13900, "Extension of Slave Relay Surveillance Test intervals", April 1994.
  15. WCAP-14117, "Reliability Assessment of Potter and Brumfield MDR Series Relays."
  16. WCAP-9226, "Reactor Core Response to Excessive Secondary Steam Releases," Revision 1, January 1978.
  17. WCAP-11082, Rev. 5, "Westinghouse Setpoint Methodology for Protection Systems, Diablo Canyon Units 1 and 2, 24 Month Fuel Cycle Evaluation," January 1997.
  18. NSP-1-20-13F Unit 1 "Turbine Auto Stop Low Oil Pressure."
  19. NSP-2-20-13F Unit 2 "Turbine Auto Stop Low Oil Pressure."
  20. J-110 "24 Month Fuel Cycle Allowable Value Determination / Documentation and ITDP Uncertainty Sensitivity."
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## B 3.3 INSTRUMENTATION

### B 3.3.2 Engineered Safety Feature Actuation System (ESFAS) Instrumentation

#### BASES

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##### BACKGROUND

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

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

- Field transmitters or process sensors and instrumentation: provide a measurable electronic signal based on the physical characteristics of the parameter being measured;
- Signal processing equipment including digital protection system, field contacts, and protection channel sets: provide signal conditioning, bistable setpoint comparison, process algorithm actuation, compatible electrical signal output to protection system devices, and control board/control room/miscellaneous indications; and
- Solid State Protection System (SSPS) including input, logic, and output bays: initiates the proper unit shutdown or engineered safety feature (ESF) actuation in accordance with the defined logic and based on the bistable outputs from the signal process control and protection system. The residual heat removal pump trip or refueling water storage tank level-low signal is not processed by the SSPS. The associated relays are located in the residual heat removal pumps control system.

##### Field Transmitters or Sensors

To meet the design demands for redundancy and reliability, more than one, and often as many as four, field transmitters or sensors are used to measure unit parameters. In many cases, field transmitters or sensors that input to the ESFAS are shared with the Reactor Trip System (RTS). In some cases, the same channels also provide control system inputs. To account for calibration tolerances and instrument drift, which are assumed to occur between calibrations, statistical allowances are provided in the Trip Setpoint and Allowable Values. The OPERABILITY of each transmitter or sensor can be evaluated when its "as found" calibration data are compared against its documented acceptance criteria.

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BACKGROUND  
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Signal Processing Equipment

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

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

Generally, if a parameter is used for input to the SSPS and a control function, four channels with a two-out-of-four logic are sufficient to provide the required reliability and redundancy. In the case of the Digital Feedwater Control System (DFWCS), the median/signal select (MSS) feature prevents control/protection interaction even though there are only three inputs and 2-out-of-3 logic. The circuit must be able to withstand both an input failure to the control system, which may then require the protection function actuation, and a single failure in the other channels providing the protection function actuation. Again, a single failure will neither cause nor prevent the protection function actuation.

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

The channels are designed such that testing required to be performed at power may be accomplished without causing an ESF actuation. The Process Protection System is designed to permit any one channel to be tested and maintained at power in a bypass mode.

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### BACKGROUND

#### Signal Processing Equipment (continued)

If a channel has been bypassed for any purpose, the bypass is continuously indicated in the control room as required by applicable codes and standards. As an alternate to testing in the bypass mode, testing in the trip mode is also possible and permitted.

#### Trip Setpoints and Allowable Values

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

The Trip Setpoints used in the bistables are based on the analytical limits stated in Reference 2. The selection of these Trip Setpoints is such that adequate protection is provided when all sensor and processing time delays are taken into account. To allow for calibration tolerances, instrumentation uncertainties, instrument drift, and severe environment errors for those ESFAS channels that must function in harsh environments as defined by 10 CFR 50.49 (Ref. 5), the Trip Setpoints and Allowable Values specified in Table 3.3.2-1 in the accompanying LCO are conservatively adjusted with respect to the analytical limits. A detailed description of the methodology used to calculate the Trip Setpoints, including their explicit uncertainties, is provided in WCAP-11082, Rev. 5, "Westinghouse Setpoint Methodology for Protection Systems Diablo Canyon Units 1 & 2, 24 Month Fuel Cycle Evaluation," January 1997 (Ref. 12), calculation J-54 Rev 15 (Ref. 13) and calculation J-110 Rev 5 (Ref. 14). Interlock setpoints are nominal values provided in the PLS (Westinghouse Precautions Limitations and Setpoints) and their allowable values are calculated in Calculation J-110 Rev. 5 (Ref. 14). The actual nominal Trip Setpoint entered into the bistable is more conservative than that specified by the Allowable Value to account for Rack Drift and Rack Measuring and Test Equipment uncertainties. The calibration tolerance, after conversion, should correspond to the rack comparator setting accuracy defined in the latest setpoint study. One example of such a change in measurement error is drift during the surveillance interval. If the measured setpoint does not exceed the Allowable Value, the bistable is considered OPERABLE. Rack drift in excess of the Allowable Value exhibits the behavior that the rack has not met its allowance. Since there is a small statistical chance that this will happen, an infrequent excessive drift is expected. Rack or sensor drift in excess of the allowance that is more than occasional may be indicative of more serious problems and warrants further investigation.

(continued)

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Trip Setpoints and Allowable Values (continued)

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

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

The Trip Setpoints and Allowable Values listed in Table 3.3.2-1 are based on the methodology described in Reference 12, 13, and 14, which incorporates all of the known uncertainties applicable for each channel. The magnitudes of these uncertainties are factored into the determination of each Trip Setpoint. In the event a channel's setpoint is found nonconservative with respect to the specified Trip Setpoint, but more conservative than the Allowable Value, the setpoint must be adjusted consistent with the Trip Setpoint value. When a channel's Trip Setpoint is nonconservative with respect to the Allowable Value, declare the channel inoperable and apply the applicable ACTION statement until the channel is returned to OPERABLE status with its Setpoint adjusted consistent with the Trip Setpoint value. All field sensors and signal processing equipment for these channels are assumed to operate within the allowances of these uncertainty magnitudes.

The ESFAS Trip Setpoints may be administratively redefined in the conservative direction for several reasons including startup, testing, process error accountability, or even a conservative response for equipment malfunction or inoperability. ESFAS functions are not historically redefined at the beginning of each cycle for purposes of startup or testing as several reactor Trip functions are. However, calibration to within the defined calibration tolerance of an administratively redefined, conservative Trip Setpoint is acceptable. Redefinition at full power conditions for these functions is expected and acceptable.

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(continued)

Solid State Protection System

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

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

The bistable outputs from the signal processing equipment are sensed by the SSPS equipment and combined into logic matrices that represent combinations indicative of various transients. If a required logic matrix combination is completed, the system will send actuation signals via master and slave relays to those components whose aggregate Function best serves to alleviate the condition and restore the unit to a safe condition. Examples are given in the Applicable Safety Analyses, LCO, and Applicability sections of this Bases.

Each SSPS train has a built in testing device that can automatically test the decision logic matrix functions and the actuation devices while the unit is at power. When any one train is taken out of service for testing, the other train is capable of providing unit monitoring and protection until the testing has been completed. The testing device is semiautomatic to minimize testing time.

The actuation of ESF components is accomplished through master and slave relays. The SSPS energizes the master relays appropriate for the condition of the unit. Each master relay then energizes one or more slave relays, which then cause actuation of the end devices. The master and slave relays are routinely tested to ensure operation. The test of the master relays energizes the relay, which then operates the contacts and applies a low voltage to the associated slave relays. The low voltage is not sufficient to actuate the slave relays but only demonstrates signal path continuity. The SLAVE RELAY TEST actuates the devices if their operation will not interfere with continued unit operation. For the latter case, actual component operation is prevented by the SLAVE RELAY TEST circuit, and slave relay contact

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Solid State Protection System (continued)

operation is verified by a continuity check of the circuit containing the slave relay. The SLAVE RELAY TEST interval is 24 months. The test frequency is based on relay reliability assessments presented in WCAP-13878, "Reliability Assessment of Potter and Brumfield MDR Series Relays," WCAP-13900, "Extension of Slave Relay Surveillance Test Intervals," and WCAP-14117, "Reliability Assessment of Potter and Brumfield MDR Series Relay." These reliability assessments are relay specific and apply only to Potter and Brumfield MDR series relays which are the only relays used in the ESF actuation system. Note that for normally energized applications, the relays may have to be replaced periodically in accordance with the guidance given in WCAP-13878 for MDR relays.

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Each of the analyzed accidents can be detected by one or more ESFAS Functions. One of the ESFAS Functions is the primary actuation signal for that accident. An ESFAS Function may be the primary actuation signal for more than one type of accident. An ESFAS Function may also be a secondary, or backup, actuation signal for one or more other accidents. Functions such as manual initiation, not specifically credited in the accident safety analysis, are qualitatively credited in the safety analysis and the NRC staff approved licensing basis for the unit. These Functions may provide protection for conditions that do not require dynamic transient analysis to demonstrate Function performance. These Functions may also serve as backups to Functions that were credited in the accident analysis (Ref. 3).

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

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

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

1. Safety Injection

Safety Injection (SI) provides two primary functions:

1. Primary side water addition to ensure maintenance or recovery of reactor vessel water level (coverage of the active fuel for heat removal, clad integrity, and for limiting peak clad temperature to  $< 2200^{\circ}\text{F}$ ); and
2. Boration to ensure recovery and maintenance of SDM ( $k_{\text{eff}} < 1.0$ ).

These functions are necessary to mitigate the effects of high energy line breaks (HELBs) both inside and outside of containment. The SI signal is also used to initiate other Functions such as:

- Phase A Isolation;
- Containment Ventilation Isolation;
- Reactor Trip;
- Turbine Trip from Reactor Trip with P-9;
- Feedwater Isolation and Feedwater Pump Turbine Trip;
- Start of motor driven auxiliary feedwater (AFW) pumps;
- Control room ventilation to pressurization mode via Phase A isolation, and Auxiliary Building to "Building and Safeguards or Safeguards Only" mode;
- Start of the diesel generators (DGs) and transfer to the startup bus;
- Start of the containment fan cooler units (CFCUs) in low speed;
- Start of the component cooling water and auxiliary salt water pumps;
- Input to containment spray pump and discharge valve auto start (with containment spray signal);
- Isolate SG sample blowdown lines.

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1. Safety Injection (continued)

These other functions ensure:

- Isolation of nonessential systems through containment penetrations;
- Trip of the turbine and reactor to limit power generation;
- Isolation of main feedwater (MFW) to limit secondary side mass losses;
- Start of AFW to ensure secondary side cooling capability;
- Transfer of the control room ventilation to ensure habitability;
- Transfer of the auxiliary building ventilation to ensure ventilation cooling to the ESF pump rooms;
- Start of the DGs to compensate for a possible loss of offsite power (LOOP); and
- Start of the components associated with the accident heat removal systems.

a. Safety Injection -- Manual Initiation

The LCO requires one channel per train to be OPERABLE. The operator can initiate SI at any time by using either of two switches in the control room. This action will cause actuation of all components in the same manner as any of the automatic actuation signals.

The LCO for the Manual Initiation Function ensures the proper amount of redundancy is maintained in the manual ESFAS actuation circuitry to ensure the operator has manual ESFAS initiation capability.

Each channel consists of one control switch and the interconnecting wiring to the actuation logic cabinet. Each control switch actuates both trains. This configuration does not allow testing at power.

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b. Safety Injection-Automatic Actuation Logic and Actuation Relays

This LCO requires two trains to be OPERABLE. Actuation logic consists of all circuitry housed within the actuation subsystems, including the initiating relay contacts responsible for actuating the ESF equipment.

Manual and automatic initiation of SI must be OPERABLE in MODES 1, 2, 3, and 4. In these MODES, there is sufficient energy in the primary and secondary systems to warrant automatic initiation of ESF systems. Because of the large number of components actuated on a SI, actuation is simplified by the use of the manual actuation control switches. Automatic actuation logic and actuation relays must be OPERABLE in MODE 4 to support system level manual initiation.

These Functions are not required to be OPERABLE in MODES 5 and 6 because there is adequate time for the operator to evaluate unit conditions and respond by manually starting individual systems, pumps, and other equipment to mitigate the consequences of an abnormal condition or accident. Unit pressure and temperature are very low and many ESF components are administratively locked out or otherwise prevented from actuating to prevent inadvertent overpressurization of unit systems.

c. Safety Injection-Containment Pressure-High

This signal provides protection against the following accidents:

- SLB inside containment;
- LOCA; and
- Feed line break inside containment.

Containment Pressure-High provides no input to any control functions. Thus, three OPERABLE channels are sufficient to satisfy protective requirements with a two-out-of-three logic. The transmitters (d/p cells) and electronics are located outside of containment with the sensing line (high pressure side of the transmitter) located inside containment.

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c. Safety Injection-Containment Pressure-High (continued)

Thus, the high pressure Function will not experience any adverse environmental conditions and the Trip Setpoint reflects only steady state instrument uncertainties.

Containment Pressure-High must be OPERABLE in MODES 1, 2, 3, and 4 when there is sufficient energy in the primary and secondary systems to pressurize the containment following a pipe break. In MODES 5, and 6, there is insufficient energy in the primary or secondary systems to pressurize the containment.

d. Safety Injection-Pressurizer Pressure-Low

This signal provides protection against the following accidents:

- Inadvertent opening of a steam generator (SG) relief or safety valve;
- SLB;
- A spectrum of rod cluster control assembly ejection accidents (rod ejection);
- Inadvertent opening of a pressurizer relief or safety valve;
- LOCAs; and
- SG Tube Rupture.

Pressurizer pressure provides both control and protection functions: input to the Pressurizer Pressure Control System, reactor trip, and SI. Therefore, the actuation logic must be able to withstand both an input failure to control system, which may then require the protection function actuation, and a single failure in the other channels providing the protection function actuation. Thus, four OPERABLE channels are required to satisfy the requirements with a two-out-of-four logic.

The transmitters are located inside containment, with the taps in the vapor space region of the pressurizer, and thus possibly experiencing adverse environmental conditions (LOCA, SLB inside containment, rod ejection). Therefore, the Trip Setpoint reflects the inclusion of both steady state and adverse environmental instrument uncertainties.

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d. Safety Injection-Pressurizer Pressure-Low (continued)

This Function must be OPERABLE in MODES 1, 2, and 3 (above P-11 interlock and below P-11 interlock, unless the Safety Injection - Pressurizer Pressure - Low Function is blocked) to mitigate the consequences of an HELB inside containment. This signal may be manually blocked by the operator below the P-11 setpoint. Automatic SI actuation below this pressure setpoint is then performed by the Containment Pressure-High signal.

This Function is not required to be OPERABLE in MODE 3 below the P-11 interlock. In MODES 4, 5, and 6, this Function is not needed for accident detection and mitigation.

e. Safety Injection-Steam Line Pressure

(1) Steam Line Pressure-Low

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

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

Steam Line Pressure-Low provides input to the DFWCS functions. The MSS function prevents the excursion of one of the inputs from causing a process disturbance that would require protective action from the remaining channels on the affected steam line. Thus, three OPERABLE channels on each steam line are sufficient to satisfy the protective requirements with a two-out-of-three logic on each steam line.

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

This Function is anticipatory in nature and has a lead/lag ratio of 50/5.

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e. Safety Injection-Steam Line Pressure (continued)

Steam Line Pressure-Low must be OPERABLE in MODES 1, 2, and 3 (above P-11 interlock and below P-11 interlock, unless the Safety Injection - Steam Line Pressure - Low Function is blocked) when a secondary side break or stuck open valve could result in the rapid depressurization of the steam lines. This signal may be manually blocked by the operator below the P-11 setpoint. This Function is not required to be OPERABLE in MODE 4, 5, or 6 because there is insufficient energy in the secondary side of the unit to cause an accident.

(2) Not used

f, g. Not used

2. Containment Spray

Containment Spray coincident with an SI signal provides three primary functions:

1. Lowers containment pressure and temperature after an HELB in containment;
2. Reduces the amount of radioactive iodine in the containment atmosphere; and
3. Adjusts the pH of the water in the containment recirculation sump after a large break LOCA.

These functions are necessary to:

- Ensure the pressure boundary integrity of the containment structure;
- Limit the release of radioactive iodine to the environment in the event of a failure of the containment structure; and
- Minimize corrosion of the components and systems inside containment following a LOCA.

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2. Containment Spray (continued)

The containment spray actuation signal coincident with SI starts the containment spray pumps and aligns the discharge of the pumps to the containment spray nozzle headers in the upper levels of containment. Water is initially drawn from the RWST by the containment spray pumps and mixed with a sodium hydroxide solution from the spray additive tank. When the RWST reaches the low low level setpoint, the spray pumps are manually tripped. Spray flow can then be shifted to the RHR system if continued containment spray is required. Containment spray is actuated by Containment Pressure-High High coincident with an SI signal.

a. Containment Spray-Manual Initiation

The operator can manually initiate containment spray from the control room if an SI signal is present by simultaneously turning both Containment Isolation Phase "B" (containment spray) actuate Trains A & B switches. Because an inadvertent actuation of containment spray could have such serious consequences, two switches must be turned simultaneously and an SI signal must be present to initiate containment spray. Simultaneously turning the two switches in either set will actuate containment spray in both trains in the same manner as the automatic actuation signal. Two Manual Initiation switches in each train are required to be OPERABLE. Note that Manual Initiation of containment spray also actuates Phase B containment isolation and CVI.

b. Containment Spray-Automatic Actuation Logic and Actuation Relays

Automatic actuation logic and actuation relays consist of the same features and operate in the same manner as described for ESFAS Function 1.b.

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b. Containment Spray-Automatic Actuation Logic and Actuation Relays (continued)

Manual and automatic initiation of containment spray must be OPERABLE in MODES 1, 2, 3, and 4 when there is a potential for an accident to occur, and sufficient energy in the primary or secondary systems to pose a threat to containment integrity due to overpressure conditions. Because of the large number of components actuated on a containment spray, actuation is simplified by the use of the manual actuation control switches. Automatic actuation logic and actuation relays must be OPERABLE in MODE 4 to support system level manual initiation. In MODES 5 and 6, there is insufficient energy in the primary and secondary systems to result in containment overpressure. In MODES 5 and 6, there is also adequate time for the operators to evaluate unit conditions and respond, to mitigate the consequences of abnormal conditions by manually starting individual components.

c. Containment Spray-Containment Pressure

This signal provides protection against a LOCA or an SLB inside containment. The transmitters (d/p cells) are located outside of containment with the sensing line (high pressure side of the transmitter) located inside containment. The transmitters and electronics are located outside of containment. Thus, they will not experience any adverse environmental conditions and the Trip Setpoint reflects only steady state instrument uncertainties.

This is one of the Functions that requires the bistable output to energize to perform its required action. It is not desirable to have a loss of power actuate containment spray, since the consequences of an inadvertent actuation of containment spray could be serious. Note that this Function also has the inoperable channel placed in bypass rather than trip to decrease the probability of an inadvertent actuation.

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c. Containment Spray-Containment Pressure (continued)

The logic configuration is a two-out-of-four. This configuration is called the Containment Pressure-High High Setpoint. Additional redundancy is warranted because this Function is energize to trip. Containment Pressure- High High must be OPERABLE in MODES 1, 2, 3, and 4 when there is sufficient energy in the primary and secondary sides to pressurize the containment following a pipe break. In MODES 5, and 6, there is insufficient energy in the primary and secondary sides to pressurize the containment and reach the Containment Pressure- High High setpoints.

3. Containment Isolation

Containment Isolation provides isolation of the containment atmosphere, and all process systems that penetrate containment, from the environment. This Function is necessary to prevent or limit the release of radioactivity to the environment in the event of a large break LOCA.

There are two separate Containment Isolation signals, Phase A and Phase B. Phase A isolation isolates all automatically isolable process lines, except component cooling water (CCW), at a relatively low containment pressure indicative of primary or secondary system leaks. For these types of events, forced circulation cooling using the reactor coolant pumps (RCPs) and SGs is the preferred (but not required) method of decay heat removal. Since CCW is required to support RCP operation, not isolating CCW on the low pressure Phase A signal enhances unit safety by allowing operators to use forced RCS circulation to cool the unit. Isolating CCW on the low pressure signal may force the use of feed and bleed cooling, which could prove more difficult to control.

Phase A containment isolation is actuated automatically by SI, or manually via the automatic actuation logic. All process lines penetrating containment, with the exception of CCW, are isolated. CCW is not isolated at this time to permit continued operation of the RCPs with cooling water flow to the thermal barrier heat exchangers and oil coolers. All process lines not equipped with remote operated isolation valves are manually closed, or otherwise isolated, prior to reaching MODE 4.

Manual Phase A Containment Isolation is accomplished by either of two switches in the control room. Either switch actuates both trains. Note that manual actuation of Phase A Containment Isolation also actuates Containment Ventilation Isolation.

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3. Containment Isolation (continued)

The Phase B signal isolates CCW. This occurs at a relatively high containment pressure that is indicative of a large break LOCA or an SLB. For these events, forced circulation using the RCPs is no longer desirable. Isolating the CCW at the higher pressure does not pose a challenge to the containment boundary because the CCW System is a closed loop inside containment. Although some system components do not meet all of the ASME Code requirements applied to the containment itself, the system is continuously pressurized to a pressure greater than the Phase B setpoint. Thus, routine operation demonstrates the integrity of the system pressure boundary for pressures exceeding the Phase B setpoint. Furthermore, because system pressure exceeds the Phase B setpoint, any system leakage prior to initiation of Phase B isolation would be into containment. Therefore, the combination of CCW System design and Phase B isolation ensures the CCW System is not a potential path for radioactive release from containment except for leakage in a containment fan cooler coil following an accident. The radioactivity associated with the leak would actuate the CCW system radiation monitor. The monitor in turn would annunciate in the control room and close the vent valve located just up-stream of the CCW surge tank back-pressure regulator to prevent the regulator from venting after sensing high tank pressure. The operator could then take appropriate action to isolate the failed component. In addition to the radiation monitoring system, the condition of high level and high pressure in the surge tank would be annunciated as the tank filled. If the in-leakage continues after the vent is closed, the surge tank pressure would increase until the high surge tank pressure alarm annunciated and the relief valve setpoint was reached. The relief valve on the surge tank will protect the surge tank from overpressurization. Relief valve discharge from the CCW surge tank is routed to the skirted area under the surge tank, which then enters a floor drain routed to the auxiliary building sump.

Phase B containment isolation is actuated by Containment Pressure-High High, or manually, via the automatic actuation logic, as previously discussed. For containment pressure to reach a value high enough to actuate Containment Pressure-High High, a large break LOCA or SLB must have occurred and containment spray must have been actuated. RCP operation will no longer be required and CCW to the RCPs is, therefore, no longer necessary. The RCPs can be operated with seal injection flow alone and without CCW flow to the thermal barrier heat exchanger.

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3. Containment Isolation (continued)

Manual Phase B Containment Isolation is accomplished by the same switches that actuate Containment Spray. When the two switches are operated simultaneously, Phase B Containment Isolation and Containment Spray will be actuated in both trains.

a. Containment Isolation-Phase A Isolation

(1) Phase A Isolation-Manual Initiation

Manual Phase A Containment Isolation is actuated by either of two switches in the control room. Either switch actuates both trains. Note that manual initiation of Phase A Containment Isolation also actuates Containment Ventilation Isolation.

(2) Phase A Isolation-Automatic Actuation Logic and Actuation Relays

Automatic Actuation Logic and Actuation Relays consist of the same features and operate in the same manner as described for ESFAS Function 1.b.

Manual and automatic initiation of Phase A Containment Isolation must be OPERABLE in MODES 1, 2, 3, and 4, when there is a potential for an accident to occur. Because of the large number of components actuated on a Phase A Containment Isolation, actuation is simplified by the use of the manual actuation control switches. Automatic actuation logic and actuation relays must be OPERABLE in MODE 4 to support system level manual initiation. In MODES 5 and 6, there is insufficient energy in the primary or secondary systems to pressurize the containment to require Phase A Containment Isolation. There also is adequate time for the operator to evaluate unit conditions and manually actuate individual isolation valves in response to abnormal or accident conditions.

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(3) Phase A Isolation-Safety Injection

Phase A Containment Isolation is also initiated by all Functions that initiate SI. The Phase A Containment Isolation requirements for these Functions are the same as the requirements for their SI function. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead, Function 1, SI, is referenced for all initiating Functions and requirements.

b. Containment Isolation-Phase B Isolation

Phase B Containment Isolation is accomplished by Manual Initiation, Automatic Actuation Logic and Actuation Relays, and by Containment Pressure channels (the same channels that actuate Containment Spray, Function 2). The Containment Pressure trip of Phase B Containment Isolation is energized to trip in order to minimize the potential of spurious trips that may damage the RCPs.

(1) Phase B Isolation-Manual Initiation

(2) Phase B Isolation-Automatic Actuation Logic and Actuation Relays

Manual and automatic initiation of Phase B containment isolation must be OPERABLE in MODES 1, 2, 3, and 4 when there is a potential for an accident to occur. Because of the large number of components actuated on a Phase B containment isolation, actuation is simplified by the use of the manual actuation switches. In MODES 5 and 6, there is insufficient energy in the primary or secondary systems to pressurize the containment to require Phase B containment isolation. There also is adequate time for the operator to evaluate unit conditions and manually actuate individual isolation valves in response to abnormal or accident conditions.

(3) Phase B Isolation -- Containment Pressure

The basis for containment pressure MODE applicability is as discussed for ESFAS Function 2.c above.

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4. Steam Line Isolation

Isolation of the main steam lines provides protection in the event of an SLB inside or outside containment. Rapid isolation of the steam lines will limit the steam break accident to the blowdown from one SG, at most. For an SLB upstream of the main steam isolation valves (MSIVs), inside or outside of containment, closure of the MSIVs limits the accident to the blowdown from only the affected SG. For an SLB downstream of the MSIVs, closure of the MSIVs terminates the accident as soon as the steam lines depressurize.

a. Steam Line Isolation-Manual Initiation

Manual initiation of Steam Line Isolation can be accomplished from the control room via an individual switch for each valve. The LCO requires one channel per valve to be OPERABLE.

b. Steam Line Isolation-Automatic Actuation Logic and Actuation Relays

Automatic actuation logic and actuation relays consist of the same features and operate in the same manner as described for ESFAS Function 1.b.

Manual and automatic initiation of steam line isolation must be OPERABLE in MODES 1, 2, and 3 when there is sufficient energy in the RCS and SGs to have an SLB or other accident. This could result in the release of significant quantities of energy and cause a cooldown of the primary system. The Steam Line Isolation Function is required in MODES 2 and 3 unless all MSIVs are closed and de-activated, i.e. actions are taken to ensure the valves cannot be inadvertently opened. In MODES 4, 5, and 6, there is insufficient energy in the RCS and SGs to experience an SLB or other accident releasing significant quantities of energy.

c. Steam Line Isolation-Containment Pressure-High-High

This Function actuates closure of the MSIVs in the event of a LOCA or an SLB inside containment to limit the mass and energy release to containment from a single SG. The transmitters (d/p cells) are located outside containment with the sensing line (high pressure side of the transmitter) located inside containment. Containment Pressure — High-High provides no input to any control functions. Thus, three OPERABLE channels are sufficient to satisfy protective requirements with two-out-of-three logic. However, for

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c. Steam Line Isolation-Containment Pressure-High-High  
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enhanced reliability, this Function was designed with four channels and a two-out-of-four logic. The transmitters and electronics are located outside of containment. Thus, they will not experience any adverse environmental conditions, and the Trip Setpoint reflects only steady state instrument uncertainties.

Containment Pressure-High-High must be OPERABLE in MODES 1, 2, and 3, when there is sufficient energy in the primary and secondary side to pressurize the containment following a pipe break. This would cause a significant increase in the containment pressure, thus allowing detection and closure of the MSIVs. The Steam Line Isolation Function remains OPERABLE in MODES 2 and 3 unless all MSIVs are closed and de-activated, i.e., actions are taken to assure that the valve cannot be inadvertently opened. In MODE 4, the increase in containment pressure following a pipe break would occur over a relatively long time period such that manual action could reasonably be expected to provide protection and ESFAS Function 4.d need not be OPERABLE. In MODES 4, 5, and 6, there is not enough energy in the primary and secondary sides to pressurize the containment to the Containment Pressure-High-High setpoint

d. Steam Line Isolation-Steam Line Pressure

(1) Steam Line Pressure-Low

Steam Line Pressure-Low provides closure of the MSIVs in the event of an SLB to maintain at least one unfaulted SG as a heat sink for the reactor, and to limit the mass and energy release to containment. This Function provides closure of the MSIVs in the event of a feed line break to ensure a supply of steam for the turbine driven AFW pump. Steam Line Pressure-Low was discussed previously under SI Function 1.e.1.

Steam Line Pressure-Low Function must be OPERABLE in MODES 1, 2, and 3 (above P-11 interlock and below P-11 interlock if the Steam Line Pressure - Low function is not blocked), with any main steam valve open, when a secondary side break or stuck open valve could result in the rapid depressurization of the steam lines. This signal may be manually blocked by the operator below

(continued)

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- (1) Steam Line Pressure-Low (continued)  
the P-11 setpoint. Below P-11 when blocked, an inside containment SLB will be terminated by automatic actuation via Containment Pressure-High-High. Stuck valve transients and outside containment SLBs will be terminated by the Steam Line Pressure-Negative Rate-High signal for Steam Line Isolation below P-11 when SI has been manually blocked. The Steam Line Isolation Function is required in MODES 2 and 3 unless all MSIVs are closed and de-activated, i.e., actions are taken to ensure the valves cannot be inadvertently opened. This Function is not required to be OPERABLE in MODES 4, 5, and 6 because there is insufficient energy in the secondary side of the unit to have an accident.
- (2) Steam Line Pressure-Negative Rate-High  
Steam Line Pressure-Negative Rate-High provides closure of the MSIVs for an SLB when less than the P-11 setpoint, to maintain at least one unfaulted SG as a heat sink for the reactor, and to limit the mass and energy release to containment. When the operator manually blocks the Steam Line Pressure-Low main steam isolation signal when less than the P-11 setpoint, the Steam Line Pressure-Negative Rate-High signal is automatically enabled. Steam Line Pressure-Negative Rate-High provides no input to any control functions. Thus, three OPERABLE channels are sufficient to satisfy requirements with a two-out-of-three logic on each steam line.  
  
Steam Line Pressure-Negative Rate-High must be OPERABLE in MODE 3 (trip coincidence 2 per steam line in any steam line) when less than the P-11 setpoint, when a secondary side break or stuck open valve could result in the rapid depressurization of the steam line(s). In MODES 1 and 2, and in MODE 3, when above the P-11 setpoint, this signal is automatically disabled and the Steam Line Pressure-Low signal is automatically enabled. When below P-11, this Function is automatically blocked when Safety Injection on Steam Line Pressure-Low is not blocked. The Steam Line Isolation Function is required to be OPERABLE in MODES 2 and 3 unless all MSIVs are closed and de-activated, i.e., actions are taken to ensure the valves cannot be inadvertently opened. In MODES 4, 5, and 6,  
(continued)

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(2) Steam Line Pressure-Negative Rate-High (continued)

there is insufficient energy in the primary and secondary sides to have an SLB or other accident that would result in a release of significant enough quantities of energy to cause a cooldown of the RCS.

While the transmitters may experience elevated ambient temperatures due to an SLB, the trip function is based on rate of change, not the absolute accuracy of the indicated steam pressure. Therefore, the Trip Setpoint reflects only steady state instrument uncertainties.

e, f. Not used

g. Not used

h. Not used

5. Turbine Trip and Feedwater Isolation

The primary functions of the Turbine Trip and Feedwater Isolation signals are to prevent damage to the turbine due to water in the steam lines, and to stop the excessive flow of feedwater into the SGs. These Functions are necessary to mitigate the effects of a high water level in the SGs, which could result in carryover of water into the steam lines and excessive cooldown of the primary system. The SG high water level is due to excessive feedwater flows.

The Function is actuated when the level in any SG exceeds the high high setpoint, and performs the following functions:

- Trips the main turbine;
- Trips the MFW pumps;
- Initiates feedwater isolation; and
- Shuts the MFW regulating valves and the bypass feedwater regulating valves coincident with P-4.

This Function is actuated by SG Water Level-High High or by an SI signal. The RTS also initiates a turbine trip signal whenever a reactor trip (P-4) is generated. In the event of SI, the unit is taken off line and the turbine generator must be tripped. The MFW System is also taken out of operation and the AFW System is automatically started. The SI signal was discussed previously.

(continued)

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- a. Turbine Trip and Feedwater Isolation-Automatic Actuation Logic and Actuation Relays  
Automatic Actuation Logic and Actuation Relays consist of the same features and operate in the same manner as described for ESFAS Function 1.b.
- b. Turbine Trip and Feedwater Isolation-Steam Generator Water Level-High High (P-14)  
This signal provides protection against excessive feedwater flow. The ESFAS SG water level instruments provide input to the SG Water Level Control System. Therefore, the actuation logic must be able to withstand both an input failure to the control system (which may then require the protection function actuation) and a single failure in the other channels providing the protection function actuation. Thus, three OPERABLE channels (narrow range instrument span for each generator) are required to satisfy the requirements with a two-out-of-three logic and a median signal selector is provided to prevent control and protection function interactions.  
  
The transmitters (d/p cells) are located inside containment. However, the events that this Function protects against cannot cause a severe environment in containment. Therefore, the Trip Setpoint reflects only steady state instrument uncertainties.
- c. Turbine Trip and Feedwater Isolation-Safety Injection  
Turbine Trip and Feedwater Isolation is also initiated by all Functions that initiate SI. The Feedwater Isolation Function requirements for these Functions are the same as the requirements for their SI function. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead Function 1, SI, is referenced for all initiating functions and requirements.  
  
Turbine Trip and Feedwater Isolation Functions must be OPERABLE in MODES 1 and 2 except when all MFIVs, MFRVs, and associated bypass valves are closed and de-activated or isolated by a closed manual valve when the MFW System is in operation and the turbine generator may be in operation. In MODES 3, 4, 5, and 6, the MFW System and the turbine generator are not in service and this Function is not required to be OPERABLE.

(continued)

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6. Auxiliary Feedwater

The AFW System is designed to provide a secondary side heat sink for the reactor in the event that the MFW System is not available. The system has two motor driven pumps and a turbine driven pump, making it available during normal unit operation, during a loss of AC power, a loss of MFW, and during a Feedwater System pipe break. The normal source of water for the AFW System is the condensate storage tank (CST) . The AFW System is aligned so that upon a pump start, flow is initiated to the respective SGs immediately.

a. Auxiliary Feedwater - Manual Initiation

Manual initiation of Auxiliary Feedwater can be accomplished from the Control Room. Each of the three AFW pumps has a switch for manual initiation. The LCO requires three channels to be OPERABLE.

b. Auxiliary Feedwater-Automatic Actuation Logic and Actuation Relays (Solid State Protection System)

Automatic actuation logic and actuation relays consist of the same features and operate in the same manner as described for ESFAS Function 1.b.

c. Not used

d.1) Auxiliary Feedwater-Steam Generator Water Level-Low Low

SG Water Level-Low Low provides protection against a loss of heat sink. A feed line break, inside or outside of containment, or a loss of MFW, would result in a loss of SG water level. SG Water Level-Low Low provides input to the SG Level Control System. Therefore, the actuation logic must be able to withstand both an input failure to the control system which may then require a protection function actuation and a single failure in the other channels providing the protection function actuation. Thus, three OPERABLE channels (narrow range instrument span each generator) are required to satisfy the requirements with two-out-of-three logic and a median signal selector is provided for level control.

This function is actuated on two out of three low-low water level signals occurring in any steam generator. If a low-low water level condition is detected in one steam generator, signals are generated to start the motor driven auxiliary feedwater pumps. If a low-low water level condition is

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d.1) Auxiliary Feedwater-Steam Generator Water Level-Low Low  
(continued)

detected in two or more steam generators, a signal is generated to start the turbine driven auxiliary feedwater pump as well.

With the transmitters (d/p cells) located inside containment and thus possibly experiencing adverse environmental conditions (feed line break), the Trip Setpoint reflects the inclusion of both steady state and adverse environmental instrument uncertainties.

d.2) SG Water Level - Low Low Trip Time Delay (TTD)

The signals to start auxiliary feedwater pumps are delayed through the use of a Trip Time Delay (TTD) system for reactor power levels below 50.7% of RTP. Low-low water level in any protection set in any steam generator will generate a signal which starts an elapsed time trip delay timer. The allowable trip time delay is based upon the prevailing power level at the time the low-low level trip setpoint is reached. If power level rises after the trip time delay setpoints have been determined, the trip time delay is re-determined (i.e., decreased) according to the increase in power level. However, the trip time delay is not changed if the power level decreases after the delay has been determined. The use of this delay allows added time for natural steam generator level stabilization or operator intervention to avoid an inadvertent protection system actuation.

e. Auxiliary Feedwater-Safety Injection

An SI signal starts the motor driven AFW pumps. The AFW initiation functions are the same as the requirements for their SI function. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead, Function 1, SI, is referenced for all initiating functions and requirements.

f. Not used

Functions 6.a, 6.b, and 6.d must be OPERABLE in MODES 1, 2, and 3 to ensure that the SGs remain the heat sink for the reactor. SG Water Level-Low Low in any operating SG will cause the motor driven AFW pumps to start.

(continued)

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6. Auxiliary Feedwater (continued)

The system is aligned so that upon a start of the pump, water immediately begins to flow to the SGs. SG Water Level-Low Low in any two operating SGs will cause the turbine driven pumps to start. These Functions do not have to be OPERABLE in MODES 5 and 6 because there is not enough heat being generated in the reactor to require the SGs as a heat sink. In MODE 4, AFW actuation does not need to be OPERABLE because either AFW or residual heat removal (RHR) will already be in operation to remove decay heat or sufficient time is available to manually place either system in operation.

g. Auxiliary Feedwater-Undervoltage Reactor Coolant Pump

A loss of power on the buses that provide power to the RCPs provides indication of a pending loss of RCP forced flow in the RCS during MODE 1 operation above P-7. Below P-7, this ESFAS and RTS function is blocked since there is insufficient heat to be concerned about DNB. The Undervoltage RCP Function senses the voltage upstream of each RCP breaker. A loss of power on two RCPs will start the turbine driven AFW pump to ensure that at least one SG contains enough water to serve as the heat sink for reactor decay heat and sensible heat removal following the reactor trip.

h. Not used

Function 6.g must be OPERABLE in MODE 1. This ensures that at least one SG is provided with water to serve as the heat sink to remove reactor decay heat and sensible heat in the event of an accident. In MODES 2, 3, 4, and 5, the pump trip is not indicative of a condition requiring automatic AFW initiation of the TDAFW pump. No other anticipatory start signals are necessary for the TDAFW pump, only low level in 2 of 4 SGs.

i. Not used

7. Residual Heat Removal Pump Trip on Refueling Water Storage Tank Level - Low

At the end of the injection phase of a LOCA, the RWST will be nearly empty. Continued cooling must be provided by the ECCS to remove decay heat. The source of water for the ECCS pumps is manually switched to the containment recirculation sump. This pump trip feature is blocked if the RHR pumps are already taking suction from the containment recirculation sump. The low head RHR pumps draw the water from the containment recirculation sump.

(continued)



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7. Residual Heat Removal Pump Trip on Refueling Water Storage Tank Level - Low (continued)

The RHR pumps pump the water through the RHR heat exchanger, inject the water back into the RCS, and supply the cooled water to the other ECCS pumps. Switchover from the RWST to the containment sump must occur before the RWST empties to prevent damage to the RHR pumps and a loss of core cooling capability. For similar reasons, switchover must not occur before there is sufficient water in the containment sump to support RHR pump suction. Furthermore, early switchover must not occur to ensure that sufficient borated water is injected from the RWST. This ensures the reactor remains shut down in the recirculation mode.

During the injection phase of a LOCA, the RWST is the source of water for all ECCS pumps. The RHR pump trip on RWST low level provides protection against a loss of water for the ECCS pumps and indicates the end of the injection phase of the LOCA. The RWST is equipped with three level transmitters. These transmitters provide no control functions. Therefore, a two-out-of-three logic is adequate to initiate the protection function actuation.

The Allowable Value/Trip Setpoint upper limit is selected to ensure adequate water inventory in the containment sump to provide RHR pump suction. The high limit also ensures enough borated water is injected to ensure the reactor remains shut down.

The transmitters are located in an area not affected by HELBs or post accident high radiation. Thus, they will not experience any adverse environmental conditions and the trip setpoint reflects only steady state instrument uncertainties.

This Function must be OPERABLE in MODES 1, 2, 3, and 4 when there is a potential for a LOCA to occur, to ensure a continued supply of water for the ECCS pumps. This Function is not required to be OPERABLE in MODES 5 and 6 because there is adequate time for the operator to evaluate unit conditions and respond by manually starting systems, pumps, and other equipment to mitigate the consequences of an abnormal condition or accident. System pressure and temperature are very low and many ESF components are prevented from actuating to prevent inadvertent overpressurization of unit systems or are not required to be OPERABLE.

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8. Engineered Safety Feature Actuation System Interlocks

To allow some flexibility in unit operations, several interlocks are included as part of the ESFAS. These interlocks permit the operator to block some signals, automatically enable other signals, prevent some actions from occurring, and cause other actions to occur. The interlock Functions back up manual actions to ensure bypassable functions are in operation under the conditions assumed in the safety analyses.

a. Engineered Safety Feature Actuation System Interlocks-Reactor Trip, P-4

The P-4 interlock is enabled when a reactor trip breaker (RTB) and its associated bypass breaker is open. This Function allows operators to manually block reactivation of SI systems after the initial phase of injection is complete. Once SI is blocked, automatic actuation of SI cannot occur until the RTBs have been manually closed. The functions of the P-4 interlock are:

- Trip the main turbine;
- Isolate MFW with coincident low  $T_{avg} \leq 554^{\circ}\text{F}$ ;
- Allows manual block of the automatic reactivation of SI ;
- Transfer the steam dump from the load rejection controller to the plant trip controller; and
- Prevent opening of the MFW Regulating valves or bypass valves if they were closed on SI or high SG Water Level.

Each of the above Functions is interlocked with P-4 to avert or reduce the continued cooldown of the RCS following a reactor trip. An excessive cooldown of the RCS following a reactor trip could cause an insertion of positive reactivity with a subsequent increase in core power. To avoid such a situation, the noted Functions have been interlocked with P-4 as part of the design of the unit control and protection system.

None of the noted Functions serves a mitigation function in the unit licensing basis safety analyses. Only the turbine trip Function is explicitly assumed since it is an immediate consequence of the reactor trip Function. Neither turbine trip, nor any of the other four Functions associated with the reactor trip signal, is required to show that the unit licensing basis safety analysis acceptance criteria are met.

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8. Engineered Safety Feature Actuation System Interlocks  
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The RTB position switches that provide input to the P-4 interlock only function to energize or de-energize or open or close contacts. Therefore, this Function has no adjustable trip setpoint with which to associate a Trip Setpoint and Allowable Value.

This Function must be OPERABLE in MODES 1, 2, and 3 when the reactor may be critical or approaching criticality. This Function does not have to be OPERABLE in MODE 4, 5, or 6 because the main turbine, the MFW System, and the Steam Dump System are not in operation.

b. Engineered Safety Feature Actuation System  
Interlocks-Pressurizer Pressure, P-11

The P-11 interlock permits a normal unit cooldown and depressurization without actuation of SI or main steam line isolation. With two-out-of-three pressurizer pressure channels (discussed previously) less than the P-11 setpoint, the operator can manually block the Pressurizer Pressure-Low and Steam Line Pressure-Low SI signals and the Steam Line Pressure-Low steam line isolation signal (previously discussed). When the Steam Line Pressure-Low steam line isolation signal is manually blocked, a main steam isolation signal on Steam Line Pressure-Negative Rate-High is enabled. This provides protection for an SLB by closure of the MSIVs. With two-out-of-three pressurizer pressure channels above the P-11 setpoint, the Pressurizer Pressure-Low and Steam Line Pressure-Low SI signals and the Steam Line Pressure-Low steam line isolation signal are automatically enabled. The operator can also enable these trips by use of the respective manual reset switches. When the Steam Line Pressure-Low steam line isolation signal is enabled, the main steam isolation on Steam Line Pressure-Negative Rate-High is disabled. The Trip Setpoint reflects only steady state instrument uncertainties.

This Function must be OPERABLE in MODES 1, 2, and 3 to allow an orderly cooldown and depressurization of the unit without the actuation of SI or main steam isolation. This Function does not have to be OPERABLE in MODE 4, 5, or 6 because system pressure must already be below the P-11 setpoint for the requirements of the heatup and cooldown curves to be met.

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c. Not used

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

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A Note has been added in the ACTIONS to clarify the application of Completion Time rules. The Conditions of this Specification may be entered independently for each Function listed on Table 3.3.2-1.

With an ESFAS Instrumentation Channel or Interlock Trip Setpoint less conservative than the value shown in the Trip Setpoint column but more conservative than the value shown in the Allowable Values column of Table 3.3.2-1, adjust the Setpoint consistent with the Trip Setpoint value.

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 bistable is found inoperable, then all affected Functions provided by that channel must be declared inoperable and the LCO Condition(s) entered for the protection Function(s) affected. When the Required Channels in Table 3.3.2-1 are specified (e.g., on a per steam line, per loop, per SG, etc., basis), then the Condition may be entered separately for each steam line, loop, SG, etc., as appropriate.

When the number of inoperable channels in a trip function exceed those specified in one or other related Conditions associated with a trip function, then the unit is outside the safety analysis. Therefore, LCO 3.0.3 should be immediately entered if applicable in the current MODE of operation.

A.1

Condition A applies to all ESFAS protection functions.

Condition A addresses the situation where one or more channels or trains for one or more Functions are inoperable at the same time. The Required Action is to refer to Table 3.3.2-1 and to take the Required Actions for the protection functions affected. The Completion Times are those from the referenced Conditions and Required Actions.

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### ACTIONS (continued)

#### B.1, B.2.1 and B.2.2

Condition B applies to manual initiation of:

- SI;
- Containment Spray;
- Phase A Isolation; and
- Phase B Isolation.

This action addresses the train orientation of the SSPS for the functions listed above. If a channel or train is inoperable, 48 hours is allowed to return it to an OPERABLE status. Note that for containment spray and Phase B isolation, failure of one or both channels in one train renders the train inoperable. Condition B, therefore, encompasses both situations. The specified Completion Time is reasonable considering that there are two automatic actuation trains and another manual initiation train OPERABLE for each Function, and the low probability of an event occurring during this interval. If the train cannot be restored to OPERABLE status, the unit must be placed in a MODE in which the LCO does not apply. This is done by placing the unit in at least MODE 3 within an additional 6 hours (54 hours total time) and in MODE 5 within an additional 30 hours (84 hours total time). The allowable Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

#### C.1, C.2.1 and C.2.2

Condition C applies to the automatic actuation logic and actuation relays for the following functions:

- SI;
- Containment Spray;
- Phase A Isolation; and
- Phase B Isolation

This action addresses the train orientation of the SSPS and the master and slave relays. If one train is inoperable, 6 hours are allowed to restore the train to OPERABLE status. The specified Completion Time is reasonable considering that there is another train OPERABLE, and the low probability of an event occurring during this interval. If the train cannot be restored to OPERABLE status, the unit must be placed in a MODE in which the LCO does not apply. This is done by placing the

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### ACTIONS

#### C.1, C.2.1 and C.2.2 (continued)

unit in at least MODE 3 within an additional 6 hours (12 hours total time) and in MODE 5 within an additional 30 hours (42 hours total time). The Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

The Required Actions are modified by a Note that allows one train to be bypassed for up to 4 hours for surveillance testing, provided the other train is OPERABLE. This allowance is based on the reliability analysis assumption of WCAP-10271-P-A (Ref. 8) that 4 hours is the average time required to perform channel surveillance.

#### D.1, D.2.1, and D.2.2

Condition D applies to:

- SI - Pressurizer Pressure — Low;
- SI - Steam Line Pressure — Low;
- Steam Line Isolation - Steam Line Pressure — Negative Rate — High;
- Steam Line Isolation - Steam Line Pressure — Low; and
- Auxiliary Feedwater - SG Water level — Low Low;

If one channel is inoperable, 6 hours are allowed to restore the channel to OPERABLE status or to place it in the tripped condition. Generally this Condition applies to functions that operate on two-out-of-three logic (excluding pressurizer pressure - low which is two-out-of-four due to its control input function). Therefore, failure of one channel places the Function in a two-out-of-two configuration. The inoperable channel must be tripped to place the Function in a one-out-of-two configuration that satisfies redundancy requirements. Since pressurizer pressure is used for control and SSPS input, its coincidence is two-out-of-four to provide to required reliability and redundancy. Failure of one channel places the function in a two-out-of-three configuration. The inoperable channel must be placed in the tripped condition to place the Function in a one-out-of-three configuration that satisfies the reliability and redundancy requirements.

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ACTIONS

D.1, D.2.1, and D.2.2 (continued)

Failure to restore the inoperable channel to OPERABLE status or place it in the tripped condition within 6 hours requires the unit be placed in MODE 3 within the following 6 hours and MODE 4 within the next 6 hours.

The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. In MODE 4, these Functions are no longer required OPERABLE.

The Required Actions are modified by a Note that allows the inoperable channel or one additional channel for Function 1.d to be bypassed for up to 4 hours for surveillance testing of other channels. For Functions 1.e, 4.d(1), 4.d(2) and 6.d(1) only the inoperable channel may be bypassed for surveillance testing of the other channels. The 6 hours allowed to restore the channel to OPERABLE status or to place the inoperable channel in the tripped condition, and the 4 hours allowed for testing, are justified in Reference 8.

E.1, E.2.1, and E.2.2

Condition E applies to:

- Steam Line Isolation - Containment Pressure - High-high

This signal does not input to a control function. Thus, two-out-of-three logic is necessary to meet acceptable protective requirements. However, a two-out-of-three design would require tripping a failed channel. This is undesirable because a single failure of the Containment Pressure input would then cause spurious containment spray initiation. Spurious spray actuation is undesirable because of the cleanup problems presented. Therefore, these channels are designed with two-out-of-four logic so that a failed channel may be bypassed rather than tripped. Note that one channel may be bypassed and still satisfy the single failure criterion. Furthermore, with one channel bypassed, a single instrumentation channel failure will not spuriously initiate containment spray.

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E.1, E.2.1, and E.2.2 (continued)

To avoid the inadvertent actuation of containment spray and Phase B containment isolation, the inoperable channel should not be placed in the tripped condition. Instead it is bypassed. Restoring the channel to OPERABLE status, or placing the inoperable channel in the bypass condition within 6 hours, is sufficient to assure that the Function remains OPERABLE and minimizes the time that the Function may be in a partial trip condition (assuming the inoperable channel has failed high). The Completion Time is further justified based on the low probability of an event occurring during this interval. Failure to restore the inoperable channel to OPERABLE status, or place it in the bypassed condition within 6 hours, requires the unit be placed in MODE 3 within the following 6 hours and MODE 4 within the next 6 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. In MODE 4, these Functions are no longer required OPERABLE.

The Required Actions are modified by a Note that allows one additional channel to be bypassed for up to 4 hours for surveillance testing. Placing a second channel in the bypass condition for up to 4 hours for testing purposes is acceptable based on the results of Reference 8.

F.1, F.2.1, and F.2.2

Condition F applies to the P-4 Interlock.

For the P-4 Interlock Function, this action addresses the train orientation of the SSPS. If a train is inoperable, 48 hours is allowed to return it to OPERABLE status. The specified Completion Time is reasonable considering the nature of this Function, the available redundancy, and the low probability of an event occurring during this interval. If the Function cannot be returned to OPERABLE status, the unit must be placed in MODE 3 within the next 6 hours and MODE 4 within the following 6 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power in an orderly manner and without challenging unit systems. In MODE 4, the unit does not have any analyzed transients or conditions that require the explicit use of the protection function noted above.

(continued)



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ACTIONS  
(continued)

G.1, G.2.1 and G.2.2

Condition G applies to the automatic actuation logic and actuation relays for the Steam Line Isolation and AFW actuation Functions.

The action addresses the train orientation of the SSPS and the master and slave relays for these functions. If one train is inoperable, 6 hours are allowed to restore the train to OPERABLE status. The Completion Time for restoring a train to OPERABLE status is reasonable considering that there is another train OPERABLE, and the low probability of an event occurring during this interval. If the train cannot be returned to OPERABLE status, the unit must be brought to MODE 3 within the next 6 hours and MODE 4 within the following 6 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. Placing the unit in MODE 4 removes all requirements for OPERABILITY of the protection channels and actuation functions. In this MODE, the unit does not have analyzed transients or conditions that require the explicit use of the protection functions noted above.

The Required Actions are modified by a Note that allows one train to be bypassed for up to 4 hours for surveillance testing provided the other train is OPERABLE. This allowance is based on the reliability analysis (Ref. 8) assumption that 4 hours is the average time required to perform channel surveillance.

H.1 and H.2

Condition H applies to the Automatic Actuation Logic and Actuation Relays for the Turbine Trip and Feedwater Isolation Function.

This action addresses the train orientation of the SSPS and the master and slave relays for this Function. If one train is inoperable, 6 hours are allowed to restore the train to OPERABLE status or the unit must be placed in MODE 3 within the following 6 hours. The Completion Time for restoring a train to OPERABLE status is reasonable considering that there is another train OPERABLE, and the low probability of an event occurring during this interval. The allowed Completion Time of 6 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging unit systems. These Functions are no longer required in MODE 3. Placing the unit in MODE 3 removes all requirements for OPERABILITY of the protection channels and actuation functions. In this MODE, the unit does not have analyzed transients or conditions that require the explicit use of the protection functions noted above.

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ACTIONS

H.1 and H.2 (continued)

The Required Actions are modified by a Note that allows one train to be bypassed for up to 4 hours for surveillance testing provided the other train is OPERABLE. This allowance is based on the reliability analysis (Ref. 8) assumption that 4 hours is the average time required to perform channel surveillance.

I.1 and I.2

Condition I applies to Auxiliary Feedwater - Undervoltage Reactor Coolant Pump

If one channel is inoperable, 6 hours are allowed to restore one channel to OPERABLE status or to place it in the tripped condition. If placed in the tripped condition, the function is then in a partial trip condition where one additional tripped channel will result in actuation. The 6 hour Completion Time is justified in Ref. 8. Failure to restore the inoperable channel to OPERABLE status or place it in the tripped condition within 6 hours, requires the Unit to be placed in MODE 2 within the following 6 hours. The allowed Completion time of 6 hours is reasonable, based on operating experience, to reach MODE 2 from full power conditions in an orderly manner without challenging unit systems. In MODE 2, this Function is no longer required OPERABLE.

The Required Actions are modified by a Note that allows the inoperable channel to be bypassed for up to 4 hours for surveillance testing of other channels. In accordance with WCAP 10271, very specific circumstances are related to the use of this bypass condition for ESFAS Functions 6.g. Since this channel is not designed with Bypass-capable logic that meets the requirements of IEEE 279, the provisions for bypass only apply to a specific type of channel failure. To apply, the channel must fail in such a way that it does not trip the bistables. With this type of failure, the channel may be returned to service and considered "bypassed" under this Note. Specifically, the bypass condition is the state when a failed channel is taken out of the forced "tripped" state and placed in operation. Due to the failed nature of the channel, the channel cannot be assumed to be OPERABLE, and is therefore considered to be in a state of bypass when the channel failure is such that its bistables are not tripped. The provisions of WCAP 10271 specifically prohibit the use of jumpers or lifted leads to bypass this channel. In this configuration, a second channel can be tested with the channel in the tripped mode without completing ESFAS logic. The 6 hours allowed to place the inoperable channel in the tripped condition, and the 4 hours allowed for a second channel to be in the bypassed condition for testing, are justified in Reference 8.

(continued)

BASES

ACTIONS

J.1 and J.2

Condition J applies to the Turbine Trip and Feedwater Isolation Actuation signal resulting from Steam Generator Level - High-High (P-14).

If one channel is inoperable, 6 hours are allowed to restore one channel to OPERABLE status or to place it in the tripped condition. If placed in the tripped condition, the Function is then in a partial trip condition where one-out-of-two logic will result in actuation. The 6-hour Completion Time is justified in Reference 8. Failure to restore the inoperable channel to OPERABLE status or place in the tripped condition within 6 hours requires the unit to be placed in MODE 3 within 12 hours. The allowed Completion time of 12 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging unit systems. In MODE 3, this Function is no longer required OPERABLE.

The Required Actions are modified by a Note that allows the inoperable channel to be bypassed for up to 4 hours for surveillance testing of other channels. The 6 hours allowed to place the inoperable channel in the tripped condition, and the 4 hours allowed for a second channel to be in the bypassed condition for testing, are justified in Reference 8.

K.1.1, K.1.2, K.2.1 and K.2.2

Condition K applies to the Residual Heat Removal Pump Trip on RWST Level - Low. Restoring the channel to OPERABLE status or placing the inoperable channel in the bypass (cut-out) condition within 6 hours is sufficient to ensure that the Function remains OPERABLE and minimizes the time that the Function may be in a partial trip condition (assuming the inoperable channel has failed low). Placing the out-of-service channel in cut-out removes that channel from the trip logic, similar to a bypass function. This provides a two-out-of-two trip logic from the remaining channels. The 6 hour Completion Time is justified in Reference 8. If the channel cannot be placed in the cut-out condition within 6 hours, and returned to an OPERABLE status within 48 hours, the unit must be brought to MODE 3 within 54 hours and MODE 5 within 84 hours. The allowed Completion Times for shutdown are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. In MODE 5, the unit does not have any analyzed transients or conditions that require the explicit use of the pump trip function noted above.

(continued)

## BASES

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### ACTIONS

#### L.1, L.2.1 and L.2.2

Condition L applies to the P-11 interlock.

With one or more channels inoperable, the operator must verify that the interlock is in the required state for the existing unit condition. This action manually accomplishes the function of the interlock.

Determination must be made within 1 hour. The verification determination can be made by observation of the associated annunciator window(s). The 1 hour Completion Time is equal to the time allowed by LCO 3.0.3 to initiate shutdown actions in the event of a complete loss of ESFAS function. If the interlock is not in the required state (or placed in the required state) for the existing unit condition, the unit must be placed in MODE 3 within the next 6 hours and MODE 4 within the following 6 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. Placing the unit in MODE 4 removes all requirements for OPERABILITY of these interlocks.

#### M.1, M.2, M.3.1 and M.3.2

Condition M applies to the Trip Time Delay (TTD) circuitry for the SG Water Level-Low Low actuation of the turbine-driven AFW pump and is required to be OPERABLE in MODES 1, 2 and 3. With one or more TTD circuitry delay timers inoperable or the RSC  $\Delta T$  equivalent power input inoperable, 6 hours are allowed to adjust the threshold power level for no time delay to 0% RTP. This sets the TTD timer to zero seconds and effectively removes its input for the SG water level circuit. If the TTD timer cannot be set to zero seconds for a single SG water level control, then the affected SG water level low-low channel must be placed in trip. Only one SG water level low-low channel can be placed in trip position without tripping the plant. The Completion Time of 6 hours is reasonable considering the nature of these functions and the low probability of an event occurring during this interval as justified in Reference 8.

If the TTD threshold power for no time delay cannot be adjusted to 0% RTP (zero seconds time delay) or the single SG water level channel cannot be placed in the trip condition within the specified Completion Time, the unit must be placed in MODE 4 where these Functions are not required OPERABLE. A completion time of 12 hours is allowed to place the unit in MODE 3 and 18 hours for MODE 4. These completion times are reasonable time, based on operating experience, to place the unit in MODE 4 from full power in an orderly manner and without challenging unit systems. In MODE 4 there are no analyzed transients requiring the use of the turbine-driven AFW pump.

(continued)

BASES

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ACTIONS

M.1, M.2, M.3.1 and M.3.2 (Continued)

The Required Actions have been modified by a note that allows placing the SG water level channel or one additional channel in the bypassed condition for up to 4 hours while performing routine surveillance testing of the other channels.

N.1 or N.2

Condition N applies to:

- Manual Initiation of Steam Line Isolation; and
- Manual Initiation of Auxiliary Feedwater.

If a channel is inoperable, 48 hours is allowed to return the channel to an OPERABLE status. The specified Completion Time is reasonable considering the nature of these functions, the available redundancy, and the low probability of an event occurring during this interval. If the Function cannot be returned to OPERABLE status, the associated pump or valve shall be declared inoperable immediately and the REQUIRED ACTION of 3.7.5 or 3.7.2 as applicable complied with immediately.

O.1 or O.2.1 and O.2.2

Condition O applies to Safety Injection resulting from Containment Pressure - High.

If one channel is inoperable, 6 hours are allowed to restore the channel to OPERABLE status or to place it in the tripped condition. Failure of one channel places the function in a two-out-of-two configuration since the trip coincidence is two-out-of-three. The inoperable channel must be tripped to place the Function in a one-out-of-two configuration that satisfies redundancy requirements.

Failure to restore the inoperable channel to OPERABLE status or place it in the tripped condition within 6 hours requires the unit be placed in MODE 3 within 12 hours and MODE 5 in 42 hours.

The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. In MODE 5, these functions are no longer required OPERABLE.

The Required Actions are modified by a Note that allows the inoperable channel to be bypassed for up to 4 hours for surveillance testing of other channels. The 6 hours allowed to restore the channel to OPERABLE status or to place the inoperable channel in the tripped condition, and the 4 hours allowed for testing, are justified in Reference 8.

(continued)

## BASES

### ACTIONS

#### P.1 or P.2.1 and P.2.2

Condition P applies to:

- Containment Spray - Containment Pressure - High-High.
- Containment Isolation - Phase B Isolation - Containment Pressure - High-High

Neither of these signals has input to a control function. Thus, two-out-of-three logic is necessary to meet acceptable protective requirements. However, a two-out-of-three design would require tripping a failed channel. This is undesirable because a single failure would then cause spurious containment spray initiation. Spurious spray actuation is undesirable because of the cleanup problems presented. Therefore, these channels are designed with two-out-of-four logic so that a failed channel may be bypassed rather than tripped. Note that one channel may be bypassed and still satisfy the single failure criterion. Furthermore, with one channel bypassed, a single instrumentation channel failure will not spuriously initiate containment spray. The containment spray signal is also interlocked with SI and will not initiate without simultaneous SI and containment spray signals.

To avoid the inadvertent actuation of containment spray and Phase B containment isolation, the inoperable channel is bypassed. Restoring the channel to OPERABLE status, or placing the inoperable channel in the bypass condition within 6 hours, is sufficient to assure that the Function remains OPERABLE and minimizes the time that the Function may be in a partial trip condition (assuming the inoperable channel has failed high). The Completion Time is further justified based on the low probability of an event occurring during this interval.

Failure to restore the inoperable channel to OPERABLE status or place it in the tripped condition within 6 hours requires the unit be placed in MODE 3 within 12 hours, and MODE 5 in 42 hours.

The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. In MODE 5, these Functions are no longer required OPERABLE.

The Required Actions are modified by a Note that allows one additional channel to be bypassed for up to 4 hours for surveillance testing. The 6 hours allowed to restore the channel to OPERABLE status or to place the inoperable channel in the tripped condition, and the 4 hours allowed for testing, are justified in Reference 8.

(continued)

## BASES

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### SURVEILLANCE REQUIREMENTS

The SRs for each ESFAS Function are identified by the SRs column of Table 3.3.2-1.

A Note has been added to the SR Table to clarify that Table 3.3.2-1 determines which SRs apply to which ESFAS Functions.

Note that each channel of process protection supplies both trains of the ESFAS. When testing channel I, train A and train B must be examined. Similarly, train A and train B must be examined when testing channel II, channel III, and channel IV (if applicable).

The CHANNEL CALIBRATION and COTs are performed in a manner that is consistent with the assumptions used in analytically calculating the required channel accuracies.

#### SR 3.3.2.1

Performance of the CHANNEL CHECK once every 12 hours ensures that a 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 other channels. 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. A CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

Agreement criteria are established in STP I-1A, based on a combination of the channel instrument uncertainties, including indication and reliability. If a channel is outside the criteria, it may be an indication that the sensor or the signal processing equipment has drifted outside its limit.

The Frequency is based on operating experience that demonstrates channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the LCO required channels.

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS  
(Continued)

SR 3.3.2.2

SR 3.3.2.2 is the performance of an ACTUATION LOGIC TEST. The SSPS is tested every 31 days on a STAGGERED TEST BASIS, using the semiautomatic tester. The train being tested is placed in the bypass condition, thus preventing inadvertent actuation. Through the semiautomatic tester, all possible logic combinations, with and without applicable permissives, are tested for each protection function. In addition, the master relay coil is pulse tested for continuity. This verifies that the logic modules are OPERABLE and that there is an intact voltage signal path to the master relay coils. The Frequency of every 31 days on a STAGGERED TEST BASIS is adequate. It is based on industry operating experience, considering instrument reliability and operating history data.

SR 3.3.2.3 - Not used

SR 3.3.2.4

SR 3.3.2.4 is the performance of a MASTER RELAY TEST. The MASTER RELAY TEST is the energizing of the master relay, verifying contact operation and a low voltage continuity check of the slave relay coil. Upon master relay contact operation, a low voltage is injected to the slave relay coil. This voltage is insufficient to pick up the slave relay, but large enough to demonstrate signal path continuity. This test is performed every 31 days on a STAGGERED TEST BASIS. The time allowed for the testing (4 hours) and the surveillance interval are justified in Reference 8.

SR 3.3.2.5

SR 3.3.2.5 is the performance of a COT.

A COT is performed on each required channel to ensure the entire channel will perform the intended Function. Setpoints must be found within the Allowable Values specified in Table 3.3.1-1.

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

The "as found" and "as left" values must also be recorded and reviewed for consistency with the assumptions of the surveillance interval extension analysis (Ref. 8) when applicable.

The Frequency of 92 days is justified in Reference 8.

(continued)



BASES

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SURVEILLANCE  
REQUIREMENTS  
(Continued)

SR 3.3.2.6

SR 3.3.2.6 is the performance of a SLAVE RELAY TEST. The SLAVE RELAY TEST is the energizing of the slave relays. Contact operation is verified in one of two ways. Actuation equipment that may be operated in the design mitigation MODE is either allowed to function, or is placed in a condition where the relay contact operation can be verified without operation of the equipment. Actuation equipment that may not be operated in the design mitigation MODE is prevented from operation by the SLAVE RELAY TEST circuit. For this latter case, contact operation is verified by a continuity check of the circuit containing the slave relay. This test is performed every 24 months. The Frequency is adequate, based on operating experience, considering relay reliability and operating history data (Ref. 7)

SR 3.3.2.7 - Not used

SR 3.3.2.8

SR 3.3.2.8 is the performance of a TADOT. This test is a check of the Manual Actuation Functions (except AFW; see SR 3.3.2.13). It is performed every 24 months. Each Manual Actuation Function is tested up to, and including, the master relay coils. In some instances, the test includes actuation of the end device (i.e., pump starts, valve cycles, etc.). The Frequency is adequate, based on industry operating experience and is consistent with the typical refueling cycle. The SR is modified by a Note that excludes verification of setpoints during the TADOT for manual initiation Functions. The manual initiation Functions have no associated setpoints.

SR 3.3.2.9

SR 3.3.2.9 is the performance of a CHANNEL CALIBRATION.

A CHANNEL CALIBRATION is performed every 24 months, or approximately at every refueling. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor. The test verifies that the channel responds to measured parameter within the necessary range and accuracy.

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

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BASES

SURVEILLANCE  
REQUIREMENTS  
(Continued)

SR 3.3.2.9 (Continued)

Whenever an RTD is replaced in Function 6.d., the next required CHANNEL CALIBRATION of the RTDs is accomplished by an inplace cross calibration that compares the other sensing elements with the recently installed sensing element.

The Frequency of 24 months is based on the assumption of an 24 month calibration interval in the determination of the magnitude of equipment drift in the setpoint methodology.

This SR is modified by a Note stating that this test should include verification that the time constants are adjusted to the prescribed values where applicable.

SR 3.3.2.10

This SR ensures the individual channel ESF RESPONSE TIMES are less than or equal to the maximum values assumed in the accident analysis. RESPONSE TIME testing acceptance criteria and the individual Functions requiring RESPONSE TIME Verification are included in ECG 38.2. Individual component response times are not modeled in the analyses. The analyses model the overall or total elapsed time, from the point at which the parameter exceeds the Trip Setpoint value at the sensor, to the point at which the equipment in both trains reaches the required functional state (e.g., pumps at rated discharge pressure, valves in full open or closed position).

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

Response time may be verified by actual response time tests in any series of sequential, overlapping or total channel measurements, or by the summation of allocated sensor response times with actual response time tests on the remainder of the channel. Allocations for sensor response times may be obtained from: 1) historical records based on acceptable response time tests (hydraulic, noise, or power interrupt tests), 2) inplace, onsite, or offsite (e.g., vendor) test measurements, or 3) utilizing vendor engineering specifications.

WCAP-13632-P-A, revision 2, "elimination of Pressure sensor

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS

SR 3.3.2.10 (Continued)

Response time Testing requirements," dated January 1996, provides the basis and the methodology of using allocated sensor response times in the overall verification of the channel response time for specific sensors identified in the WCAP. Response time verification for other sensor types must be demonstrated by test.

The allocations for sensor response times must be verified prior to placing the component in initial operational service and re-verified following maintenance that may adversely affect response time. In general, electrical repair work does not impact response time provided the parts used for repair are of the same type and value. One example where response time could be affected is replacing the sensing assembly of a transmitter.

ESF RESPONSE TIME tests are conducted on a 24 month STAGGERED TEST BASIS.

Each verification shall include at least one train such that both trains are verified at least once per 48 months and one channel per function such that all channels are tested at least once every N times 24 months where N is the total number of redundant channels in a specific ESFAS function. Testing of the final actuation devices, which make up the bulk of the response time, is included in the testing of each train. Therefore, staggered testing results in response time verification of one train of devices every 24 months. The 24 month Frequency is consistent with the typical refueling cycle and is based on unit operating experience, which shows that random failures of instrumentation components causing serious response time degradation, but not channel failure, are infrequent occurrences.

This SR is modified by a Note that clarifies that the turbine driven AFW pump is tested within 24 hours after reaching 650 psig in the SGs.

SR 3.3.2.11

SR 3.3.2.11 is the performance of a TADOT as described in SR 3.3.2.8, except that it is performed for the P-4 Reactor Trip Interlock. The 24 month Frequency is based on operating experience.

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

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS

SR 3.3.2.12

SR 3.3.2.12 is the performance of an ACTUATION LOGIC TEST. This SR is applied to the RHR Pump Trip on RWST Level-Low actuation logic and relays which are not processed through the SSPS. This test is performed every 24 months. The frequency is adequate based on site and industry operating experience, considering equipment reliability and historical data.

SR 3.3.2.13

SR 3.3.2.13 is the performance of a TADOT. This test is a check of the Manual Actuation Function for AFW. It is performed every 18 months. Each Manual Actuation Function is tested up to, and including, the master relay coils. In some instances, the test includes actuation of the end device (i.e., pump starts, valve cycles, etc.). The Frequency is adequate, based on industry operating experience. The SR is modified by a Note that excludes verification of setpoints during the TADOT for manual initiation Functions. The manual initiation Functions have no associated setpoints.

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REFERENCES

1. FSAR, Chapter 6.
2. FSAR, Chapter 7.
3. FSAR, Chapter 15.
4. IEEE-279-1971.
5. 10 CFR 50.49.
6. Blank
7. WCAP-13900, "Extension of Slave Relay Surveillance Test intervals", April 1994
8. WCAP-10271-P-A, Supplement 2, Rev. 1, June 1990.

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BASES

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REFERENCES  
(Continued)

9. WCAP-13878, "Reliability of Potter & Brumfield MDR Relays", June 1994.
  10. WCAP-14117, "Reliability Assessment of Potter and Brumfield MDR Series Relays."
  11. WCAP-13632-P-A, Revision 2, "Elimination of Pressure Sensor Response Time Testing Requirements," January 1996.
  12. WCAP-11082, Revision 5, "Westinghouse Setpoint Methodology for Protection Systems, Diablo Canyon Units 1 and 2, 24 Month Fuel Cycle Evaluation," January 1997.
  13. Calculation J-54, "Nominal Setpoint Calculation for Selected PLS Setpoints."
  14. J-110, "24 Month Fuel Cycle Allowable Value Determination / Documentation and ITDP Uncertainty Sensitivity."
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## B 3.3 INSTRUMENTATION

### B 3.3.3 Post Accident Monitoring (PAM) Instrumentation

#### BASES

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##### BACKGROUND

The primary purpose of the PAM instrumentation is to display unit variables that provide information required by the control room operators during accident situations. This information provides the necessary support for the operator to take the manual actions for which no automatic control is provided and that are required for safety systems to accomplish their safety functions for Design Basis Accidents (DBAs).

The OPERABILITY of the accident monitoring instrumentation ensures that there is sufficient information available on selected unit parameters to monitor and to assess unit status and behavior following an accident.

The availability of accident monitoring instrumentation is important so that responses to corrective actions can be observed and the need for, and magnitude of, further actions can be determined. These essential instruments are identified in the FSAR section 7.5 (Ref. 1) based upon the recommendations of Regulatory Guide 1.97 (Ref. 2) as required by Supplement 1 to NUREG-0737 (Ref. 3).

The instrument channels required to be OPERABLE by this LCO include two classes of parameters identified during unit specific implementation of Regulatory Guide 1.97 as Type A and/or Category I variables.

Type A variables are included in this LCO because they provide the primary information required for the control room operator to take specific manually controlled actions for which no automatic control is provided, and that are required for safety systems to accomplish their safety functions for DBAs.

Category I variables are the key variables deemed risk significant because they are needed to:

- Determine whether other systems important to safety are performing their intended functions;
- Provide information to the operators that will enable them to determine the likelihood of a gross breach of the barriers to radioactivity release; and

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## BASES

BACKGROUND (continued)	<ul style="list-style-type: none"> <li>• Provide information regarding the release of radioactive materials to allow for early indication of the need to initiate action necessary to protect the public, and to estimate the magnitude of any impending threat.</li> </ul> <p>The specific instrument Functions listed in Table 3.3.3-1 are discussed in the LCO section.</p>
APPLICABLE SAFETY ANALYSES	<p>The PAM instrumentation ensures the operability of Regulatory Guide 1.97 Type A and Category I variables so that the control room operating staff can:</p> <ul style="list-style-type: none"> <li>• Perform the diagnosis specified in the emergency operating procedures (these variables are restricted to preplanned actions for the primary success path of DBAs), e.g., loss of coolant accident (LOCA);</li> <li>• Take the specified, pre-planned, manually controlled actions, for which no automatic control is provided, and that are required for safety systems to accomplish their safety function;</li> <li>• Determine whether systems important to safety are performing their intended functions;</li> <li>• Determine the likelihood of a gross breach of the barriers to radioactivity release;</li> <li>• Determine if a gross breach of a barrier has occurred; and</li> <li>• Initiate action necessary to protect the public and to estimate the magnitude of any impending threat.</li> </ul> <p>PAM instrumentation that meets the definition of Type A in Regulatory Guide 1.97 satisfies Criterion 3 of 10 CFR 50.36 (c)(2)(ii). Category I, non-Type A, instrumentation must be retained in TS because it is intended to assist operators in minimizing the consequences of accidents. Therefore, Category I, non-Type A, variables are important for reducing public risk.</p>
LCO	<p>The PAM instrumentation LCO provides OPERABILITY requirements for Regulatory Guide 1.97 Type A monitors, which provide information required by the control room operators to perform certain manual actions specified in the unit Emergency Operating Procedures. These manual actions ensure that a system can accomplish its safety function, and are credited in the safety analyses. Additionally, this LCO addresses Regulatory Guide 1.97 instruments that have been designated Category I, non-Type A.</p>

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BASES

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LCO  
(continued)

The OPERABILITY of the PAM instrumentation ensures there is sufficient information available on selected unit parameters to monitor and assess unit status following an accident. This capability is consistent with the recommendations of Reference 1.

LCO 3.3.3 requires two OPERABLE channels for most Functions. Two OPERABLE channels ensure no single failure prevents operators from getting the information necessary for them to determine the safety status of the unit, and to bring the unit to and maintain it in a safe condition following an accident.

Furthermore, OPERABILITY of two channels allows a CHANNEL CHECK during the post accident phase to confirm the validity of displayed information.

The exception to the two channel requirement is Containment Isolation Valve (CIV) Position, Auxiliary Feedwater (AFW) flow indication and Steam Generator (SG) water level (wide range). For the CIV position, the important information is the status of the containment penetrations. The LCO requires one position indicator for each active CIV. This is sufficient to redundantly verify the isolation status of each isolable penetration either via indicated status of the active valve and prior knowledge of a passive valve, or via system boundary status. If a normally active CIV is known to be closed and deactivated, position indication is not needed to determine status. Therefore, the position indication for valves in this state is not required to be OPERABLE.

For SG water level (wide range) and AFW flow rate there is one indicator for each SG. Even though redundancy is not available, diverse indications are available. Loss of a single indicator would be addressed via Condition C for these two instrument functions.

There is one wide range water level indicator for each steam generator in the main control room. Wide range steam generator level measurement meets the intent of the single failure criterion for Category 1 variables by virtue of independent, diverse variables. Auxiliary feedwater (AFW) flow, narrow range SG level, SG pressure, reactor coolant pressure, and reactor coolant temperature indications are diverse variables which can be used to assist in determining whether adequate core cooling is provided. The wide range SG level is used to assist in determining the loss of the heat sink. Having one wide range level indicator, in conjunction with one AFW flow indicator, per SG is consistent with NUREG-0737 Item II.E.1.2 for Westinghouse plants.

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## BASES

LCO  
(continued)

There is one AFW flow rate indicator for each SG in the main control room. Diverse indications are available from one wide range level indicator and three narrow range level indicators per SG. Each of the four AFW flow indicators is powered by a different source. Since only two of four SGs are required to establish a heat sink for the RCS, flow indication to at least two intact SGs is assured even if a single failure is assumed.

Table 3.3.3-1 includes instrumentation which is classified as either Type A and/or Category I variables in accordance with Regulatory Guide 1.97, FSAR Section 7.5, and SER 14.

Type A and Category I variables are required to meet Regulatory Guide 1.97 Category I (Ref. 2) design and qualification requirements for seismic and environmental qualification, single failure criterion, utilization of emergency standby power, immediately accessible display, continuous readout, and recording of display, except as exempted in SSER 31. Regulatory Guide 1.97, for certain Functions, requires that the Function be recorded on at least one channel. For these channels where direct and immediate trend or transient information is not essential for operator information, or both channels would be recorded per Regulatory Guide 1.97, the loss of the recorder is not considered to be a loss of Function. However, the recorder should be returned to service as soon as possible and an alternate means of obtaining the recorded information be established if the recorder is to be out-of service beyond the channel AOT.

Listed below are discussions of the specified instrument Functions listed in Table 3.3.3-1.

### 1. Neutron Flux (Wide Range NIS)

Neutron Flux indication is provided to verify reactor shutdown. The wide range NIS is necessary to cover the full range of flux that may occur post accident.

Neutron flux is used for accident diagnosis, verification of subcriticality, and diagnosis of positive reactivity insertion.

### 2. Steam Line Pressure

Steam pressure is used to determine if a high energy secondary line rupture has occurred and the availability of the steam generators as a heat sink. It is also used to verify that a faulted steam generator is isolated. Steam pressure may be used to ensure proper cooldown rates or to provide a diverse indication for natural circulation cooldown.

(continued)

BASES

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LCO  
(continued)

3, 4. Reactor Coolant System (RCS) Hot and Cold Leg Temperatures (Wide Range)

RCS Hot and Cold Leg Temperatures are Category I variables provided for verification of core cooling and long term surveillance. The intent of requiring this instrumentation is to be able to monitor  $\Delta T$ . Therefore, to have an OPERABLE RCS inlet and outlet temperature, they should be in the same primary loop. If the outlet temperature is inoperable, core exit thermocouples can be used in conjunction with RCS inlet temperature to determine  $\Delta T$ .

RCS hot (outlet) and cold (inlet) leg temperatures are used to determine RCS subcooling margin. RCS subcooling margin will allow termination of safety injection (SI), if still in progress, or reinitiation of SI if it has been stopped. RCS subcooling margin is also used for unit stabilization and cooldown control. RCS hot leg temperature also provides a temperature compensating signal for the reactor vessel level instrumentation system (RVLIS).

In addition, RCS cold leg temperature is used in conjunction with RCS hot leg temperature to verify the unit conditions necessary to establish natural circulation in the RCS. The RCS cold leg temperature also provides a temperature input signal for the low temperature overpressure protection (LTOP) system.

Reactor outlet temperature inputs to the Reactor Protection System are provided by two fast response resistance elements and associated transmitters in each loop. The channels provide indication over a range of 0°F to 700°F.

Each of the 4 hot legs and each of the 4 cold legs has one wide range RTD. These are separate from the narrow range RTDs providing input into the Reactor Protection System.

5. Reactor Coolant System Pressure (Wide Range)

RCS wide range pressure is a Category I variable provided for verification of core cooling and RCS integrity long term surveillance.

RCS pressure is used to verify delivery of SI flow to RCS from at least one train when the RCS pressure is below the pump shutoff head. RCS pressure is also used to verify closure of manually closed spray line valves and pressurizer power operated relief valves (PORVs).

In addition to these verifications, RCS pressure is used for determining RCS subcooling margin. RCS subcooling margin will allow termination of SI, if still in progress, or reinitiation of SI if it has been stopped. RCS pressure can also be used:

(continued)

BASES

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LCO

5. Reactor Coolant System Pressure (Wide Range) (continued)

- to determine whether to terminate actuated SI or to reinitiate stopped SI;
- to determine when to reset SI and shut off low head SI;
- to manually restart low head SI;
- as reactor coolant pump (RCP) trip criteria; and
- to make a determination on the nature of the accident in progress and where to go next in the procedure.

RCS subcooling margin is also used for unit stabilization and cooldown control.

RCS pressure is also related to three decisions about depressurization. They are:

- to determine whether to proceed with primary system depressurization;
- to verify termination of depressurization; and
- to determine whether to close accumulator isolation valves during a controlled cooldown/depressurization.

Two final uses of RCS pressure are to determine whether to operate the pressurizer heaters and as an input to Reactor Vessel Water Level Instrumentation System (RVLIS).

RCS pressure is a Type A variable because the operator uses this indication to monitor the cooldown of the RCS following a steam generator tube rupture (SGTR) or small break LOCA. Operator actions to maintain a controlled cooldown, such as adjusting steam generator (SG) pressure or level, would use this indication. Furthermore, RCS pressure is one factor that may be used in decisions to terminate RCP operation.

6. Reactor Vessel Water Level Indication System (RVLIS)

RVLIS is provided for verification and long term surveillance of core cooling. It is also used for accident diagnosis and to determine reactor coolant inventory adequacy.

The RVLIS provides a direct measurement of the collapsed liquid level above the fuel alignment plate. The collapsed level represents the amount of liquid mass that is in the reactor vessel above the core. Measurement of the collapsed water level is selected because it is a direct indication of the water inventory.

(continued)

BASES

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LCO  
(continued)

7. a. Containment Recirculation Sump Level (Narrow Range) and  
b. Containment Reactor Cavity Sump Water Level (Wide Range)

Containment Recirculation Sump Level (Narrow Range) is used to verify that sufficient water is contained in the recirculation sump to allow operation of the Residual Heat Removal Pumps with the suction aligned to the containment recirculation sump.

Containment Reactor Cavity Sump Water Level (Wide Range) is provided for verification and long term surveillance of RCS integrity. The required Regulatory Guide 1.97 recorder for this function is part of this instrument channel.

The Containment Reactor Cavity Sump level instrumentation encompasses the range of the Containment Recirculation Sump and can be used to determine the appropriate time for swap-over of the RHR pumps from RWST to the Containment Recirculation Sump if required.

8. a. Containment Pressure (Wide Range) and  
b. Containment Pressure (Normal Range)

Containment Pressure is provided for verification of RCS and containment OPERABILITY.

Containment pressure is used to verify closure of main steam isolation valves (MSIVs) during a main steam line break inside containment, and containment spray Phase B isolation when high-high containment pressure is reached.

Both instruments are required to cover the Regulatory Guide 1.97 range requirements.

9. Containment Isolation Valve Position

CIV Position is provided for verification of Containment OPERABILITY, and Phase A and Phase B isolation, and containment ventilation system isolation.

When used to verify Phase A and Phase B isolation, the important information is the isolation status of the containment penetrations. The LCO requires one channel of valve position indication in the control room to be OPERABLE for each active CIV in a containment penetration flow path, i.e., two total channels of CIV position indication for a penetration flow path with two active valves. For containment penetrations with only one active CIV having control room indication, Note (b) requires a single channel

(continued)

## BASES

LCO

### 9. Containment Isolation Valve Position (continued)

of valve position indication to be OPERABLE. This is sufficient to redundantly verify the isolation status of each isolable penetration either via indicated status of the active valve, as applicable, and prior knowledge of a passive valve, or via system boundary status. If a normally active CIV is known to be closed and deactivated, position indication is not needed to determine status. Therefore, the position indication for valves in this state is not required to be OPERABLE. This Function is on a per valve basis and ACTION A is entered separately for each inoperable valve indication. Note (a) to the Required Channels states that the Function is not required for isolation valves whose associated penetration is isolated by at least one closed and deactivated automatic valve, closed manual valve, blind flange, or check valve with flow through the valve secured.

### 10. Containment Area Radiation (High Range)

Containment Area Radiation is provided to monitor for the potential of significant radiation releases for use by operators in determining the need to invoke site emergency plans. Containment radiation level is used to determine if a high energy line break (HELB) containing radioactive fluid has occurred, and whether the event is inside or outside of containment.

### 11. Hydrogen Monitors

Hydrogen monitoring is provided to detect high hydrogen concentration conditions that represent a potential for containment breach from a hydrogen explosion. This variable is also important in verifying the adequacy of mitigating actions, and is used to determine whether or not hydrogen recombiners should be started.

### 12. Pressurizer Level

Pressurizer Level is used to determine whether to terminate SI, if still in progress, or to reinitiate SI if it has been stopped. Knowledge of pressurizer water level is also used to verify the unit conditions necessary to establish natural circulation in the RCS and to verify that the unit is maintained in a safe shutdown condition.

### 13. a. Steam Generator Water Level (Wide Range) and b. Steam Generator Level (Narrow Range)

SG Water Level (Wide Range) is provided to monitor operation of decay heat removal via the SGs. The wide range level covers a span of 12 inches above the lower tubesheet to the steam generator separator. The measured differential pressure is displayed in percent level (cold calibration).

(continued)

BASES

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LCO

13. a. Steam Generator Water Level (Wide Range) and  
b. Steam Generator Level (Narrow Range) (continued)

SG Water Level is used to:

- identify the faulted SG following a tube rupture;
- verify that the intact SGs are an adequate heat sink for the reactor;
- determine the nature of the accident in progress (e.g., verify an SGTR); and
- verify unit conditions for termination of SI during secondary unit HELBs outside containment.

Operator action is based on the control room indication of SG level. The RCS response during a design basis small break LOCA depends on the break size. For a certain range of break sizes, the reflux cooling mode of heat transfer is necessary to remove decay heat. Wide range level is a Type A variable because the operator must manually raise and control SG level to establish reflux cooling heat transfer. Operator action is initiated on a loss of subcooled margin. Feedwater flow is increased until the indicated wide range level reaches the reflux cooling initiation point.

There are 4 total required Steam Generator Wide Range Channels with one required on each steam generator. The redundancy of this Function is provided by the presence of 4 Steam Generators.

SG Water Level (Narrow Range) is redundant to the SG wide range level, and provides indication of adequate RCS heat removal capability during normal SG inventory conditions. The narrow range level covers a span from  $\geq 437$  inches to 581 inches above the lower tubesheet.

There are 3 Steam Generator Narrow Range Channels per steam generator with 2 required for this function.

14. Condensate Storage Tank (CST) Level

CST Level is provided to ensure water supply for auxiliary feedwater (AFW). The CST provides the ensured safety grade water supply for the AFW System. CST Level is displayed on a control room indicator, strip chart recorder, and unit computer.

CST Level is considered a Type A variable because the control room meter is the primary indication used by the operator.

The DBAs that require AFW are the loss of electric power, steam line break (SLB), and small break LOCA.

(continued)

BASES

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LCO

14. Condensate Storage Tank (CST) Level (continued)

The CST is the initial source of water for the AFW System. However, as the CST is depleted, manual operator action is necessary to replenish the CST or align suction to the AFW pumps from the Fire Water Storage Tank or other alternate sources.

15, 16, 17, 18. In-Core Thermocouples

In-Core Thermocouples are provided for verification and long term surveillance of core cooling.

An evaluation was made of the minimum number of valid in-core thermocouples necessary for measuring core cooling. The evaluation determined the reduced complement of in-core thermocouple necessary to detect initial core recovery and trend the ensuing core heatup. The evaluations account for core nonuniformities, including incore effects of the radial decay power distribution, excore effects of condensate runback in the hot legs, and nonuniform inlet temperatures. Based on these evaluations, core cooling can be adequately monitored with two valid in-core thermocouple channels per quadrant with two in-core thermocouples per required channel. Core Exit Temperature is used to determine whether to terminate SI, if still in progress, or to reinitiate SI if it has been stopped. Core Exit Temperature is also used for unit stabilization and cooldown control.

Two OPERABLE channels of In-Core Thermocouples are required in each quadrant to provide indication of radial distribution of the coolant temperature rise across representative regions of the core. Power distribution symmetry was considered in determining the specific number and locations provided for diagnosis of local core problems. Therefore, two randomly selected thermocouples are not sufficient to meet the two thermocouples per channel requirement in any quadrant. The two thermocouples in each channel must meet the additional requirement that one is located near the center of the core and the other near the core perimeter, such that the pair of Core Exit Temperatures indicate the radial temperature gradient across their core quadrant. Unit specific evaluations in response to Item II.F.2 of NUREG-0737 (Ref. 3) should have identified the thermocouple pairings that satisfy these requirements. Two sets of two thermocouples ensure a single failure will not disable the ability to determine the radial temperature gradient.

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(continued)

BASES

LCO  
(continued)

19. Auxiliary Feedwater (AFW) Flow

AFW Flow is provided to monitor operation of decay heat removal via the SGs. One AFW flow channel is provided for each steam generator.

The AFW Flow to each SG is determined from a differential pressure measurement calibrated for a range of 0 gpm to 300 gpm. Each differential pressure transmitter provides an input to a control room indicator and the unit computer. Since the primary indication used by the operator during an accident is the control room indicator, the PAM specification deals specifically with this portion of the instrument channel.

AFW flow is used three ways:

- to verify delivery of AFW flow to the SGs;
- to determine whether to terminate SI if still in progress, in conjunction with SG water level (narrow range); and
- to regulate AFW flow so that the SG tubes remain covered.

AFW flow is a Type A variable because operator action is required to throttle flow during an SLB accident to prevent the AFW pumps from operating in runout conditions. AFW flow is also used by the operator to verify that the AFW System is delivering the correct flow to each SG. However, the primary indication used by the operator to ensure an adequate inventory is SG level (Narrow Range) during normal SG inventory conditions.

20. Refueling Water Storage Tank (RWST) Water Level

RWST water level is used to verify the water source availability to the emergency core cooling system (ECCS) and Containment Spray Systems. It may also provide an indication of time for initiating cold leg recirculation from the sump following a LOCA. The RWST level channel additionally trips the Residual Heat Removal Pumps in preparation for transfer to cold leg recirculation.

APPLICABILITY

The PAM instrumentation LCO is applicable in MODES 1, 2, and 3. These variables are related to the diagnosis and pre-planned actions required to mitigate DBAs. The applicable DBAs are assumed to occur in MODES 1, 2, and 3. In MODES 4, 5, and 6, unit conditions are such that the likelihood of an event that would require PAM instrumentation is low; therefore, the PAM instrumentation is not required to be OPERABLE in these MODES.

(continued)



BASES (continued)

ACTIONS

Note 1 has been added in the ACTIONS to exclude the MODE change restriction of LCO 3.0.4. This exception allows entry into the applicable MODE while relying on the ACTIONS even though the ACTIONS may eventually require unit shutdown. This exception is acceptable due to the passive function of the instruments, the operator's ability to respond to an accident using alternate instruments and methods, and the low probability of an event requiring these instruments.

Note 2 has been added in the ACTIONS to clarify the application of Completion Time rules. The Conditions of this Specification may be entered independently for each Function listed on Table 3.3.3-1. When the required channels in Table 3.3.3-1 are specified on a per steam generator basis, then the Condition may be entered separately for each steam generator.

The Completion Time(s) of the inoperable channel(s) of a Function will be tracked separately for each Function starting from the time the Condition was entered for that Function.

A.1

Condition A applies when one or more Functions have one required channel that is inoperable. Required Action A.1 requires restoring the inoperable channel to OPERABLE status within 30 days. The 30 day Completion Time is based on operating experience and takes into account the remaining OPERABLE channel (or in the case of a Function that has only one required channel, other non-Regulatory Guide 1.97 instrument channels to monitor the Function), the passive nature of the instrument (no critical automatic action is assumed to occur from these instruments), and the low probability of an event requiring PAM instrumentation during this interval.

B.1

Condition B applies when the Required Action and associated Completion Time for Condition A are not met. This Required Action specifies immediate initiation of actions in Specification 5.6.8, which requires a written report to be submitted to the NRC. This report discusses the results of the root cause evaluation of the inoperability and identifies proposed restorative actions. This action is appropriate in lieu of a shutdown requirement since alternative actions are identified before loss of functional capability, and given the likelihood of unit conditions that would require information provided by this instrumentation.

(continued)

## BASES

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### ACTIONS (continued)

#### C.1

Condition C applies when one or more Functions have two or more inoperable required channels (i.e., two or more channels inoperable in the same function). Required Action C.1 requires restoring all but one channel in the Function(s) to OPERABLE status within 7 days. The Completion Time of 7 days is based on the relatively low probability of an event requiring PAM instrument operation and the availability of alternate means to obtain the required information. Continuous operation with no required channels OPERABLE in a Function is not acceptable because the alternate indications may not fully meet all performance qualification requirements applied to the PAM instrumentation. Therefore, requiring restoration of all but one inoperable channel of the Function limits the risk that the PAM Function will be in a degraded condition should an accident occur. Condition C is modified by a Note that excludes hydrogen monitor channels.

#### D.1

Condition D applies when two hydrogen monitor channels are inoperable. Required Action D.1 requires restoring one hydrogen monitor channel to OPERABLE status within 72 hours. The 72 hour Completion Time is reasonable based on the unlikely event that a LOCA (which would cause core damage) would occur during this time.

#### E.1

Condition E applies when the Required Action and associated Completion Time of Condition C or D are not met. Required Action E.1 requires entering the appropriate Condition referenced in Table 3.3.3-1 for the channel immediately. The applicable Condition referenced in the Table is Function dependent. Each time an inoperable channel has not met any Required Action of Condition C or D, and the associated Completion Time has expired, Condition E is entered for that channel and provides for transfer to the appropriate subsequent Condition.

#### F.1 and F.2

If the Required Action and associated Completion Time of Conditions C or D are not met and Table 3.3.3-1 directs entry into Condition F, the unit must be brought to a MODE where the requirements of this LCO do not apply. To achieve this status, the unit must be brought to at least MODE 3 within 6 hours and MODE 4 within 12 hours.

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## BASES

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### ACTIONS

#### F.1 and F.2 (continued)

The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

#### G.1

Alternate means of monitoring Reactor Vessel Water Level and Containment Area Radiation have been developed. These alternate means may be temporarily installed if the normal PAM channel cannot be restored to OPERABLE status within the allotted time. Monitoring the Core Exit Thermocouples, Pressurizer Level indication (07-LI-459A, 460A or 461), and RCS Subcooling Monitor indication (07-YI-31) provide an alternate means for RVLIS. These three parameters provide diverse information to verify there is adequate core cooling or RCS inventory. When Containment Area Radiation Level (High Range) monitors (R-30 and R-31) are inoperable, selected portable radiation monitoring equipment is made available for taking correlated readings at the equipment or personnel hatches as the alternate method. If these alternate means are used, the Required Action is not to shut down the unit but rather to follow the directions of Specification 5.6.8, in the Administrative Controls section of the TS. The report provided to the NRC should discuss the alternate means used, describe the degree to which the alternate means are equivalent to the installed PAM channels, justify the areas in which they are not equivalent, and provide a schedule for restoring the normal PAM channels.

### SURVEILLANCE REQUIREMENTS

A Note has been added to the SR Table to clarify that SR 3.3.3.1 and SR 3.3.3.2 apply to each PAM instrumentation Function in Table 3.3.3-1.

#### SR 3.3.3.1

Performance of the CHANNEL CHECK once every 31 days ensures that a gross instrumentation failure has not occurred. A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on other channels. 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. A CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying the instrumentation continues to operate properly between each CHANNEL CALIBRATION. The high radiation instrumentation should be compared to similar unit instruments located throughout the unit.

(continued)

BASES

SURVEILLANCE  
REQUIREMENTS

SR 3.3.3.1 (continued)

Agreement criteria are determined by the unit staff, based on a combination of the channel instrument uncertainties, including isolation, 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 limit. If the channels are within the criteria, it is an indication that the channels are OPERABLE.

As specified in the SR, a CHANNEL CHECK is only required for those channels that are normally energized. The Containment Hydrogen Concentration monitors are maintained in a "standby" condition which does not energize all of the monitor components, thus the monitors are not considered "normally energized."

The Frequency of 31 days is based on operating experience that demonstrates that channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the LCO required channels.

SR 3.3.3.2

A CHANNEL CALIBRATION is performed every 24 months, or approximately at every refueling. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor. The test verifies that the channel responds to measured parameter with the necessary range and accuracy. CHANNEL CALIBRATION of the Neutron Flux Wide Range Function excludes the detectors. To ensure that the detectors are verified, the Neutron Flux Wide Range Channels are cross-correlated and normalized to reactor thermal power. CHANNEL CALIBRATION of the Containment Radiation Level (High Range) Function may consist of an electronic calibration of the channel, not including the detector, for range decades above 10R/h and a one point calibration check of the detector below 10 R/h with an installed or portable gamma source. Whenever an RTD is replaced in Functions 3 or 4, the next required CHANNEL CALIBRATION of the RTDs is accomplished by an inplace cross calibration that compares the other sensing elements with the recently installed sensing element. Whenever an incore thermocouple is replaced in Function 15, 16, 17, or 18 the next required CHANNEL CALIBRATION of the incore thermocouples is accomplished by an inplace cross calibration that compares the other sensing elements with the recently installed sensing element. For function 9, Containment Isolation Valve Position, the instrument loop consists of the position switch mounted on the valve, the indication lights in the monitor boxes and the interconnecting wiring. For the CHANNEL CALIBRATION to verify that the channel

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BASES

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SURVEILLANCE  
REQUIREMENTS  
(continued)

SR 3.3.3.2 (continued)

responds with the necessary range and accuracy, the test must verify that the proper indication is received when the valve is stroked to the fully closed position. Verification of intermediate position or actual percentage closed is not required, however, for OPERABILITY, the position indication must be able to communicate the proper isolation status of the containment penetration. Adjustments to the channel may be done as part of this surveillance or through other controlled instructions. The Frequency is based on operating experience and consistency with the typical industry refueling cycle.

SR 3.3.3.3

A CHANNEL CALIBRATION is performed every 92 days. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor. The test verifies that the channel responds to measured parameters with the necessary range and accuracy. The calibration sequence uses a zero and span sample gas in accordance with the manufacturer's recommendations. The Frequency is based on the manufacturer's recommendations and on operating experience.

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REFERENCES

1. FSAR, 7.5.
  2. Regulatory Guide 1.97, Revision 3.
  3. NUREG-0737, Supplement 1, "TMI Action Items."
  4. Supplemental Safety Evaluation Report 14.
  5. Supplemental Safety Evaluation Report 31.
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### B 3.3 INSTRUMENTATION

#### B 3.3.4 Remote Shutdown System

##### BASES

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##### BACKGROUND

The Remote Shutdown System provides the control room operator with sufficient instrumentation and controls to place and maintain the unit in a safe shutdown condition from a location other than the control room. This capability is necessary to protect against the possibility that the control room becomes inaccessible. A safe shutdown condition is defined as MODE 3. With the unit in MODE 3, the Auxiliary Feedwater (AFW) System and the steam generator (SG) safety valves can be used to remove core decay heat and meet all safety requirements. The long term supply of water for the AFW System allows extended operation in MODE 3 until such time that either control is transferred back to the Control Room or a cooldown is initiated from outside the control room.

If the control room becomes inaccessible, the operators can establish control at the remote shutdown panel (hot shutdown panel), and place and maintain the unit in MODE 3. Not all controls and necessary transfer switches are located at the hot shutdown panel. Some controls and transfer switches will have to be operated locally at the switchgear, motor control panels, or other local stations. The unit automatically reaches MODE 3 following a unit shutdown and can be maintained safely in MODE 3 for an extended period of time.

The OPERABILITY of the following remote shutdown control and instrumentation functions ensures there is sufficient information available on selected unit parameters to place and maintain the unit in MODE 3 should the control room become inaccessible.

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(continued)

BASES (continued)

<u>INSTRUMENT/CONTROL FUNCTION</u>	<u>READOUT/CONTROL LOCATION</u>	<u>REQUIRED CHANNELS</u>
1. Reactor Trip Breaker Indication	Reactor Trip Breaker	1/trip breaker
2. Pressurizer Pressure	Hot Shutdown Panel	1
3. & 4. RCS Loop 1 Temperature Indication	Dedicated Shutdown Panel	Hot and Cold Leg Temperature Indication
5. Auxiliary Feedwater Flow Control — AFW Pump, and Associated Valves — Transfer Switches	Hot Shutdown Panel 4kV Switchgear	2 of 3 AFW pumps
6. Steam Generator Pressure	Hot Shutdown Panel	1/stm. gen.
7. Steam Generator Wide Range Water Level	Hot Shutdown Panel	1/stm. gen.
8. Auxiliary Feedwater Flow	Hot Shutdown Panel	1/stm. gen.
9. Condensate Storage Tank Water Level	Hot Shutdown Panel	1
10. Pressurizer Level	Hot Shutdown Panel	1
11. Charging Flow Control — Centrifugal Charging Pump — Transfer Switch	Hot Shutdown Panel 4kV Switchgear	2 of 2 pumps
12. Charging Flow	Hot Shutdown Panel	1
13. Emergency Diesel Generator Control — EDG Start	EDG Local Control Panel	3 of 3 EDGs
14. Component Cooling Water Control — Component Cooling Water Pump — Transfer Switch	Hot Shutdown Panel 4kV Switchgear	2 of 3 CCW pumps
15. Auxiliary Salt Water Control — Auxiliary Saltwater Pump — Transfer Switch	Hot Shutdown Panel 4kV Switchgear	2 of 2 pumps

(continued)

BASES (continued)

APPLICABLE  
SAFETY  
ANALYSES

The Remote Shutdown System is required to provide equipment at appropriate locations outside the control room with a capability to promptly shut down and maintain the unit in a safe condition in MODE 3.

The criteria governing the design and specific system requirements of the Remote Shutdown System are located in 10 CFR 50, Appendix A, GDC 19 (Ref. 1).

The Remote Shutdown System is considered an important contributor to the reduction of unit risk to accidents and as such it has been retained in the Technical Specifications as indicated by Criterion 4 of 10 CFR 50.36(c)(2)(ii).

LCO

The Remote Shutdown System LCO provides the OPERABILITY requirements of the functions necessary to place and maintain the unit in MODE 3 from a location other than the control room. The functions required are listed in Table 3.3.4-1 in the accompanying LCO.

The controls, instrumentation, and transfer switches are required for the individual functions that provide the following general functions:

- Reactor trip indication;
- RCS pressure control;
- Decay heat removal via the AFW System and the SG safety valves;
- RCS inventory control via charging flow; and
- Safety support systems for the above Functions, including auxiliary saltwater, component cooling water, and diesel generators.

A Function of a Remote Shutdown System is OPERABLE if all required instrument and control channels for that function listed in Table 3.3.4-1 are OPERABLE.

The remote shutdown instrument and control circuits covered by this LCO do not need to be energized to be considered OPERABLE. This LCO is intended to ensure the instruments and control circuits will be OPERABLE if unit conditions require that the Remote Shutdown System be placed in operation.

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BASES (continued)

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**APPLICABILITY** The Remote Shutdown System LCO is applicable in MODES 1, 2, and 3. This is required so that the unit can be placed and maintained in MODE 3 for an extended period of time from a location other than the control room until either control is transferred back to the control room or a cooldown is initiated.

This LCO is not applicable in MODE 4, 5, or 6. In these MODES, the facility is already subcritical and in a condition of reduced RCS energy. Under these conditions, considerable time is available to restore necessary instrument control functions if control room instruments or controls become unavailable.

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**ACTIONS** Note 1 is included which excludes the MODE change restriction of LCO 3.0.4. This exception allows entry into an applicable MODE while relying on the ACTIONS even though the ACTIONS may eventually require a unit shutdown. This exception is acceptable due to the low probability of an event requiring the Remote Shutdown System and because the equipment can generally be repaired during operation without significant risk of spurious trip.

Note 2 has been added to the ACTIONS to clarify the application of Completion Time rules. Separate Condition entry is allowed for each Function listed on Table 3.3.4-1. The Completion Time(s) of the inoperable channel(s)/train(s) of a Function will be tracked separately for each Function starting from the time the Condition was entered for that Function.

A.1

Condition A addresses the situation where one or more required Functions of the Remote Shutdown System are inoperable. This includes any Function listed in Table 3.3.4-1, as well as the control and transfer switches.

The Required Action is to restore the required Function to OPERABLE status within 30 days. The Completion Time is based on operating experience and the low probability of an event that would require evacuation of the control room.

B.1 and B.2

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

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(continued)

BASES (continued)

SURVEILLANCE  
REQUIREMENTS

SR 3.3.4.1

Performance of the CHANNEL CHECK once every 31 days ensures that a 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 other channels. 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 unit staff, based on a combination of the channel instrument uncertainties, including indication and readability. If the channels are within the criteria, it is an indication that the channels are OPERABLE. If the channels are normally off scale times when Surveillance is required, the CHANNEL CHECK will verify only that they are off scale in the same direction. Offscale low current loop channels are verified to be reading at the bottom of the range and not failed downscale.

The CHANNEL CHECK for the RTB serves to verify that the indication correctly indicates the position of the RTB.

The Frequency of 31 days is based upon operating experience which demonstrates that channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the LCO required channels.

SR 3.3.4.2

SR 3.3.4.2 verifies each required Remote Shutdown System control circuit and transfer switch performs the intended function. This verification is performed from the hot shutdown panel and locally, as appropriate. Operation of the equipment from the remote shutdown panel is not necessary. The Surveillance can be satisfied by performance of a continuity check. This will ensure that if the control room becomes inaccessible, the unit can be placed and maintained in MODE 3 from the remote shutdown panel and the local control stations. The 24 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. (However, this Surveillance is not

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS

SR 3.3.4.2 (continued)

required to be performed only during a unit outage.) Operating experience demonstrates that remote shutdown control channels usually pass the Surveillance test when performed at the 24 month Frequency.

SR 3.3.4.3

CHANNEL CALIBRATION is a complete check of the instrument loop and the sensor. The test verifies that the channel responds to a measured parameter within the necessary range and accuracy.

The channel calibration is not applicable to the RTB indication.

Whenever an RTD is replaced in Function 3.a or 3.b, the next required CHANNEL CALIBRATION of the RTDs is accomplished by an inplace cross calibration that compares the other sensing elements with the recently installed sensing element.

The Frequency of 24 months is based upon operating experience and consistency with the typical industry refueling cycle.

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REFERENCES

1. 10 CFR 50, Appendix A, GDC 19 (associated with 1967 GDC 11 per FSAR Appendix 3.1A.).
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## B 3.3 INSTRUMENTATION

### B 3.3.5 Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation

#### BASES

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##### BACKGROUND

The DGs provide a source of emergency power when offsite power is either unavailable or is degraded below a point that would allow safe unit operation. Undervoltage protection will generate an LOP start if a loss of voltage or degraded voltage condition occurs on the 4.16kV vital bus. There are three LOP start signals, one for each 4.16 kV vital bus.

Three undervoltage relays are provided on each 4160 Class 1E vital bus for detecting sustained degraded voltage condition or a loss of bus voltage. A relay will generate an LOP signal (first level undervoltage type relay setpoint) if the voltage is below 75% for a short time. The DG start relays (one per bus) have an inverse time characteristic and will generate an LOP signal with a  $\leq 0.8$  sec time delay at  $\geq 0$  volts and at  $\leq 10$  seconds for  $\geq 2583$  volts. In addition, the circuit breakers for all loads, except the 4160-480 V load center transformers, are opened automatically by Load Shedding Relays for first level undervoltage. Each of the vital 4160 kV buses has a separate pair of these relays. The relays have a two-out-of-two logic arrangement for each bus to prevent inadvertent tripping of operating loads during a loss of voltage either from a single failure in the potential circuits or from human error. One relay trips instantaneously at  $\geq 2870$  volts. The second of the two relays has an inverse time characteristic and delay of  $\leq 4$  seconds at no voltage and a  $\leq 24$  second delay with  $\geq 2583$  volts to prevent loss of operating loads during transient voltage dips, and to permit the offsite power sources to pick up the load. The LOP start actuation is described in FSAR, Section 8.3 (Ref. 1).

Should there be a degraded voltage condition (second level undervoltage), where the voltage of the vital 4160 kV buses remains at approximately 3785 kV or below, but above the setpoints of the first level undervoltage relays, the following second level undervoltage actions occur automatically:

- (1) After a  $\leq 10$  second time delay, the respective diesel generators will start.
- (2) After a  $\leq 20$  second time delay, if the undervoltage condition persists, the circuit breakers for all loads to the respective vital 4160 kV buses, except the 4160-480 V load center transformer, are opened and sequentially loaded on the DG.

(continued)

## BASES

### BACKGROUND (continued)

Each vital 4160 kV bus has two second level undervoltage relays operating with a two-out-of-two logic. Each vital 4160kV Bus also has two second level undervoltage timers. One timer provides the Diesel Generator start and the other will initiate load shedding.

#### Allowable Value Setpoints

The Setpoints used in the relays are based on the analytical limits presented in FSAR, Chapter 15 (Ref. 2). The selection of these Setpoints is such that adequate protection is provided when all sensor and processing time delays are taken into account.

The actual nominal Setpoint entered into the relays is normally still more conservative than that required by the Allowable Value. If the measured setpoint does not exceed the Allowable Value, the undervoltage relay is considered OPERABLE. If the measured time delay does not exceed the Allowable Value, the timer is considered OPERABLE.

Setpoints adjusted in accordance with the Allowable Value ensure that the consequences of accidents will be acceptable, providing the unit is operated from within the LCOs at the onset of the accident and that the equipment functions as designed.

Allowable Values are specified for each Function in the LCO. The nominal setpoints are selected to ensure that the setpoint measured by the surveillance procedure does not exceed the Allowable Value if the undervoltage relay is performing as required. If the measured setpoint does not exceed the Allowable Value, the undervoltage relay is considered OPERABLE. Operation with a Setpoint less conservative than the nominal Setpoint, but within the Allowable Value, is acceptable provided that operation and testing is consistent with the assumptions of the unit specific setpoint calculation. Each Allowable Value specified is more conservative than the analytical limit assumed in the transient and accident analyses in order to account for instrument uncertainties appropriate to the trip function. These uncertainties are defined in calculations 174A-DC Rev. 0 (Ref. 4) and 357P-DC Rev. 0 (Ref. 5).

### APPLICABLE SAFETY ANALYSES

The LOP DG start instrumentation is required for the Engineered Safety Features (ESF) Systems to function in any accident with a loss of offsite power. Its design basis is that of the ESF Actuation System (ESFAS).

(continued)

BASES

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APPLICABLE  
SAFETY  
ANALYSES  
(continued)

Accident analyses credit the loading of the DG based on the loss of offsite power during a loss of coolant accident (LOCA). The actual DG start has historically been associated with the ESFAS actuation. The DG loading has been included in the delay time associated with each safety system component requiring DG supplied power following a loss of offsite power. The analyses assume a non-mechanistic DG loading, which does not explicitly account for each individual component of loss of power detection and subsequent actions.

The required channels of LOP DG start instrumentation, in conjunction with the ESF systems powered from the DGs, provide unit protection in the event of any of the analyzed accidents discussed in Reference 2, in which a loss of offsite power is assumed.

The delay times assumed in the safety analysis for the ESF equipment include the 10 second DG start delay, and the appropriate sequencing delay, if applicable. The response times for ESFAS actuated equipment in LCO 3.3.2, "Engineered Safety Feature Actuation System (ESFAS) Instrumentation," include the appropriate DG loading and sequencing delay.

The LOP DG start instrumentation channels satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

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LCO

The LCO for LOP DG start instrumentation requires that one channel per bus for loss of voltage DG start with, two channels per bus for initiation of load shed and their two corresponding timers and two channels per bus of degraded voltage function with one timer per bus for DG start and one timer per bus for initiation of load shed Functions shall be OPERABLE in MODES 1, 2, 3, and 4 when the LOP DG start instrumentation supports safety systems associated with the ESFAS. In MODES 5 and 6, the channels must be OPERABLE whenever the associated DG is required to be OPERABLE to ensure that the automatic start of the DG is available when needed. Loss of the LOP DG Start Instrumentation Function could result in the delay of safety systems initiation when required. This could lead to unacceptable consequences during accidents. During the loss of offsite power the DG powers the motor driven auxiliary feedwater pumps. Failure of these pumps to start would leave only one turbine driven pump, as well as an increased potential for a loss of decay heat removal through the secondary system.

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(continued)

BASES (continued)

APPLICABILITY	<p>The LOP DG Start Instrumentation Functions are required in MODES 1, 2, 3, and 4 because ESF Functions are designed to provide protection in these MODES. Actuation in MODE 5 or 6 is required whenever the required DG must be OPERABLE so that it can perform its function on an LOP or degraded power to the vital bus.</p>
ACTIONS	<p>In the event a channel's Setpoint is found nonconservative with respect to the Allowable Value, or the channel is found inoperable, then the function that channel provides must be declared inoperable and the LCO Condition entered for the particular protection function affected.</p> <p>Because the required channels are specified on a per bus basis, the Condition may be entered separately for each bus as appropriate.</p> <p>A Note has been added in the ACTIONS to clarify the application of Completion Time rules. The Conditions of this Specification may be entered independently for each Function listed in the LCO. The Completion Time(s) of the inoperable channel(s) of a Function will be tracked separately for each Function starting from the time the Condition was entered for that Function.</p> <p><u>A.1</u></p> <p>Condition A applies when one or more of the loss of voltage or the degraded voltage channel functions (this includes both relays and timers) on a single bus are inoperable.</p> <p>In these circumstances the Conditions specified in LCO 3.8.1, "AC Sources-Operating," or LCO 3.8.2, "AC Sources-Shutdown," for the DG made inoperable by failure of the LOP instrumentation are required to be entered immediately. The actions of those LCOs provide for adequate compensatory actions to assure unit safety.</p> <p>A Note is added to allow bypassing one channel for up to 2 hours for surveillance testing. This allowance is made where bypassing the channel does not cause an actuation and where at least one other channel is monitoring that parameter.</p>
SURVEILLANCE REQUIREMENTS	<p><u>SR 3.3.5.1</u> not used</p> <p><u>SR 3.3.5.2</u></p> <p>SR 3.3.5.2 is the performance of a TADOT. This test is performed every 24 months. The test checks trip devices that provide actuation signals directly, bypassing the analog process control equipment. For these tests, the relay Setpoints are verified and adjusted as necessary. The Frequency is based on the known reliability of the relays and controls and the multichannel redundancy available, and has been shown to be acceptable through operating experience.</p>

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS  
(continued)

SR 3.3.5.3

SR 3.3.5.3 is the performance of a CHANNEL CALIBRATION.

The setpoints, as well as the response to a loss of voltage and a degraded voltage test, shall include a single point verification that the trip occurs within the required time delay.

A CHANNEL CALIBRATION is performed every 24 months. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor. The test verifies that the channel responds to a measured parameter within the necessary range and accuracy.

The Frequency of 24 months is based on operating experience and consistency with the typical industry refueling cycle and is justified by the assumption of 24 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.

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REFERENCES

1. FSAR, Section 8.3.
  2. FSAR, Chapter 15.
  3. Blank
  4. Calculation 174A-DC, "Undervoltage Relay Settings for 4KV System (27HFB2 & 27HFT1)."
  5. Calculation 357P-DC, "SLUR and SLUR Timer Setpoints."
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### B 3.3 INSTRUMENTATION

#### B 3.3.6 Containment Ventilation Isolation Instrumentation

##### BASES

###### BACKGROUND

Containment ventilation isolation instrumentation closes the containment purge supply (FCV-660, 661), exhaust (RCV-11, 12), and the vacuum/pressure relief valves (FCV-662, 663, 664). It also closes the containment atmosphere sample valves (FCV-678, 679, 681). This action in conjunction with a Phase A signal isolates the containment atmosphere from the environment to minimize releases of radioactivity in the event of an accident. The Purge or Vacuum/Pressure Relief System may be in use during reactor operation or reactor shutdown.

Containment ventilation isolation initiates on a automatic safety injection (SI) signal through the Containment Isolation-Phase A Function, or by manual actuation of Phase A Isolation. The Bases for LCO 3.3.2, "Engineered Safety Feature Actuation System (ESFAS) Instrumentation," discuss these modes of initiation.

Two radiation monitoring channels (RM 44A and 44B) are also provided as input to the containment ventilation isolation. The two channels measure containment radiation in the exhaust duct for fan E-3. Both detectors will respond to events that release radiation to containment. Both monitors are gaseous activity monitors that will respond to noble gases, particulate and Iodine. The high alarm setpoint is based upon the design basis fuel handling accident source term which does not have a particulate component. The actual high alarm setpoint is more than a factor of 500 below the design calculation earliest actuation point. Since the monitors can only be adjusted to one high alarm setpoint and no particulate is expected during a fuel handling accident, a setpoint based on site boundary noble gases is conservative. For the purposes of this LCO the channels are redundant.

A high radiation signal from either of the two channels initiates containment ventilation isolation, which closes the containment ventilation isolation valves. These systems are described in the Bases for LCO 3.6.3, "Containment Isolation Valves."

###### APPLICABLE SAFETY ANALYSES

The safety analyses assume that the containment remains intact with penetrations unnecessary for core cooling isolated early in the event, within approximately 60 seconds. The isolation of the containment ventilation valves has not been analyzed mechanistically in the dose calculations, although its isolation, using a conservative isolation time, is assumed. The containment ventilation isolation radiation monitors act as backup to the SI signal to ensure closing of the containment ventilation isolation valves following a LOCA.

(continued)

BASES

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APPLICABLE  
SAFETY  
ANALYSES  
(continued)

They are also the primary means for automatically isolating containment in the event of a fuel handling accident or any other source within containment during shutdown. Containment isolation in turn ensures meeting the containment leakage rate assumptions of the safety analyses, and ensures that the calculated accidental offsite radiological doses are below 10 CFR 100 (Ref. 1) limits.

The containment ventilation isolation instrumentation satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

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LCO

The LCO requirements ensure that the instrumentation necessary to initiate Containment Ventilation Isolation, listed in Table 3.3.6-1, is OPERABLE.

1. Manual Initiation - Not used
2. Automatic Actuation Logic and Actuation Relays

The LCO requires two trains of Automatic Actuation Logic and Actuation Relays OPERABLE to ensure that no single random failure can prevent automatic actuation.

Automatic Actuation Logic and Actuation Relays consist of the same features and operate in the same manner as described for ESFAS Function 1.b, SI, and ESFAS Function 3.a, Containment Phase A Isolation. The applicable MODES and specified conditions for the Containment Ventilation Isolation portion of these Functions are different and less restrictive than those for their Phase A isolation and SI roles. If one or more of the SI or Phase A isolation Functions becomes inoperable in such a manner that only the Containment Ventilation Isolation Function is affected, the Conditions applicable to their SI and Phase A isolation Functions need not be entered. The less restrictive Actions specified for inoperability of the Containment Ventilation Isolation Functions specify sufficient compensatory measures for this case.

3. Containment Radiation

The LCO specifies two required channels of radiation monitors to ensure that the radiation monitoring instrumentation necessary to initiate Containment ventilation Isolation remains OPERABLE in MODES 1-4.

The LCO only requires one monitor to be OPERABLE during CORE ALTERATIONS or during movement of irradiated fuel assemblies in containment. In order to provide the CVI function under these conditions without placing the entire SSPS in service, an alternate circuit is provided to power the output relays and provide logic actuation signals independent of the SSPS.

(continued)

## BASES

LCO  
(continued)

### 3. Containment Radiation (continued)

This circuit also disconnects the normal logic and actuation paths such that only high radiation signals may generate a CVI.

### 4. Containment Isolation - SI

Refer to LCO 3.3.2, Function 1 and 3, for all initiating Functions and requirements.

APPLICABILITY

The Automatic Actuation Logic and Actuation Relays, Containment Isolation-Phase A, and Containment Radiation Functions are required OPERABLE in MODES 1, 2, 3, and 4, and during CORE ALTERATIONS or movement of irradiated fuel assemblies within containment. Under these conditions, the potential exists for an accident that could release fission product radioactivity into containment. Therefore, the containment ventilation isolation instrumentation must be OPERABLE in these MODES.

While in MODES 5 and 6 without fuel handling in progress, the containment ventilation isolation instrumentation need not be OPERABLE since the potential for radioactive releases is minimized and operator action is sufficient to ensure post accident offsite doses are maintained within the limits of Reference 1.

ACTIONS

The most common cause of channel inoperability is outright failure or drift of the bistable or process module sufficient to exceed the tolerance allowed by unit specific calibration procedures. 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 CFT and/or CHANNEL CALIBRATION, when the process instrumentation is set up for adjustment to bring it within specification. Drift can also be observed during a CHANNEL CHECK or CFT and if observed would prompt action to correct the discrepancy. If the Trip Setpoint is less conservative than the tolerance specified by the calibration procedure, the channel must be declared inoperable immediately and the appropriate Condition entered.

A Note has been added to the ACTIONS to clarify the application of Completion Time rules. The Conditions of this Specification may be entered independently for each Function listed in Table 3.3.6-1. The Completion Time(s) of the inoperable channel(s)/train(s) of a Function will be tracked separately for each Function starting from the time the Condition was entered for that Function.

#### A.1

Condition A applies to the failure of one Containment ventilation Isolation radiation monitor channel. The 4 hours allowed to restore the affected channel is justified by the low likelihood

(condition)

BASES

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ACTIONS

A.1 (continued)

of events occurring during this interval, and recognition that the remaining channel will respond.

A Note has been added to state that Condition A is only applicable in MODE 1, 2, 3, or 4.

B.1

Condition B applies to all Containment Ventilation Isolation Functions and addresses the train orientation of the Solid State Protection System (SSPS) and the master and slave relays for these Functions. It also addresses the failure of both radiation monitoring channels, or the inability to restore a single failed channel to OPERABLE status in the time allowed for Required Action A.1.

If a train is inoperable, both radiation channels are inoperable, or the Required Action and associated Completion Time of Condition A are not met, operation may continue as long as the Required Action for the applicable Conditions of LCO 3.6.3 to place and maintain containment ventilation isolation valves (RCV-11, 12, FCV-660, 661, 662, 663, 664) in their closed position is met. The completion Time for these Required Actions is Immediately.

Although FCV-678, 679, and 681 are also categorized as containment ventilation isolation valves, they are not required to be closed due to this Condition. The reason is that it is undesirable to have these valves closed during normal and refueling activities because this results in the loss of operability of containment radioactivity monitors RM-11 and RM-12 which play an important part in RCS leak detection in Modes 1, 2, 3, and 4 (Ref. 3).

A Note is added stating that Condition B is only applicable in MODE 1, 2, 3, or 4.

C.1 and C.2

Condition C applies to all Containment Ventilation Isolation Functions and addresses the train orientation of the SSPS and the master and slave relays for these Functions. It also addresses the condition of no OPERABLE radiation monitoring channels. If a train is inoperable, or the required radiation monitor is inoperable, operation may continue as long as the Required Action to place and maintain containment ventilation isolation valves (RCV-11, 12, FCV 660, 661, 662, 663, 664) in their closed position is met or the applicable Conditions of LCO 3.9.4, "Containment Penetrations," are met for each valve made inoperable by failure of isolation instrumentation. The Completion Time for these Required Actions is Immediately.

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BASES (continued)

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SURVEILLANCE  
REQUIREMENTS

A Note states that Condition C is applicable during CORE ALTERATIONS and during movement of irradiated fuel assemblies within containment.

A Note has been added to the SR Table to clarify that Table 3.3.6-1 determines which SRs apply to which Containment Ventilation Isolation Functions.

SR 3.3.6.1

Performance of the CHANNEL CHECK once every 12 hours ensures that a 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 other channels. 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. A CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

Agreement criteria are determined by the unit 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 limit.

The Frequency is based on operating experience that demonstrates channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the LCO required channels.

SR 3.3.6.2

SR 3.3.6.2 is the performance of an ACTUATION LOGIC TEST. The train being tested is placed in the bypass condition, thus preventing inadvertent actuation. Through the semiautomatic tester, all possible logic combinations, with and without applicable permissives, are tested for each protection function. In addition, the master relay coil is pulse tested for continuity. This verifies that the logic modules are OPERABLE and there is an intact voltage signal path to the master relay coils. This test is performed every 31 days on a STAGGERED TEST BASIS. The Surveillance interval is acceptable based on instrument reliability and industry operating experience.

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS  
(continued)

SR 3.3.6.3

SR 3.3.6.3 is the performance of a MASTER RELAY TEST. The MASTER RELAY TEST is the energizing of the master relay, verifying contact operation and a low voltage continuity check of the slave relay coil. Upon master relay contact operation, a low voltage is injected to the slave relay coil. This voltage is insufficient to pick up the slave relay, but large enough to demonstrate signal path continuity. This test is performed every 31 days on a STAGGERED TEST BASIS. The Surveillance interval is acceptable based on instrument reliability and industry operating experience.

SR 3.3.6.4

A CFT is performed every 92 days on each required channel to ensure the entire channel will perform the intended Function. The Frequency is based on the staff recommendation for increasing the availability of radiation monitors according to NUREG-1366 (Ref. 2). This test verifies the capability of the instrumentation to provide the containment purge and vacuum/pressure relief system isolation.

To ensure complete end-to-end testing through the CVI mode selector switch, the CFT is only valid for the position in use during the test.

SR 3.3.6.5

SR 3.3.6.5 is the performance of a SLAVE RELAY TEST. The SLAVE RELAY TEST is the energizing of the slave relays. Contact operation is verified in one of two ways. Actuation equipment that may be operated in the design mitigation mode is either allowed to function or is placed in a condition where the relay contact operation can be verified without operation of the equipment. Actuation equipment that may not be operated in the design mitigation mode is prevented from operation by the SLAVE RELAY TEST circuit. For this latter case, contact operation is verified by a continuity check of the circuit containing the slave relay. This test is performed every 24 months. The Frequency is acceptable based on instrument reliability and industry operating experience.

SR 3.3.6.6

There is no manual actuation of CVI except via SI, phase A or B. This testing is performed as part of SR 3.3.2.8

SR 3.3.6.7

A CHANNEL CALIBRATION is performed every 24 months, or approximately at every refueling. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor.

(continued)

BASES

SURVEILLANCE  
REQUIREMENTS

SR 3.3.6.7 (continued)

The test verifies that the channel responds to a measured parameter within the necessary range and accuracy. The Frequency is based on operating experience and is consistent with the typical industry refueling cycle.

SR 3.3.6.8

This SR assures that the individual channel RESPONSE TIMES for the CVI from Containment Purge Radiation Gaseous and Particulate function are less than or equal to the maximum values assumed in the accident analysis. Response Time testing acceptance criteria are included in ECG 38.2. Individual component response times are not modeled in the analyses. The analyses model the overall or elapsed time, from the point at which the parameter exceeds the Trip Setpoint value at the sensor, to the point at which the equipment in both trains reaches the required functional state (e.g., valves in full closed position). The response time may be measured by a series of overlapping tests such that the entire response time is measured.

RESPONSE TIME tests are conducted on an 24 month STAGGERED TEST BASIS. Each verification shall include at least one train such that both trains are verified at least once per 48 months and one channel per function such that all channels are tested at least once every N times 24 months where N is the total number of redundant channels in a specific ESFAS function. Testing of the final actuation devices, which make up the bulk of the response time, is included in the testing of each train. Therefore, staggered testing results in response time verification of one train of devices every 24 months. The 24 month Frequency is consistent with the typical refueling cycle and is based on unit operating experience, which shows that random failures of instrumentation components causing serious response time degradation, but not channel failure, are infrequent occurrences.

REFERENCES

- 1 10 CFR 100.11.
2. NUREG-1366, December 1992.
3. DCM No. T-16, Containment Function.

### B 3.3 INSTRUMENTATION

#### B 3.3.7 Control Room Ventilation System (CRVS) Actuation Instrumentation

##### BASES

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###### BACKGROUND

The CRVS provides an enclosed control room environment from which both units can be operated following an uncontrolled release of radioactivity. Upon receipt of an actuation signal, the CRVS shifts from normal operation and initiates filtered ventilation and pressurization of the control room. This system is described in the Bases for LCO 3.7.10, "Control Room Ventilation System", and is common to both units.

The CRVS Actuation Instrumentation system is also common to both units and consists of two trains of Automatic Actuation Relays (one train in each unit) and two channels of Control Room (CR) Radiation Atmosphere Air Intakes (two intake systems). One channel of CR Radiation Atmosphere Air Intakes consists of at least one of two redundant radiation monitors in a respective air intake to the control room areas. These channels therefore, have two detectors in each of the two normal control room air intakes. However, since they take suction from a common area, the North and South sides of the mechanical equipment room, only one detector per unit is required in each air intake to provide protection against a single failure, therefore, the total required detectors is two for the common control room area (one in each intake). One train of Automatic Actuation Relays consists of two sets of actuation relay logic. Each set receives an input from its respective radiation monitor and a Phase A / SI signal from a train of SSPS. Only one relay logic set in each unit is necessary to satisfy a TS train requirement. A Phase "A" containment isolation signal or a high radiation signal from either of the required detectors in the normal intake will initiate CRVS pressurization from the opposite unit pressurization system (the system selects the opposite unit assuming that pressurization would be the lowest radiation level), or from the pressurization intake with the lowest radiation level (each pressurization intake, one on the North end of the turbine building and one on the South, has two additional radiation monitors. This provides the ability to swap the pressurization intakes. This is an added feature of the system, but is not credited in any accident scenarios, thus it is not required for CRVS OPERABILITY). Only the actuation of the pressurization system via an SI signal directly is processed through the SSPS. The actuation of the pressurization system via an atmosphere intake monitor directly actuates the CRVS actuation relays independent of the SSPS. The control room operator can also initiate CRVS pressurization by manual switches in the control room.

(continued)



BASES

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BACKGROUND  
(continued)

The CRVS has two additional manually selected emergency operating modes; smoke removal and recirculation. Neither of these modes are required for the CRVS to be OPERABLE, but they are useful for certain non-DBA circumstances.

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APPLICABLE  
SAFETY  
ANALYSES

The control room must be kept habitable for the operators stationed there during accident recovery and post accident operations.

The CRVS acts to terminate the supply of unfiltered outside air to the control room, initiate filtration, and pressurize the control room. These actions are necessary to ensure the control room is kept habitable for the operators stationed there during accident recovery and post accident operations by minimizing the radiation exposure of control room personnel.

In MODES 1, 2, 3, and 4, the radiation monitor actuation of the CRVS is a backup for the Phase A signal actuation. This ensures initiation of the CRVS during a loss of coolant accident or steam generator tube rupture involving a release of radioactive materials.

The radiation monitor actuation of the CRVS in MODES 5 and 6, during movement of irradiated fuel assemblies, is the primary means to ensure control room habitability in the event of a fuel handling or waste gas decay tank rupture accident. The CRVS pressurization system actuation instrumentation satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

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LCO

The LCO requirements ensure that instrumentation necessary to initiate the CRVS pressurization system is OPERABLE.

1. Manual Initiation

The LCO requires two trains OPERABLE. The operator can initiate the CRVS pressurization mode at any time by using either of two switches in the control room. This action will cause actuation of all components in the same manner as any of the automatic actuation signals.

The LCO for Manual Initiation ensures the proper amount of redundancy is maintained in the manual actuation circuitry to ensure the operator has manual initiation capability.

2. Automatic Actuation Relays

The LCO requires two trains of Actuation Relays OPERABLE to ensure that no single random failure can prevent automatic actuation of the pressurization system. Since each unit has one train of Actuation Relays consisting of two sets of actuation logic, each unit must have at least one logic set for both trains to be considered OPERABLE.

(continued)

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BASES

LCO  
(continued)

2. Automatic Actuation Relays (continued)

If one or more of the SI or Phase A functions becomes inoperable in such a manner that only the CRVS function is affected (such as a Phase A Slave Relay output to the CRVS logic), the Conditions applicable to their SI or Phase A functions need not be entered. The less restrictive Actions specified for inoperability of the CRVS Functions specify sufficient compensatory measures for this case.

3. Control Room Radiation Atmosphere Air Intakes

The LCO specifies two required channels of Control Room Normal Intake Radiation Monitors to ensure that the radiation monitoring instrumentation necessary to initiate the CRVS pressurization system remains OPERABLE. One channel consists of two Radiation Monitors per intake, however, only one monitor is necessary for the channel to be OPERABLE.

4. Safety Injection

Refer to LCO 3.3.2, Function 1, for all initiating Functions and requirements.

As noted above, a safety injection signal does not directly initiate CRVS pressurization, but a Phase A signal does and Phase A is initiated by SI.

APPLICABILITY

The CRVS Functions must be OPERABLE in MODES 1, 2, 3, 4, and during movement of irradiated fuel assemblies. The Functions must also be OPERABLE in MODES 5 and 6 when required for a waste gas decay tank rupture accident, or a fuel handling or core alteration accident to ensure a habitable environment for the control room operators.

ACTIONS

The most common cause of channel inoperability is outright failure or drift of the bistable or process module sufficient to exceed the tolerance allowed by the unit specific calibration procedures. 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 CFT and/or CHANNEL CALIBRATION, when the process instrumentation is set up for adjustment to bring it within specification. Drift can also be observed during a CHANNEL CHECK or CFT and if observed would prompt action to correct the discrepancy. If the Trip Setpoint is less conservative than the acceptance criteria specified by the calibration procedure, the instrument must be declared inoperable immediately and the appropriate Condition entered.

(continued)

## BASES

### ACTIONS (continued)

A Note has been added to the ACTIONS indicating that separate Condition entry is allowed for each Function. The Conditions of this Specification may be entered independently for each Function listed in Table 3.3.7-1 in the accompanying LCO. The Completion Time(s) of the inoperable channel(s)/train(s) of a Function will be tracked separately for each Function starting from the time the Condition was entered for that Function.

#### A.1

Condition A applies to the actuation train Function of the CRVS, the intake radiation monitor channel Functions, and the manual channel Functions.

If one complete actuation train is inoperable, or one complete intake radiation monitor channel is inoperable in one or more Functions, 7 days are permitted to restore it to OPERABLE status. The 7 day Completion Time is the same as is allowed if one train of the mechanical portion of the system is inoperable. The basis for this Completion Time is the same as provided in LCO 3.7.10. If the complete channel/train cannot be restored to OPERABLE status, one CRVS train must be placed in the pressurization mode of operation. This accomplishes the actuation instrumentation Function and places the unit in a conservative mode of operation.

#### B.1.1 and B.1.2

Condition B applies to the failure of two complete CRVS actuation trains, two complete intake radiation monitor channels, or two manual channels. The first Required Action is to place one CRVS train in the pressurization mode of operation immediately. This accomplishes the actuation instrumentation Function that may have been lost and places the unit in a conservative mode of operation. Both trains cannot be placed in the pressurization mode since the design of the system is such that operation of two pressurization fans would overpressurize the supply ducting to the filters. The applicable Conditions and Required Actions of LCO 3.7.10 must also be entered for the CRVS train made inoperable by the inoperable actuation instrumentation. This ensures appropriate limits are placed upon train inoperability as discussed in the Bases for LCO 3.7.10.

#### C.1 and C.2

Condition C applies when the Required Action and associated Completion Time for Condition A or B have not been met and the unit is in MODE 1, 2, 3, or 4. The unit must be brought to a MODE in which the LCO requirements are not applicable. To achieve this status, the unit must be brought to MODE 3 within 6 hours and MODE 5 within 36 hours.

(continued)

BASES

ACTIONS  
(continued)

C.1 and C.2 (continued)

The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

D.1 and D.2

Condition D applies when the Required Action and associated Completion Time for Condition A or B have not been met during CORE ALTERATIONS or when irradiated fuel assemblies are being moved. Movement of irradiated fuel assemblies and CORE ALTERATIONS must be suspended immediately to reduce the risk of accidents that would require CRVS actuation.

E.1

Condition E applies when the Required Action and associated Completion Time for Condition A or B have not been met in MODE 5 or 6. Actions must be initiated to restore the inoperable train(s) to OPERABLE status immediately to ensure adequate isolation capability in the event of a waste gas decay tank rupture.

SURVEILLANCE  
REQUIREMENTS

A Note has been added to the SR Table to clarify that Table 3.3.7-1 determines which SRs apply to which CRVS Actuation Functions.

SR 3.3.7.1

Performance of the CHANNEL CHECK once every 12 hours ensures that a 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 other channels. 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. A CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

Agreement criteria are determined by the unit 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 limit.

The Frequency is based on operating experience that demonstrates channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the LCO required channels.

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS  
(continued)

SR 3.3.7.2

A CFT is performed once every 92 days on each required radiation monitor to ensure the entire channel will perform the intended function. This test verifies the capability of the instrumentation to provide the CRVS actuation. The CRVS pressurization system actuation relays are directly actuated by the CRVS atmosphere intake radiation monitors. This signal is not processed through the SSPS, but goes directly to the CRVS actuation relays. The pressurization system is also actuated by Phase A, however, this signal is processed via the SSPS and the testing of the associated relays is performed via SR 3.3.2.2, SR 3.3.2.4, and SR 3.3.2.6. The Frequency is based on the known reliability of the monitoring equipment and has been shown to be acceptable through operating experience.

SR 3.3.7.3

SR 3.3.7.3 is the performance of an ACTUATION LOGIC TEST. This test verifies the signal path to the Master Relay Coil. Although there are no "Master Relays" as in the SSPS, this surveillance was maintained to preserve the format of the standard specification. The surveillance is intended to ensure that the complete logic is tested for the function. Since the radiation monitors directly actuate the actuation relays, this test is performed every 92 days as part of the performance of SR 3.3.7.2.

SR 3.3.7.4

SR 3.3.7.4 is the performance of a MASTER RELAY TEST. This test energizes the Master Relay and verifies the actuation signal injected into the Slave Relays. Although there are no "Master Relays" as in the SSPS, this surveillance was maintained to preserve the format of the standard specification. The surveillance is intended to ensure that the complete logic is tested for the function. Since the radiation monitors directly actuate the actuation relays, this test is performed every 92 days as part of the performance of SR 3.3.7.2.

SR 3.3.7.5

SR 3.3.7.5 is the performance of a SLAVE RELAY TEST. This test energizes the Slave Relays and verifies actuation of the equipment to the pressurization mode. Although there are no "Slave Relays" as in the SSPS, this surveillance was maintained to preserve the format of the standard specification. The surveillance is intended to ensure that the actuation relays, downstream of the logic, function to actuate the pressurization mode equipment. Since the radiation monitors directly actuate the actuation relays, this test is performed every 92 days as part of the performance of SR 3.3.7.2.

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS  
(continued)

SR 3.3.7.6

SR 3.3.7.6 is the performance of a TADOT. This test is a check of the Manual Actuation Functions and is performed every 18 months. Each Manual Actuation Function is tested up to, and including, the master relay coils. In some instances, the test includes actuation of the end device (i.e., pump starts, valve cycles, etc.).

The Frequency is based on the known reliability of the Function and the redundancy available, and has been shown to be acceptable through operating experience. The SR is modified by a Note that excludes verification of setpoints during the TADOT. The Functions tested have no setpoints associated with them.

SR 3.3.7.7

A CHANNEL CALIBRATION is performed every 18 months. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor. The test verifies that the channel responds to a measured parameter within the necessary range and accuracy.

The Frequency is based on operating experience and is consistent with the typical industry refueling cycle.

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REFERENCES

1. WCAP-13878, "Reliability of Potter & Brumfield MDR Relays", June 1994.
  2. WCAP-13900, "Extension of Slave Relay Surveillance Test Intervals", April 1994
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## B 3.3 INSTRUMENTATION

### B 3.3.8 Fuel Building Ventilation System (FBVS) Actuation Instrumentation

#### BASES

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##### BACKGROUND

The FBVS ensures that radioactive materials in the fuel building atmosphere following a fuel handling accident are filtered and adsorbed prior to exhausting to the environment. The system is described in the Bases for LCO 3.7.13, "Fuel Handling Building Ventilation System." The system initiates filtered ventilation of the fuel building automatically following receipt of a high radiation signal from the Spent Fuel Pool Monitor or from the New Fuel Storage Vault Monitor. Initiation may also be performed manually as needed from the main control room or fuel handling building.

High radiation, from either of the two monitors, provides FBVS initiation. These actions function to prevent exfiltration of contaminated air by initiating filtered ventilation, which imposes a negative pressure on the fuel building.

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##### APPLICABLE SAFETY ANALYSES

The FBVS ensures that radioactive materials in the fuel building atmosphere following a fuel handling accident are filtered and adsorbed prior to being exhausted to the environment. This action reduces the radioactive content in the fuel building exhaust following a fuel handling accident so that offsite doses remain within the limits specified in 10 CFR 100 (Ref. 1).

The FBVS actuation instrumentation satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

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##### LCO

The LCO requirements ensure that instrumentation necessary to initiate the FBVS is OPERABLE.

##### 1. Manual Initiation

The LCO requires two channels OPERABLE. The operator can initiate the FBVS at any time by using either of two switches, one in the control room and another in the fuel handling building. This action will cause actuation of all components in the same manner as any of the automatic actuation signals.

The LCO for Manual Initiation ensures the proper amount of redundancy is maintained in the manual actuation circuitry to ensure the operator has manual initiation capability.

(continued)

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BASES

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LCO  
(continued)

2. Fuel Handling Building Radiation

The LCO specifies two required Radiation Monitor channels to ensure that the radiation monitoring instrumentation necessary to initiate the FBVS remains OPERABLE.

Only the Trip Setpoint is specified for each FBVS Function in the LCO.

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APPLICABILITY

The manual FBVS initiation must be OPERABLE when moving irradiated fuel assemblies in the fuel building, to ensure the FBVS operates to remove fission products associated with a fuel handling accident.

High radiation initiation of the FBVS must be OPERABLE in any MODE during movement of irradiated fuel assemblies in the fuel building to ensure automatic initiation of the FBVS when the potential for a fuel handling accident exists.

While in MODES 5 and 6 without fuel handling in progress, the FBVS instrumentation need not be OPERABLE since a fuel handling accident cannot occur.

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ACTIONS

The most common cause of channel inoperability is outright failure or drift of the bistable or process module sufficient to exceed the tolerance allowed by unit specific calibration procedures. 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 CFT and/or CHANNEL CALIBRATION, when the process instrumentation is set up for adjustment to bring it within specification. If the Trip Setpoint is less conservative than the tolerance specified by the calibration procedure, the channel must be declared inoperable immediately and the appropriate Condition entered. Drift can also be observed during a CHANNEL CHECK or CFT and if observed would prompt action to correct the discrepancy.

A Note has been added to the ACTIONS to clarify the application of Completion Time rules. The Conditions of this Specification may be entered independently for each Function listed in Table 3.3.8-1 in the accompanying LCO. The Completion Time(s) of the inoperable channel(s)/train(s) of a Function will be tracked separately for each Function starting from the time the Condition was entered for that Function.

(continued)

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BASES

ACTIONS  
(continued)

A.1.1, A.1.2.1, A.1.2.2, and A.1.3

Condition A applies to the radiation monitor functions, and the manual function. Condition A applies to the failure of one or more radiation monitor channels, or a single manual channel. If one or more channels or trains are inoperable, movement of irradiated fuel may continue for a period of 30 days. If movement of irradiated fuel continues, an appropriate portable continuous monitor with the same setpoint, or an individual qualified in radiation protection procedures with a dose rate monitoring device must be in the spent fuel pool area immediately and, one FBVS train must be placed in the Iodine Removal mode of operation immediately. This effectively accomplishes the actuation instrumentation function and places the area in a conservative mode of operation or provides appropriate monitoring for continued fuel movement.

B.1

Condition B applies when the Required Action and associated Completion Time for Condition A has not been met and irradiated fuel assemblies are being moved in the fuel building. Movement of irradiated fuel assemblies in the fuel building must be suspended immediately to eliminate the potential for events that could require FBVS actuation.

SURVEILLANCE  
REQUIREMENTS

A Note has been added to the SR Table to clarify that Table 3.3.8-1 determines which SRs apply to which FBVS Actuation Functions.

SR 3.3.8.1

Performance of the CHANNEL CHECK once every 12 hours ensures that a 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 other channels. 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. A CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

Agreement criteria are determined by the unit 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 limit.

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS

SR 3.3.8.1 (continued)

The Frequency is based on operating experience that demonstrates channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the LCO required channels.

SR 3.3.8.2

A CFT is performed once every 92 days on each required channel to ensure the entire channel will perform the intended function. This test verifies the capability of the instrumentation to provide the FBACS actuation. The Frequency of 92 days is based on the known reliability of the monitoring equipment and has been shown to be acceptable through operating experience.

SR 3.3.8.3 - Not used

SR 3.3.8.4

SR 3.3.8.4 is the performance of a TADOT. This test is a check of the manual actuation functions and is performed every 18 months. Each manual actuation function is tested up to, and including, the master relay coils. In some instances, the test includes actuation of the end device (e.g., pump starts, valve cycles, etc.). The Frequency is based on operating experience and is consistent with the typical industry refueling cycle. The SR is modified by a Note that excludes verification of setpoints during the TADOT. The Functions tested have no setpoints associated with them.

SR 3.3.8.5

A CHANNEL CALIBRATION is performed every 18 months. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor. The test verifies that the channel responds to a measured parameter within the necessary range and accuracy. The Frequency is based on operating experience and is consistent with the typical industry refueling cycle.

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REFERENCES

1. 10 CFR 100.11.
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## B 3.4 REACTOR COOLANT SYSTEM (RCS)

### B 3.4.1 RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits

#### BASES

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##### BACKGROUND

These Bases address requirements for maintaining RCS pressure, temperature, and flow rate within limits assumed in the safety analyses. The safety analyses (Ref. 1) of normal operating conditions and anticipated operational occurrences assume initial conditions within the normal steady state envelope. The limits placed on RCS pressure, temperature, and flow rate ensure that the minimum departure from nucleate boiling ratio (DNBR) will be met for each of the transients analyzed.

The RCS pressure limit is consistent with operation within the nominal operational envelope. Pressurizer pressure indications are averaged to come up with a value for comparison to the limit. A lower pressure will cause the reactor core to approach DNB limits.

The RCS coolant average temperature limit is consistent with full power operation within the nominal operational envelope. Indications of temperature are averaged to determine a value for comparison to the limit. A higher average temperature will cause the core to approach DNB limits.

The RCS flow rate normally remains constant during an operational fuel cycle with all pumps running. The minimum RCS flow limit corresponds to that assumed for DNB analyses and is variable with reactor thermal power down to 90% RTP as shown on Tables 3.4.1-1 and 3.4.1-2. Flow rate indications from the plant computer or RCS flow rate indicators are averaged to come up with a value for comparison to the limit. A lower RCS flow will cause the DNB limits to be approached.

Operation for significant periods of time outside the limits on RCS flow, pressurizer pressure and average RCS temperature increases the likelihood of a fuel cladding failure if a DNB limited event were to occur.

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##### APPLICABLE SAFETY ANALYSES

The requirements of this LCO represent the initial conditions for DNB limited transients analyzed in the plant safety analyses (Ref. 1). The safety analyses have shown that transients initiated from the limits of this LCO will result in meeting the DNBR correlation limit of  $\geq 1.17$  (Ref. 2 and 3). This is the acceptance limit for the RCS DNB parameters. Changes to the unit that could impact these parameters must be assessed for their impact on the DNBR criterion. The analyzed transients include loss of coolant flow events and dropped or stuck rod events. A key assumption for the analysis of these events is that the core power distribution is within the limits of LCO 3.1.6, "Control Bank

(continued)

BASES

APPLICABLE  
SAFETY  
ANALYSES  
(continued)

Insertion Limits"; LCO 3.2.3, "AXIAL FLUX DIFFERENCE (AFD)"; and LCO 3.2.4, "QUADRANT POWER TILT RATIO (QPTR)."

The pressurizer pressure limit of 2197.3 psig and the RCS average temperature limit of 584.3°F correspond to nominal analytical limits of 2250 psia and 577.6°F for Unit 2 (the limiting unit) used for the DNB calculation in the reload analyses with allowance for analysis initial consideration uncertainty (38 psi and 6.7°F).

The RCS DNB parameters satisfy Criterion 2 of 10 CFR 50.36 (c)(2)(ii).

LCO

This LCO specifies limits on the monitored process variables-pressurizer pressure, RCS average temperature, and RCS total flow rate to ensure the core operates within the limits assumed in the safety analyses. Operating within these limits will result in meeting the DNBR criterion in the event of a DNB limited transient.

RCS total flow limits are provided for a RTP range of 90% to 100% on Tables 3.4.1-1 and 3.4.1-2 for Unit 1 and Unit 2 respectively.

The RCS total flow rate limit allows for a measurement error of 2.394% (Unit 1) and 2.401% (Unit 2) of thermal design flow, or equivalently 2.338% (Unit 1) and 2.344% (Unit 2) of minimum measured flow, based on performing a precision heat balance and using the result to normalize the RCS flow rate indicators. Potential fouling of the feedwater venturi, which might not be detected, could bias the result from the precision heat balance in a non-conservative manner. A bias error of 0.1% for undetected fouling of the feedwater venturi is included in the measurement error analysis.

Any fouling that might significantly bias the flow rate measurement greater than 0.1% can be detected by monitoring and trending various plant performance parameters. If detected, either the effect of the fouling shall be quantified and compensated for in the RCS flow rate measurement or the venturi shall be cleaned to eliminate the fouling.

The LCO numerical values for pressure, temperature, and flow rate have not been adjusted for instrument error.

APPLICABILITY

In MODE 1, the limits on pressurizer pressure, RCS coolant average temperature, and RCS flow rate must be maintained during steady state operation in order to ensure the DNBR criteria will be met in the event of an unplanned loss of forced coolant flow or other DNB limited transient. In all other MODES, the power level is low enough that DNB is not a concern.

(continued)

BASES

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APPLICABILITY  
(continued)

A Note has been added to indicate the limit on pressurizer pressure is not applicable during short term operational pressure transients such as a THERMAL POWER ramp increase > 5% RTP per minute or a THERMAL POWER step increase > 10% RTP. These conditions represent short term perturbations where actions to control pressure variations might be counterproductive. Also, since they represent transients initiated from power levels < 100% RTP, an increased DNBR margin exists to offset the temporary pressure variations.

Another set of limits on DNB related parameters is provided in SL 2.1.1, "Reactor Core SLs." Those limits are less restrictive than the limits of this LCO, but violation of a Safety Limit (SL) merits a stricter, more severe Required Action. Should a violation of this LCO occur, the operator must check whether or not an SL may have been exceeded.

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ACTIONS

A.1

RCS pressure and RCS average temperature are controllable and measurable parameters. With one or both of these parameters not within LCO limits, action must be taken to restore parameter(s).

RCS total flow rate is not a controllable parameter and is not expected to vary during steady state operation. If the indicated RCS total flow rate is below the LCO limit, power must be reduced, as required by Required Action B.1, to restore DNB margin and reduce the potential for violation of the accident analysis limits.

The 2 hour Completion Time for restoration of the parameters provides sufficient time to adjust plant parameters, to determine the cause for the off normal condition, and to restore the readings within limits, and is based on plant operating experience.

B.1

If Required Action A.1 is not met within the associated Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 2 within 6 hours. In MODE 2, the reduced power condition reduces the potential for violation of the accident analysis limits. The Completion Time of 6 hours is reasonable to reach the required plant conditions in an orderly manner.

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BASES

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SURVEILLANCE  
REQUIREMENTS

SR 3.4.1.1

Since Required Action A.1 allows a Completion Time of 2 hours to restore parameters that are not within limits, the 12 hour Surveillance Frequency for pressurizer pressure is sufficient to ensure the pressure can be restored to a normal operation, steady state condition following load changes and other expected transient operations. The 12 hour interval has been shown by operating practice to be sufficient to regularly assess for potential degradation and to verify operation is within safety analysis assumptions.

SR 3.4.1.2

Since Required Action A.1 allows a Completion Time of 2 hours to restore parameters that are not within limits, the 12 hour Surveillance Frequency for RCS average temperature is sufficient to ensure the temperature can be restored to a normal operation, steady state condition following load changes and other expected transient operations. The 12 hour interval has been shown by operating practice to be sufficient to regularly assess for potential degradation and to verify operation is within safety analysis assumptions.

SR 3.4.1.3

The 12 hour Surveillance Frequency for the indicated RCS total flow rate is performed using the installed flow instrumentation. The 12 hour interval has been shown by operating practice to be sufficient to regularly assess potential degradation and to verify operation within safety analysis assumptions. The term "indicated RCS total flow" is used to distinguish between the "measured RCS total flow" determined in SR 3.4.1.4.

SR 3.4.1.4

SR 3.4.1.4 has two surveillance requirements, one for the CHANNEL CALIBRATION of the RCS flow indicators and the other for measurement of RCS total flow rate. Measurement of RCS total flow rate by performance of a precision calorimetric heat balance or other acceptable method once every 24 months allows the installed RCS flow instrumentation to be normalized and verifies the actual RCS flow rate is greater than or equal to the minimum required RCS flow rate.

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BASES (Continued)

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The second part of this surveillance is the routine CHANNEL CALIBRATION of the RCS flow indication instrumentation. The routine calibration of the flow instrumentation ensures that the channels are within the necessary range and accuracy for proper flow indication. The routine CHANNEL CALIBRATION of the RCS flow indication instrumentation is performed every 24 months.

The Frequency of 24 months for the measurement of RCS total flow rate reflects the importance of verifying flow after a refueling outage when the core has been altered, which may have caused an alteration of flow resistance. Flow verification demonstrates that setpoints are relevant and RCS flow resistance is within limits. The frequency of 24 months for the routine CHANNEL CALIBRATION of the flow indication instrumentation is based on operating experience and consistency with the typical industry refueling cycle.

REFERENCES

1. FSAR, Section 15.
  2. Diablo Canyon Power Plant Unit 1 Cycle 9 Reload Safety Evaluation, August 1995.
  3. Diablo Canyon Power Plant Unit 2 Cycle 8 Reload Safety Evaluation, Rev.1, April 1996.
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## B 3.4 REACTOR COOLANT SYSTEM (RCS)

### B 3.4.2 RCS Minimum Temperature for Criticality

#### BASES

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##### BACKGROUND

This LCO is based upon meeting several major considerations before the reactor can be made critical and while the reactor is critical.

The first consideration is moderator temperature coefficient (MTC), LCO 3.1.3, "Moderator Temperature Coefficient (MTC)." In the transient and accident analyses, the MTC is assumed to be in a range from slightly positive to negative and the operating temperature is assumed to be within the nominal operating envelope while the reactor is critical. The LCO on minimum temperature for criticality helps ensure the plant is operated consistent with these assumptions.

The second consideration is the protective instrumentation. Because certain protective instrumentation (e.g., excore neutron detectors) can be affected by moderator temperature, a temperature value within the nominal operating envelope is chosen to ensure proper indication and response while the reactor is critical.

The third consideration is the pressurizer operating characteristics. The transient and accident analyses assume that the pressurizer is within its normal startup and operating range (i.e., saturated conditions and steam bubble present). It is also assumed that the RCS temperature is within its normal expected range for startup and power operation. Since the density of the water, and hence the response of the pressurizer to transients, depends upon the initial temperature of the moderator, a minimum value for moderator temperature within the nominal operating envelope is chosen.

The fourth consideration is that the reactor vessel is above its minimum nil ductility reference temperature when the reactor is critical.

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##### APPLICABLE SAFETY ANALYSES

Although the RCS minimum temperature for criticality is not itself an initial condition assumed in Design Basis Accidents (DBAs), the closely aligned temperature for hot zero power (HZP) is a process variable that is an initial condition of DBAs, such as the rod cluster control assembly (RCCA) withdrawal, RCCA ejection, and main steam line break accidents performed at zero power that either assumes the failure of, or presents a challenge to, the integrity of a fission product barrier.

All low power safety analyses assume initial RCS loop temperatures  $\geq$  the HZP temperature of 547°F (Ref. 1). The minimum temperature for criticality limitation provides a small band, 6°F, for critical operation below HZP. This band allows critical operation below HZP during plant

(continued)



BASES

APPLICABLE SAFETY ANALYSES (continued)	<p>startup and does not adversely affect any safety analyses since the MTC is not significantly affected by the small temperature difference between HZP and the minimum temperature for criticality.</p> <p>The RCS minimum temperature for criticality satisfies Criterion 2 of 10 CFR 50.36 (c)(2)(ii).</p>
LCO	<p>Compliance with the LCO ensures that the reactor will not be made or maintained critical (<math>k_{\text{eff}} \geq 1.0</math>) with an operating loop temperature less than a small band below the HZP temperature, which is assumed in the safety analysis. Failure to meet the requirements of this LCO may produce initial conditions inconsistent with the initial conditions assumed in the safety analysis.</p>
APPLICABILITY	<p>In MODE 1 and MODE 2 with <math>k_{\text{eff}} \geq 1.0</math>, LCO 3.4.2 is applicable since the reactor can only be critical (<math>k_{\text{eff}} \geq 1.0</math>) in these MODES. The special test exception of LCO 3.1.8, "PHYSICS TESTS, Exceptions, MODE 2" permits PHYSICS TESTS to be performed at <math>\leq 5\%</math> RTP with RCS loop average temperatures slightly lower than normally allowed so that fundamental nuclear characteristics of the core can be verified. In order for nuclear characteristics to be measured, it may be necessary to operate outside the normal restrictions of this LCO. For example, to measure the MTC at beginning of cycle, it is necessary to allow RCS loop average temperatures to fall below <math>T_{\text{no load}}</math>, which may cause RCS loop average temperatures to fall below the temperature limit of this LCO.</p>
ACTIONS	<p><u>A.1</u></p> <p>If the parameters that are outside the limit cannot be restored, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to MODE 2 with <math>k_{\text{eff}} &lt; 1.0</math> within 30 minutes. Rapid reactor shutdown can be readily and practically achieved within a 30 minute period. The allowed time is reasonable, based on operating experience, to reach MODE 2 with <math>k_{\text{eff}} &lt; 1.0</math> in an orderly manner and without challenging plant systems.</p>
SURVEILLANCE REQUIREMENTS	<p><u>SR 3.4.2.1</u></p> <p>RCS loop average temperature is required to be verified at or above 541°F every 12 hours. The SR to verify RCS loop average temperatures every 12 hours is frequent enough to prevent inadvertent violation of the LCO and takes into account indications and alarms that are continuously available to the operator in the control room. If the <math>T_{\text{avg}} - T_{\text{ref}}</math> deviation were to alarm, the specific alarm response procedure would provide an increased frequency of monitoring. Following the clearance of the alarm, the frequency returns to 12 hours to monitor RCS <math>T_{\text{avg}}</math>.</p>

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS

SR 3.4.2.1 (continued)

RCS loop average temperature is required to be verified at or above 541°F every 12 hours. The SR to verify RCS loop average temperatures every 12 hours takes into account indications and alarms that are continuously available to the operator in the control room and is consistent with other routine surveillances which are typically performed once per shift. In addition, operators are trained to be sensitive to RCS temperature during approach to criticality and will ensure that the minimum temperature for criticality is met as criticality is approached.

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REFERENCES

1. FSAR, Chapter 15.
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## B 3.4 REACTOR COOLANT SYSTEM (RCS)

### B 3.4.3 RCS Pressure and Temperature (P/T) Limits

#### BASES

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##### BACKGROUND

All components of the RCS are designed to withstand effects of cyclic loads due to system pressure and temperature changes. These loads are introduced by startup (heatup) and shutdown (cooldown) operations, power transients, and reactor trips. This LCO limits the pressure and temperature changes during RCS heatup and cooldown, within the design assumptions and the stress limits for cyclic operation.

The PRESSURE TEMPERATURE LIMITS REPORT (PTLR) contains pressure/temperature (P/T) limit curves for heatup, cooldown, inservice leak and hydrostatic (ISLH) testing, and data for the maximum rate of change of reactor coolant temperature.

Each P/T limit curve defines an acceptable region for normal operation. The usual use of the curves is operational guidance during heatup or cooldown maneuvering, when pressure and temperature indications are monitored and compared to the applicable curve to determine that operation is within the allowable region.

The LCO references the PTLR which establishes operating limits that provide a margin to brittle failure of the reactor vessel and piping of the reactor coolant pressure boundary (RCPB). The vessel is the component most subject to brittle failure, and the PTLR limits apply mainly to the vessel. The limits do not apply to the pressurizer, which has different design characteristics and operating functions.

10 CFR 50, Appendix G (Ref. 2), requires the establishment of P/T limits for specific material fracture toughness requirements of the RCPB materials. The NRC reviewed and approved methodology to be applied to determine P/T Limits is documented in the Administrative Controls Section 5.6.6.

The neutron embrittlement effect on the material toughness is reflected by increasing the nil ductility reference temperature ( $RT_{NDT}$ ) as exposure to neutron fluence increases.

The actual shift in the  $RT_{NDT}$  of the vessel material will be established periodically by removing and evaluating the irradiated reactor vessel material specimens, in accordance with the methodology identified in Section 5.6.6. The operating P/T limit curves will be adjusted, as necessary, in agreement with the evaluation findings based on methods used in the PTLR.

(continued)

## BASES

### BACKGROUND (continued)

The P/T limit curves are composite curves established by superimposing limits derived from stress analyses of those portions of the reactor vessel and head that are the most restrictive. At any specific pressure, temperature, and temperature rate of change, one location within the reactor vessel will dictate the most restrictive limit. Across the span of the P/T limit curves, different locations are more restrictive, and, thus, the curves are composites of the most restrictive regions.

The heatup curve represents a different set of restrictions than the cooldown curve because the directions of the thermal gradients through the vessel wall are reversed. The thermal gradient reversal alters the location of the tensile stress between the outer and inner walls.

The criticality limit curve includes the Reference 2 requirement that it be  $\geq 40^{\circ}\text{F}$  above the heatup curve or the cooldown curve, and not less than the minimum permissible temperature for ISLH testing. However, the criticality curve is not operationally limiting; a more restrictive limit exists in LCO 3.4.2, "RCS Minimum Temperature for Criticality."

The consequence of violating the LCO limits is that the RCS has been operated under conditions that can result in brittle failure of the RCPB, possibly leading to a nonisolable leak or loss of coolant accident. In the event these limits are exceeded, an evaluation must be performed to determine the effect on the structural integrity of the RCPB components.

### APPLICABLE SAFETY ANALYSES

The P/T limits are not derived from Design Basis Accident (DBA) analyses. They are prescribed during normal operation to avoid encountering pressure, temperature, and temperature rate of change conditions that might cause undetected flaws to propagate and cause nonductile failure of the RCPB, an unanalyzed condition. Administrative Controls Section 5.6.6, identifies the NRC reviewed and approved methodology for determining the P/T limits. Although the P/T limits are not derived from any DBA, the P/T limits are acceptance limits since they preclude operation in an unanalyzed condition.

RCS P/T limits satisfy Criterion 2 of 10 CFR 50.36 (c)(2)(ii).

### LCO

The two elements of this LCO are:

- a. The limit curves for heatup, cooldown, and ISLH testing; and
- b. Limits on the rate of change of temperature.

(continued)

## BASES

### LCO (continued)

The LCO limits apply to all components of the RCS, except the pressurizer. These limits define allowable operating regions and permit a large number of operating cycles while providing a wide margin to nonductile failure.

The limits for the rate of change of temperature control the thermal gradient through the vessel wall and are used as inputs for calculating the heatup, cooldown, and ISLH testing P/T limit curves. Thus, the LCO for the rate of change of temperature restricts stresses caused by thermal gradients and also ensures the validity of the P/T limit curves.

Violating the LCO limits places the reactor vessel outside of the bounds of the stress analyses and can increase stresses in other RCPB components. The consequences depend on several factors, as follow:

- a. The severity of the departure from the allowable operating P/T regime or the severity of the rate of change of temperature;
- b. The length of time the limits were violated (longer violations allow the temperature gradient in the thick vessel walls to become more pronounced); and
- c. The existences, sizes, and orientations of flaws in the vessel material.

### APPLICABILITY

The RCS P/T limits LCO provides a definition of acceptable operation for prevention of nonductile failure in accordance with 10 CFR 50, Appendix G (Ref. 2). Although the P/T limits were developed to provide guidance for operation during heatup or cooldown (MODES 3, 4, and 5) or ISLH testing, their Applicability is at all times in keeping with the concern for nonductile failure. The limits do not apply to the pressurizer.

During MODES 1 and 2, other Technical Specifications provide limits for operation that can be more restrictive than or can supplement these P/T limits. LCO 3.4.1, "RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits"; LCO 3.4.2, "RCS Minimum Temperature for Criticality"; and 2.1, "Safety Limits," also provide operational restrictions for pressure and temperature and maximum pressure. Furthermore, MODES 1 and 2 are above the temperature range of concern for nonductile failure, and stress analyses have been performed for normal maneuvering profiles, such as power ascension or descent.

(continued)

BASES (continued)

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ACTIONS

A.1 and A.2

Operation outside the P/T limits during MODE 1, 2, 3, or 4 must be corrected so that the RCPB is returned to a condition that has been verified by stress analyses.

The 30 minute Completion Time reflects the urgency of restoring the parameters to within the analyzed range. Most violations will not be severe, and the activity can be accomplished in this time in a controlled manner.

Besides restoring operation within limits, an evaluation is required to determine if RCS operation can continue. The evaluation must verify the RCPB integrity remains acceptable and must be completed before continuing operation. Several methods may be used, including comparison with pre-analyzed transients in the stress analyses, new analyses, or inspection of the components.

ASME Code, Section XI, Appendix E (Ref. 3), may be used to support the evaluation. However, its use is restricted to evaluation of the vessel beltline.

The 72 hour Completion Time is reasonable to accomplish the evaluation. The evaluation for a mild violation is possible within this time, but more severe violations may require special, event specific stress analyses or inspections. A favorable evaluation must be completed before continuing to operate.

Condition A is modified by a Note requiring Required Action A.2 to be completed whenever the Condition is entered. The Note emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone per Required Action A.1 is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

B.1 and B.2

If a Required Action and associated Completion Time of Condition A are not met, the plant must be placed in a lower MODE because either the RCS remained in an unacceptable P/T region for an extended period of increased stress or a sufficiently severe event caused entry into an unacceptable region. Either possibility indicates a need for more careful examination of the event, best accomplished with the RCS at reduced pressure and temperature. In reduced pressure and temperature conditions, the possibility of propagation with undetected flaws is decreased.

(continued)

## BASES

### ACTIONS

#### B.1 and B.2 (continued)

If the required restoration activity cannot be accomplished within 30 minutes, Required Action B.1 and Required Action B.2 must be implemented to reduce pressure and temperature.

If the required evaluation for continued operation cannot be accomplished within 72 hours or the results are indeterminate or unfavorable, action must proceed to reduce pressure and temperature as specified in Required Action B.1 and Required Action B.2. (Note that Action B.1 is not required when in MODE 4). A favorable evaluation must be completed and documented before returning to operating pressure and temperature conditions.

Pressure and temperature are reduced by bringing the plant to MODE 3 within 6 hours and to MODE 5 with RCS pressure < 500 psig within 36 hours.

The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

#### C.1 and C.2

Actions must be initiated immediately to correct operation outside of the P/T limits at times other than when in MODE 1, 2, 3, or 4, so that the RCPB is returned to a condition that has been verified by stress analysis.

The immediate Completion Time reflects the urgency of initiating action to restore the parameters to within the analyzed range. Most violations will not be severe, and the activity can be accomplished in this time in a controlled manner.

Besides restoring operation within limits, an evaluation is required to determine if RCS operation can continue. The evaluation must verify that the RCPB integrity remains acceptable and must be completed prior to entry into MODE 4. Several methods may be used, including comparison with pre-analyzed transients in the stress analyses, or inspection of the components.

ASME Code, Section XI, Appendix E (Ref. 3), may be used to support the evaluation. However, its use is restricted to evaluation of the vessel beltline.

Condition C is modified by a Note requiring Required Action C.2 to be completed whenever the Condition is entered. The Note emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone per Required Action C.1 is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

(continued)

BASES (continued)

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SURVEILLANCE  
REQUIREMENTS

SR 3.4.3.1

Verification that operation is within the PTLR limits is required every 30 minutes when RCS pressure and temperature conditions are undergoing planned changes. This Frequency is considered reasonable in view of the control room indication available to monitor RCS status. Also, since temperature rate of change limits are specified in hourly increments, 30 minutes permits assessment and correction for minor deviations within a reasonable time.

Surveillance for heatup, cooldown, or ISLH testing may be discontinued when the definition given in the relevant plant procedure for ending the activity is satisfied.

This SR is modified by a Note that only requires this SR to be performed during system heatup, cooldown, and ISLH testing. No SR is given for criticality operations because LCO 3.4.2 contains a more restrictive requirement.

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REFERENCES

1. Not Used
  2. 10 CFR 50, Appendix G.
  3. ASME, Boiler and Pressure Vessel Code, Section XI, Appendix E.
  4. NRC Generic Letter 96-03, "Relocation of the Pressure Temperature Curves and Low Temperature Overpressure Protection System Limits," January 31, 1996.
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## B 3.4 REACTOR COOLANT SYSTEM (RCS)

### B 3.4.4 RCS Loops — MODES 1 and 2

#### BASES

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##### BACKGROUND

The primary function of the RCS is removal of the heat generated in the fuel due to the fission process, and transfer of this heat, via the steam generators (SGs), to the secondary plant.

The secondary functions of the RCS include:

- a. Moderating the neutron energy level to the thermal state, to increase the probability of fission;
- b. Improving the neutron economy by acting as a reflector;
- c. Carrying the soluble neutron poison, boric acid;
- d. Providing a second barrier against fission product release to the environment; and
- e. Removing the heat generated in the fuel due to fission product decay following a unit shutdown.

The reactor coolant is circulated through four loops connected in parallel to the reactor vessel, each containing an SG, a reactor coolant pump (RCP), and appropriate flow and temperature instrumentation for both control and protection. The reactor vessel contains the clad fuel. The SGs provide the heat sink to the isolated secondary coolant. The RCPs circulate the coolant through the reactor core and SGs at a sufficient rate to ensure proper heat transfer and prevent fuel damage. This forced circulation of the reactor coolant ensures mixing of the coolant for proper boration and chemistry control.

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##### APPLICABLE SAFETY ANALYSES

Safety analyses contain various assumptions for the design bases accident initial conditions including RCS pressure, RCS temperature, reactor power level, core parameters, and safety system setpoints. The important aspect for this LCO is the reactor coolant forced flow rate, which is represented by the number of RCS loops in service.

All of the accident/safety analyses performed at RTP assume that all four RCS loops are in operation as an initial condition. Some accident/safety analyses have been performed at zero power conditions assuming only two RCS loops are in operation to conservatively bound lower modes of operation. The uncontrolled Rod Control Cluster Assembly (RCCA) Bank withdrawal from subcritical event is included in this category. While all accident/safety analyses performed at full rated power assume that all RCS loops are in operation, selected events examine the effects resulting from a loss of RCP operation. These include the complete and partial loss of forced

(continued)

BASES

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APPLICABLE  
SAFETY  
ANALYSES  
(continued)

RCS flow, RCP rotor seizure, and RCP shaft break events. For each of these events, it is demonstrated that all the applicable safety criteria are satisfied. For the remaining accident/safety analyses, operation of all four RCS loops during the transient up to the time of reactor trip is assured thereby ensuring that all the applicable acceptance criteria are satisfied. Those transients analyzed beyond the time of reactor trip were examined assuming that a loss of offsite power occurs which results in the RCPs coasting down.

The plant is designed to operate with all RCS loops in operation to maintain DNBR above the Safety Limit value during all normal operations and anticipated transients. By ensuring heat transfer in the nucleate boiling region, adequate heat transfer is provided between the fuel cladding and the reactor coolant.

RCS Loops - MODES 1 and 2 satisfy Criterion 2 of 10 CFR 50.36 (c)(2)(ii).

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LCO

The purpose of this LCO is to require an adequate forced flow rate for core heat removal. Flow is represented by the number of RCPs in operation for removal of heat by the SGs. To meet safety analysis acceptance criteria for DNB, four pumps are required at rated power.

An OPERABLE RCS loop consists of one OPERABLE RCP for heat transport and the associated SG, OPERABLE in accordance with the Steam Generator Tube Surveillance Program, with a water level within the limits specified in SR 3.4.5.2, except for operational transients. A RCP is OPERABLE if it is capable of being powered and is able to provide forced flow if required.

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APPLICABILITY

In MODES 1 and 2, the reactor is critical and thus has the potential to produce maximum THERMAL POWER. Thus, to ensure that the assumptions of the accident analyses remain valid, all RCS loops are required to be OPERABLE and in operation in these MODES to prevent DNB and core damage.

The decay heat production rate is much lower than the full power heat rate. As such, the forced circulation flow and heat sink requirements are reduced for lower, noncritical MODES as indicated by the LCOs for MODES 3, 4, and 5.

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(continued)

## BASES

APPLICABILITY (continued)	<p>Operation in other MODES is covered by:</p> <p>LCO 3.4.5, "RCS Loops — MODE 3";</p> <p>LCO 3.4.6, "RCS Loops — MODE 4";</p> <p>LCO 3.4.7, "RCS Loops — MODE 5, Loops Filled";</p> <p>LCO 3.4.8, "RCS Loops — MODE 5, Loops Not Filled";</p> <p>LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation — High Water Level" (MODE 6); and</p> <p>LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation — Low Water Level" (MODE 6).</p>
ACTIONS	<p><u>A.1</u></p> <p>If the requirements of the LCO are not met, the Required Action is to reduce power and bring the plant to MODE 3. This lowers power level and thus reduces the core heat removal needs and minimizes the possibility of violating DNB limits.</p> <p>The Completion Time of 6 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging safety systems.</p>
SURVEILLANCE REQUIREMENTS	<p><u>SR 3.4.4.1</u></p> <p>This SR requires verification every 12 hours that each RCS loop is in operation. Verification may include flow rate, temperature, or pump status monitoring, which help ensure that forced flow is providing heat removal while maintaining the margin to DNB. The Frequency of 12 hours is sufficient considering other indications and alarms available to the operator in the control room to monitor RCS loop performance.</p>
REFERENCES	<p>1. FSAR, Section 15.</p>

## B 3.4 REACTOR COOLANT SYSTEM (RCS)

### B 3.4.5 RCS Loops - MODE 3

#### BASES

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##### BACKGROUND

In MODE 3, the primary function of the reactor coolant is removal of decay heat and transfer of this heat, via the steam generator (SG), to the secondary plant fluid. The secondary function of the reactor coolant is to act as a carrier for soluble neutron poison, boric acid.

The reactor coolant is circulated through four RCS loops, connected in parallel to the reactor vessel, each containing an SG, a reactor coolant pump (RCP), and appropriate flow, pressure, level, and temperature instrumentation for control, protection, and indication. The reactor vessel contains the clad fuel. The SGs provide the heat sink. The RCPs circulate the water through the reactor core and SGs at a sufficient rate to ensure proper heat transfer and prevent fuel damage.

In MODE 3, RCPs are used to provide forced circulation for heat removal during heatup and cooldown. The MODE 3 decay heat removal requirements are low enough that a single RCS loop with one RCP running is sufficient to remove core decay heat. However, two RCS loops are required to be OPERABLE to ensure redundant capability for decay heat removal.

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##### APPLICABLE SAFETY ANALYSES

Whenever the Control Rod Drive Mechanisms (CRDMs) are energized, an inadvertent rod withdrawal from subcritical, resulting in a power excursion, is possible. Such a transient could be caused by a malfunction of the Rod Control System. In addition, the possibility of a power excursion due to the ejection of an inserted control rod is possible. Such a transient could be caused by the mechanical failure of a CRDM.

Therefore, in MODE 3 with the Rod Control System capable of rod withdrawal, accidental control rod withdrawal from subcritical is postulated and requires at least two RCS loops to be OPERABLE and in operation to ensure that the accident analyses limits are met. For those conditions when the Rod Control System is not capable of rod withdrawal, two RCS loops are required to be OPERABLE, but only one RCS loop is required to be in operation to be consistent with MODE 3 accident analyses.

Failure to provide decay heat removal may result in challenges to a fission product barrier. The RCS loops are part of the primary success path that functions or actuates to prevent or mitigate a Design Basis Accident or transient that either assumes the failure of, or presents a challenge to, the integrity of a fission product barrier.

RCS Loops-MODE 3 satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

(continued)

BASES (continued)

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LCO

The purpose of this LCO is to require that at least two RCS loops be OPERABLE. In MODE 3 with the Rod Control System capable of rod withdrawal, two RCS loops must be in operation. Two RCS loops are required to be in operation in MODE 3 with the Rod Control System capable of rod withdrawal due to the postulation of a power excursion because of an inadvertent control rod withdrawal. The required number of RCS loops in operation ensures that the Safety Limit criteria will be met for all of the postulated accidents.

When the Rod Control System is not capable of rod withdrawal, only one RCS loop in operation is necessary to ensure removal of decay heat from the core and homogenous boron concentration throughout the RCS. An additional RCS loop is required to be OPERABLE to ensure that redundancy for heat removal is maintained.

The Note permits all RCPs to be removed from operation for  $\leq 1$  hour per 8 hour period. The purpose of the Note is to perform tests that are required to be performed without flow or pump noise. One of these tests is validation of the pump coastdown curve used as input to a number of accident analyses including a loss of flow accident. This test is generally performed in MODE 3 during the initial startup testing program, and as such should only be performed once. If, however, changes are made to the RCS that would cause a change to the flow characteristics of the RCS, the input values of the coastdown curve must be revalidated by conducting the test again.

Utilization of the Note is permitted provided the following conditions are met, along with any other conditions imposed by test procedures:

- a. No operations are permitted that would dilute the RCS boron concentration, thereby maintaining the margin to criticality. Boron reduction is prohibited because a uniform concentration distribution throughout the RCS cannot be ensured when in natural circulation; and
- b. Core outlet temperature is maintained at least 10°F below saturation temperature, so that no vapor bubble may form and possibly cause a natural circulation flow obstruction.

An OPERABLE RCS loop consists of one OPERABLE RCP and one OPERABLE SG in accordance with the Steam Generator Tube Surveillance Program, which has the minimum water level specified in SR 3.4.5.2. An RCP is OPERABLE if it is capable of being powered and is able to provide forced flow if required.

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(continued)

BASES (continued)

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**APPLICABILITY** In MODE 3, this LCO ensures forced circulation of the reactor coolant to remove decay heat from the core and to provide proper boron mixing. The most stringent condition of the LCO, that is, two RCS loops OPERABLE and two RCS loops in operation, applies to MODE 3 with the Rod Control System capable of rod withdrawal. The least stringent condition, that is, two RCS loops OPERABLE and one RCS loop in operation, applies to MODE 3 with the Rod Control System not capable of rod withdrawal.

Operation in other MODES is covered by:

LCO 3.4.4, "RCS Loops-MODES 1 and 2";

LCO 3.4.6, "RCS Loops-MODE 4";

LCO 3.4.7, "RCS Loops-Mode 5, Loops Filled";

LCO 3.4.8, "RCS Loops-Mode 5, Loops Not Filled";

LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation-High Water Level" (MODE 6); and

LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation-Low Water Level" (MODE 6).

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**ACTIONS**

A.1

If one required RCS loop is inoperable, redundancy for heat removal is lost. The Required Action is restoration of the required RCS loop to OPERABLE status within the Completion Time of 72 hours. This time allowance is a justified period to be without the redundant, nonoperating loop because a single loop in operation has a heat transfer capability greater than that needed to remove the decay heat produced in the reactor core and because of the low probability of a failure in the remaining loop occurring during this period.

B.1

If restoration is not possible within 72 hours, the unit must be brought to MODE 4. In MODE 4, the unit may be placed on the Residual Heat Removal (RHR) System. The additional Completion Time of 12 hours is compatible with required operations to achieve cooldown and depressurization from the existing plant conditions in an orderly manner and without challenging plant systems.

C.1 and C.2

If the required RCS loop is not in operation and the Rod Control System is capable of rod withdrawal, the Required Action is either to restore the required RCS loop to operation or to place the Rod Control System in a condition incapable of rod withdrawal, (e.g., de-energize all CRDMs by opening the RTBs or de-energizing the motor generator

(continued)

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## BASES

### ACTIONS

#### C.1 and C.2 (continued)

(MG) sets.) When the Rod Control System is capable of rod withdrawal, it is postulated that a power excursion could occur in the event of an inadvertent control rod withdrawal. This mandates having the heat transfer capacity of two RCS loops in operation. If only one loop is in operation, the Rod Control System must not be capable of rod withdrawal. The Completion Time of 1 hour to restore the required RCS loop to operation or to defeat the Rod Control System is adequate to perform these operations in an orderly manner without exposing the unit to risk for an undue time period.

#### D.1, D.2, and D.3

If four RCS loops are inoperable or no RCS loop is in operation, except as during conditions permitted by the Note in the LCO section, place the Rod Control System in a condition incapable of rod withdrawal, (e.g., all CRDMs must be de-energized by opening the RTBs or de-energizing the MG sets.) All operations involving a reduction of RCS boron concentration must be suspended, and action to restore one of the RCS loops to OPERABLE status and operation must be initiated. Boron dilution requires forced circulation for proper mixing, and opening the RTBs or de-energizing the MG sets removes the possibility of an inadvertent rod withdrawal.

The immediate Completion Time reflects the importance of maintaining operation for heat removal. The action to restore must be continued until one loop is restored to OPERABLE status and operation.

### SURVEILLANCE REQUIREMENTS

#### SR 3.4.5.1

This SR requires verification every 12 hours that the required loops are in operation. Verification may include flow rate, temperature, or pump status monitoring, which help ensure that forced flow is providing heat removal. The Frequency of 12 hours is sufficient considering other indications and alarms available to the operator in the control room to monitor RCS loop performance.

#### SR 3.4.5.2

SR 3.4.5.2 requires verification of SG OPERABILITY. SG OPERABILITY is verified by ensuring that the secondary side narrow range water level is  $\geq 15\%$  for required RCS loops. If the SG secondary side narrow range water level is  $< 15\%$ , the tubes may become uncovered and the associated loop may not be capable of providing the heat sink for removal of the decay heat. The 12 hour Frequency is considered adequate in view of other indications available in the control room to alert the operator to a loss of SG level.

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS  
(continued)

SR 3.4.5.3

Verification that the required RCPs are OPERABLE ensures that safety analyses limits are met. The requirement also ensures that an additional RCP can be placed in operation, if needed, to maintain decay heat removal and reactor coolant circulation. Verification is performed by verifying proper breaker alignment and power availability to the required RCPs.

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REFERENCES

None.

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## B 3.4 REACTOR COOLANT SYSTEM (RCS)

### B 3.4.6 RCS Loops — MODES 4

#### BASES

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##### BACKGROUND

In MODE 4, the primary function of the reactor coolant is the removal of decay heat and the transfer of this heat to either the steam generator (SG) secondary side coolant or the component cooling water via the residual heat removal (RHR) heat exchangers. The secondary function of the reactor coolant is to act as a carrier for soluble neutron poison, boric acid.

The reactor coolant is circulated through four RCS loops connected in parallel to the reactor vessel, each loop containing an SG, a reactor coolant pump (RCP), and appropriate flow, pressure, level, and temperature instrumentation for control, protection, and indication. The RCPs circulate the coolant through the reactor core and SGs at a sufficient rate to ensure proper heat transfer and to prevent boric acid stratification.

In MODE 4, either RCPs or RHR loops can be used to provide forced circulation. For RHR operation, the reactor coolant is circulated by means of two RHR loops connected to the RCS, each loop containing an RHR heat exchanger, a RHR pump, and appropriate flow and temperature instrumentation for control, protection, and indication. One RHR loop circulates the water through the RCS at a sufficient rate to remove decay heat and to prevent boric acid stratification.

Although NUREG-1431 uses "loop" to define RHR system requirements, past practice is use of "train", consistent with ECCS discussions of train availability and redundancy. Plant procedures are written using "train". The designations of "loop" and "train" are considered synonymous.

In MODE 4, either RCPs or RHR loops can be used to provide forced circulation. The intent of this LCO is to provide forced flow from at least one RCP or one RHR loop for decay heat removal and transport. The flow provided by one RCP loop or RHR loop is adequate for decay heat removal. The other intent of this LCO is to require that two paths be available to provide redundancy for decay heat removal.

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##### APPLICABLE SAFETY ANALYSES

In MODE 4, RCS circulation is considered in the determination of the time available for mitigation of the accidental boron dilution event. The RCS and RHR loops provide this circulation.

RCS Loops - MODE 4 have been identified in 10 CFR 50.36(c)(2)(ii) as important contributors to risk reduction.

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(continued)

BASES (continued)

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LCO

The purpose of this LCO is to require that at least two loops be OPERABLE in MODE 4 and that one of these loops be in operation. The LCO allows the two loops that are required to be OPERABLE to consist of any combination of RCS loops and RHR loops. Any one loop in operation provides enough flow to remove the decay heat from the core with forced circulation. An additional loop is required to be OPERABLE to provide redundancy for heat removal.

Note 1 permits all RCPs or RHR pumps to be removed from operation for  $\leq 1$  hour per 8 hour period. The purpose of the Note is to permit tests that are required to be performed without flow or pump noise. 1 hour is adequate to perform the test, and operating experience has shown that boron stratification is not a problem during this short period with no forced flow.

Utilization of Note 1 is permitted provided the following conditions are met along with any other conditions imposed by test procedures:

- a. No operations are permitted that would dilute the RCS boron concentration, therefore maintaining the margin to criticality. Boron reduction is prohibited because a uniform concentration distribution throughout the RCS cannot be ensured when in natural circulation; and
- b. Core outlet temperature is maintained at least 10°F below saturation temperature, so that no vapor bubble may form and possibly cause a natural circulation flow obstruction.

Note 2 requires that the secondary side water temperature of each SG be  $< 50^\circ\text{F}$  above each of the RCS cold leg temperatures before the start of an RCP with any RCS cold leg temperature  $\leq$  LTOP arming temperature specified in the PTLR (the current limiting temperature for DCP is  $270^\circ\text{F}$ .) Note 2 also includes a DCP plant specific alternate condition under which a RCP may be started in MODE 4 and in MODE 5 with the loops filled. Note that RCPs may be "bumped" following a condition of RCS depressurization to establish "loops filled" condition. The Note specifies that a RCP may be started if the pressurizer water level is less than 50%. This option of RCP start with pressurizer water level less than 50% supports plant operational flexibility. The open volume in the pressurizer provides space to sustain reactor coolant thermal swell without incurring a possible excessive pressure transient due to energy additions from the SG secondary water. The purpose of conditions to allow initial RCP start when none is running is to prevent a possible low temperature RCS overpressure event due to a thermal transient when a RCP is started. The condition of SG/RCS

(continued)

## BASES

LCO (continued)      temperature difference limits the available relative energy source and the pressurizer level condition provides an expansion volume to accommodate possible reactor coolant thermal swell. These conditions are intended to prevent a low temperature overpressure event due to a thermal transient when a RCP is started.

An OPERABLE RCS loop comprises an OPERABLE RCP and an OPERABLE SG in accordance with the Steam Generator Tube Surveillance Program, which has the minimum water level specified in SR 3.4.6.2.

Similarly for the RHR System, an OPERABLE RHR loop comprises an OPERABLE RHR pump capable of providing forced flow to an OPERABLE RHR heat exchanger. RCPs and RHR pumps are OPERABLE if they are capable of being powered and are able to provide forced flow if required. A RHR loop is in operation when the pump is operating and providing forced flow through the loop. Because a loop can be operating without being OPERABLE, the LCO requires at least one loop OPERABLE and in operation.

APPLICABILITY      In MODE 4, this LCO ensures forced circulation of the reactor coolant to remove decay heat from the core and to provide proper boron mixing. One loop of either RCS or RHR provides sufficient circulation for these purposes. However, two loops consisting of any combination of RCS and RHR loops are required to be OPERABLE to meet single failure considerations.

Operation in other MODES is covered by:

LCO 3.4.4, "RCS Loops - MODES 1 and 2";

LCO 3.4.5, "RCS Loops - MODE 3";

LCO 3.4.7, "RCS Loops - MODE 5, Loops Filled";

LCO 3.4.8, "RCS Loops - MODE 5, Loops Not Filled";

LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation-High Water Level" (MODE 6); and

LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation-Low Water Level" (MODE 6).

ACTIONS      A.1 and A.2

If one required RCS loop is inoperable and two RHR loops are inoperable, redundancy for heat removal is lost. Action must be initiated to restore a second RCS loop or RHR loop to OPERABLE status. The immediate Completion Time reflects the importance of maintaining the availability of two paths for heat removal.

(continued)

## BASES

## ACTIONS

A.1 and A.2 (continued)

If one required RHR loop is OPERABLE and in operation and there are no RCS loops OPERABLE, an inoperable RCS loop or RHR loop must be restored to OPERABLE status to provide a redundant means for decay heat removal.

If the parameters that are outside the limits cannot be restored, the unit must be brought to MODE 5 within 24 hours. Bringing the unit to MODE 5 is a conservative action with regard to decay heat removal. With only one RHR loop OPERABLE, redundancy for decay heat removal is lost and, in the event of a loss of the remaining RHR loop, it would be safer to initiate that loss from MODE 5 ( $\leq 200^{\circ}\text{F}$ ) rather than MODE 4 ( $> 200^{\circ}\text{F}$  to  $< 350^{\circ}\text{F}$ ). The Completion Time of 24 hours is a reasonable time, based on operating experience, to reach MODE 5 from MODE 4 in an orderly manner and without challenging plant systems.

B.1 and B.2

If no loop is OPERABLE or in operation, except during conditions permitted by Note 1 in the LCO section, all operations involving a reduction of RCS boron concentration must be suspended and action to restore one RCS or RHR loop to OPERABLE status and operation must be initiated.

Boron dilution requires forced RCS circulation from at least one RCP for proper mixing, so that an inadvertent criticality may be prevented. The immediate Completion Times reflect the importance of maintaining operation for decay heat removal. The action to restore must be continued until one loop is restored to OPERABLE status and operation.

SURVEILLANCE  
REQUIREMENTSSR 3.4.6.1

This SR requires verification every 12 hours that one RCS loop or RHR loop is in operation. Verification may include flow rate, temperature, or pump status monitoring, which help ensure that forced flow is providing heat removal. The Frequency of 12 hours is sufficient considering other indications and alarms available to the operator in the control room to monitor RCS and RHR loop performance.

SR 3.4.6.2

SR 3.4.6.2 requires verification of SG OPERABILITY. SG OPERABILITY is verified by ensuring that the secondary side narrow range water level is  $\geq 15\%$ . If the SG secondary side narrow range water level is  $< 15\%$ , the tubes may become uncovered and the

(continued)

BASES

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SURVEILLANCE  
REQUIREMENTS

SR 3.4.6.2 (continued)

associated loop may not be capable of providing the heat sink necessary for removal of decay heat. The 12 hour Frequency is considered adequate in view of other indications available in the control room to alert the operator to the loss of SG level.

SR 3.4.6.3

Verification that the required pump is OPERABLE ensures that an additional RCS or RHR pump can be placed in operation, if needed, to maintain decay heat removal and reactor coolant circulation. Verification is performed by verifying proper breaker alignment and power available to the required pump. The Frequency of 7 days is considered reasonable in view of other administrative controls available and has been shown to be acceptable by operating experience.

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REFERENCES

None.

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