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SURVEILLANCE
REQUIREMENTS
(continued)SR 3.3.1.9

SR 3.3.1.9 is the performance of a CHANNEL CALIBRATION every 24 months. This SR is modified by a Note stating that neutron detectors are excluded from the CHANNEL CALIBRATION. The CHANNEL CALIBRATION for the power range neutron detectors consists of a normalization of the detectors based on a power calorimetric and flux map performed above 20% RTP. Below 20% RTP, the design of the incore detector system, low core power density, and detector accuracy make use of the incore detectors inadequate for use as a reference standard for comparison to the excore channels. The CHANNEL CALIBRATION for the source range and intermediate range neutron detectors consists of obtaining the detector plateau or preamp discriminator curves, evaluating those curves, and comparing the curves to the manufacturer's data. This Surveillance is not required for the power range detectors for entry into MODES 2 and 1, and is not required for the intermediate range detectors for entry into MODE 2, because the plant must be in at least MODE 2 to perform the test for the intermediate range detectors and MODE 1 for the power range detectors. The 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. Operating experience has shown these components usually pass the Surveillance when performed on the 24 month Frequency.

SR 3.3.1.10

SR 3.3.1.10 is the performance of a TADOT of the Manual Reactor Trip, and the SI, ADS Actuation, and CMT Injection inputs from the ESFACs. This TADOT is performed every 24 months. The test shall independently verify the OPERABILITY of the undervoltage and shunt trip mechanisms for the Manual Reactor Trip Function for the Reactor Trip Breakers.

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.

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SR 3.3.1.11

This SR 3.3.1.11 verifies that the individual channel/division actuation response times are less than or equal to the maximum values assumed in the accident analysis. Response Time testing criteria are included in Reference 2.

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 test such that the entire response time is measured.

Each division response must be verified every 24 months on a STAGGERED TEST BASIS (i.e., all four Protection Channel Sets would be tested after 96 months). Response times cannot be determined during plant operation because equipment operation is required to measure response times. Experience has shown that these components usually pass this surveillance when performed on a refueling frequency. Therefore, the Frequency was concluded to be acceptable from a reliability standpoint.

The SR 3.3.1.11 is modified by exempting neutron detectors from response time testing. A Note to the Surveillance indicates that neutron detectors may be 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.

REFERENCES

1. Chapter 6.0, "Engineered Safety Features."
2. Chapter 7.0, "Instrumentation and Controls."
3. Chapter 15.0, "Accident Analysis."
4. WCAP-14606, "Westinghouse Setpoint Methodology for Protection Systems," April 1996 (nonproprietary).

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5. Institute of Electrical and Electronic Engineers, IEEE-279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations," April 5, 1972.
 6. 10 CFR 50.49, "Environmental Qualifications of Electric Equipment Important to Safety for Nuclear Power Plants."
 7. WCAP-10271-P-A, "Evaluation of Surveillance Frequencies and Out of Service Times for the Reactor Protection Instrumentation System," Supplement 2, Revision 1, June 1996.
 8. NRC Generic Letter No. 83-27, Surveillance Intervals in Standard Technical Specifications.
 9. ESBU-TB-97-01, Westinghouse Technical Bulletin, "Digital Process Rack Operability Determination Criteria," May 1, 1997.
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B 3.3 INSTRUMENTATION

B 3.3.2 ENGINEERED SAFETY FEATURE ACTUATION SYSTEM (ESFAS) INSTRUMENTATION

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BACKGROUND

The ESFAS initiates necessary safety systems, based upon 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 four distinct but interconnected modules as identified below:

- Field inputs from process sensors, nuclear instrumentation;
- Integrated Protection Cabinets (IPCs);
- Engineered Safety Features Actuation Cabinets (ESFACs); and
- Protection Logic Cabinets (PLCs).

Field Transmitters and Sensors

Normally, four redundant measurements using four separate sensors, are made for each variable used for actuation of ESF. The use of four channels for protection Functions is based on a minimum of two channels being required for a trip or actuation, one channel in test or bypass, and a single failure on the remaining channel. The signal selector in the Plant Control System will function correctly with only three channels. This includes two channels properly functioning and one channel having a single failure. Minimum requirements for protection and control is achieved with three channels OPERABLE. The fourth channel is provided to increase plant availability, and permits the plant to run for an indefinite time with a single channel out of service. The circuit design is 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 (Ref. 4). The actual

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Field Transmitters and Sensors (continued)

number of channels provided for each plant parameter is specified in Reference 2.

Engineered Safety Features (ESF) Channel

An ESF channel extends from the sensor to the output of the associated ESF subsystem (ESF1 or ESF2) in the IPCs, and shall include the sensor (or sensors), the signal conditioning, any associated data links, and the associated ESF subsystem. For ESF channels containing nuclear instrumentation, the ESF channel shall also include the nuclear instrument signal conditioning and the associated Nuclear Instrumentation Signal Processing and Control (NISPEC) subsystem in the IPCs. Any manual ESF controls that are associated with a particular ESF channel are also included in that ESF channel.

IPCs

The IPCs contain the necessary equipment to:

- Permit acquisition and analysis of the sensor inputs, including plant process sensors and nuclear instrumentation, required for reactor trip and ESF calculations;
- Perform computation or logic operations on variables based on these inputs;
- Provide trip signals to the reactor trip switchgear and ESF actuation data to the ESFACs as required;
- Permit manual trip or bypass of each individual reactor trip Function and permit manual actuation or bypass of each individual voted ESF Function;
- Provide data to other systems in the Instrumentation and Control (I&C) architecture;
- Provide functional diversity for the reactor trips and ESF actuations; and

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IPCs (continued)

- Provide separate input circuitry for control Functions that require input from sensors that are also required for protection Functions.

Each of the four IPCs provides signal conditioning, comparable output signals for indications in the main control room, and comparison of measured input signals with established setpoints. The basis of the setpoints are described in References 1, 2, and 3. If the measured value of a unit parameter exceeds the predetermined setpoint, an output is generated which is transmitted to the ESFACs for logic evaluation.

ESFACs

The ESFACs contain the necessary equipment to:

- Permit reception of the data supplied by the four IPCs and perform voting on the trip outputs;
- Perform system level logic using the input data from the IPCs and transmit the output to the PLCs; and
- Provide redundant hardware capable of providing system level commands to the PLCs.

ESF Actuation Logic

The ESF actuation logic shall extend from, but not include, the outputs of the various ESF channels to the output from the logic cabinet associated with the actuated device. The ESF actuation logic shall include the ESF actuation subsystems in the ESFACs, the Functional Logic Subsystems in the associated PLC, the I/O hardware associated with the actuated device, any associated datalinks and any associated data highways. Any manual ESF controls that are associated with a particular ESF actuation logic are also included in that ESF actuation logic.

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(continued)PLCs

The PLCs contain the necessary equipment to:

- Receive automatic system level signals supplied by the associated ESFAC;
- Receive and transmit data to/from main control room multiplexers;
- Receive and transmit data to/from other PLCs on the same logic bus;
- Receive status data from component position switches (such as limit switches and torque switches); and
- Perform logic computations on received data, generate logic commands for final actuators (such as START, STOP, OPEN, and CLOSE).

ESFAC and PLC Operability Background

Each ESFAC and PLC has two microprocessor subsystems that communicate by means of redundant halves of the logic bus. In the ESFAC, each microprocessor subsystem is called an actuation subsystem. In the PLC, each microprocessor subsystem is called a functional logic group. This arrangement permits each microprocessor subsystem in an ESFAC or PLC to be temporary removed from service to facilitate testing. While the microprocessor subsystem is moved from service, the remaining microprocessor subsystem continues to function and the ESF division continues to provide full protection. At least one of these redundant halves is connected to the battery backed portion of the power system. This provides full functionality of the ESF division even when all ac power sources are lost. As long as one battery microprocessor subsystem within an ESFAC or PLC continues to operate, the ESF division is unaffected. As ESF division is only affected when all battery backed microprocessor subsystem within an ESFAC or PLC are not OPERABLE.

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(continued)Trip Setpoints and Allowable Values

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

The Trip Setpoints used in the trip output 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, instrument drift, and severe environment errors for those ESFAS channels that must function in harsh environments as defined by 10 CFR 50.49 (Ref. 5), the Trip Setpoints and Allowable Values specified in Table 3.3.2-1 in the accompanying LCO are conservatively adjusted with respect to the analytical limits. A detailed description of the methodology used to calculate the Trip Setpoints, including their explicit uncertainties, is provided in the "Westinghouse Setpoint Methodology for Protection Systems" (Refs. 9 and 10). The actual nominal Trip Setpoint entered into the bistable is more conservative than that specified by the Allowable Value to account for changes in random measurement errors detectable by a COT. One example of such a change in measurement error is drift during the surveillance interval. If the measured setpoint does not exceed the Allowable Value, the trip output is considered OPERABLE.

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.

Each channel can be tested on line to verify that the signal processing equipment and setpoint accuracy is within the specified allowance requirements of Reference 9. 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.

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Trip Setpoints and Allowable Values (continued)

The Trip Setpoints and Allowable Values listed in Table 3.3.2-1 are based on the methodology described in Reference 9, which incorporates all of the known uncertainties applicable for each channel. The magnitudes of these uncertainties are factored into the determination of each Trip Setpoint. All field sensors and signal processing equipment for these channels are assumed to operate within the allowances of these uncertainty magnitudes.

Calibration tolerances and drift allowances must be specified in plant calibration procedures, and must be consistent with the values used in the setpoint methodology.

The OPERABILITY of each transmitter or sensor can be evaluated when its "as found" calibration data are compared against the "as left" data and are shown to be within the setpoint methodology assumptions. The basis of the setpoints is described in References 1, 2, 3, and 9. Trending of transmitter calibration is required by Generic Letter 91-04, "Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle."

Each channel of the IPC can be tested on line to verify that the signal or setpoint accuracy is within the specified allowance requirements. This test may be performed by using the built-in automatic tester. Once a designated channel is automatically 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. The IPC channel is considered to be OPERABLE if the channel passes the automatic testing. Surveillance Requirements for the channels are specified in the Surveillance Requirements section.

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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

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accidents. For example, Pressurizer Pressure – Low is a primary actuation signal for small loss of coolant accidents (LOCAs) and a backup actuation signal for steam line breaks (SLBs) outside containment. Functions such as manual initiation not specifically credited in the accident safety analysis are qualitatively credited in the safety analysis and the NRC staff approved licensing basis for the plant. These Functions may provide protection for conditions which 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 generally requires OPERABILITY of four channels in each instrumentation/logic Function and two devices for each manual initiation Function. The two-out-of-four configurations allow one channel to be bypassed during maintenance or testing without causing an ESFAS initiation. Two manual initiation channels are required to ensure no single random failure disables the ESFAS.

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

1. Safeguards Actuation

The Safeguards Actuation signal actuates the alignment of the Core Makeup Tank (CMT) valves for passive injection to the RCS. The Safeguards Actuation signal provides two primary Functions:

- Primary side water addition to ensure maintenance or recovery of reactor vessel water level (coverage of the active fuel for heat removal and clad integrity, peak clad temperature < 2200°F); and
- Boration to ensure recovery and maintenance of SHUTDOWN MARGIN ($k_{eff} < 1.0$).

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1. Safeguards Actuation (continued)

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

- Containment Isolation;
- Reactor Trip;
- Turbine Trip;
- Close Main Feedwater Control Valves;
- Trip Main Feedwater Pumps and Closure of Isolation and Crossover Valves; and
- Reactor Coolant Pump Trip.

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 to limit secondary side mass losses;
- Trip of the reactor coolant pumps to ensure proper CMT actuation;
- Enabling automatic depressurization of the RCS on CMT Level – Low 1 to ensure continued safeguards actuated injection.

Manual and automatic initiation of Safeguards Actuation 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. Automatic actuation in MODE 4 is provided by the high containment pressure signal.

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1. Safeguards Actuation (continued)

Manual initiation is required in MODE 5 to support system level initiation. Automatic initiation is not required to be OPERABLE in MODE 5 because parameters are not available to provide automatic actuation, and manual initiation is sufficient to mitigate the consequences of an accident.

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

1.a. Manual Initiation

The LCO requires that two manual initiation devices are OPERABLE. The operator can initiate the Safeguards Actuation signal at any time by using either of two switches in the main control room. This action will cause actuation of all components in the same manner as any of the automatic actuation signals.

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

Each device consists of one switch and the interconnecting wiring to all four ESFACs. Each manual initiation device actuates all four ESFAC divisions. This configuration does not allow testing at power.

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1.b. Containment Pressure – High 2

This signal provides protection against the following accidents:

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

The transmitters (d/p cells) and electronics are located inside of containment. Since the transmitters and electronics are located inside of containment, they will experience adverse environmental conditions and the trip setpoint reflects environmental instrument uncertainties. The Containment Pressure – High 2 setpoint has been specified as low as reasonable, without creating potential for spurious trips during normal operations, consistent with the TMI action item (NUREG-0933, Item II.E.4.2) guidance.

The LCO requires four channels of Containment Pressure – High 2 to be OPERABLE in MODES 1, 2, 3, and 4. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function.

1.c. Pressurizer Pressure – Low

This signal provides protection against the following accidents:

- Inadvertent opening of a steam generator (SG) safety valve;
 - SLB;
 - A spectrum of rod cluster control assembly ejection accidents (rod ejection);
 - Inadvertent opening of a pressurizer safety valve;
 - LOCAs; and
 - Steam Generator Tube Rupture (SGTR). (continued)
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APPLICABILITY1.c. Pressurizer Pressure – Low (continued)

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). Therefore, the Trip Setpoint reflects the inclusion of both steady state and adverse environmental instrument uncertainties.

The LCO requires four channels of Pressurizer Pressure – Low to be OPERABLE in MODES 1, 2, and 3 (above P-11, when the RCS boron concentration is below that necessary to meet the SDM requirements at an RCS temperature of 200°F), to mitigate the consequences of a high energy line rupture inside containment. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. This signal may be manually blocked by the operator below the P-11 setpoint. Automatic actuation below this pressure is then performed by the Containment Pressure – High 2 signal.

This Function is not required to be OPERABLE in MODE 3 below the P-11 setpoint. Other ESF Functions are used to detect accident conditions and actuate the ESF systems in this MODE. In MODES 4, 5, and 6, this Function is not needed for accident detection and mitigation.

1.d. 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.

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APPLICABILITY1.d. Steam Line Pressure – Low (continued)

It is possible for the transmitters to experience adverse environmental conditions during a secondary side break. Therefore, the Trip Setpoint reflects both steady state and adverse environmental instrument uncertainties.

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

The LCO requires four channels of Steam Line Pressure – Low to be OPERABLE in MODES 1, 2, and 3 (above P-11, when the RCS boron concentration is below that necessary to meet the SDM requirements at an RCS temperature of 200°F). At these conditions, a secondary side break or stuck open valve could result in the rapid depressurization of the steam lines. Four channels are provided in each steam line to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. This signal may be manually blocked by the operator below the P-11 setpoint. Below P-11, feed line break is not a concern, inside containment SLB will be terminated by automatic actuation via Containment Pressure – High 2, and outside containment SLB will be terminated by the Steam Line Pressure-Negative Rate – High signal for steam line isolation. In MODE 4, 5, or 6, this Function is not needed for accident detection and mitigation because the steam line pressure is below the actuation setpoint. Low steam line pressure in these MODES is not an adequate indication of a feed line or steam line break.

1.e. RCS Cold Leg Temperature (T_{cold}) – Low

This signal provides protection against the following accidents:

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

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1.e. RCS Cold Leg Temperature (T_{cold}) - Low (continued)

The LCO requires four channels of T_{cold} - Low to be OPERABLE in MODES 1 and 2, and in MODE 3 with any main steam isolation valve open and above P-11 when the RCS boron concentration is below that necessary to meet the SDM requirements at an RCS temperature of 200°F. At these conditions, a secondary side break or stuck open valve could result in the rapid cooldown of the primary side. Four channels are provided in each loop to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. In MODES 4, 5, and 6, this Function is not needed for accident detection and mitigation because the cold leg temperature is reduced below the actuation setpoint.

2. Core Makeup Tank (CMT) Actuation

CMT Actuation provides the passive injection of borated water into the RCS. Injection provides RCS makeup water and boration during transients or accidents when the normal makeup supply from the Chemical and Volume Control System (CVS) is lost or insufficient. Two tanks are available to provide passive injection of borated water. CMT injection mitigates the effects of high energy line breaks by adding primary side water to ensure maintenance or recovery of reactor vessel water level following a LOCA, and by borating to ensure recovery or maintenance of SHUTDOWN MARGIN following a steam line break. CMT Valve Actuation is initiated by the Safeguards Actuation signal, Pressurizer Level - Low 2, ADS Stages 1, 2 and 3 Actuation, or manually.

The LCO requires that manual and automatic CMT Valve Actuation be OPERABLE in MODES 1 through 4. Manual and Automatic actuation of the CMT valves is additionally required in MODE 5 with the RCS pressure boundary intact. Actuation of this Function is not required in MODE 5 with the RCS pressure boundary open, or MODE 6 because the CMTs are not required to be OPERABLE in these MODES.

2.a. Manual Initiation

Manual CMT Valve Actuation is accomplished by either of two switches in the main control room. Either switch activates all four ESFAC divisions.

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2.b. Pressurizer Water Level – Low 2

This Function also initiates CMT Valve Actuation from the coincidence of pressurizer level below the Low 2 Setpoint in any two of the four divisions. This function can be manually blocked when the pressurizer water level is below the P-12 Setpoint. This Function is automatically unblocked when the pressurizer water level is above the P-12 Setpoint. The Setpoint reflects both steady state and adverse environmental instrument uncertainties as the detectors provide protection for an event that results in a harsh environment.

2.c. Safeguards Actuation (Function 1)

CMT Valve Actuation is also initiated by all Functions that initiate the Safeguards Actuation signal. The CMT Valve Actuation Function requirements are the same as the requirements for the Safeguards Actuation Functions, but only apply in MODES 1 through 4, and in MODE 5 with the RCS pressure boundary intact. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead, Function 1 is referenced for all initiating Functions and requirements.

2.d. ADS Stages 1, 2, and 3 Actuation (Function 9)

The CMTs are actuated on an ADS Stages 1, 2, and 3 actuation. The CMT Actuation Function requirements are the same as the requirements for the ADS Stages 1, 2, and 3 Actuation Function, but only apply in MODES 1 through 4, and in MODE 5 with the RCS pressure boundary intact. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead, Function 9 is referenced for all initiating functions and requirements.

3. Containment Isolation

Containment Isolation provides isolation of the containment atmosphere and selected process systems which 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.

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3. Containment Isolation (continued)

Containment Isolation is actuated by the Safeguards Actuation signal, manual actuation of containment cooling, or manually.

Manual and automatic initiation of Containment Isolation must be OPERABLE in MODES 1, 2, 3, and 4, when containment integrity is required. Manual initiation is required in MODE 5 and MODE 6 for closure of open penetrations providing direct access from the containment atmosphere to the outside atmosphere. Manual initiation of this Function in MODES 5 and 6 is not applicable if the direct access lines penetrating containment are isolated. Initiation of containment isolation by manual initiation of passive containment cooling in MODE 5 or 6 with decay heat ≤ 6.0 Mwt is not required because operability of the passive containment cooling system is not required when air cooling is sufficient. This provides the capability to manually initiate containment isolation during all MODES. Automatic Safeguards Actuation is required in MODE 5 for closure of open penetrations providing direct access from the containment atmosphere to the outside atmosphere. Automatic Safeguards Actuation is not required in MODE 6 because manual initiation is sufficient to mitigate the consequences of an accident in this MODE.

3.a. Manual Initiation

Manual Containment Isolation is accomplished by either of two switches in the main control room. Either switch actuates all four ESFAC divisions.

3.b. Manual Initiation of Passive Containment Cooling
(Function 12.a)

Containment Isolation is also initiated by Manual Initiation of Passive Containment Cooling. This is accomplished as described for ESFAS Function 12.a, but are not applicable if the direct access flow paths are isolated.

3.c. Safeguards Actuation (Function 1)

Containment Isolation is also initiated by all Functions that initiate the Safeguards Actuation

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3.c. Safeguards Actuation (Function 1) (continued)

signal. The Containment Isolation Function requirements are the same as the requirements for the Safeguards Actuation Function, but are not applicable if the direct access flow paths are isolated. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead, Function 1 is referenced for all initiating functions and requirements.

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 isolation valves, inside or outside of containment, closure of the isolation valves limits the accident to the blowdown from only the affected SG. For a SLB downstream of the isolation valves, closure of the isolation valves terminates the accident as soon as the steam lines depressurize.

Closure of the turbine stop and control valves and the main steam branch isolation valves is initiated by this Function. Closure of these valves limits the accidental depressurization of the main steam system associated with an inadvertent opening of a single steam dump, relief, safety valve, or a rupture of a main steam line. Closure of these valves also supports a steam generator tube rupture event by isolating the faulted steam generator.

4.a. Manual Initiation

Manual initiation of Steam Line Isolation can be accomplished from the main control room. There are two switches in the main control room and either switch can initiate action to immediately close all main steam isolation valves (MSIVs). The LCO requires two OPERABLE channels in MODES 1, 2, 3, and 4 with any main steam valve open, when there is sufficient energy in the RCS and SGs to have an SLB or other accident resulting in the release of significant quantities of energy to cause a cooldown of the primary system. In MODES 5 and 6, this

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4.a. Manual Initiation (continued)

Function is not required to be OPERABLE because there is insufficient energy in the secondary side of the unit to cause an accident.

4.b. Containment Pressure - High 2

This Function actuates closure of the MSIVs in the event a SLB inside containment to limit the mass and energy release to containment and limit blowdown to a single SG.

The transmitters and electronics are located inside containment, thus, they will experience harsh environmental conditions and the Trip Setpoint reflects environmental instrument uncertainties.

The Containment Pressure - High 2 setpoint has been specified as low as reasonable, without creating potential for spurious trips during normal operations, consistent with the TMI action item (NUREG-0933, Item II.E.4.2) guidance. The LCO requires four channels of Containment Pressure - High 2 to be OPERABLE in MODES 1, 2, 3, and 4, with any main steam valve open, when there is sufficient energy in the primary and secondary side to pressurize the containment following a pipe break. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. There would be a significant increase in the containment pressure, thus allowing detection and closure of the MSIVs. In MODES 5 and 6, there is not enough energy in the primary and secondary sides to pressurize the containment to the Containment Pressure - High 2 setpoint.

4.c. Steam Line Pressure

(1) Steam Line Pressure - Low

Steam Line Pressure - Low provides closure of the MSIVs in the event of an SLB to limit the mass and energy release to containment and limit blowdown to a single SG.

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(1) Steam Line Pressure – Low (continued)

The LCO requires four channels of Steam Line Pressure – Low Function to be OPERABLE in MODES 1, 2, and 3 (above P-11, when the RCS boron concentration is below that necessary to meet the SDM requirements at an RCS temperature of 200°F), with any main steam isolation valve open, when a secondary side break or stuck open valve could result in the rapid depressurization of the steam lines. Four channels are provided in each steam line to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. This signal may be manually blocked by the operator below the P-11 setpoint. Below P-11, an inside containment SLB will be terminated by automatic actuation via Containment Pressure – High 2, and stuck open valve transients and outside containment steam line breaks will be terminated by the Steam Line Pressure-Negative Rate – High signal for Steam Line Isolation. In MODES 4, 5, and 6, this Function is not needed for accident detection and mitigation.

(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 when less than the P-11 setpoint, the Steam Line Pressure-Negative Rate – High signal is automatically enabled.

The LCO requires four channels of Steam Line Pressure-Negative Rate – High to be OPERABLE in MODE 3, with any main steam valve open, 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). Four channels are provided in each steam line to

(continued)

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

permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. In MODES 1 and 2, and in MODE 3 when above the P-11 setpoint with the RCS boron concentration below that necessary to meet the SDM requirements at an RCS temperature of 200°F, this signal is automatically disabled and the Steam Line Pressure - Low signal is automatically enabled.

In MODES 4, 5, and 6, this Function is not needed for accident detection and mitigation.

While the transmitters may experience elevated ambient temperatures due to a steam line break, the Trip Function is on rate of change, not the absolute accuracy of the indicated steam pressure. Therefore, the Trip Setpoint reflects only steady state instrument uncertainties.

4.d. Tcold - Low

This Function provides closure of the MSIVs during a SLB or inadvertent opening of a SG relief or a safety valve 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 was discussed as Safeguards Actuation Function 1.e.

The LCO requires four channels of Tcold - Low to be OPERABLE in MODES 1 and 2, and in MODE 3 above P-11 when the RCS boron concentration is below that necessary to meet the SDM requirements at an RCS temperature of 200°F, with any main steam isolation valve open, when a secondary side break or stuck open valve could result in the rapid cooldown of the primary side. Four channels are provided in each loop to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. In MODE 3 below P-11 and in MODES 4, 5, and 6, this Function is not needed for accident detection and mitigation because the cold leg temperature is reduced below the actuation setpoint.

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5. Turbine Trip

The primary Function of the Turbine Trip is to prevent damage to the turbine due to water in the steam lines. This Function is necessary in MODES 1 and 2, and 3 above P-11 to mitigate the effects of a large SLB or a large Feedline Break (FLB). Failure to trip the turbine following a SLB or FLB can lead to additional mass and energy being delivered to the steam generators, resulting in excessive cooldown and additional mass and energy release in containment. In MODES 3, 4, 5, and 6, the turbine is not in operation and this function is not required to be OPERABLE.

This Function is actuated by Steam Generator Water Level – High 2, by a Safeguards Actuation signal, or manually. The Reactor Trip Signal also initiates a turbine trip signal whenever a reactor trip (P-4) is generated.

5.a. Manual Main Feedwater Isolation

The Turbine Trip is also initiated by the Manual Main Feedwater Control Valve Isolation Function. The requirements for this Function are the same as the requirements for Manual Main Feedwater Control Valve Isolation (Function 6.a), but only apply in MODES 1 and 2. Therefore, the requirements are not repeated in Table 3.3.2-1, and Function 6.a is referenced for all requirements.

5.b. Steam Generator Narrow Range Water Level – High 2

This signal provides protection against excessive feedwater flow by closing the main feedwater control, isolation and crossover valves, tripping of the main feedwater pumps, and tripping the turbine. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. The transmitters (d/p cells) are located inside containment. However, the events which this Function protect against cannot cause severe environment in containment. Therefore, the Setpoint reflects only steady state instrument uncertainties.

(continued)

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5.c. Safeguards Actuation (Function 1)

Turbine Trip is also initiated by all Functions that initiate the Safeguards Actuation signal. The Turbine Trip Function requirements are the same as the requirements for the Safeguards Actuation Function, but only apply in MODES 1 and 2. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead Function 1 is referenced for all initiating Functions and requirements. The Safeguards Actuation signal closes all main feedwater control, isolation and crossover valves, trips all main feedwater pumps, and trips the turbine.

5.d. Reactor Trip (Function 18.a)

Turbine Trip is also initiated by all functions that initiate Reactor Trip. The turbine trip function requirements are the same as the requirements for the Reactor Trip Function, but only apply in MODES 1 and 2. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead Function 18.a, P-4 (Reactor Trip), is referenced for all initiating Functions and requirements.

6. Main Feedwater Control Valve Isolation

The primary Function of Main Feedwater Control Valve Isolation is to prevent damage to the turbine due to water in the steam lines and to stop the excessive flow of feedwater into the SGs. This Function is actuated by Steam Generator Narrow Range Water Level – High 2, by a Safeguards Actuation signal, or manually. The Reactor Trip Signal also initiates closure of the main feedwater control valves coincident with a low RCS average temperature (T_{avg}) signal whenever a reactor trip (P-4) is generated.

Closing the Main Feedwater Control Valves on Manual Main Feedwater Isolation, SG Narrow Range Water Level-High 2, or Safeguards Actuation is necessary in MODES 1, 2, and 3 to mitigate the effects of a large SLB or a large FLB. This Function is also required to be OPERABLE in MODES 1

(continued)

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6. Main Feedwater Control Valve Isolation (continued)

and 2 on Tavg Low-1 coincident with Reactor Trip (P-4). Failure to close the main feedwater control valves following a SLB or FLB can lead to additional mass and energy being delivered to the steam generators, resulting in excessive cooldown and additional mass and energy release in containment. Manual main feedwater isolation is required to be OPERABLE in MODE 4 when the main feedwater control valves are open. This Function is not applicable in MODE 4 for valve isolation if the main feedwater line is isolated. Automatic actuation on a Steam Generator Narrow Range Water Level - High 2 is required to be OPERABLE in MODE 4 when the RCS is not being cooled by the RNS. In MODES 5 and 6, the energy in the RCS and the steam generators is low and this function is not required to be OPERABLE.

6.a. Manual Main Feedwater Isolation

Manual Main Feedwater Isolation can be accomplished from the main control room. There are two switches in the main control room and either switch can initiate action in both divisions to close all main and startup feedwater control, isolation and crossover valves, trip all main and startup feedwater pumps, and trip the turbine.

6.b. Steam Generator Narrow Range Water Level - High 2

This signal provides protection against excessive feedwater flow by closing the main feedwater control, isolation and crossover valves, tripping of the Main Feedwater Pumps, and tripping the turbine.

Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. The transmitters (d/p cells) are located inside containment. However, the events which this Function protect against cannot cause severe environment in containment. Therefore, the Setpoint reflects only steady state instrument uncertainties.

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6.c. Safeguards Actuation (Function 1)

This Function is also initiated by all Functions that initiate the Safeguards Actuation signal. The Main Feedwater Control Valve Isolation Function requirements are the same as the requirements for the Safeguards Actuation Function, but do not apply in MODE 4 with the flow paths isolated. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead Function 1 is referenced for all initiating Functions and requirements. The Safeguards Actuation signal closes all main feedwater control, isolation and crossover valves, trips all main feedwater pumps, and trips the turbine.

6.d. Tavg Low-1 Coincident with Reactor Trip (P-4)

This signal provides protection against excessive feedwater flow by closing the main feedwater control valves. This signal results from a coincidence of two of the four divisions of reactor loop average temperature below the Low 1 setpoint coincident with the P-4 permissive. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure that no single random failure will disable this trip Function.

7. Main Feedwater Pump Trip and Valve Isolation

The primary function of the Main Feedwater Pump Trip and Isolation is to prevent damage to the turbine due to water in the steam lines and to stop the excessive flow of feedwater into the SGs. Valve isolation includes closing the main feedwater isolation and crossover valves. Isolation of main feedwater is necessary to prevent an increase in heat removal from the reactor coolant system in the event of a feedwater system malfunction. Addition of excessive feedwater causes an increase in core power by decreasing reactor coolant temperature. This Function is actuated by Steam Generator Water Level – High 2, by a Safeguards Actuation signal, or manually. The Reactor Trip Signal also initiates a turbine trip signal whenever a reactor trip (P-4) is generated.

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7. Main Feedwater Pump Trip and Valve Isolation (continued)

This Function is necessary in MODES 1, 2, 3, and 4 to mitigate the effects of a large SLB or a large FLB except Tavg Low 2 coincident with Reactor Trip (P-4) which is required to be OPERABLE in MODES 1 and 2. Failure to trip the turbine or isolate the main feedwater system following a SLB or FLB can lead to additional mass and energy being delivered to the steam generators, resulting in excessive cooldown and additional mass and energy release in containment. Manual main feedwater isolation is required to be OPERABLE in MODE 4 when the main feedwater isolation valves are open. This Function is not applicable in MODE 4 for valve isolation if the main feedwater line is isolated. Automatic actuation on a Steam Generator Narrow Range Water Level - High 2 is required to be OPERABLE in MODE 4 when the RCS is not being cooled by the RNS. In MODES 5 and 6, the energy in the RCS and the steam generators is low and this Function is not required to be OPERABLE.

7.a. Manual Main Feedwater Isolation

The Main Feedwater Pump Trip and Valve Isolation is also initiated by the Manual Main Feedwater Control Valve Isolation Function. The requirements for this Function are the same as the requirements for Manual Main Feedwater Control Valve Isolation (Function 6.a). Therefore, the requirements are not repeated in Table 3.3.2-1, and Function 6.a is referenced for all requirements.

7.b. Steam Generator Narrow Range Water Level - High 2

This signal provides protection against excessive feedwater flow by closing the main feedwater control, isolation and crossover valves, tripping of the main feedwater pumps, and tripping the turbine. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. The transmitters (d/p cells) are located inside containment. However, the events which this Function protect against cannot cause severe environment in containment. Therefore, the Setpoint reflects only steady state instrument uncertainties.

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7.c. Safeguards Actuation (Function 1)

This Function is also initiated by all Functions that initiate the Safeguards Actuation signal. The Main Feedwater Pump Trip and Valve Isolation Function requirements are the same as the requirements for their Safeguards Actuation Function, but do not apply in MODE 4 with the flow paths isolated. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead Function 1 is referenced for all initiating Functions and requirements. The Safeguards Actuation signal closes all main feedwater control, isolation and crossover valves, trips all main feedwater pumps, and trips the turbine.

7.d. Tavg Low-2 Coincident with Reactor Trip (P-4)

This signal provides protection against excessive feedwater flow by closing the main feedwater isolation and crossover leg valves, and tripping of the main feedwater pumps. This signal results from a coincidence of two out of four divisions of reactor loop average temperature below the Low 2 setpoint coincident with the P-4 permissive. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure that no single random failure will disable this trip Function. This Function may be manually blocked when the pressurizer pressure is below the P-11 setpoint. The block is automatically removed when the pressurizer pressure is above the P-11 setpoint.

8. Startup Feedwater Isolation

The primary Function of the Startup Feedwater Isolation is to stop the excessive flow of feedwater into the SGs. This Function is necessary in MODES 1, 2, 3, and 4 to mitigate the effects of a large SLB or a large FLB. Failure to isolate the startup feedwater system following a SLB or FLB can lead to additional mass and energy being delivered to the steam generators, resulting in excessive cooldown and additional mass and energy release in containment.

Startup feedwater isolation must be OPERABLE in MODES 1, 2, 3, and 4 when there is significant mass and energy in

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8. Startup Feedwater Isolation (continued)

the RCS and the steam generators. This Function is not applicable in MODE 4 when the startup feedwater flow paths are isolated. In MODES 5 and 6, the energy in the RCS and the steam generators is low and this Function is not required to be OPERABLE.

8.a. Steam Generator (SG) Narrow Range Water Level - High 2

If steam generator narrow range level reaches the High 2 setpoint in either steam generator, then all startup feedwater control and isolation valves are closed and the startup feedwater pumps are tripped. Four channels are provided in each steam generator to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function.

8.b. T_{cold} - Low

This Function closes the startup feedwater control and isolation valves and trips the startup feedwater pumps if reactor coolant system cold leg temperature is below the T_{cold} setpoint in any loop. Startup feedwater isolation on this condition may be manually blocked when the pressurizer pressure is below the P-11 setpoint. This function is automatically unblocked when the pressurizer pressure is above the P-11 setpoint with the RCS boron concentration below that necessary to meet the SDM requirements at an RCS temperature of 200°F. Four channels are provided in each loop to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function.

8.c. Manual Main Feedwater Control Valve Isolation (Function 6.a)

The Startup Feedwater Isolation is also initiated by the Manual Main Feedwater Control Valve Isolation Function. The requirements for this Function are the same as the requirements for the Manual Main Feedwater Control Valve Isolation (Function 6.a). Therefore, the requirements are not repeated in Table 3.3.2-1, and Function 6.a is referenced for all requirements.

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9. ADS Stages 1, 2, & 3 Actuation

The Automatic Depressurization System (ADS) provides a sequenced depressurization of the reactor coolant system to allow passive injection from the CMTs, accumulators, and the in-containment refueling water storage tank (IRWST) to mitigate the effects of a LOCA. The depressurization is accomplished in four stages, with the first three stages discharging into the IRWST and the last stage discharging into containment. Each of the first three stages consists of two parallel paths with each path containing an isolation valve and a depressurization valve.

The first stage isolation valves open on any ADS Stages 1, 2, and 3 actuation. The first stage depressurization valves are opened following a preset time delay after the actuation of the isolation valves. The second stage isolation valves are opened following a preset time delay after actuation of the first stage depressurization valves open. The second stage depressurization valves are opened following a preset time delay after the second stage isolation valves are actuated, similar to stage one. Similar to the second stage, the third stage isolation valves are opened following a preset time delay after the actuation of the second stage depressurization valves. The third stage depressurization valves are opened following a preset time delay after the third stage isolation valves are actuated.

9.a. Manual Initiation

The first stage depressurization valves open on manual actuation. Any ADS Stages 1, 2, and 3 actuation also actuates PRHR and trips all reactor coolant pumps. The operator can initiate an ADS Stages 1, 2, and 3 actuation from the main control room by simultaneously actuating two ADS actuation devices in the same set. There are two sets of two switches each in the main control room. Simultaneously actuating the two devices in either set will actuate ADS Stages 1, 2, and 3. This Function must be OPERABLE in MODES 1, 2, 3, and 4. This Function must also be OPERABLE in MODES 5 and 6 when the required ADS valves are not open, and in MODE 6 with the upper internals in place. The required ADS valves or equivalent relief area are specified in LCO 3.4.13, ADS - Shutdown, RCS Intact and LCO 3.4.14, ADS - Shutdown, RCS Open.

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9.b. CMT Level – Low 1 Coincident with CMT Actuation

This Function ensures continued passive injection or borated water to the RCS following a small break LOCA. ADS Stages 1, 2 and 3 actuation is initiated when the CMT Level reaches its Low 1 Setpoint coincident with any CMT Actuation signal (Function 2). Four channels are provided in each CMT to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function.

The ADS Stages 1, 2, and 3 Actuation Function requirements are the same as the requirements discussed in Function 2 (CMT Actuation). Therefore, the requirements are not repeated in Table 3.3.2-1. Instead Function 2 is referenced for all initiating functions and requirements. This Function must be OPERABLE in MODES 1, 2, 3, and 4.

This Function must also be OPERABLE in MODE 5 with pressurizer level $\geq 20\%$ and the required ADS valves not open. The required ADS valves or equivalent relief area are specified in LCO 3.4.13, ADS - Shutdown, RCS Intact and LCO 3.4.14, ADS - Shutdown, RCS Open. In MODE 5, only one CMT is required to be OPERABLE in accordance with LCO 3.5.3, CMTs - Shutdown, RCS Intact; therefore, CMT level channels are only required on an OPERABLE CMT.

10. ADS Stage 4 Actuation

The ADS provides a sequenced depressurization of the reactor coolant system to allow passive injection from the CMTs, accumulators, and the IRWST to mitigate the effects of a LOCA. The depressurization is accomplished in four stages, with the first three stages discharging into the IRWST and the fourth stage discharging into containment.

The fourth stage of the ADS consists of four parallel paths. Each of these paths consists of a normally open isolation valve and a depressurization valve. The four paths are divided into two groups with two paths in each group. Within each group, one path is designated to be substage A and the second path is designated to be substage B.

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10. ADS Stage 4 Actuation (continued)

The substage A depressurization valves are opened following a preset time delay after the substage A isolation valve confirmatory open signal. The sequence is continued with substage B. A confirmatory open signal is provided to the substage B isolation valves following a preset time delay after the substage A depressurization valve has been opened. The signal to open the substage B depressurization valve is provided following a preset time delay after the substage B isolation valves confirmatory open signal.

10.a. Manual Initiation Coincident with RCS Wide Range Pressure - Low or ADS Stages 1, 2, and 3 Actuation (Function 9)

The fourth stage depressurization valves open on manual actuation. The operator can initiate Stage 4 of ADS from the main control room. There are two sets of two switches each in the main control room. Actuating the two switches in either set will actuate all 4th stage ADS valves. This manual actuation is interlocked to actuate with either the low RCS pressure signal or with the ADS Stages 1, 2, & 3 actuation (Function 9). These interlocks minimize the potential for inadvertent actuation of this Function. This interlock with Function 9 allows manual actuation of this Function if automatic or manual actuation of the ADS Stages 1, 2, & 3 valves fails to depressurize the RCS due to common mode failure. This consideration is important in PRA modeling to improve the reliability of reducing the RCS pressure following a small LOCA or transient event. This Function must be OPERABLE in MODES 1, 2, 3, and 4. This Function must also be OPERABLE in MODES 5 and 6 when the required ADS valves are not open, and in MODE 6 with the upper internals in place. The required ADS valves or equivalent relief area are specified in LCO 3.4.13, ADS - Shutdown, RCS Intact and LCO 3.4.14, ADS - Shutdown, RCS Open.

10.b. CMT Level - Low 2 Coincident with RCS Wide Range Pressure - Low

The fourth stage depressurization valves open on CMT Level - Low 2 in two-out-of-four channels in

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10.b. CMT Level – Low 2 Coincident with RCS Wide Range
Pressure – Low
(continued)

either CMT. Actuation of the fourth stage depressurization valves is interlocked with the third stage depressurization signal such that the fourth stage is not actuated unless the third stage has been previously actuated following a preset time delay. Actuation of the fourth stage ADS valves are further interlocked with a low RCS pressure signal such that the ADS Stage 4 actuation is not actuated unless the RCS pressure is below a predetermined setpoint. Four channels of CMT level are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip function. This function must be OPERABLE in MODES 1, 2, 3, and 4. This function must also be OPERABLE in MODE 5 when the required ADS valves are not open and with the pressurizer level $\geq 20\%$. The required ADS valves or equivalent relief area are specified in LCO 3.4.13, ADS - Shutdown, RCS Intact and LCO 3.4.14, ADS - Shutdown, RCS Open. In MODE 5, only one CMT is required to be OPERABLE in accordance with LCO 3.5.3, CMTs - Shutdown, RCS Intact; therefore, CMT level channels are only required on an OPERABLE CMT.

10.c. Coincident RCS Loop 1 and 2 Hot Leg Level – Low

A signal to automatically open the ADS Stage 4 is also generated when coincident loop 1 and 2 reactor coolant system hot leg level indication decreases below an established setpoint for a duration exceeding an adjustable time delay. This function is required to be OPERABLE in MODE 4 with the RCS being cooled by the RNS. This function is also required to be OPERABLE in MODE 5 and in MODE 6 when the required ADS valves are not open. The required ADS valves or equivalent relief area are specified in LCO 3.4.13, ADS - Shutdown, RCS Intact and LCO 3.4.14, ADS - Shutdown, RCS Open.

11. Reactor Coolant Pump Trip

Reactor Coolant Pump (RCP) Trip allows the passive injection of borated water into the RCS. Injection provides RCS makeup water and boration during transients or accidents when the normal makeup supply from the CVS is lost or insufficient. Two tanks provide passive injection of borated water by gravity when the reactor coolant pumps are tripped. CMT injection mitigates the

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11. Reactor Coolant Pump Trip (continued)

effects of high energy line breaks by adding primary side water to ensure maintenance or recovery of reactor vessel water level following a LOCA, and by borating to ensure recovery or maintenance of SHUTDOWN MARGIN following a steam line break. RCP trip on high bearing water temperature protects the RCP coast down. RCP trip is actuated by High RCP bearing water temperature ADS Stages 1, 2, and 3 Actuation (Function 9), and CMT actuation.

11.a. ADS Stage 1, 2, and 3 Actuation (Function 9)

The RCPs are tripped any time ADS Stage 1, 2, and 3 actuation is initiated. The RCP trip Function requirements for the ADS Stage 1, 2, and 3 actuation are the same as the requirements for the ADS Function. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead Function 9 is referenced for all initiating functions and requirements.

11.b. Reactor Coolant Pump Bearing Water Temperature - High

Each affected RCP will be tripped if two-out-of-four sensors on the RCP indicate high bearing water temperature. This Function is required to be OPERABLE in MODES 1 and 2. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function.

11.c. Manual CMT Actuation (Function 2.a)

RCP trip is also initiated by the manual CMT actuation Function. The RCP trip Function requirements are the same as the requirements for the manual CMT actuation Function. Therefore, the requirements are not repeated in Table 3.3.2-1, and Function 2.a is referenced for all requirements.

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11.d. Pressurizer Water Level – Low 2

The RCPs are tripped when the pressurizer water level reaches its Low 2 setpoint. This signal results from the coincidence of pressurizer water level below the Low 2 setpoint in any two-of-four divisions. This Function is required to be OPERABLE in MODES 1, 2, 3, and 4. This Function is also required to be OPERABLE in MODE 5 with pressurizer level $\geq 20\%$, when the RCS is not being cooled by the RNS. This Function can be manually blocked when the pressurizer water level is below the P-12 setpoint. This Function is automatically unblocked when the pressurizer water level is above the P-12 setpoint.

11.e. Safeguards Actuation (Function 1)

This Function is also initiated by all Functions that initiated the Safeguards Actuation signal. The requirements for the reactor trip Functions are the same as the requirements for the Safeguards Actuation Function. Therefore, the requirements are not repeated in Table 3.3.2.1. Instead, Function 1 is referenced for all initiating Functions and requirements.

12. Passive Containment Cooling Actuation

The Passive Containment Cooling System (PCS) transfers heat from the reactor containment to the environment. This Function is necessary to prevent the containment design pressure and temperature from being exceeded following any postulated DBA (such as LOCA or SLB). Heat removal is initiated automatically in response to a Containment Pressure – High 2 signal or manually.

A Passive Containment Cooling Actuation signal initiates water flow by gravity by opening the isolation valves. The water flows onto the containment dome, wetting the outer surface. The path for natural circulation of air along the outside walls of the containment structure is always open.

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12. Passive Containment Cooling Actuation (continued)

The LCO requires this Function to be OPERABLE in MODES 1, 2, 3, and 4 when the potential exists for a DBA that could require the operation of the Passive Containment Cooling System. In MODES 5 and 6, with decay heat more than 6.0 Mwt, manual initiation of the PCS provides containment heat removal. Section B 3.6.7, Applicability, provides the basis for the decay heat limit.

12.a. Manual Initiation

The operator can initiate Containment Cooling at any time from the main control room by actuating either of the two containment cooling actuation switches. There are two switches in the main control room, either of which will actuate containment cooling in all divisions. Manual Initiation of containment cooling also actuates containment isolation.

12.b. Containment Pressure – High 2

This signal provides protection against a LOCA or SLB inside containment. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function.

The transmitters and electronics are located inside containment, thus, they will experience harsh environmental conditions and the trip setpoint reflects only steady state instrument uncertainties associated with the containment environment. The Containment Pressure – High 2 setpoint has been specified as low as reasonable, without creating potential for spurious trips during normal operations, consistent with the TMI action item (NUREG-0933, Item II.E.4.2) guidance.

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13. PRHR Heat Exchanger Actuation

The PRHR Heat Exchanger (HX) provides emergency core decay heat removal when the Startup Feedwater System is not available to provide a heat sink. PRHR is actuated when the discharge valves are opened in response to Steam Generator Narrow Range (NR) Level – Low coincident with Startup Feedwater Flow – Low, Steam Generator Wide Range (WR) Level – Low, ADS Stages 1, 2, and 3 Actuation, CMT Actuation, Pressurizer Water Level - High 3, or Manual Initiation.

13.a. Manual Initiation

Manual PRHR actuation is accomplished by either of two switches in the main control room. Either switch actuates all four ESFAC Divisions.

This Function is required to be OPERABLE in MODES 1, 2, 3, and 4, and MODE 5 with the RCS pressure boundary intact. This ensures that PRHR can be actuated in the event of a loss of the normal heat removal systems.

13.b. Steam Generator Narrow Range Level – Low
Coincident with Startup Feedwater Flow – Low

PRHR is actuated when the Steam Generator Narrow Range Level reaches its low setpoint coincident with an indication of low Startup Feedwater Flow.

The LCO requires four channels per steam generator to be OPERABLE to satisfy the requirements with a two-out-of-four logic. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. The Setpoint reflects both steady state and adverse

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13.b. Steam Generator Narrow Range Level – Low
Coincident with Startup Feedwater Flow – Low
(continued)

environmental instrument uncertainties as the detectors provide protection for an event that results in a harsh environment.

Startup Feedwater Flow – Low uses a one-out-of-two logic on each of the two startup feedwater lines. This Function is required to be OPERABLE in MODES 1, 2, and 3 and in MODE 4 when the RCS is not being cooled by the Normal Residual Heat Removal System (RNS). This ensures that PRHR can be actuated in the event of a loss of the normal heat removal systems. In MODE 4 when the RCS is being cooled by the RNS, and in MODES 5 and 6, the SGs are not required to provide the normal RCS heat sink. Therefore, startup feedwater flow is not required, and PRHR actuation on low startup feedwater flow is not required.

13.c. Steam Generator Wide Range Level – Low

PRHR is also actuated when the SG Wide Range Level reaches its Low Setpoint. There are four wide range level channels for each steam generator and a two-out-of-four logic is used. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. This Function is required to be OPERABLE in MODES 1, 2, and 3 and in MODE 4 when the RCS is not being cooled by the RNS. This ensures that PRHR can be actuated in the event of a loss of the normal heat removal systems. In MODE 4 when the RCS is being cooled by the RNS, and in MODES 5 and 6, the SGs are not required to provide the normal RCS heat sink. Therefore, SG Wide Range Level is not required, and PRHR actuation on low wide range SG level is not required.

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13.d. ADS Stages 1, 2, and 3 Actuation

PRHR is also actuated any time ADS Stages 1, 2, and 3 Actuation is initiated. The PRHR actuation Function requirements for the ADS Stages 1, 2, and 3 actuation are the same as the requirements for the ADS Stages 1, 2, and 3 Actuation Function, but only in MODES 2, 3, and 4, and in MODE 5 with the RCS pressure boundary intact.

13.e. CMT Actuation (Function 2)

PRHR is also actuated by all the Functions that actuate CMT injection. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead, Function 2 (CMT Actuation) is referenced for all initiating functions and requirements.

13.f. Pressurizer Water Level – High 3

PRHR is actuated when the pressurizer water level reaches its High 3 setpoint. This signal provides protection against a pressurizer overflow following an inadvertent core makeup tank actuation with consequential loss of offsite power. This Function is automatically unblocked when RCS pressure is above the P-19 setpoint. This Function is required to be OPERABLE in MODES 1, 2, and 3, and in MODE 4 when the RCS is not being cooled by the RNS and above the P-19 (RCS pressure) interlock. This Function is not required to be OPERABLE in MODES 5 and 6 because it is not required to mitigate DBA in these MODES.

14. Steam Generator Blowdown Isolation

The primary Function of the steam generator blowdown isolation is to ensure that sufficient water inventory is present in the steam generators to remove the excess heat being generated until the decay heat has decreased to within the PRHR HX capability.

This Function closes the isolation valves of the Steam Generator Blowdown System in both steam generators when a signal is generated from the PRHR HX Actuation or Steam

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14. Steam Generator Blowdown Isolation (continued)

Generator Narrow Range Water Level – Low. This Function is required to be OPERABLE in MODES 1, 2, and 3, and in MODE 4 when the RCS is not being cooled by the RNS. This Function is not required to be OPERABLE in MODE 4 if the steam generator blowdown line is isolated.

14.a. PRHR Heat Exchanger Actuation (Function 13)

Steam Generator Blowdown Isolation is also initiated by all Functions that initiate PRHR actuation. The Steam Generator Blowdown Isolation requirements for these Functions are the same as the requirements for the PRHR Actuation. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead, Function 13, PRHR HX Actuation, is referenced for all initiating Functions and requirements.

14.b. Steam Generator Narrow Range Level – Low

The Steam Generator Blowdown isolation is actuated when the Steam Generator Narrow Range Level reaches its Low Setpoint.

The LCO requires four channels per steam generator to be OPERABLE to satisfy the requirements with a two-out-of-four logic. This Function is required to be OPERABLE in MODES 1, 2, and 3, and in MODE 4 when the RCS is not being cooled by the RNS. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function. Setpoint reflects both steady state and adverse environmental instrument uncertainties as the detectors provide protection for an event that results in a harsh environment.

15. Boron Dilution Block

The block of boron dilution is accomplished by closing the CVS suction valves to demineralized water storage tanks, and aligning the boric acid tank to the CVS makeup pumps. This Function is actuated by Source Range Neutron Flux Multiplication, Reactor Trip, and Battery Charger Input Voltage – Low.

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15.a. Source Range Neutron Flux Multiplication

A signal to block boron dilution in MODE 2 below the P-6 interlock and MODE 3, 4, or 5 is derived from source range neutron flow increasing at an excessive rate (source range flow multiplication). This Function is not applicable in MODES 4 and 5 if the demineralized water makeup flowpath is isolated. The source range neutron detectors are used for this Function. The LCO requires four divisions to be OPERABLE. There are four divisions and two-out-of-four logic is used. On a coincidence of excessively increasing source range neutron flow in two of the four divisions, demineralized water makeup is isolated to preclude a boron dilution event. In MODE 6, a dilution event is precluded by the requirement in LCO 3.9.2 to close, lock and secure at least one valve in each unborated water source flow path.

15.b. Reactor Trip (Function 18.a)

Demineralized Water Makeup is also isolated by all the Functions that initiate a Reactor Trip. The isolation requirements for these Functions are the same as the requirements for the Reactor Trip Function. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead Function 18.a, (P-4 Reactor Trip Breakers), is referenced for all initiating Functions and requirements.

15.c. Battery Charger Input Voltage – Low

Block of boron dilution is also actuated from the loss of ac power. A short, preset time delay is provide to prevent actuation upon momentary power fluctuations; however, actuation occurs before ac power is restored by the onsite diesel generators. The loss of all ac power is detected by undervoltage sensors that are connected to the input of each of the four Class 1E battery chargers. The loss of ac power signal is based on the detection of an undervoltage conditions by each of the two sensors connected to two of the four battery chargers. This Function is required to be OPERABLE in MODES 1, 2, 3, 4, and 5. This Function is not applicable in MODES 4 and 5 if the

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15.c. Battery Charger Input Voltage – Low (continued)

associated flowpath is closed. In MODE 6, a dilution event is precluded by the requirement in LCO 3.9.2 to close, lock and secure at least one valve in each unborated water source flow path.

16. Chemical Volume and Control System Makeup Line Isolation

The CVS makeup line is isolated following certain events to prevent overfilling of the RCS. In addition, this line is isolated on High 2 containment radioactivity to provide containment isolation following an accident. This line is not isolated on a containment isolation signal, to allow the CVS makeup pumps to perform their defense-in-depth functions. However, if very high containment radioactivity exists (above the High 2 setpoint) this line is isolated.

A signal to isolate the CVS is derived from two-out - of-four high steam generator levels on either steam generator, two-out-of-four channels of pressurizer level indicating high or two-out-of-four channels of containment radioactivity indicating high. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure no single random failure will disable this trip Function.

16.a. Steam Generator Narrow Range Water Level – High 2

Four channels of steam generator level are provided for each steam generator. Two-out-of four channels on either steam generator indicating level greater than the setpoint will close the isolation valves for the CVS. This Function prevents adding makeup water to the RCS during a SGTR. This Function is required to be OPERABLE in MODES 1, 2, 3, and 4 with the RCS not being cooled by the RNS. This Function is not applicable in MODES 3 and 4 if the CVS makeup flowpath is isolated. This Function is not required to be OPERABLE in MODES 5 and 6 because the RCS pressure and temperature are reduced and a steam generator tube rupture event is not credible.

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16.b. Pressurizer Water Level – High 1 Coincident with Safeguards Actuation

Four channels of pressurizer level are provided on the pressurizer. Two-out-of-four channels on indicating level greater than the High 1 setpoint coincident with a Safeguards Actuation signal (Function 1) will close the containment isolation valves for the CVS. This Function prevents the pressurizer level from reaching a level that could lead to water relief through the pressurizer safety valves during some DBAs. This Function is required to be OPERABLE in MODES 1, 2, and 3. This function is not required to be OPERABLE in MODES 4, 5, and 6, because it is not required to mitigate a DBA in these MODES. This Function is not applicable in MODE 3, if the CVS makeup flowpath is isolated.

16.c. Pressurizer Water Level – High 2

A signal to close the CVS isolation valves is generated on Pressurizer Water Level – High 2. This Function results from the coincidence of pressurizer level above the High 2 setpoint in any two of the four divisions. This Function is automatically blocked when the pressurizer pressure is below the P-11 permissive setpoint to permit pressurizer water solid conditions with the plant cold and to permit level makeup during plant cooldowns. This Function is automatically unblocked when RCS pressure is above the P-19 setpoint. This Function is required to be OPERABLE in MODES 1, 2, and 3 and in MODE 4 when the RCS is not being cooled by the RNS. This Function is not required to be OPERABLE in MODE 4 if the CVS makeup flowpath is isolated. This Function is not required to be OPERABLE in MODES 5 and 6 because it is not required to mitigate a DBA in these MODES.

16.d. Containment Radioactivity – High 2

Four channels of Containment Radioactivity – High 2 are required to be OPERABLE in MODES 1, 2, and 3 when the potential exists for a LOCA, to ensure that the radioactivity inside containment is not released to the atmosphere. This Function is not

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16.d. Containment Radioactivity – High 2 (continued)

required to be OPERABLE in MODE 3 if the associated flowpath is isolated. This signal results from the coincidence of containment radioactivity above the High 2 Setpoint in any two of the four divisions. These Functions are not required to be OPERABLE in MODES 4, 5, and 6 because there is no credible release of radioactivity into the containment in these MODES that would result in a High 2 actuation.

16.e Manual Initiation

Manual Chemical Volume Control System Makeup Isolation is actuated by either of two switches in the main control room. Either switch closes Chemical Volume Control System Makeup valves. The LCO requires two switches to be OPERABLE.

17. Normal Residual Heat Removal System Isolation

The RNS suction line is isolated by closing the containment isolation valves on High 2 containment radioactivity to provide containment isolation following an accident. This line is isolated on a safeguards actuation signal. However, the valves may be reset to permit the RNS pumps to perform their defense-in-depth functions post-accident. Should a high containment radiation signal (above the High 2 setpoint) develop following the containment isolation signal, the RNS valves would re-close. A high containment radiation signal is indicative of a high RCS source term and the valves would re-close to assure offsite doses do not exceed regulatory limits.

17.a. Containment Radioactivity – High 2

A signal to isolate the normal residual heat removal system is generated from the coincidence of containment radioactivity above the High 2 setpoint in two-out-of-four channels. Four channels of Containment Radioactivity – High 2 are required to be OPERABLE in MODES 1, 2, and 3 when the potential exists for a LOCA, to ensure that the radioactivity inside containment is not released to the atmosphere. This Function is not

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17.a. Containment Radioactivity - High 2 (continued)

required to be OPERABLE in MODE 3 if the RNS suction line is isolated. These Functions are not required to be OPERABLE in MODES 4, 5, and 6 because no DBA that could release radioactivity into the containment is considered credible in these MODES.

17.b. Safeguards Actuation (Function 1)

This Function is also initiated by all Functions that initiated the Safeguards Actuation signal. The requirements to isolate the normal residual heat removal system are the same as the requirements for the Safeguards Actuation Function. Therefore, the requirements are not repeated in Table 3.3.2.1. Instead, Function 1 is referenced for all initiating Functions and requirements.

17.c. Manual Initiation

The operator can initiate RNS isolation at any time from the control room by simultaneously actuating two switches in the same actuation set. Because an inadvertent actuation of RNS isolation could have serious consequences, two switches must be actuated simultaneously to initiate isolation. There are two sets of two switches in the control room. Simultaneously actuating the two switches in either set will isolate the RNS in the same manner as the automatic actuation signal. Two Manual Initiation switches in each set are required to be OPERABLE to ensure no single failure disables the Manual Initiation Function.

18. ESFAS 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 backup manual actions to ensure bypassable Functions are in operation under the conditions assumed in the safety analyses.

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18.a. Reactor Trip, P-4

There are eight reactor trip breakers with two breakers in each division. The P-4 interlock is enabled when the breakers in two-out-of-four divisions are open. Additionally, the P-4 interlock is enabled by all Automatic Reactor Trip Actuations. The Functions of the P-4 interlock are:

- Trip the main turbine
- Permit the block of automatic Safeguards Actuation after a predetermined time interval following automatic Safeguards Actuation.
- Block boron dilution
- Isolate main feedwater coincident with low reactor coolant temperature (This function is not assumed in safety analysis therefore, it is not included in the technical specifications.)

The reactor trip breaker 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.

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 to trip the main turbine, because the main turbine is not in operation.

The P-4 Function does not have to be OPERABLE in MODE 4 or 5 to block boron dilution, because Function 15.a, Source Range Neutron Flux Multiplication, provides the required block. In MODE 6, the P-4 interlock with the Boron Dilution Block Function is not required, since the unborated water source flow path isolation valves are locked closed in accordance with LCO 3.9.2.

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18.b. Pressurizer Pressure, P-11

The P-11 interlock permits a normal unit cooldown and depressurization without Safeguards Actuation or main steam line and feedwater isolation. With pressurizer pressure channels less than the P-11 setpoint, the operator can manually block the Pressurizer pressure - Low, Steam Line Pressure - Low, and T_{cold} - Low Safeguards Actuation signals and the Steam Line Pressure - Low and T_{cold} - Low steam line isolation signals. When the Steam Line Pressure - Low 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 main steam isolation valves. Manual block of feedwater isolation on T_{avg} - Low 1, Low 2, and T_{cold} - Low is also permitted below P-11. With pressurizer pressure channels \geq P-11 setpoint, the Pressurizer Pressure - Low, Steam Line Pressure - Low, and T_{cold} - Low Safeguards Actuation signals and the Steam Line Pressure Low and T_{cold} - Low steam line isolation signals are automatically enabled. The feedwater isolation signals on T_{cold} - Low, T_{avg} - Low 1 and Low 2 are also automatically enabled above P-11. The operator can also enable these signals by use of the respective manual reset buttons. When the Steam Line Pressure - Low and T_{cold} - Low steam line isolation signals are enabled, the main steam isolation on Steam Line Pressure-Negative Rate - High is disabled. The 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 Safeguards Actuation or main steam or feedwater isolation. This Function does not have to be OPERABLE in MODE 4, 5, or 6, because plant 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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18.c. Intermediate Range Neutron Flux, P-6

The Intermediate Range Neutron Flux, P-6 interlock is actuated when the respective NIS intermediate range channel goes approximately one decade above the minimum channel reading. Above the setpoint, the P-6 interlock allows a manual block of the flux multiplication actuation, permitting block of boron dilution. Normally, this Function is blocked by the main control room operator during reactor startup. This Function is required to be OPERABLE in MODE 2.

18.d. Pressurizer Level, P-12

The P-12 interlock is provided to permit midloop operation without core makeup tank actuation, IRWST actuation, reactor coolant pump trip, or purification line isolation. With pressurizer level channels less than the P-12 setpoint, the operator can manually block low pressurizer level signal used for these actuations. Concurrent with blocking CMT actuation on low pressurizer level, IRWST actuation on Low 2 RCS hot leg level is enabled. When the pressurizer level is above the P-12 setpoint, the pressurizer level signal is automatically enabled and a confirmatory open signal is issued to the isolation valves on the CMT cold leg balance lines. This Function is required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6.

18.e. RCS Pressure, P-19

The P-19 interlock is provided to permit water solid conditions (i.e., when the pressurizer water level is [$>92\%$]) in lower MODES without automatic isolation of the CVS makeup pumps. With RCS pressure below the P-19 setpoint, the operator can manually block CVS isolation on High 2 pressurizer water level. When RCS pressure is above the P-19 setpoint, this Function is automatically unblocked. This Function is required to be OPERABLE IN MODES 1, 2, 3, and 4 with the RCS not being cooled by the RNS. When the RNS is cooled by the RNS, the RNS suction relief valve provides the required overpressure protection (LCO 3.4.15).

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19. Containment Air Filtration System Isolation

Some DBAs such as a LOCA may release radioactivity into the containment where the potential would exist for the radioactivity to be released to the atmosphere and exceed the acceptable site dose limits. Isolation of the Containment Air Filtration System provides protection to prevent radioactivity inside containment from being released to the atmosphere.

19.a. Containment Radioactivity - High 1

Three channels of Containment Radioactivity - High 1 are required to be OPERABLE in MODES 1, 2, 3, and 4 with the RCS not being cooled by the RNS, when the potential exists for a LOCA, to protect against radioactivity inside containment being released to the atmosphere. These Functions are not required to be OPERABLE in MODE 4 with the RCS being cooled by the RNS or MODES 5 and 6, because any DBA release of radioactivity into the containment in these MODES would not require containment isolation.

19.b. Containment Isolation (Function 3)

Containment Air Filtration System Isolation is also initiated by all Functions that initiate Containment Isolation. The Containment Air Filtration System Isolation requirements for these Functions are the same as the requirements for the Containment Isolation. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead, Function 3, Containment Isolation, is referenced for initiating Functions and requirements.

20. Main Control Room Isolation and Air Supply Initiation

Isolation of the main control room and initiation of the air supply provides a protected environment from which operators can control the plant following an uncontrolled release of radioactivity. This Function is required to be OPERABLE in MODES 1, 2, 3, and 4, and during movement of irradiated fuel because of the potential for a fission product release following a fuel handling accident, or other DBA. This Function is required to be OPERABLE during CORE ALTERATIONS, to be consistent with Standard Technical Specifications, NUREG-1431, LCO 3.3.7, Control Room Emergency Filtration System Actuation Instrumentation requirements and to support defense-in-depth.

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20.a. Control Room Air Supply Radiation – High 2

Two radiation monitors are provided on the main control room air intake. If either monitor exceeds the High 2 setpoint, control room isolation is actuated.

20.b. Battery Charger Input Voltage – Low

Low input voltage to the 1E dc battery chargers will actuate main control room isolation and air supply initiation.

21. Auxiliary Spray and Purification Line Isolation

The CVS maintains the RCS fluid purity and activity level within acceptable limits. The CVS purification line receives flow from the discharge of the RCPs. The CVS also provides auxiliary spray to the pressurizer. To preserve the reactor coolant pressure in the event of a break in the CVS loop piping, the purification line and the auxiliary spray line is isolated on a pressurizer water level Low 1 setpoint. This helps maintain reactor coolant system inventory.

21.a. Pressurizer Water Level – Low 1

A signal to isolate the purification line and the auxiliary spray line is generated upon the coincidence of pressurizer level below the Low 1 setpoint in any two-out-of-four divisions. This Function is required to be OPERABLE in MODES 1 and 2 to help maintain RCS inventory. In MODES 3, 4, 5, and 6, this Function is not needed for accident detection and mitigation.

21.b. Manual Chemical Volume Control System Makeup Isolation (Function 16.e)

The Auxiliary Spray and Purification Line Isolation is also initiated by the Manual Chemical Volume Control System Makeup Isolation Function. The requirements for this Function are the same as the requirements for Manual Chemical Volume Control System Makeup Isolation (Function 16.e),

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21.b. Manual Chemical Volume Control System Makeup Isolation (Function 16.e) (continued)

but only apply in MODES 1 and 2. Therefore, the requirements are not repeated in Table 3.3.2-1, and Function 16.e is referenced for all requirements.

22. IRWST Injection Line Valve Actuation

The PXS provides core cooling by gravity injection and recirculation for decay heat removal following an accident. The IRWST has two injection flow paths. Each injection path includes a normally open motor operated isolation valve and two parallel lines, each isolated by one check valve and one squib valve in series. Manual initiation or automatic actuation on an ADS Stage 4 actuation signal or a coincident RCS Loops 1 and 2 Hot Leg Level-Low will generate a signal to open the IRWST injection line and actuate IRWST injection.

22.a. Manual Initiation

The operator can open IRWST injection line valves at any time from the main control room by actuating two IRWST injection actuation switches in the same actuation set. There are two sets of two switches each in the main control room. This Function is required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6.

22.b. ADS Stage 4 Actuation (Function 10)

An open signal will be issued to the IRWST injection isolation valves when an actuation signal is issued to the ADS Stage 4 valves. The requirements for this function are the same as the requirements for the ADS Stage 4 Actuation Function. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead, Function 10 is referenced for all initiating functions and requirements.

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22.c. Coincident RCS Loops 1 and 2 Hot Leg Level - Low

A signal to automatically open the IRWST injection line valves is also generated when coincident loops 1 and 2 reactor coolant system hot leg level indication decreases below an established setpoint for a duration exceeding an adjustable time delay. This Function is required to be OPERABLE in MODE 4 with the RCS being cooled by the RNS. This Function is also required to be OPERABLE in MODES 5 and 6.

23. IRWST Containment Recirculation Valve Actuation

The PXS provides core cooling by gravity injection and recirculation for decay heat removal following an accident. The PXS has two containment recirculation flow paths. Each path contains two parallel flow paths, one path is isolated by a motor operated valve in series with a squib valve and one path is isolated by a check valve in series with a squib valve. Manual initiation or automatic actuation on a Safeguards Actuation signal coincident with a Low 3 level signal in the IRWST will open these valves.

23.a. Manual Initiation

The operator can open the containment recirculation valves at any time from the main control room by actuating two containment recirculation actuation switches in the same actuation set. There are two sets of two switches each in the main control room. This Function is required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6.

23.b. ADS Stage 4 Actuation Coincident with IRWST Level - Low 3

A low IRWST level coincident with a ADS Stage 4 Actuation signal will open the containment recirculation valves. Four channels are provided to permit one channel to be in trip or bypass indefinitely and still ensure that no single random failure will disable this trip Function.

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23.b. ADS Stage 4 Actuation Coincident with IRWST
Level - Low 3 (continued)

This Function is required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6, except when the ADS Stage 4 valves are open or an equivalent relief area is open. The required ADS valves or equivalent relief area are specified in LCO 3.4.13, ADS - Shutdown, RCS Intact and LCO 3.4.14, ADS - Shutdown, RCS Open.

24. Spent Fuel Pool Isolation

The spent fuel pool lines from the refueling cavity/IRWST to the spent fuel system suction header and returning to the refueling cavity/IRWST are isolated on a Low setpoint to maintain the water inventory in the spent fuel pool due to line leakage.

24.a. Spent Fuel Pool Level - Low

This Function actuates the spent fuel pool valves to isolate the spent fuel pool when the spent fuel pool level is below the Low setpoint in any two of three channels. This Function is required to be OPERABLE in MODE 6 to maintain water inventory in the spent fuel pool.

25. ESFACs Logic

This LCO requires four sets of ESFACs, each set with one battery backed actuation logic group OPERABLE to support automatic actuation. These logic groups are implemented as microprocessor based actuation subsystems. The ESFACs provide the system level logic interfaces for the divisions.

25.a. Actuation Subsystems

If one battery backed actuation subsystem per ESFAC cabinet for all four divisions is OPERABLE, an additional single failure will not prevent ESF actuations because three divisions will still be available to provide redundant actuation for all ESF Functions. This Function is required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6.

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26. Protection Logic Cabinets

This LCO requires that for each of the PLCs, one battery backed logic group be OPERABLE to support both automatic and manual actuation. These logic groups are implemented as microprocessor subsystems. The PLCs provide the logic and power interfaces for the actuated components.

26.a. Functional Logic Subsystem

If one battery backed logic group is OPERABLE for each PLC in all four divisions, an additional single failure will not prevent ESF actuations because PLCs in the other three divisions are still available to provide redundant actuation for ESF Functions. The remaining logic cabinets in the division with a failed PLC are still OPERABLE and will provide their ESF Functions. This Function is required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6.

The ESFAS instrumentation satisfies Criterion 3 of the NRC Policy Statement.

27. Pressurizer Heater Trip

Pressurizer heaters are automatically tripped upon receipt of a core makeup tank operation signal or a Pressurizer Water Level - High 3 signal. This pressurizer heater trip reduces the potential for steam generator overflow and automatic ADS Stages 1, 2, and 3 actuation for a steam generator tube rupture event. Automatically tripping the pressurizer heaters reduces the pressurizer level swell for certain non-LOCA events such as loss of normal feedwater, inadvertent CMT operation, and CVS malfunction resulting in an increase in RCS inventory. For small break LOCA analysis, tripping the pressurizer heaters supports depressurization of the RCS following actuation of the CMTs.

27a. CMT Actuation (Function 2)

A signal to trip the pressurizer heaters is generated on a CMT actuation signal. The requirements for this function are the same as the requirements for the CMT Actuation Function,

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27a. CMT Actuation (Function 2) (continued)

except this function is only required to be OPERABLE in MODES 1, 2, and 3, and in MODE 4 when the RCS is not being cooled by the RNS and above the P-19 (RCS pressure) interlock. Therefore, the requirements are not repeated in Table 3.3.2.1. Instead, Function 2 is referenced for initiating Functions and requirements and SR 3.3.2.9 also applies.

27b. Pressurizer Water Level – High 3

A signal to trip the pressurizer heaters is generated when the pressurizer water level reaches its High 3 setpoint. This signal provides protection against a pressurizer overflow following an inadvertent core makeup tank actuation with consequential loss of offsite power. This Function is automatically unblocked when RCS pressure is above the P-19 setpoint. This Function is required to be OPERABLE in MODES 1, 2, and 3, and in MODE 4 when the RCS is not being cooled by the RNS and above the P-19 (RCS pressure) interlock. This Function is not required to be OPERABLE in MODES 5 and 6 because it is not required to mitigate DBA in these MODES.

28. Chemical and Volume Control System Letdown Isolation

The CVS provides letdown to the liquid radwaste system to maintain the pressurizer level. To help maintain RCS inventory in the event of a LOCA, the CVS letdown line is isolated on a Low 1 hot leg level signal in either of the RCS hot leg loops. This Function is required to be OPERABLE in MODE 4 with the RCS being cooled by the RNS. This Function is also required to be OPERABLE in MODE 5, and in MODE 6 with the water level < 23 feet above the top of the reactor vessel flange.

28a. Hot Leg Level – Low 1

A signal to isolate the CVS letdown valves is generated upon the occurrence of a Low 1 hot leg level in either of the two RCS hot leg loops. This helps to maintain reactor system inventory in the event of a LOCA. These letdown valves are also closed by all of the initiating Functions and requirements that generate the Containment Isolation Function in Function 3.

(continued)

BASES

APPLICABLE
SAFETY ANALYSES,
LCOs, and
APPLICABILITY
(continued)

29. SG Power Operated Relief Valve and Block Valve Isolation

The Function of the SG Power Operated Relief Valve and Block Valve Isolation is to ensure that the SG PORV flow paths can be isolated during a SG tube rupture (SGTR) event. The PORV flow paths must be isolated following a SGTR to minimize radiological releases from the ruptured steam generator into the atmosphere. The PORV flow path is assumed to open due to high secondary side pressure, during the SGTR. Dose analyses take credit for subsequent isolation of the PORV flow path by the PORV and/or the block valve which receive a close signal on low steam line pressure. Additionally, the PORV flow path can be isolated manually.

This Function is required to be OPERABLE in MODES 1, 2, 3, and 4 with the RCS cooling not being provided by the Normal Residual Heat Removal System (RNS). In MODE 4 with the RCS cooling being provided by the RNS and in MODES 5 and 6, the steam generators are not being used for RCS cooling and the potential for a SGTR is minimized due to the reduced mass and energy in the RCS and steam generators.

29.a. Manual Initiation

Manual initiation of SG Power Operated Relief Valve and Block Valve Isolation can be accomplished from the control room. There are two switches in the control room and either switch can close the SG PORVs and PORV block valves. The LCO requires two switches to be OPERABLE.

29.b. Steam Line Pressure – Low

Steam Line Pressure – Low provides closure of the PORV flow paths in the event of SGTR in which the PORV(s) open, to limit the radiological releases from the ruptured steam generator into the atmosphere.

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

The LCO requires four channels of Steam Line Pressure – Low Function to be OPERABLE in MODES 1, 2, 3, and 4 with the RCS cooling not being

(continued)

BASES

APPLICABILITY
SAFETY ANALYSES,
LCOs, and
APPLICABILITY

29.b. Steam Line Pressure – Low (continued)

provided by the RNS. Four channels are provided in each steam line to permit one channel to be in trip or bypass indefinitely and still ensure that no single random failure will disable this Function.

ACTIONS

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

A second Note has been added to provide clarification that, more than one Condition is listed for each of the Functions in Table 3.3.2-1. If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the second Condition shall be entered.

In the event a channel's Nominal Trip Setpoint is not met, or the transmitter, or IPC, associated with a specific Function is found inoperable, then all affected Functions provided by that channel must be declared inoperable and the LCO Condition(s) entered for the particular protection Function(s) affected. When the Required Channels are specified only on a per steam line, per loop, per SG, 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 plant is outside the safety analysis. Therefore, LCO 3.0.3 in MODES 1 through 4 and LCO 3.0.8 for MODE 5 and 6 should be immediately entered if applicable in the current MODE of operation.

(continued)

BASES

ACTIONS
(continued)A.1

Condition A is applicable to all ESFAS protection Functions. Condition A addresses the situation where one or more channels/divisions 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.

B.1

With one or two channels or divisions inoperable, the affected channel(s) or division(s) must be placed in a bypass condition within 6 hours. If one or two are bypassed, the logic becomes two-out-of-three or one-out-of-two, respectively, while still meeting single failure criterion (a failure in one of the three or one of the two remaining channels or divisions will not prevent the protective Function. However, with two channels or divisions in bypass, a single failure in one of the two remaining channels or divisions could cause a spurious protective function. The 6 hours allowed to place the inoperable channel(s) or division(s) in the bypass condition is justified in Reference 6.

C.1

With one channel inoperable, the affected channel must be placed in a bypass condition within 6 hours. The 6 hours allowed to place the inoperable channel in the bypass condition is justified in Reference 6. If one spent fuel pool isolation channel is bypassed, the logic becomes one-out-of-two, respectively, while still meeting single failure criterion (a failure in one of the two remaining channels will not prevent the protective Function. If one CVS isolation channel is bypassed, the logic becomes one-out-of-one. A single failure in one of the two remaining channel could cause a spurious CVS isolation. Spurious CVS isolation, while undesirable, would not cause an upset plant condition.

(continued)

BASES

ACTIONS
(continued)

D.1

With one required division inoperable, the affected division must be restored to OPERABLE status within 6 hours.

Condition D applies to one inoperable required division of P-4 Interlock (Function 18.a). With one required division inoperable, the 2 remaining OPERABLE divisions are capable of providing the required interlock function, but without a single failure. The P-4 Interlock is enabled when RTBs in two divisions are detected as open. The status of the other inoperable, non-required P-4 division is not significant, since P-4 divisions can not be tripped or bypassed. In order to provide single failure tolerance, 3 required divisions must be OPERABLE.

Condition D also applies to one inoperable division of ESFAC or PLC (Functions 25 and 26). The ESFAC and PLC divisions are inoperable when their associated battery-backed subsystem is inoperable. With one inoperable division, the 3 remaining OPERABLE divisions are capable of mitigating all DBAs, but without a single failure.

The 6 hours allowed to restore the inoperable division is reasonable based on the capability of the remaining OPERABLE divisions to mitigate all DBAs and the low probability of an event occurring during this interval.

E.1

Condition E is applicable to manual initiation of:

- Safeguards Actuation;
- CMT Actuation;
- Containment Isolation;
- Steam Line Isolation;
- Main Feedwater Control Valve Isolation;
- Main Feedwater Pump Trip and Valve Isolation;
- ADS Stages 1, 2, & 3 Actuation;
- ADS Stage 4 Actuation;

(continued)

BASES

ACTIONS

E.1 (continued)

- Passive Containment Cooling Actuation;
- PRHR Heat Exchanger Actuation;
- IRWST Injection Line Valve Actuation;
- IRWST Containment Recirculation Valve Actuation.

This Action addresses the inoperability of the system level manual initiation capability for the ESF Functions listed above. With one switch or switch set inoperable for one or more Functions, the system level manual initiation capability is reduced below that required to meet single failure criterion. Required Action E.1 requires the switch or switch set for system level manual initiation to be restored to OPERABLE status within 48 hours. The specified Completion Time is reasonable considering that the remaining switch or switch set is capable of performing the safety function.

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

Condition F is applicable to the Main Control Room (MCR) isolation and air supply initiation function which has only two channels of the initiating process variable. With one channel inoperable, the logic becomes one-out-of-one and is unable to meet single failure criterion. Restoring all channels to OPERABLE status ensures that a single failure will not prevent the protective Function.

Alternatively, radiation monitor(s) which provide equivalent information and control room isolation and air supply initiation manual controls may be verified to be OPERABLE. These provisions for operator action can replace one channel of radiation detection and system actuation. The 72 hour Completion Time is reasonable considering that there is one remaining channel OPERABLE and the low probability of an event occurring during this interval.

(continued)

BASES

ACTIONS
(continued)G.1

With one switch, switch set, channel, or division inoperable, the system level initiation capability is reduced below that required to meet single failure criterion. Therefore, the required switch, switch set, channel, and division must be returned to OPERABLE status within 72 hours. The specified Completion Time is reasonable considering the remaining switch, switch set, channel, or division is capable of performing manual initiation.

H.1

With one channel inoperable, the inoperable channel must be placed in a trip condition within 6 hours.

Condition H is applicable to the PRHR heat exchangers actuation on SG Narrow Range Water Level Low coincident with Startup Feedwater Flow Low (Function 13.b). With one startup feedwater channel inoperable, the inoperable channel must be placed in a trip condition within 6 hours. If one channel is tripped, the interlock condition is satisfied. The specified Completion Time is reasonable considering the time required to complete this action.

I.1 and I.2

Condition I applies to IRWST containment recirculation valve actuation on safeguards actuation coincident with IRWST Level Low 3 (Function 23.b). With one IRWST level channel inoperable, the one inoperable channel must be placed in a bypass condition within 6 hours. With two channels inoperable, one channel must be placed in a bypass condition within 6 hours and the remaining inoperable channel must be placed in a trip condition within 6 hours. If one or two channels are inoperable, the logic becomes two-out-of-three while still meeting single failure criterion (a failure in one of the three or one of the two remaining channels will not prevent the protective Function.) However, with one channel in bypass and one channel in trip, a single failure in one of the two remaining channels coincident with safeguards actuation could cause a spurious actuation. The 6 hours allowed to place the inoperable channel(s) in the bypassed or tripped condition is justified in Reference 6.

(continued)

BASES

ACTIONS
(continued)J.1 and J.2

Condition J applies to the P-6, P-11, P-12, and P-19 interlocks. With one or two required channel(s) inoperable, the associated interlock must be verified to be in its required state for the existing plant condition within 1 hour, or any Function channels associated with inoperable interlocks placed in a bypassed condition within 7 hours. Verifying the interlock state manually accomplishes the interlock role.

If one or two associated, Function channels are bypassed, the logic becomes two-out-of-three or one-out-of-two, respectively, while still meeting single failure criterion (a failure in one of the three or one of the two remaining channels will not prevent the protective Function.) However, with two channels in bypass one-out-of-two logic, a single failure in one of the two remaining channels could cause a spurious interlock state change.

K.1 and K.2

Condition K is applicable to the MCR Isolation and Air Supply Initiation (Function 20), during CORE ALTERATIONS and movement of irradiated fuel assemblies. If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the plant must suspend CORE ALTERATIONS and movement of the irradiated fuel assemblies immediately. The required action suspends activities with potential for releasing radioactivity that might enter the MCR. This action does not preclude the movement of fuel to a safe position.

L.1

If the required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the plant must be placed in a MODE in which the LCO does not apply. This accomplished by placing the plant in MODE 3 within 6 hours. The allowed time is reasonable, based operating experience, to reach the required plant conditions from full power conditions in an orderly manner without challenging plant systems.

(continued)

BASES

ACTIONS
(continued)

M.1 and M.2

If the Required Action and associated Completion Time of the first condition listed in Table 3.3.2-1 is not met, the plant must be placed in a MODE in which the LCO does not apply. This is accomplished by placing the plant in MODE 3 within 6 hours and in MODE 4 within 12 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner without challenging plant systems.

N.1 and N.2

If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the plant must be placed in a MODE in which the LCO does not apply. This is accomplished by placing the plant in MODE 3 within 6 hours and in MODE 4 with the RCS being cooled by the RNS within 24 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 without challenging plant systems.

O.1 and O.2

If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the plant must be placed in a MODE in which the LCO does not apply. This is accomplished by placing the plant in MODE 3 within 6 hours and in MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner without challenging plant systems.

P.1, P.2.1, and P.2.2

If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 cannot be met, the plant must be placed in a condition where the instrumentation Function for valve isolation is no longer needed. This is accomplished by isolating the affected flow path(s) within 24 hours. By isolating the flow path from the demineralized

(continued)

BASES

ACTIONS

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

water storage tank to the RCS, the need for automatic isolation is eliminated.

To assure that the flow path remains closed, the flow path shall be isolated by the use of one of the specified means (P.2.1) or the flow path shall be verified to be isolated (P.2.2). A means of isolating the affected flow path(s) includes at least one closed and deactivated automatic valve, closed manual valve, blind flange, or check valve with flow through the valve secured within 7 days. If one of the P.2.1 specified isolation means is not used, the affected flow path shall be verified to be isolated once per 7 days.

This action is modified by a Note allowing the flow path(s) to be unisolated intermittently under administrative control. These administrative controls consist of stationing a dedicated operator at the valve controls, who is in continuous communication with the control room. In this way the flow path can be rapidly isolated when a need for flow path isolation is indicated.

Q.1, Q.2.1, and Q.2.2

If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the plant must be placed in a condition where the instrumentation Function for valve isolation is no longer needed. This is accomplished by isolating the affected flow path by the use of at least one closed manual or closed and deactivated automatic valve within 6 hours.

If the flow path is not isolated within 6 hours the plant must be placed in a MODE in which the LCO does not apply. This is accomplished by placing the plant in MODE 3 within 12 hours and in MODE 4 within 18 hours.

This action is modified by a Note allowing the flow path(s) to be unisolated intermittently under administrative control. These administrative controls consist of stationing a dedicated operator at the valve controls, who is in continuous communication with the control room. In this way the flow path can be rapidly isolated when a need for flow path isolation is indicated.

(continued)

BASES

ACTIONS
(continued)

R.1, R.2.1.1, R.2.1.2, and R.2.2

If the Required Action and associated Completion Time of the first Condition given in Table 3.3.2-1 is not met the plant must be placed in a condition in which the likelihood and consequences of an event are minimized. This is accomplished by placing the plant in MODE 3 within 6 hours and isolating the affected flow path(s) within 12 hours. To assure that the flow path remains closed, the affected flow path shall be verified to be isolated once per 7 days.

If the flow path is not isolated within 12 hours the plant must be placed in a MODE in which the LCO does not apply. This is accomplished by placing the plant in MODE 4 with the RCS cooling provided by the RNS within 30 hours. The allowed Completion Time is reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner without challenging plant systems.

This action is modified by a Note allowing the flow path(s) to be unisolated intermittently under administrative control. These administrative controls consist of stationing a dedicated operator at the valve controls, who is in continuous communication with the control room. In this way the flow path can be rapidly isolated when a need for flow path isolation is indicated.

S.1, S.2.1.1, S.2.1.2, S.2.1.3, and S.2.2

If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the plant must be placed in a condition in which the likelihood and consequences of an event are minimized. This is accomplished by placing the plant in MODE 3 within 6 hours and in MODE 4 with the RCS cooling provided by the RNS within 24 hours. Once the plant has been placed in MODE 4 the affected flow path must be isolated within 30 hours. To assure that the flow path remains closed, the affected flow path shall be verified to be isolated once per 7 days.

If the flow path is not isolated within 12 hours, the plant must be placed in a MODE in which the LCO does not apply. This is accomplished by placing the plant in MODE 5 within 42 hours. The allowed Completion Time is reasonable, based on operating experience, to reach the required plant

(continued)

BASES

ACTIONS

S.1, S.2.1.1, S.2.1.2, S.2.1.3, and S.2.2 (continued)

conditions from full power conditions in an orderly manner without challenging plant systems.

This action is modified by a Note allowing the flow path(s) to be unisolated intermittently under administrative control. These administrative controls consist of stationing a dedicated operator at the valve controls, who is in continuous communication with the control room. In this way the flow path can be rapidly isolated when a need for flow path isolation is indicated.

T.1.1, T.1.2.1, T.1.2.2, T.2.1, and T.2.2

If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the plant must be placed in a Condition in which the likelihood and consequences of an event are minimized. This is accomplished by isolating the affected flow path within 6 hours and isolating the affected flow path(s) by the use of at least one closed and deactivated automatic valve, closed manual valve, blind flange, or check valve with flow through the valve secured within 7 days or verify the affected flow path is isolated once per 7 days.

If the flow path is not isolated within 6 hours the plant must be placed in a MODE in which the LCO does not apply. This is accomplished by placing the plant in MODE 3 within 12 hours and in MODE 5 within 42 hours. The allowed Completion Time is reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner without challenging plant systems.

This action is modified by a Note allowing the flow path(s) to be unisolated intermittently under administrative control. These administrative controls consist of stationing a dedicated operator at the valve controls, who is in continuous communication with the control room. In this way the flow path can be rapidly isolated when a need for flow path isolation is indicated.

(continued)

BASES

ACTIONS
(continued)U.1 and U.2

If the Required Action and the associated Completion Time of the first Condition given in Table 3.3.2-1 is not met, and the required switch or switch set is not restored to OPERABLE status within 48 hours, the plant must be placed in a condition in which the likelihood and consequences of an event are minimized. This is accomplished by placing the plant in MODE 5 within 12 hours. Once in MODE 5, action shall be immediately initiated to open the RCS pressure boundary and establish $\geq 20\%$ pressurizer level. The 12 hour Completion Time is a reasonable time to reach MODE 5 from MODE 4 with RCS cooling provided by the RNS (approximately 350°F) in an orderly manner without challenging plant systems. Opening the RCS pressure boundary assures that cooling water can be injected without ADS operation. Filling the RCS to provide $\geq 20\%$ pressurizer level minimizes the consequences of a loss of decay heat removal event.

V.1, V.2.1, and V.2.2

If the Required Action and the associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met and the required channel(s) is not bypassed within 6 hours, the inoperable channel(s) must be restored within 168 hours. The 168 hour Completion Time is based on the ability of the two remaining OPERABLE channels to provide the protective Function even with a single failure.

If the channel(s) is not restored within the 168 hour Completion Time, the plant shall be placed in a condition in which the likelihood and consequences of an event are minimized. This is accomplished by placing the plant in MODE 5 within 180 hours (the next 12 hours). Once in MODE 5, action shall be initiated to open the RCS pressure boundary and establish $\geq 20\%$ pressurizer level. The 12 hours is a reasonable time to reach MODE 5 from MODE 4 with RCS cooling provided by the RNS (approximately 350°F) in an orderly manner without challenging plant systems.

Opening the RCS pressure boundary assures that cooling water can be injected without ADS operation. Filling the RCS to provide $\geq 20\%$ pressurizer level minimizes the consequences of a loss of decay heat removal event.

(continued)

BASES

ACTIONS
(continued)W.1, W.2, W.3, and W.4

If the Required Action and the associated Completion Time listed in Table 3.3.2-1 is not met while in MODES 5 and 6, the plant must be placed in a MODE in which the likelihood and consequences of an event are minimized. This is accomplished by immediately initiating action to be in MODE 5 with the RCS open and $\geq 20\%$ pressurizer level or to be in MODE 6 with the upper internals removed. The flow path from the demineralized water storage tank to the RCS shall also be isolated by the used of at least one closed and de-activated automatic valve or closed manual valve. These requirements minimize the consequences of the loss of decay heat removal by maximizing RCS inventory and maintaining RCS temperature as low as practical. Additionally, the potential for a criticality event is minimized by isolation of the demineralized water storage tank and by suspension of positive reactivity additions.

X.1, X.2, and X.3

If the Required Action and the associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met while in MODES 5 and 6, the plant must be placed in a MODE in which the likelihood and consequences of an event are minimized. This is accomplished by immediately initiating action to be in MODE 5 with the RCS open and $\geq 20\%$ pressurizer level or to be in MODE 6 with the upper internals removed. These requirements minimize the consequences of the loss of decay heat removal by maximizing RCS inventory and maintaining RCS temperature as low as practical. Additionally, the potential for a criticality event is minimized by suspension of positive reactivity additions.

Y.1, Y.2, Y.3, and Y.4

If the Required Action and the associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met while in MODE 4, with RCS cooling provided by the RNS, MODE 5, or MODE 6, the plant must be placed in a MODE in which the likelihood and consequences of an event are minimized. If in MODE 4, this is accomplished by placing the plant in MODE 5 within 12 hours. The 12 hours is a reasonable time to reach MODE 5 from MODE 4 with RCS cooling provided by the RNS (approximately 350°F) in an orderly manner without challenging plant systems.

(continued)

BASES

ACTIONS

Y.1, Y.2, Y.3, and Y.4 (continued)

If in MODE 4 or 5, Required Action Y.3 requires initiation of action within 12 hours to close the RCS pressure boundary and establish $\geq 20\%$ pressurizer level. The 12 hour Completion Time allows transition to MODE 5 in accordance with Y.2, if needed, prior to initiating action to open the RCS pressure boundary.

If in MODE 6, Required Action Y.4 requires the plant to be maintained in MODE 6 and initiation of action to establish the reactor cavity water level ≥ 23 feet above the top of the reactor vessel flange.

Required Actions Y.2, Y.3, and Y.4 minimize the consequences of a loss of decay heat removal event by optimizing conditions for RCS cooling in MODE 5 using the PRHR HX or in MODE 6 using IRWST injection. Additionally, maximizing RCS inventory and maintaining RCS temperature as low as practical further minimize the consequences of a loss of decay heat removal event. Closing the RCS pressure boundary in MODE 5 assures that PRHR HX cooling is available. Additionally, the potential for a criticality event is minimized by suspension of positive reactivity additions.

Z.1, Z.2.1, and Z.2.2

If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the plant must be placed in a condition where the instrumentation Function for valve isolation is no longer needed. This is accomplished by isolating the affected flow path by the use of at least one closed manual or closed and deactivated automatic valve within 6 hours.

If the flow path is not isolated within 6 hours, the plant must be placed in a MODE in which the LCO does not apply. This is accomplished by placing the plant in MODE 3 within 12 hours and in MODE 4 with RCS cooling provided by the RNS within 30 hours.

This Action is modified by a Note allowing the flow path(s) to be unisolated intermittently under administrative control. These administrative controls consist of stationing a dedicated operator at the valve controls, who is in continuous communication with the control room. In this way the flow path can be rapidly isolated when a need for flow path isolation is indicated.

(continued)

BASES

ACTIONS
(continued)

AA.1.1, AA.1.2.1, AA.1.2.2, AA.2.1, AA.2.2, and AA.2.3

If the Required Action and associated Completion Time of the first condition listed in Table 3.3.2-1 is not met, the plant must be placed in a condition where the instrumentation Function for valve isolation is no longer needed. This is accomplished by isolating the affected flow path within 24 hours. By isolating the CVS letdown flow path from the RCS, the need for automatic isolation is eliminated.

To assure that the flow path remains closed, the flow path shall be isolated by the use of one of the specified means (AA.1.2.1) or the flow path shall be verified to be isolated (AA.1.2.2). A means of isolating the affected flow path includes at least one closed and deactivated automatic valve, closed manual valve, blind flange, or check valve with flow through the valve secured, within 7 days. If one of the P.2.1 specified isolation means is not used, the affected flow path shall be verified to be isolated once per 7 days.

This action is modified by a Note allowing the flow path to be unisolated intermittently under administrative control. These administrative controls consist of stationing a dedicated operator at the valve controls, who is in continuous communication with the control room. In this way the flow path can be rapidly isolated when a need for flow path isolation is indicated.

If the flow path cannot be isolated in accordance with Required Actions AA.1.1, AA.1.2.1 and AA.1.2.2, the plant must be placed in a MODE in which the likelihood and consequences of an event are minimized. If in MODE 4, this is accomplished by placing the plant in MODE 5 within 12 hours. The 12 hours is a reasonable time to reach MODE 5 from MODE 4 with RCS cooling provided by the RNS (approximately 350°F) in an orderly manner without challenging plant systems.

If in MODE 4 or 5, Required Action AA.2.2 requires initiation of action, within 12 hours, to establish > 20% pressurizer level. The 12 hour Completion Time allows transition to MODE 5 in accordance with AA.2.1, if needed, prior to initiating action to establish the pressurizer level.

(continued)

BASES

ACTIONS

AA.1.1, AA.1.2.1, AA.1.2.2, AA.2.1, AA.2.2, and AA.2.3
(continued)

If in MODE 6, Required Action AA.2.3 requires the plant to be maintained in MODE 6 and initiation of action to establish the reactor cavity water level \geq 23 feet above the top of the reactor vessel flange.

Required Actions AA.2.2 and AA.2.3 minimize the consequences of an event by optimizing conditions for RCS cooling in MODE 5 using the PRHR HX or in MODE 6 using IRWST injection.

BB.1 and BB.2

With one channel inoperable, the inoperable channel must be placed in bypass and the hot leg level continuously monitored.

If one channel is placed in bypass, automatic actuation will not occur. Continuous monitoring of the hot leg level provides sufficient information to permit timely operator action to ensure that IRWST injection and ADS Stage 4 actuation can occur, if needed to mitigate events requiring RCS makeup, boration, or core cooling. Operator action to manually initiate IRWST injection and ADS Stage 4 actuation is assumed in the analysis of shutdown events (Reference 11). It is also credited in the shutdown PRA (Reference 12) when automatic actuation is not available.

SURVEILLANCE
REQUIREMENTS

The Surveillance Requirements for each ESF Function are identified by the Surveillance Requirements column of Table 3.3.2-1. A Note has been added to the Surveillance Requirement table to clarify that Table 3.3.2-1 determines which Surveillance Requirements apply to which ESF Functions.

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 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 even something more serious. A CHANNEL CHECK will detect gross channel failure; thus, it is key to

(continued)

BASES

SURVEILLANCE
REQUIREMENTS

SR 3.3.2.1 (continued)

verifying the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

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

The Surveillance Frequency is based on operating experience that demonstrates channel failure is rare. Automated operator aids may be used to facilitate performance of the CHANNEL CHECK.

SR 3.3.2.2

SR 3.3.2.2 is the performance of an ACTUATION LOGIC TEST. This test, in conjunction with the ACTUATION DEVICE TEST, demonstrates that the actuated device responds to a simulated actuation signal. The ESFAC and PLCs within a division are tested every 92 days on a STAGGERED TEST BASIS using the automatic tester. One half of the microprocessor subsystems in a division are tested while the remaining microprocessor subsystems continue to provide protection. Then the second half is tested while the first half provides protection. Through the automatic tester, the possible logic conditions, with and without applicable permissives, are tested for each ESF Function. Prior to the start of testing, the calibration of the automatic tester shall be verified and adjustments made as required. After the automatic tester has completed the tests of the ESFAC and PLCs within the division, the results of the automatic test shall be reviewed to verify completeness and adequacy of results.

The Frequency of every 92 days on a STAGGERED TEST BASIS provides a complete test of all four divisions once per year. This frequency is adequate based on the inherent high reliability of the solid state devices which comprise this equipment; the additional reliability provided by the redundant microprocessor subsystems; and the use of continuous diagnostic test features, such as deadman timers, memory checks, numeric coprocessor checks, and tests of timers, counters, and crystal time basis, which will report a failure within these cabinets to the operator.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS
(continued)

SR 3.3.2.3

SR 3.3.2.3 is the performance of a TADOT of the manual actuations, initiations, and blocks for various ESF Functions, the Class 1E battery charger undervoltage inputs, and the reactor trip (P-4) input from the IPCs. This TADOT is performed every 24 months.

The Frequency is based on the known reliability of the ESF 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 setpoints for the Class 1E battery charger undervoltage relays require bench calibration and are verified during CHANNEL CALIBRATION. The other functions have no setpoints associated with them.

SR 3.3.2.4

SR 3.3.2.4 is the performance of a CHANNEL CALIBRATION every 24 months or approximately at every refueling. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor and the IPC.

The Frequency is based on operating experience and consistency with the refueling cycle.

This Surveillance Requirement is modified by a Note. The Note states that this test should include verification that the time constants are adjusted to the prescribed values where applicable.

SR 3.3.2.5

SR 3.3.2.5 is the performance of an CHANNEL OPERATIONAL TEST (COT) every 92 days.

A COT is performed on each required channel to provide reasonable assurance that the entire channel will perform the intended ESF Function.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS

SR 3.3.2.5 (continued)

The automatic tester provided with the integrated protection cabinets is intended to aid the plant staff in performing the COT. Prior to the COT, the calibration of the automatic tester shall be verified and adjustments made as required to the voltage and time base references in the automatic tester. Subsequent to the COT, the results of the automatic test shall be reviewed to verify completeness and adequacy of results.

The 92 day Frequency is based on Reference 6 and the use of continuous diagnostic test features, such as deadman timers, A/D channel automatic calibration, memory checks, numeric coprocessor checks, and tests of timers, counters and crystal time bases, which will report a failure within the integrated protection cabinets to the operator.

During the COT, the integrated protection cabinets in the division under test may be placed in bypass.

SR 3.3.2.6

This SR ensures the individual channel ESF RESPONSE TIMES are less than or equal to the maximum values assumed in the accident analysis. 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 (e.g., 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 Chapter 7 (Ref. 2) 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.

(continued)

BASES

SURVEILLANCE
REQUIREMENTSSR 3.3.2.6 (continued)

ESF RESPONSE TIME tests are conducted on an 24 month STAGGERED TEST BASIS. Testing of the devices, which make up the bulk of the response time, is included in the testing of each channel. The final actuation device in one train is tested with each channel. Therefore, staggered testing results in response time verification of these 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.

SR 3.3.2.7

SR 3.3.2.7 is the performance of an ACTUATION DEVICE TEST. This test, in conjunction with the ACTUATION LOGIC TEST, demonstrates that the actuated device responds to a simulated actuation signal. This Surveillance Requirement is applicable to the equipment which is actuated by the Protection Logic Cabinets except squib valves. The OPERABILITY of the actuated equipment is checked by exercising the equipment on an individual basis.

The Frequency of 24 months is based on the need to perform this surveillance during periods in which the plant is shutdown for refueling to prevent any upsets of plant operation.

This Surveillance Requirement is modified by a Note that states that actuated equipment, that is included in the Inservice Test (IST) Program, is exempt from this surveillance. The IST Program provides for exercising of the safety related valves on a more frequent basis. The results from the IST Program can therefore be used to verify OPERABILITY of the final actuated equipment.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS
(continued)

SR 3.3.2.8

SR 3.3.2.8 is the performance of an ACTUATION DEVICE TEST, similar to that performed in SR 3.3.2.7, except this Surveillance Requirement is specifically applicable to squib valves. This test, in conjunction with the ACTUATION LOGIC TEST, demonstrates that the actuated device responds to a simulated actuation signal. The OPERABILITY of the squib valves is checked by performing a continuity check of the circuit from the Protection Logic Cabinets to the squib valve.

The Frequency of 24 months is based on the need to perform this surveillance during periods in which the plant is shutdown for refueling to prevent any additional risks associated with inadvertent operation of the squib valves.

SR 3.3.2.9

SR 3.3.2.9 is the performance of an ACTUATION DEVICE TEST. This test, in conjunction with the ACTUATION LOGIC TEST, demonstrates that the actuated device responds to a simulated actuation signal. This Surveillance Requirement is applicable to the circuit breakers which de-energize the power to the pressurizer heaters upon a pressurizer heater trip. The OPERABILITY of these breakers is checked by opening these breakers using the Plant Control System.

The Frequency of 24 months is based on the need to perform this surveillance during periods in which the plant is shutdown for refueling to prevent any upsets of plant operation. This Frequency is adequate based on the use of multiple circuit breakers to prevent the failure of any single circuit breaker from disabling the function and that all circuit breakers are tested.

(continued)

BASES (continued)

- REFERENCES
1. Chapter 6, "Engineered Safety Features."
 2. Chapter 7, "Instrumentation and Controls."
 3. Chapter 15, "Accident Analysis."
 4. Institute of Electrical and Electronic Engineers, IEEE-279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations," April 5, 1972.
 5. 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants."
 6. WCAP-10271-P-A, Supplement 2, Rev. 1, "Evaluation of Surveillance Frequencies and Out of Service Times for the Reactor Protection Instrumentation System," dated June 1990.
 7. 10 CFR 50, Appendix A, "General Design Criteria for Nuclear Power Plants."
 8. NUREG-1218, "Regulatory Analysis for Resolution of USI A-47," 4/88.
 9. WCAP-14606, "Westinghouse Setpoint Methodology for Protection Systems," April 1996 (nonproprietary).
 10. ESBU-TB-97-01, Westinghouse Technical Bulletin, "Digital Process Rack Operability Determination Criteria," May 1, 1997.
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B 3.3 INSTRUMENTATION

B 3.3.3 Post Accident Monitoring (PAM) Instrumentation

BASES

BACKGROUND

The primary purpose of the PAM Instrumentation is to display unit variables that provide information required by the main control room operators during accident situations. These plant variables provide the necessary information to assess the process of accomplishing or maintaining critical safety functions. The instruments which monitor these variables are designated in accordance with Reference 1.

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

A PAM CHANNEL shall extend from the sensor up to the display device, and shall include the sensor (or sensors), the signal conditioning, any associated datalinks, the display device, any signal gathering or processing subsystems, and any data processing subsystems. Note that for digital PAM CHANNELS, the information may be displayed on multiple display devices. For this case, the PAM CHANNEL shall extend to any available qualified display device.

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 Category 1 variables. The unit specific implementation of Regulatory Guide 1.97 has not identified any Type A variables, therefore, only Category 1 variables are specified.

APPLICABLE SAFETY ANALYSES

The PAM Instrumentation ensures that the main control room operating staff can:

- Determine whether systems important to safety are performing their intended functions;

(continued)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

- Determine the likelihood of a gross breach of the barriers to radioactivity release;
- Determine if a gross breach of a barrier has occurred; and
- Initiate action necessary to protect the public and to estimate the magnitude of any impending threat.

PAM Instrumentation that is required in accordance with Regulatory Guide 1.97 satisfies Criterion 3 of the NRC Policy Statement.

LCO

The PAM instrumentation LCO provides OPERABILITY requirements for those monitors which provide information required by the control room operators to assess the process of accomplishing or maintaining critical safety functions. This LCO addresses those Regulatory Guide 1.97 instruments which are listed in Table 3.3.3-1.

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

Category 1 non-type A variables are required to meet Regulatory Guide 1.97 Category 1 (Ref. 1) 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.

Listed below are discussions of the specified instrument functions listed in Table 3.3.3-1. Each of these is a Category 1 variable.

1. Intermediate Range Neutron Flux

Neutron Flux indication is provided to verify reactor shutdown.

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

(continued)

BASES

LCO
(continued)

2, 3. Reactor Coolant System (RCS) Wide Range Hot and Cold Leg Temperature

RCS Hot and Cold Leg Temperatures are provided for verification of core cooling and long-term surveillance. The channels provide indication over a range of [32°F to 700°F].

In addition to this, RCS cold leg temperature is used in conjunction with RCS hot leg temperature to verify the plant conditions necessary to establish natural circulation in the RCS.

4. RCS Pressure

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

5. Pressurizer Pressure and RCS Subcooling Monitor

Pressurizer Pressure is used to determine RCS Subcooling. The RCS Subcooling Monitor is provided for verification of core cooling. Subcooling margin is available when the RCS pressure is greater than the saturation pressure corresponding to the core exit temperature. Inputs to the Subcooling Monitor are pressurizer pressure and RCS hot leg temperature.

6. Containment Water Level

Containment Water Level is used to monitor the containment environment during accident conditions. The containment water level can also provide information to the operators that the various stages of safety injection along with system depressurization are progressing.

7. Containment Pressure

The containment pressure transmitters monitor the containment pressure over the range of [-5 to 10 psig]. This provides information on post accident containment pressure and containment integrity.

(continued)

BASES

LCO
(continued)

8. Containment Pressure (Extended Range)

The extended range containment pressure transmitters are instruments that operators use for monitoring the potential for breach of containment, a fission product barrier. The extended range sensors monitor containment pressure over the range of [0 to 180 psig].

9. Containment Area Radiation (High Range)

Containment Area Radiation is provided to monitor for the potential of significant radiation releases and to provide release assessment for use by operators in determining the need to invoke site emergency plans.

10. Hydrogen Monitors

Hydrogen Monitors are provided to detect high hydrogen concentration conditions which represent a potential for containment breach caused by a hydrogen explosion. This variable is also important in verifying the adequacy of mitigating actions.

11. Pressurizer Level and Associated Reference Leg Temperature

Pressurizer level is provided to monitor the RCS coolant inventory. During an accident, operation of the safeguards systems can be verified based on coolant inventory indicators.

The reference leg temperature is included in the Technical Specification since it is used to compensate the level signal.

12. In-Containment Refueling Water Storage Tank (IRWST) Water Level

The IRWST provides a long term heat sink for non-LOCA events and is a source of injection flow for LOCA events. When the IRWST is a heat sink, the level will change due to increased volume associated with the temperature increase. When saturation temperature is reached, the IRWST will begin steaming and initially lose mass to the containment atmosphere until condensation occurs on the

(continued)

BASES

LCO 12. In-Containment Refueling Water Storage Tank (IRWST) Water Level (continued)

steel containment shell which is cooled by the passive containment cooling system. The condensate is returned to the IRWST via a gutter.

During a LOCA, the IRWST is available for injection. Depending on the severity of the event, when a fully depressurized RCS has been achieved, the IRWST will inject by gravity flow.

13. Passive Residual Heat Removal (PRHR) Flow and PRHR Outlet Temperature

PRHR Flow is provided to monitor primary system heat removal during accident conditions when the steam generators are not available. PRHR provides primary protection for non-LOCA events when the normal heat sink is lost.

PRHR outlet temperature is provided to monitor primary system heat removal during accident conditions when the steam generators are not available. PRHR provides primary protection for non-LOCA events when the normal heat sink is lost.

14, 15, 16, 17. Core Exit Temperature

Core Exit Temperature is provided for verification and long term surveillance of core cooling.

An evaluation was made of the minimum number of valid core exit thermocouples necessary for In-Core Cooling (ICC) detection. The evaluation determined the reduced complement of core exit thermocouples 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 and excore effects of condensate runback in the hot legs and nonuniform inlet temperatures. Based on these evaluations, adequate ICC detection is assured with two valid core exit thermocouples per quadrant. Core Exit Temperature is also used for plant stabilization and cooldown monitoring.

(continued)

BASES

LCO 14, 15, 16, 17. Core Exit Temperature (continued)

Two OPERABLE channels of Core Exit Temperature 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. Two thermocouples in each of the two divisions ensure a single failure will not disable the ability to determine the temperature at two locations within a quadrant.

18. Passive Containment Cooling System (PCS) Storage Tank Level and PCS Flow

The PCS must be capable of removing the heat from the containment following a postulated LOCA or steam line break (SLB). The tank level instruments provide indication that sufficient water is available to meet this requirement. The PCS flow instrument provides a diverse indication of the PCS heat removal capability.

19. Remotely Operated Containment Isolation Valve Position

The Remotely Operated Containment Isolation Valve Position is provided for verification of containment OPERABILITY.

20. IRWST to RNS Suction Valve Status

The position of the motor-operated valve in the line from the IRWST to the pump suction header is monitored to verify that the valve is closed following postulated events. The valve must be closed to prevent loss of IRWST inventory into the RNS.

APPLICABILITY

The PAM instrumentation LCO is applicable in MODES 1, 2, and 3. These variables provide the information necessary to assess the process of accomplishing or maintaining critical safety functions following Design Basis Accidents (DBAs). The applicable DBAs are assumed to occur in MODES 1, 2, and 3. In MODES 4, 5, and 6, plant 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

The ACTIONS Table has been modified by two Notes.

The first Note 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 plant 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 low probability of an event requiring these instruments.

The second Note in the ACTIONS clarifies 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. 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

When one or more Functions have one required channel which is inoperable, the required inoperable channel must be restored 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

The Required Action directs actions to be taken in accordance with Specification 5.6.7 immediately. Each time an inoperable channel has not met Required Action A.1, and the associated Completion Time has expired, Condition B is entered.

C.1

Condition C is modified by a note which excludes hydrogen monitor channels. Condition D is for two hydrogen monitor channels inoperable.

(continued)

BASES

ACTIONS

C.1 (continued)

When one or more Functions have two required channels which are inoperable, (two channels inoperable in the same Function), one channel in the Function should be restored 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 two required channels inoperable 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 one inoperable channel of the Function limits the risk that the PAM function will be in a degraded condition should an accident occur.

D.1

When two hydrogen monitor channels are inoperable, one hydrogen monitor channel must be restored to OPERABLE status 72 hours from the time Condition D was entered. The 72 hour Completion Time is based on the low probability of the occurrence of a LOCA that would generate hydrogen in amounts capable of exceeding the flammability limit, the length of time after the event that operator action would be required to prevent hydrogen accumulation from exceeding this limit, and the availability of the hydrogen control system and the primary sampling system.

E.1

This Required Action directs entry into the appropriate Condition referenced in Table 3.3.3-1. 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, as applicable, and the associated Completion Time has expired, Condition E is entered for that channel and provides for transfer to the appropriate subsequent Condition.

(continued)

BASES

ACTIONS
(continued)

F.1 and F.2

If the Required Action and associated Completion Time of Condition C or D are not met for the Functions in Table 3.3.3-1, the plant must be placed in a MODE in which the LCO does not apply. This is done by placing the plant in at least MODE 3 within 6 hours and MODE 4 within 12 hours.

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

SURVEILLANCE
REQUIREMENTS

The following SRs 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 verifies that a gross instrumentation failure has not occurred. A CHANNEL CHECK is 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. The high radiation instrumentation should be compared to similar plant instruments located throughout the plant.

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 match 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 match 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.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS

SR 3.3.3.1 (continued)

The Frequency of 31 days is based on operating experience with regard to channel OPERABILITY and drift, which demonstrates that failure of more than one channel of a given function in any 31 day interval is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of those displays associated with the required channels of this LCO.

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 the measured parameter with the necessary range and accuracy. This SR is modified by a Note that excludes neutron detectors. The calibration method for neutron detectors is specified in the Bases of LCO 3.3.1, "Reactor Trip System (RTS) Instrumentation." RTD and Thermocouple channels are to be calibrated in place using cross-calibration techniques. The Frequency is based on operating experience and consistency with the typical industry refueling cycle.

REFERENCES

1. Regulatory Guide 1.97, Rev. 3, "Instrumentation for Light-Water Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," U.S. Nuclear Regulatory Commission.
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B 3.3 INSTRUMENTATION

B 3.3.4 Remote Shutdown Workstation (RSW)

BASES

BACKGROUND

The RSW provides the main control room operator with sufficient displays and controls to place and maintain the unit in a safe shutdown condition from a location other than the main control room. This capability is necessary to protect against the possibility that the main control room becomes inaccessible. Passive residual heat removal (PRHR), the core makeup tanks (CMTs), and the in-containment refueling water storage tank (IRWST) can be used to remove core decay heat. The use of passive safety systems allows extended operation in MODE 4.

If the main control room becomes inaccessible, the operators can establish control at the RSW and place and maintain the unit in MODE 4 with $T_{avg} < 350^{\circ}\text{F}$. The unit can be maintained safely in MODE 4 with $T_{avg} < 350^{\circ}\text{F}$ for an extended period of time.

The OPERABILITY of the remote shutdown control and display functions ensures there is sufficient information available on selected plant parameters to place and maintain the plant in MODE 4 with $T_{avg} < 350^{\circ}\text{F}$ should the control room become inaccessible.

APPLICABLE SAFETY ANALYSES

The RSW is required to provide equipment at appropriate locations outside the main control room with a capability to promptly shut down and maintain the plant in a safe condition in MODE 4 with $T_{avg} < 350^{\circ}\text{F}$.

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

Since the passive safety systems alone can establish and maintain safe shutdown conditions for the plant, nonsafety systems are not required for safe shutdown of the plant. Therefore, no credit is taken in the safety analysis for nonsafety systems.

(continued)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

The RSW is considered a contributor to the reduction of unit risk to accidents and as such it has been retained in the Technical Specifications, as indicated in the NRC Policy Statement.

LCO

The RSW LCO provides the requirements for OPERABILITY of the displays and controls necessary to place and maintain the plant from a location other than the main control room.

The RSW is OPERABLE if the display instrument and control functions needed to support the RSW are OPERABLE.

The RSW covered by this LCO do not need to be energized to be considered OPERABLE. This LCO is intended to ensure the RSW will be OPERABLE if plant conditions require that the RSW be placed in operation.

APPLICABILITY

The RSW LCO is applicable in MODES 1, 2, and 3 and in MODE 4 with $T_{avg} \geq 350^{\circ}\text{F}$. This is required so that the facility can be placed and maintained in MODE 4 for an extended period of time from a location other than the main control room.

This LCO is not applicable in MODE 4 with $T_{avg} < 350^{\circ}\text{F}$ or in MODE 5 or 6. In these MODES, the unit is already subcritical and in a condition of reduced Reactor Coolant System (RCS) energy. Under these conditions, considerable time is available to restore necessary instrument control functions if main control room instruments or controls become unavailable.

ACTIONS

Note 1 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 plant shutdown. This exception is acceptable due to the low probability of an event requiring the RSW and because the equipment can generally be repaired during operation without significant risk of a spurious trip.

(continued)

BASES

ACTIONS
(continued)

A.1

Condition A addresses the situation where the RSW is inoperable. The Required Action is to restore the RSW 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 main 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 with $T_{avg} < 350^{\circ}\text{F}$ within 24 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.

SURVEILLANCE
REQUIREMENTS

SR 3.3.4.1

SR 3.3.4.1 verifies that each required RSW transfer switch performs the required functions. This ensures that if the main control room becomes inaccessible, the unit can be placed and maintained in MODE 4 with $T_{avg} < 350^{\circ}\text{F}$ from the RSW. The 24 month Frequency was developed considering it is prudent that these types of surveillances be performed during a unit outage. However, this surveillance is not required to be performed only during a unit outage. This is due to the plant conditions needed to perform the surveillance and the potential for unplanned transients if the surveillance is performed with the reactor at power. Operating experience demonstrates that RSW transfer switches usually pass the surveillance test when performed on the 24 month Frequency.

SR 3.3.4.2

This Surveillance verifies that the RSW communicates controls and indications with Divisions A, B, C, and D of the PMS. Communication is accomplished by use of separate multiplexers for each division. The operator can select the controls and indications available through each PMS division.

(continued)

BASES

SURVEILLANCE
REQUIREMENTS

SR 3.3.4.2 (continued)

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

SR 3.3.4.3

SR 3.3.4.3 verifies the OPERABILITY of the RSW hardware and software by performing diagnostics to show that operator displays are capable of being called up and displayed to an operator at the RSW. The RSW has several video display units which can be used by the operator. The video display units are identical to that provided in the main control room and the operator can display information on the video display units in a manner which is identical to the way the information is displayed in the main control room. The operator normally selects an appropriate set of displays based on the particular operational goals being controlled by the operator at the time. Each display consists of static graphical and legend information which is contained within the display processor associated with each video display unit and dynamic data which is updated by the data display system.

The Frequency of 24 months is based on the use of the data display capability in the main control room as part of the normal plant operation and the availability of multiple video display units at the RSW. The Frequency of 24 months is based upon operating experience and consistency with main control room hardware and software.

SR 3.3.4.4

SR 3.3.4.4 is the performance of a TRIP ACTUATING DEVICE OPERATIONAL TEST (TADOT) every 24 months. This test should verify the OPERABILITY of the reactor trip breakers (RTBs) open and closed indication on the RSW by actuating the RTBs. The Frequency of 24 months was chosen because the RTBs may not be exercised while the facility is at power and is based on operating experience and consistency with the refueling outage.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 19.
 2. Section 7.4.1, "Safe Shutdown."
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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

BACKGROUND

These Bases address requirements for maintaining RCS pressure, temperature, and flow rate within the 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 of operating conditions. 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 DNBR 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. At the beginning of each fuel cycle, precision (calorimetric) flow measurements provide a value for comparison to the limit. The cold leg flow rate channels are normalized to the calorimetric flow measurement for 100% indication and are frequently monitored to determine flow degradation. A lower RCS flow will cause the core to approach DNB limits.

Operation for significant periods of time outside these DNB limits increases the likelihood of a fuel cladding failure in a DNB limited event.

(continued)

BASES (continued)

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 transients initiated within the requirements of this LCO will result in meeting the DNBR criterion. This is the acceptance limit for the RCS DNB parameters. Changes to the unit which could impact these parameters must be assessed for their impact on the DNBR criterion. The transients analyzed include loss of coolant flow events and dropped or stuck rod events. An assumption for the analysis of these events is that the core power distribution is within the limits of LCO 3.1.6, "Control Bank 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 2185 psig and the RCS average temperature limit of 574.1°F correspond to analytical limits, with an allowance for steady state fluctuations and measurement errors. The RCS average temperature limit corresponds to the analytical limit with allowance for controller deadband and measurement uncertainty.

The RCS DNB parameters satisfy Criterion 2 of the NRC Policy Statement.

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 DNBR criterion in the event of a DNB limited transient.

RCS total flow rate contains a measurement error 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 nonconservative manner. Therefore, a penalty for undetected fouling of the feedwater venturi raises the nominal flow measurement allowance for no fouling.

Any fouling that might bias the flow rate measurement greater than the penalty for undetected fouling of the

(continued)

BASES

LCO
(continued)

feedwater venturi 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 are given for the measurement location but have 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 plant operation in order to ensure DNBR criterion will be met in the event of an unplanned loss of forced coolant flow or other DNB-limiting transient. In all other MODES, the power level is low enough that DNB is not a concern.

A Note has been added to indicate the limit on pressurizer pressure is not applicable during short term operational 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.

The DNBR limit is provided in SL 2.1.1, "Reactor Core SLs." The conditions which define the DNBR limit 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 an SL may have been exceeded.

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

(continued)

BASES

ACTIONS

A.1 (continued)

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 eliminate the potential for violation of the accident analysis bounds.

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 eliminates the potential for violation of the accident analysis bounds. The Completion Time of 6 hours is reasonable to reach the required plant conditions in an orderly manner.

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 of 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

(continued)

BASES

SURVEILLANCE
REQUIREMENTS

SR 3.4.1.2 (continued)

following load changes and other expected transient operations. The 12 hour Frequency 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 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.

SR 3.4.1.4

Measurement of RCS total flow rate by performance of a precision calorimetric heat balance once every 24 months, at the beginning of each fuel cycle, allows the installed RCS flow instrumentation to be normalized and verifies the actual RCS flow is greater than or equal to the minimum required RCS flow rate.

The Frequency of 24 months reflects the importance of re-verifying flow after a refueling outage when the core has been altered, which may have caused an alteration of flow resistance.

This SR is modified by a Note that allows entry into MODE 1, without having performed the SR, and placement of the unit in the best condition for performing the SR. The Note states that the SR is not required to be performed until after 24 hours after $\geq 90\%$ RTP. This exception is appropriate since the heat balance requires the plant to be at a minimum of 90% RTP to obtain the stated RCS flow accuracies. The Surveillance shall be performed within 24 hours after reaching 90% RTP.

REFERENCES

1. Chapter 15, "Accident Analyses."
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.2 RCS Minimum Temperature for Criticality

BASES

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 zero 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.

(continued)

BASES (continued)

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 assume 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 545°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 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.

The RCS minimum temperature for criticality parameter satisfies Criterion 2 of the NRC Policy Statement.

LCO

Compliance with the LCO ensures that the reactor will not be made or maintained critical ($k_{\text{eff}} \geq 1.0$) at a 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.

APPLICABILITY

In MODE 1 and MODE 2 with $k_{\text{eff}} \geq 1.0$, LCO 3.4.2 is applicable since the reactor can only be critical ($k_{\text{eff}} \geq 1.0$) in these MODES.

The special test exception of LCO 3.1.8, "MODE 2 PHYSICS TEST Exceptions," permits PHYSICS TESTS to be performed at $\leq 5.0\%$ 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

(continued)

BASES

APPLICABILITY (continued) nuclear characteristics to be accurately 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 $T_{no\ load}$, which may cause RCS loop average temperatures to fall below the temperature limit of this LCO.

ACTIONS

A.1

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 3 within 30 minutes. Rapid reactor shutdown can be readily and practically achieved within 8 hours. The allowed time is reasonable, based on operating experience, to reach MODE 3 in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.4.2.1

RCS loop average temperature is required to be verified at or above 539°F every 30 minutes when $T_{avg} - T_{ref}$ deviation, low low T_{avg} alarm is not reset and any RCS loop $T_{avg} < 545^\circ\text{F}$.

The Note modifies the SR. When any RCS loop average temperature is $< 545^\circ\text{F}$ and the $T_{avg} - T_{ref}$ deviation, low low T_{avg} alarm is alarming, RCS loop average temperatures could fall below the LCO requirement without additional warning. The SR to verify RCS loop average temperatures every 30 minutes is frequent enough to prevent the inadvertent violation of the LCO.

REFERENCES

1. Chapter 15, "Accident Analyses."
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

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

BASES

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 PTLR contains 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 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 LCO 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. 1) requires the establishment of P/T limits for specific material fracture toughness requirements of the RCPB materials. An adequate margin to brittle failure must be provided during normal operation, anticipated operational occurrences, and system hydrostatic tests. Reference 1 mandates the use of the ASME Code, Section III, Appendix G (Ref. 2).

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.

(continued)

BASES

BACKGROUND
(continued)

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 ASTM E 185 (Ref. 3) and Appendix H of 10 CFR 50 (Ref. 4). The operating P/T limit curves will be adjusted, as necessary, based on the evaluation findings and the recommendations of Regulatory Guide 1.99 (Ref. 5).

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 P/T span of the 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 1 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. ASME Code, Section XI, Appendix E (Ref. 6) provides a recommended methodology for evaluating an operating event that causes an excursion outside the limits.

(continued)

BASES (continued)

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. Reference 7 establishes the 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 the NRC Policy Statement.

LCO

The two elements of this LCO are:

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

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;

(continued)

BASES

LCO
(continued)

- 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.
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APPLICABILITY

The RCS P/T limits LCO provides a definition of acceptable operation for prevention of nonductile (brittle) failure in accordance with 10 CFR 50, Appendix G (Ref. 1). Although the P/T limits were developed to provide guidance for operation during heatup or cooldown (MODES 3, 4, and 5) or ISLH testing, they are applicable 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 Safety Limit 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.

ACTIONS

The actions of this LCO consider the premise that a violation of the limits occurred during normal plant maneuvering. Severe violations caused by abnormal transients, at times accompanied by equipment failures, may also require additional actions from emergency operating procedures.

A.1 and A.2

Operation outside the P/T limits must be restored to within the limits. The RCPB must be returned to a condition that has been verified by stress analyses. Restoration is in the proper direction to reduce RCPB stress.

(continued)

BASES

ACTIONS

A.1 and A.2 (continued)

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 preanalyzed transients in the stress analyses, new analyses, or inspection of the components.

ASME Code, Section XI, Appendix E (Ref. 6) 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 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 per Required Action A.1 alone 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 in 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. A favorable evaluation must be completed and documented before returning to operate pressure and temperature conditions.

Pressure and temperature are reduced by bringing the plant to MODE 3 within 6 hours and to MODE 4 within 24 hours, with RCS pressure < 500 psig.

The allowed Completion Times are reasonable based on operating experience, to reach the required plant conditions from full power condition in an orderly manner 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.

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BASES

ACTIONS

C.1 and C.2 (continued)

ASME Code, Section XI, Appendix E (Ref. 6), 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.

SURVEILLANCE
REQUIREMENTS

SR 3.4.3.1

Verification that operation is within PTLR limits is required every 30 minutes when RCS P/T 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 surveillance to be performed during system heatup, cooldown, and ISLH testing. No SR is given for criticality operations because LCO 3.4.2, "RCS Minimum Temperature for Criticality," contains a more restrictive requirement.

(continued)

BASES (continued)

- REFERENCES
1. 10 CFR 50, Appendix G, "Fracture Toughness Requirements."
 2. ASME Boiler and Pressure Vessel Code, Section III, Appendix G, "Protection Against Non-Ductile Failure."
 3. ASTM E 185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels," July 1982.
 4. 10 CFR 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements."
 5. Embrittlement of Reactor Vessel Materials," May 1988.
 6. ASME Boiler and Pressure Vessel Code, Section XI, Appendix E, "Evaluation of Unanticipated Operating Events."
 7. WCAP-7924-A, "Basis for Heatup and Cooldown Limit Curves," April 1975.
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.4 RCS Loops – MODES 1 and 2

BASES

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. Removal of the heat generated in the fuel due to fission-product decay following a unit shutdown.

The reactor coolant is circulated through two loops connected in parallel to the reactor vessel, each containing a SG, two reactor coolant pumps (RCPs), and appropriate flow and temperature instrumentation for both control and protection. The reactor vessel contains the fuel. The SGs provide the heat sink to the isolated secondary coolant. The RCPs circulate the primary coolant through the reactor vessel 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.

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 and RCPs in service.

(continued)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

Both transient and steady state analyses have been performed to establish the effect of flow on the departure from nucleate boiling (DNB). The transient and accident analyses for the plant have been performed assuming two RCS loops are initially in operation. The majority of the plant safety analyses are based on initial conditions at high core power or zero power. The accident analyses, where RCP operation is most important are the four pump coastdown, single pump locked rotor, single pump broken shaft or coastdown, and rod withdrawal events (Ref. 1).

Steady state DNB analysis has been performed for the two RCS loop operation. For two RCS loop operation, the steady state DNB analysis, which generates the pressure and temperature Safety Limit (SL) (i.e., the departure from nucleate boiling ratio (DNBR) limit) assumes a maximum power level of 102% RATED THERMAL POWER (RTP). This is the design overpower condition for two RCS loop operation. The value for the accident analysis setpoint of the nuclear overpower (high flux) trip is 118% and is based on an analysis assumption that bounds possible instrumentation errors. The DNBR limit defines a locus of pressure and temperature points which result in a minimum DNBR greater than or equal to the critical heat flux correlation limit.

The plant is designed to operate with both RCS loops in operation to maintain DNBR above the SL, 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 3 of the NRC Policy Statement.

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.

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BASES

LCO
(continued) An OPERABLE RCS loop is composed of two OPERABLE RCPs in operation providing forced flow for heat transport and an OPERABLE SG in accordance with the Steam Generator Tube Surveillance Program, Section 5.5.5.

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, both RCS loops are required to be OPERABLE and in operation in these MODES to prevent DNB and core damage.

Maximum decay heat production is approximately 7% of RTP. As such, the forced circulation flow and heat sink requirements are reduced for lower, noncritical MODES as indicated by LCO 3.4.5, "RCS Loops – MODES 3, 4 and 5."

ACTIONS A.1

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.

When all four reactor coolant pumps are operating, a loss of a single reactor coolant pump above power level P-8 will result in an automatic reactor trip. When three reactor coolant pumps are operating, a loss of a single reactor coolant pump above power level P-10 will result in an automatic reactor trip. Operation at power levels below P-8 is permitted with three reactor coolant pumps operating, and below P-10 with two reactor coolant pumps operating, to allow for an orderly transition to MODE 3, or to re-establish four pump operation.

The Completion Time of 6 hours is reasonable to allow for an orderly transition to MODE 3 or to re-establish four pump operation. The applicable safety analyses described above bound Design Basis Accidents (DBA) initiated with three reactor coolant pumps operating at power levels below P-8, and with two reactor coolant pumps at power levels below P-10.

(continued)

BASES (continued)

SURVEILLANCE
REQUIREMENTS

SR 3.4.4.1

This SR requires verification every 12 hours that each RCS loop is in operation. Verification includes flow rate and 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 main control room to monitor RCS loop performance.

REFERENCES

1. Chapter 15, "Accident Analysis."
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.5 RCS Loops – MODES 3, 4, and 5

BASES

BACKGROUND

The reactor coolant is circulated through two loops connected in parallel to the reactor vessel, each containing a steam generator (SG), two reactor coolant pumps (RCPs), and appropriate flow and temperature instrumentation for both control and protection. The reactor vessel contains the fuel. The SGs provide the heat sink to the isolated secondary coolant. The RCPs circulate the primary coolant through the reactor vessel 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 heat transfer and prevents fuel damage. Loop 1 also contains connections to the pressurizer and passive residual heat removal (PRHR).

In MODES 3, 4, and 5, the primary function of the reactor coolant is the removal of decay heat and the transfer of this heat to either the SG secondary side coolant or the component cooling water via the normal residual heat removal system (RNS) heat exchangers. Safety related heat removal is addressed in LCO 3.5.4, "Passive Residual Heat Removal Heat Exchanger (PRHR HX) – Operating" and LCO 3.5.5, "Passive Residual Heat Removal Heat Exchanger (PRHR HX) – Shutdown, RCS Intact." The secondary function of the reactor coolant is to act as a carrier for soluble neutron poison, boric acid.

APPLICABLE SAFETY ANALYSES

Whenever the reactor trip breakers are in the closed position and the control rod drive mechanisms (CRDMs) are energized, there is the possibility of an inadvertent rod withdrawal from subcritical, resulting in a power excursion in the area of the withdrawn rod. Such a transient could be caused by a malfunction of the Plant Control System (PLS). In addition, the possibility of a power excursion due to the ejection of an inserted control rod is possible with the breakers closed or open. Such a transient could be caused by the mechanical failure of a CRDM. The initial power rise is terminated by doppler broadening in the fuel pins, followed by rod insertion. During this event, if there is

(continued)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

not adequate coolant flow along the clad surface of the fuel, there is a potential to exceed the departure from nucleate boiling ratio (DNBR) limit. Therefore, the required coolant flow is an initial condition of a design basis event that presents a challenge to the integrity of a fission product barrier.

Therefore, in MODE 3, 4 or 5 with the RTBs in the closed position and the PLS capable of rod withdrawal, accidental control rod withdrawal from subcritical is postulated and requires at least three RCPs to be OPERABLE and in operation to ensure that the accident analysis limits are met.

In MODES 3, 4 and 5, RCS circulation is considered in the determination of the time available for mitigation of the accidental boron dilution event. This is addressed in LCO 3.4.9, "Minimum RCS Flow."

RCS Loops – MODES 3, 4, and 5 satisfy Criterion 3 of the NRC Policy Statement.

LCO

The purpose of this LCO is to require that at least three RCPs be OPERABLE and in operation. The requirement that at least three RCPs must be operating in MODES 3, 4 and 5 when the RTBs are closed provides assurance that, in the event of a rod withdrawal accident, there will be adequate flow in the core to avoid exceeding the DNBR limit.

With the RTBs in the open position, the PLS is not capable of rod withdrawal; therefore only 3 RCPs in operation are necessary to ensure removal of decay heat from the core.

The NOTE permits all RCPS to be de-energized for ≤ 1 hour per 8 hour period. The purpose of the NOTE is to permit tests that are designed to validate various accident analysis values. One of these tests is for the 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 may need to be revalidated by conducting the test again.

(continued)

BASES

LCO
(continued)

Another test performed during the startup testing program is the validation of the rod drop times during cold conditions, both with and without flow.

The no-flow tests may be performed in MODE 3, 4, or 5, and require that the pumps be stopped for a short period of time. The Note permits the de-energizing of the pumps in order to perform this test and validate the assumed analysis values. As with the validation of the pump coastdown curve, this test should only be performed once, unless the flow characteristics of the RCS are changed. The 1 hour time period specified is adequate to perform the desired tests and experience has shown that boron stratification is not a problem during this short period with no forced flow.

Utilization of the NOTE is permitted provided the following conditions are met along with any other conditions imposed by initial startup 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 assured without forced circulation.
- b. Core outlet temperature is maintained at least 10°F below saturation temperature, so that no vapor bubble may form and possibly cause 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 $\leq 275^{\circ}\text{F}$. This restraint is to prevent a low temperature overpressure event due to a thermal transient when an RCP is started.

An OPERABLE RCS loop is composed of two OPERABLE RCPs in operation providing forced flow for heat transport and an OPERABLE SG in accordance with the Steam Generator Tube Surveillance Program, Section 5.5.5.

(continued)

BASES (continued)

APPLICABILITY In MODES 3, 4 and 5, this LCO ensures forced circulation of the reactor coolant to remove decay heat from the core and to provide proper boron mixing. For these purposes and because the reactor trip breakers are closed, there is the possibility of an inadvertent rod withdrawal event. At least three RCPs are required in MODES 3, 4 and 5. LCO 3.4.4, "RCS Loops – MODES 1 and 2" requires 4 RCPs to be operating whenever the reactor trip breakers are closed.

ACTIONS A.1 and A.2

If less than three RCPs are operating, the RCS flow may be insufficient to mitigate the consequences of a rod withdrawal event. The Required Action is restoration of the required flow or to open the reactor trip breakers within the Completion Time of 1 hour. This time allowance assures expeditious action will be taken, and is based on the low probability of a Design Basis Accident (DBA) occurring during this time. The time allowed is reasonable based on operating experience and the time required to reach the appropriate plant condition in an orderly manner without challenging plant systems.

SURVEILLANCE SR 3.4.5.1
REQUIREMENTS

This SR requires verification every 12 hours that a minimum of three RCPs are operating whenever the reactor trip breakers are closed and the plant is in MODE 3, 4, or 5. Verification includes flow rate and 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 the low probability of a rod withdrawal during this time, and the ease of verifying that the required RCPs are operating.

REFERENCES None.

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.6 Pressurizer

BASES

BACKGROUND

The pressurizer provides a point in the RCS where liquid and vapor are maintained in equilibrium under saturated conditions for pressure control purposes to prevent bulk boiling in the remainder of the RCS. Key functions include maintaining required primary system pressure during steady state operation, and limiting the pressure changes caused by reactor coolant thermal expansion and contraction during normal load transients.

The normal level and pressure control components addressed by this LCO include the pressurizer water level, the heaters, their controls, and power supplies. Pressurizer safety valves and automatic depressurization valves are addressed by LCO 3.4.7, "Pressurizer Safety Valves," and LCO 3.4.12, "Automatic Depressurization System (ADS) - Operating," respectively.

The intent of the LCO is to ensure that a steam bubble exists in the pressurizer prior to power operation to minimize the consequences of potential overpressure transients. The presence of a steam bubble is consistent with analytical assumptions. Relatively small amounts of noncondensable gases can inhibit the condensation heat transfer between the pressurizer spray and the steam, and diminish the spray effectiveness for pressure control.

Electrical immersion heaters, located in the lower section of the pressurizer vessel, keep the water in the pressurizer at saturation temperature and maintain a constant operating pressure.

APPLICABLE SAFETY ANALYSES

In MODES 1, 2, and 3, the LCO requirement for a steam bubble is reflected implicitly in the accident analyses. Safety analyses performed for lower MODES are not limiting. All analyses performed from a critical reactor condition assume the existence of a steam bubble and saturated conditions in the pressurizer. In making this assumption, the analyses neglect the small fraction of noncondensable gases normally present.

(continued)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

Safety analyses presented in Chapter 15 (Ref. 1) do not take credit for pressurizer heater operation, however, an implicit initial condition assumption of the safety analyses is that the RCS is operating at normal pressure.

The maximum pressurizer water level limit satisfies Criterion 2 of the NRC Policy Statement.

LCO

The LCO requirement for the pressurizer water volume $\leq 92\%$ of span, ensures that an adequate steam bubble exists. Limiting the LCO maximum operating water level preserves the steam space for pressure control. The LCO has been established to ensure the capability to establish and maintain pressure control for steady state operation and to minimize the consequences of potential overpressure transients. Requiring the presence of a steam bubble is also consistent with analytical assumptions.

APPLICABILITY

The need for pressure control is most pertinent when core heat can cause the greatest effect on RCS temperature, resulting in the greatest effect on pressurizer level and RCS pressure control. Thus, applicability has been designated for MODES 1 and 2. The applicability is also provided for MODE 3. The purpose is to prevent solid water RCS operation during heatup and cooldown to avoid rapid pressure rises caused by normal operational perturbation, such as reactor coolant pump startup.

ACTIONS

A.1 and A.2

Pressurizer water level control malfunctions or other plant evolutions may result in a pressurizer water level above the nominal upper limit, even with the plant at steady state conditions.

If the pressurizer water level is above the limit, action must be taken to restore the plant to operation within the bounds of the safety analyses. This is done by restoring the level to within limit, within 6 hours, or by placing the

(continued)

BASES

ACTIONS

A.1 and A.2 (continued)

unit in MODE 3 with the reactor trip breakers open within 6 hours, and placing the unit in MODE 4 within 12 hours. This takes the unit out of the applicable MODES and restores the unit to operation within the bounds of the safety analyses.

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

SURVEILLANCE
REQUIREMENTS

SR 3.4.6.1

This SR requires that during steady state operation, pressurizer level is maintained below the nominal upper limit to provide a minimum space for a steam bubble. The Surveillance is performed by observing the indicated level. The Frequency of 12 hours corresponds to verifying the parameter each day. The 12 hour interval has been shown by operating practice to be sufficient to regularly assess the level for any deviation and verify that operation is within safety analyses assumptions. Alarms are also available for early detection of abnormal level indications.

REFERENCES

1. Chapter 15, "Accident Analysis."
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.7 Pressurizer Safety Valves

BASES

BACKGROUND

The two pressurizer safety valves provide, in conjunction with the Protection and Safety Monitoring System (PMS), overpressure protection for the RCS. The pressurizer safety valves are totally enclosed, spring loaded, self actuated valves with backpressure compensation. The safety valves are designed to prevent the system pressure from exceeding the system Safety Limit (SL), 2733.5 psig, which is 110% of the design pressure.

Because the safety valves are totally enclosed and self actuating, they are considered independent components. The minimum relief capacity for each valve, 400,000 lb/hr, is based on postulated overpressure transient conditions resulting from a complete loss of steam flow to the turbine. This event results in the maximum surge rate into the pressurizer, which specifies the minimum relief capacity for the safety valves. The pressurizer safety valves discharge into the containment atmosphere. This discharge flow is indicated by an increase in temperature downstream of the pressurizer safety valves

Overpressure protection is required in MODES 1, 2, 3, 4, 5, and 6 when the reactor vessel head is on; however, in MODE 4 with the RNS aligned, MODE 5, and MODE 6 with the reactor vessel head on, overpressure protection is provided by operating procedures and by meeting the requirements of LCO 3.4.15, "Low Temperature Overpressure Protection (LTOP) System."

The upper and lower pressure limits are based on the + 1% tolerance requirement (Ref. 1) for lifting pressures above 1000 psig. The lift setting is for the ambient conditions associated with MODES 1, 2, and 3. This requires either that the valves be set hot or that a correlation between hot and cold settings be established.

The pressurizer safety valves are part of the primary success path and mitigate the effects of postulated accidents. OPERABILITY of the safety valves ensures that the RCS pressure will be limited to 110% of design pressure.

(continued)

BASES

BACKGROUND
(continued)

The consequences of exceeding the ASME Code, Section III pressure limit (Ref. 1) could include damage to RCS components, increased LEAKAGE, or a requirement to perform additional stress analyses prior to resumption of reactor operation.

APPLICABLE
SAFETY ANALYSES

All accident and safety analyses in Chapter 15 (Ref. 3) that require safety valve actuation assume operation of two pressurizer safety valves to limit increases in the RCS pressure. The overpressure protection analysis (Ref. 2) is also based on operation of the two safety valves. Accidents that could result in overpressurization if not properly terminated include:

- a. Uncontrolled rod withdrawal from full power;
- b. Loss of reactor coolant flow;
- c. Loss of external electrical load;
- d. Locked rotor; and
- e. Loss of AC power/loss of normal feedwater

Detailed analyses of the above transients are contained in Reference 3. Compliance with this LCO is consistent with the design bases and accident analyses assumptions.

Pressurizer Safety Valves satisfy Criterion 3 of the NRC Policy Statement.

LCO

The two pressurizer safety valves are set to open at the RCS design pressure (2500 psia), and within the ASME specified tolerance, to avoid exceeding the maximum design pressure SL, to maintain accident analyses assumptions, and to comply with ASME requirements. The upper and lower pressure tolerance limits are based on the $\pm 1\%$ tolerance requirements (Ref. 1) for lifting pressures above 1000 psig.

The limit protected by this specification is the Reactor Coolant Pressure Boundary (RCPB) SL of 110% of design pressure. Inoperability of one or more valves could result in exceeding the SL if a transient were to occur. The consequences of exceeding the ASME pressure limit could include damage to one or more RCS components, increased leakage, or additional stress analysis being required prior to resumption of reactor operation.

(continued)

BASES (continued)

APPLICABILITY

In MODES 1, 2, and 3, and portions of MODE 4 with the RNS isolated or with the RCS temperature $> 275^{\circ}\text{F}$, OPERABILITY of two valves is required because the combined capacity is required to keep reactor coolant pressure below 110% of its design value during certain accidents. MODE 3 and portions of MODE 4 are conservatively included although the listed accidents may not require the safety valves for protection.

The LCO is not applicable in MODE 4 with RNS open and in MODE 5, because LTOP is provided. Overpressure protection is not required in MODE 6 with reactor vessel head detensioned.

The Note allows entry into MODES 3 and 4 with the lift setpoints outside the LCO limits. This permits testing and examination of the safety valves at high pressure and temperature near their normal operating range, but only after the valves have had a preliminary cold setting. The cold setting gives assurance that the valves are OPERABLE near their design condition. Only one valve at a time will be removed from service for testing. The 36 hour exception is based on 18 hour outage time for each of the two valves. The 18 hour period is derived from operating experience that hot testing can be performed in this time frame.

ACTIONS

A.1

With one pressurizer safety valve inoperable, restoration must take place within 15 minutes. The Completion Time of 15 minutes reflects the importance of maintaining the RCS Overpressure Protection System. An inoperable safety valve coincident with an RCS overpressure event could challenge the integrity of the pressure boundary.

B.1 and B.2

If the Required Action of A.1 cannot be met within the required Completion Time or if two pressurizer safety valves are inoperable, the plant must be placed in a MODE in which the requirement does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 4 with the RNS aligned to the RCS and RCS temperature $< 275^{\circ}\text{F}$ within 24 hours.

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

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. With the RNS aligned to the RCS, overpressure protection is provided by the LTOP System. The change from MODE 1, 2, or 3 to MODE 4 reduces the RCS energy (core power and pressure), lowers the potential for large pressurizer insurges, and thereby removes the need for overpressure protection by two pressurizer safety valves.

SURVEILLANCE
REQUIREMENTS

SR 3.4.7.1

SRs are specified in the Inservice Testing Program. Pressurizer safety valves are to be tested one at a time and in accordance with the requirements of ASME Code Section XI (Ref. 4), which provides the activities and Frequency necessary to satisfy the SRs. No additional requirements are specified.

The pressurizer safety valve setpoint is $\pm 3\%$ for OPERABILITY; however, the values are reset to $\pm 1\%$ during the Surveillance to allow for drift.

REFERENCES

1. ASME Boiler and Pressure Vessel Code, Section III, NB 7614.3.
 2. [WCAP-7769, "Topical Report on Overpressure Protection, October 1971."]
 3. Chapter 15, "Accident Analyses."
 4. ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components."
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.8 RCS Operational LEAKAGE

BASES

BACKGROUND

Components that contain or transport the coolant to or from the reactor core comprise the RCS. Component joints are made by welding, bolting, rolling, or pressure loading, and valves isolate connecting systems from the RCS.

During plant life, the joint and valve interfaces can produce varying amounts of reactor coolant LEAKAGE, through either normal operational wear or mechanical deterioration. The purpose of the RCS Operational LEAKAGE LCO is to limit system operation in the presence of LEAKAGE from these sources to amounts that do not compromise safety. This LCO specifies the types and amounts of LEAKAGE.

10 CFR 50, Appendix A, GDC 30 (Ref. 1), requires means for detecting and, to the extent practical, identifying the source of reactor coolant LEAKAGE. Regulatory Guide 1.45 (Ref. 2) describes acceptable methods for selecting leakage detection systems.

The safety significance of RCS LEAKAGE varies widely depending on its source, rate, and duration. Therefore, detecting and monitoring RCS LEAKAGE into the containment area is necessary. Quickly separating the identified LEAKAGE from the unidentified LEAKAGE is necessary to provide quantitative information to the operators, allowing them to take corrective action should a leak occur that is detrimental to the safety of the facility and the public.

A limited amount of LEAKAGE inside containment is expected from auxiliary systems that cannot be made 100% leaktight. LEAKAGE from these systems should be detected, located, and isolated from the containment atmosphere, if possible, to not interfere with RCS LEAKAGE detection.

This LCO deals with protection of the reactor coolant pressure boundary (RCPB) from degradation and the core from inadequate cooling, in addition to preventing the accident analyses radiation release assumptions from being exceeded. The consequences of violating this LCO include the possibility of a loss of coolant accident (LOCA).

(continued)

BASES (continued)

APPLICABLE
SAFETY ANALYSES

Except for primary to secondary LEAKAGE, the safety analyses do not address operational LEAKAGE. However, other operational LEAKAGE is related to the safety analyses for LOCA. The amount of LEAKAGE can affect the probability of such an event. The safety analysis for an event resulting in steam discharge to the atmosphere assumes a 1000 gpd primary to secondary LEAKAGE as the initial condition.

Primary to secondary LEAKAGE is a factor in the dose releases outside containment resulting from a steam line break (SLB) accident. To a lesser extent, other accidents or transients involve secondary steam release to the atmosphere, such as a steam generator tube rupture (SGTR). The leak contaminates the secondary fluid.

The Chapter 15 (Ref. 3) analyses for the accidents involving secondary side releases assume 500 gpd primary to secondary LEAKAGE in each generator as an initial condition. The design basis radiological consequences resulting from a postulated SLB accident and SGTR are provided in Sections 15.1.5 and 15.6.3 of Chapter 15, respectively.

The RCS operational LEAKAGE satisfies Criterion 2 of the NRC Policy Statement.

LCO

RCS operation LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

No pressure boundary LEAKAGE is allowed, being indicative of material deterioration. LEAKAGE of this type is unacceptable as the leak itself could cause further deterioration, resulting in higher LEAKAGE. Violation of this LCO could result in continued degradation of the RCPB. LEAKAGE past seals and gaskets are not pressure boundary LEAKAGE.

b. Unidentified LEAKAGE

0.5 gpm of unidentified LEAKAGE is allowed as a reasonable minimum detectable amount that the containment air N13/F18 radioactivity monitoring and containment sump

(continued)

BASES

LCO

b. Unidentified LEAKAGE (continued)

level monitoring equipment, can detect within a reasonable time period. This leak rate supports leak before break (LBB) criteria. Violation of this LCO could result in continued degradation of the RCPB, if the LEAKAGE is from the pressure boundary.

c. Identified LEAKAGE

Up to 10 gpm of identified LEAKAGE is considered allowable because LEAKAGE is from known sources that do not interfere with detection of unidentified LEAKAGE and is well within the capability of the RCS Makeup System. Identified LEAKAGE includes LEAKAGE to the containment from specifically known and located sources, but does not include pressure boundary LEAKAGE. Violation of this LCO could result in continued degradation of a component or system.

d. Primary to Secondary LEAKAGE through Both Steam Generators (SGs)

Total primary to secondary LEAKAGE through both SGs amounting to 1000 gpd produces acceptable offsite doses in the Steam Line Break (SLB) accident analysis. Violation of this LCO could exceed the offsite dose limits for this accident. Primary to secondary LEAKAGE must be included in the total allowable limit for identified LEAKAGE.

e. Primary to Secondary LEAKAGE through One SG

The 500 gpd limit from one SG is based on the assumption that a single crack leaking this amount would not propagate to a SGTR under the stress conditions of a LOCA or a main steam line rupture.

f. Primary to IRWST LEAKAGE through the PRHR Heat Exchanger (HX)

The 500 gpd limit from the PRHR HX is based on the assumption that a single crack leaking this amount would not lead to a PRHR HX tube rupture under the stress condition of an RCS pressure increase event. If leaked

(continued)

BASES

LCO f. Primary to IRWST LEAKAGE through the PRHR Heat Exchanger (HX) (continued)

through many cracks, the cracks are very small, and the above assumption is conservative. This is conservative because the thickness of the PRHR HX tubes is approximately 60% greater than the thickness of the SG tubes. Furthermore, a PRHR HX tube rupture would result in an isolable leak and would not lead to a direct release of radioactivity to the atmosphere.

APPLICABILITY

In MODES 1, 2, 3, and 4, the potential for RCPB LEAKAGE is greatest when the RCS is pressurized.

In MODES 5 and 6, LEAKAGE limits are not required because the reactor coolant pressure is far lower, resulting in lower stresses and reduced potentials for LEAKAGE.

ACTIONS

A.1

Unidentified LEAKAGE, identified LEAKAGE, or primary to secondary LEAKAGE in excess of the LCO limits must be reduced to within limits within 4 hours. This Completion Time is based on risk considerations and allows time to verify leakage rates and either identify unidentified LEAKAGE or reduce LEAKAGE to within limits before the reactor must be shut down. This action is necessary to prevent further deterioration of the RCPB.

B.1 and B.2

If any pressure boundary LEAKAGE exists, or if unidentified LEAKAGE, identified LEAKAGE, or primary to secondary LEAKAGE cannot be reduced to within limits within 4 hours, the reactor must be brought to lower pressure conditions to reduce the severity of the LEAKAGE and its potential consequences. It should be noted that leakage past seals and gaskets is not pressure boundary LEAKAGE. The reactor must be brought to MODE 3 within 6 hours and to MODE 5 within 36 hours. This action reduces the LEAKAGE and also reduces the factors which tend to degrade the pressure boundary.

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

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 ACTIONS challenging plant systems. In MODE 5, the pressure stresses acting on the RCPB are much lower, and further deterioration is much less likely.

SURVEILLANCE
REQUIREMENTS

SR 3.4.8.1

Verifying RCS LEAKAGE within the LCO limits ensures the integrity of the RCPB is maintained. Pressure boundary LEAKAGE would at first appear as unidentified LEAKAGE and can only be positively identified by inspection.

Unidentified LEAKAGE and identified LEAKAGE are determined by performance of a RCS water inventory balance. Primary to secondary LEAKAGE is also measured by performance of an RCS water inventory balance in conjunction with effluent monitoring within the secondary steam and feedwater systems.

The RCS water inventory balance must be met with the reactor at steady state operating conditions and near operating pressure. Therefore, this SR is not required to be performed in MODES 3 and 4 until 12 hours of steady state operation near operating pressure have been established.

Steady state operation is required to perform a proper inventory balance; calculations during maneuvering are not useful and a Note requires the Surveillance to be met when steady state is established. For RCS operational LEAKAGE determination by inventory balance, steady state is defined as stable RCS pressure, temperature, power level, pressurizer and makeup tank levels, and with no makeup or letdown.

An early warning of pressure boundary LEAKAGE or unidentified LEAKAGE is provided by the automatic systems that monitor the containment atmosphere N13/F18 radioactivity and the containment sump level. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. These LEAKAGE detection systems are specified in LCO 3.4.10, "RCS LEAKAGE Detection Instrumentation."

(continued)

BASES

SURVEILLANCE
REQUIREMENTS

SR 3.4.8.1 (continued)

The containment atmosphere N13/F18 radioactivity leakage measurement is valid only for plant power > 20% RTP.

The containment atmosphere N13/F18 radioactivity leakage measurement during MODE 1 is not valid while containment purge occurs or within 2 hours after the end of containment purge.

The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid while containment purge occurs or within 2 hours after the end of containment purge.

The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid during extremely cold outside ambient conditions when frost is forming in the interior of the containment vessel.

The 72 hour Frequency is a reasonable interval to trend LEAKAGE and recognizes the importance of early leakage detection in the prevention of accidents. A Note under the Frequency column states that this SR is required to be performed during steady state operation.

SR 3.4.8.2

This SR provides the means necessary to determine SG OPERABILITY in an operational MODE. The requirement to demonstrate SG tube integrity in accordance with the Steam Generator Tube Surveillance Program emphasizes the importance of SG tube integrity, even though this Surveillance cannot be performed at normal operating conditions.

REFERENCES

1. 10 CFR 50, Appendix A GDC 30.
 2. Regulatory Guide 1.45, May 1973.
 3. Chapter 15, "Accident Analysis."
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.9 Minimum RCS Flow

BASES

BACKGROUND

The AP600 RCS consists of the reactor vessel and two heat transfer loops, each containing a steam generator (SG), two reactor coolant pumps (RCPs), a single hot leg and two cold legs for circulating reactor coolant. Loop 1 also contains connections to the pressurizer and passive residual heat removal (PRHR).

The primary function of the reactor coolant is removal of decay heat and the transfer of this heat, via the SGs to the secondary plant fluid. The secondary function of the reactor coolant is to act as a carrier for soluble neutron poison, boric acid.

Within the RCS, coolant loop flow can be provided by the reactor coolant pumps, the Normal Residual Heat Removal System (RNS), and to a lesser degree when in the passive mode of operation, natural circulation.

APPLICABLE SAFETY ANALYSES

An initial condition in the Design Basis Accident (DBA) analysis of a possible Boron Dilution Event (BDE) in MODE 3, 4, or 5 is the assumption of a minimum mixing flow in the RCS. In this scenario, dilute water is inadvertently introduced into the RCS, is uniformly mixed with the primary coolant, and flows to the core. The increase in reactivity is detected by the source range instrumentation which provides a signal to terminate the inadvertent dilution before the available SHUTDOWN MARGIN (SDM) is lost. If there is inadequate mixing in the RCS, the dilute water may stratify in the primary system, and there will be no indication by the source range instrumentation that a dilution event is in progress. When primary flow is finally increased, the dilution event may have progressed to the point that mitigation by the source range instrumentation is too late to prevent the loss of SDM.

Thus, a minimum mixing flow in the RCS is a process variable which is an initial condition in a DBA analysis.

(continued)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

Minimum RCS Flow satisfies Criterion 2 of the NRC Policy Statement.

LCO

The requirement that a minimum RCS flow be maintained provides assurance that in the event of an inadvertent BDE, the diluted water will be properly mixed with the primary system coolant, and the increase in core reactivity will be detected by the source range instrumentation.

APPLICABILITY

Minimum RCS flow is required in MODES 3, 4, and 5 because an inadvertent BDE is considered possible in these MODES.

In MODES 1 and 2, LCO 3.4.4 requires all four RCPs to be in operation. Thus, in the event of an inadvertent boron dilution, adequate mixing will occur.

A minimum mixing flow is not required in MODE 6 because LCO 3.9.2 requires that all valves used to isolate unborated water sources shall be secured in the closed position. In this situation, an inadvertent BDE is not considered credible.

ACTIONS

A.1

If no RCP is in operation, all sources of unborated water must be isolated within 1 hour. This action assures that no unborated water will be introduced into the RCS when proper mixing cannot be assured. The allowed Completion Time requires that prompt action be taken, and is based on the low probability of a DBA occurring during this time.

A.2

The Requirement to perform SR 3.1.1.1 (SDM verification) within 1 hour assures that if the boron concentration in the RCS has been reduced and not detected by the source range instrumentation, prompt action may be taken to restore the required SDM. The allowed Completion Time is consistent with that required of Action A.1 because the conditions and consequences are the same.

(continued)

BASES (continued)

SURVEILLANCE
REQUIREMENTS

SR 3.4.9.1

This Surveillance requires verification every 12 hours that a minimum mixing flow is present in the RCS. A Frequency of 12 hours is adequate considering the low probability of an inadvertent BDE during this time, and the ease of verifying the required RCS flow.

REFERENCES

None.

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.10 RCS Leakage Detection Instrumentation

BASES

BACKGROUND

GDC 30 of Appendix A to 10CFR50 (Ref. 1) requires means for detecting, and, to the extent practical, identifying the source of RCS LEAKAGE. Regulatory Guide 1.45 (Ref. 2) describes acceptable methods for selecting LEAKAGE detection systems.

LEAKAGE detection systems must have the capability to detect significant reactor coolant pressure boundary (RCPB) degradation as soon after occurrence as practical to minimize the potential for propagation to a gross failure. Thus, an early indication or warning signal is necessary to permit proper evaluation of all unidentified LEAKAGE.

Industry practice has shown that water flow changes of 0.5 gpm can be readily detected in contained volumes by monitoring changes in water level, in flow rate, or in the operating frequency of a pump. The containment sump used to collect unidentified LEAKAGE, is instrumented to alarm for increases of 0.5 gpm in the normal flow rates. This sensitivity is acceptable for detecting increases in unidentified LEAKAGE.

The reactor coolant contains radioactivity that, when released to the containment, can be detected by radiation monitoring instrumentation. Reactor coolant radioactivity used for leak detection is the decay of N13/F18. The production of N13 and F18 is proportional to the reactor power level. N13 has a short half life and comes to equilibrium quickly. F18 has a longer half life and is the dominant source used for leak detection. Instrument sensitivities for gaseous monitoring are practical for these LEAKAGE detection systems. The Radiation Monitoring System includes monitoring N13/F18 gaseous activities to provide leak detection.

(continued)

BASES (continued)

APPLICABLE
SAFETY ANALYSES

The need to evaluate the severity of an alarm or an indication is important to the operators, and the ability to compare and verify with indications from other systems is necessary. The system response times and sensitivities are described in Chapter 15 (Ref. 3).

The safety significance of RCS LEAKAGE varies widely depending on its source, rate, and duration. Therefore, detecting and monitoring RCS LEAKAGE into the containment area is necessary. Quickly separating the identified LEAKAGE from the unidentified LEAKAGE provides quantitative information to the operators, allowing them to take corrective action should a leak occur.

RCS LEAKAGE detection instrumentation satisfies Criterion 1 of the NRC Policy Statement.

LCO

One method of protecting against large RCS LEAKAGE derives from the ability of instruments to rapidly detect extremely small leaks. This LCO requires instruments of diverse monitoring principles to be OPERABLE to provide a high degree of confidence that small leaks are detected in time to allow actions to place the plant in a safe condition, when RCS LEAKAGE indicates possible RCPB degradation.

The LCO is satisfied when monitors of diverse measurement means are available. Thus, the containment sump level monitor, in combination with an N13/F18 gaseous activity monitor, provides an acceptable minimum. Containment sump level monitoring is performed by two redundant, seismically qualified level instruments. The LCO note clarifies that if leakage is prevented from draining to the sump, its level change measurements made by operable sump level instruments will not be valid for quantifying the leakage.

APPLICABILITY

Because of elevated RCS temperature and pressure in MODES 1, 2, 3, and 4, RCS LEAKAGE detection instrumentation is required to be OPERABLE.

In MODE 5 or 6, the temperature is $\leq 200^{\circ}\text{F}$ and pressure is maintained low or at atmospheric pressure. Since the temperatures and pressures are lower than those for MODES 1, 2, 3, and 4, the likelihood of leakage and crack propagation are much smaller. Therefore, the requirements of this LCO are not applicable in MODES 5 and 6.

(continued)

BASES

APPLICABILITY
(continued)

Containment sump level monitoring is a valid method for detecting leakage in MODES 1, 2, 3, and 4. The containment atmosphere N13/F18 radioactivity leakage measurement during MODE 1 is valid only for reactor power > 20% RTP. RCS inventory monitoring via the pressurizer level changes is valid in MODES 1, 2, 3, and 4 only when RCS conditions are stable, i.e., temperature is constant, pressure is constant, no makeup and no letdown.

The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid while containment purge occurs or within 2 hours after the end of containment purge.

The containment atmosphere N13/F18 radioactivity leakage measurement during MODE 1 is not valid while containment purge occurs or within 2 hours after the end of containment purge.

The containment sump level change method of detecting leaks during MODES 1, 2, 3, and 4 is not valid during extremely cold outside ambient conditions when frost is forming on the interior of the containment vessel.

ACTIONSA.1 and A.2

With two containment sump level channels inoperable, no other form of sampling can provide the equivalent information; however, the containment atmosphere N13/F18 radioactivity monitor will provide indications of changes in LEAKAGE. Together with the atmosphere monitor, the periodic surveillance for RCS inventory balance, SR 3.4.8.1, must be performed at an increased frequency of 24 hours to provide information that is adequate to detect LEAKAGE.

Restoration of one sump channel to OPERABLE status is required to regain the function in a Completion Time of 72 hours after the monitor's failure. This time is acceptable, considering the frequency and adequacy of the RCS inventory balance required by Action A.1.

(continued)

BASES

ACTIONS
(continued)

B.1.1, B.1.2, and B.2

With one gaseous N13/F18 containment atmosphere radioactivity-monitoring instrumentation channel inoperable, alternative action is required. Either grab samples of the containment atmosphere must be taken and analyzed or RCS inventory balanced, in accordance with SR 3.4.8.1, to provide alternate periodic information.

With a sample obtained and analyzed or an RCS inventory balance performed every 24 hours, the reactor may be operated for up to 30 days to allow restoration of the radioactivity monitor.

The 24 hours interval for grab samples or RCS inventory balance provides periodic information that is adequate to detect LEAKAGE. The 30 day Completion Time recognizes at least one other form of leak detection is available.

Required Action B.1 and Required Action B.2 are modified by a Note that indicates that the provisions of LCO 3.0.4 are not applicable. As a result, a MODE change is allowed when the gaseous N13/F18 containment atmosphere radioactivity monitor channel is inoperable. This allowance is provided because other instrumentation is available to monitor for RCS LEAKAGE.

C.1 and C.2

If a Required Action of Condition A or B cannot be met within the required Completion Time, the reactor must be brought to MODE 5 where the probability and consequences of an event are minimized. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner without challenging plant systems.

(continued)

BASES (continued)

SURVEILLANCE
REQUIREMENTS

SR 3.4.10.1

SR 3.4.10.1 requires the performance of a CHANNEL CHECK of the containment atmosphere N13/F18 radioactivity monitor. The check gives reasonable confidence that the channel is operating properly. The Frequency of 12 hours is based on instrument reliability and risk and is reasonable for detecting off normal conditions.

SR 3.4.10.2

SR 3.4.10.2 requires the performance of a CHANNEL OPERATIONAL TEST (COT) on the atmosphere N13/F18 radioactivity monitor. The test ensures that the monitor can perform its function in the desired manner. The test verifies the alarm setpoint and relative accuracy of the instrument string. The Frequency of 92 days considers risks and instrument reliability, and operating experience has shown that it is proper for detecting degradation.

SR 3.4.10.3 and SR 3.4.10.4

These SRs require the performance of a CHANNEL CALIBRATION for each of the RCS Leakage detection instrumentation channels. The calibration verifies the accuracy of the instrument string, including the instruments located inside containment. The Frequency of 24 months is a typical refueling cycle and considers channel reliability. Again, operating experience has proven that this Frequency is acceptable.

REFERENCES

1. 10 CFR 50, Appendix A, Section IV, GDC 30.
 2. Regulatory Guide 1.45, "Reactor Coolant Pressure Boundary LEAKAGE Detection Systems," U.S. Nuclear Regulatory Commission.
 3. Chapter 15, "Accident Analysis."
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.11 RCS Specific Activity

BASES

BACKGROUND

The limits on RCS specific activity ensure that the doses due to postulated accidents are within the doses reported in Chapter 15.

The RCS specific activity LCO limits the allowable concentration of iodines and noble gases in the reactor coolant. The LCO limits are established to be consistent with a fuel defect level of 0.25 percent and to ensure that plant operation remains within the conditions assumed for shielding and Design Basis Accident (DBA) release analyses.

The LCO contains specific activity limits for both DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133. The allowable levels are intended to limit the doses due to postulated accidents to within the values calculated in the radiological consequences analyses (as reported in Chapter 15).

APPLICABLE
SAFETY ANALYSES

The LCO limits on the reactor coolant specific activity are a factor in accident analyses that assume a release of primary coolant to the environment either directly as in a Steam Generator Tube Rupture (SGTR) or indirectly by way of LEAKAGE to the secondary coolant system and then to the environment (the Steam Line Break).

The events which incorporate the LCO values for primary coolant specific activity in the radiological consequence analysis include the following:

- Steam generator tube rupture (SGTR)
- Steam line break (SLB)
- Locked RCP rotor
- Rod ejection
- Small line break outside containment
- Loss of AC power
- Loss of coolant accident (LOCA) (early stages)

The limiting event for release of primary coolant activity is the SGTR. The tube rupture dose analysis considers the

(continued)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

possibility of a pre-existing iodine spike (in which case the maximum LCO of 24 $\mu\text{Ci/gm}$ DOSE EQUIVALENT I-131 is assumed) as well as the more likely initiation of an iodine spike due to the reactor trip and depressurization. In the latter case, the LCO of 0.4 $\mu\text{Ci/gm}$ DOSE EQUIVALENT I-131 is assumed at the initiation of the accident, but the primary coolant specific activity is assumed to increase with time due to the elevated iodine appearance rate in the coolant. The reactor coolant noble gas specific activity for both cases is assumed to be the LCO of 150 $\mu\text{Ci/gm}$ DOSE EQUIVALENT XE-133.

The LCO limits ensure that, in either case, the doses reported in Chapter 15 remain bounding.

The RCS specific activity satisfies Criterion 2 of the NRC Policy Statement.

LCO

The specific iodine activity is limited to 0.4 $\mu\text{Ci/gm}$ DOSE EQUIVALENT I-131, and the specific noble gas activity is limited to 150 $\mu\text{Ci/gm}$ DOSE EQUIVALENT XE-133. These limits ensure that the doses resulting from a DBA will be within the values reported in Chapter 15.

The SGTR accident analysis (Ref. 1) shows that the offsite doses are within acceptance limits. Violation of the LCO may result in reactor coolant radioactivity levels that could, in the event of a SGTR accident, lead to doses that exceed those reported Chapter 15.

APPLICABILITY

In MODES 1 and 2, and in MODE 3 with RCS average temperature > 500°F, operation within the LCO limits for DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133 specific activity are necessary to contain the potential consequences of a SGTR to within the calculated site boundary dose values.

For operation in MODE 3 with RCS average temperature < 500°F and in MODES 4 and 5, the release of radioactivity in the event of a SGTR is unlikely since the saturation pressure of the reactor coolant is below the lift pressure settings of the main steam safety valves.

(continued)

BASES (continued)

ACTIONS

A Note to the ACTIONS excludes the MODE change restriction of LCO 3.0.4. This exception allows entry into the applicable MODE(S) while relying on the ACTIONS even though the ACTIONS may eventually require plant shutdown. This exception is acceptable due to the significant conservatism incorporated into the specific activity limit, the low probability of an event which is limiting due to exceeding this limit, and the ability to restore transient specific activity excursions while the plant remains at, or proceeds to power operation.

A.1 and A.2

With the DOSE EQUIVALENT I-131 greater than the LCO limit, samples at intervals of 4 hours must be taken to verify that DOSE EQUIVALENT I-131 is $\leq 24 \mu\text{Ci/gm}$. The Completion Time of 4 hours is required to obtain and analyze a sample. Sampling is to continue to provide a trend.

The DOSE EQUIVALENT I-131 must be restored to normal within 48 hours. If the concentration cannot be restored to within the LCO limit in 48 hours, it is assumed that the LCO violation is not the result of normal iodine spiking.

B.1 and B.2

With DOSE EQUIVALENT XE-133 in excess of the allowed limit, an analysis must be performed within 4 hours to determine DOSE EQUIVALENT I-131. The allowed Completion Time of 4 hours is required to obtain and analyze a sample.

The change to MODE 3 and RCS average temperature $< 500^\circ\text{F}$ lowers the saturation pressure of the reactor coolant below the set points of the main steam safety valves, and prevents venting the SG to the environment in a SGTR event. 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, without challenging plant systems.

C.1

If a Required Action and the associated Completion Time of Condition A is not met or if the DOSE EQUIVALENT I-131 is $> 24 \mu\text{Ci/gm}$., the reactor must be brought to MODE 3 with RCS

(continued)

BASES

ACTIONS

C.1 (continued)

average temperature < 500°F within 6 hours. The Completion Time of 8 hours is reasonable, based on operation experience, to reach MODE 3 below 500°F from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE
REQUIREMENTS

SR 3.4.11.1

SR 3.4.11.1 requires performing a measure of the noble gas specific activity of the reactor coolant at least once every 7 days. This is a quantitative measure of radionuclides with half lives longer than 15 minutes. This Surveillance provides an indication of any increase in the release of noble gas activity from fuel rods containing cladding defects.

Trending the results of this Surveillance allows proper remedial action to be taken before reaching the LCO limit under normal operating conditions. The 7 day Frequency considers the unlikelihood of a significant increase in fuel defect level during the time.

SR 3.4.11.2

This Surveillance is performed in MODE 1 only to ensure iodine remains within limit during normal operation and following fast power changes when increased releases of iodine from the fuel (iodine spiking) is apt to occur. The 14 day Frequency is adequate to trend changes in the iodine activity level, considering gross activity is monitored every 14 days. The Frequency, between 2 and 6 hours after a power change of $\geq 15\%$ RTP within a 1 hour period, is established because the iodine levels peak during this time following fuel failures; samples at other times would provide inaccurate results.

REFERENCES

1. Section 15.6.3, "Steam Generator Tube Rupture."
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.12 Automatic Depressurization System (ADS) - Operating

BASES

BACKGROUND

The ADS is designed to assure that core cooling and injection can be achieved for Design Basis Accidents (DBA). The four stages of ADS valves are sequenced in coordination with the passive core cooling system injection performance characteristics.

The ADS consists of 10 flow paths arranged in four different stages that open sequentially (Ref. 1). Stages 1, 2, and 3 each include 2 flow paths. Each of the stage 1, 2, 3 flow paths has a common inlet header connected to the top of the pressurizer. The outlets of the stage 1, 2, 3 flow paths combine into one of the two common discharge lines to the spargers located in the incontainment refueling water storage tank (IRWST). The first stage valves are 4 inch valves with DC motor operators. The second and third stage valves are 8 inch valves with DC motor operators. An OPERABLE stage 1, 2, or 3 automatic depressurization flow path consists of two OPERABLE normally closed motor operated valves, in series.

Stage 4 includes 4 flow paths. The fourth stage ADS valves are squib valves. The four fourth stage flow paths connect directly to the top of the reactor coolant hot legs and vent directly into the associated steam generator compartment. An OPERABLE stage 4 flow path consists of an open motor operated valve and an OPERABLE closed squib valve. These motor operated valves are not required to be OPERABLE because they are open.

The automatic depressurization valves are designed to open automatically when actuated, and to remain open for the duration of any automatic depressurization event. The valves are actuated sequentially. The stage 1 valves are actuated on a low core makeup tank (CMT) level. Stages 2 and 3 are actuated on the stage 1 signal plus time delays. Stage 4 is actuated on a Low 2 CMT level signal with a minimum time delay after stage 3. Stage 4 is blocked from actuating at normal RCS pressure.

In order to perform a controlled, manual depressurization of the RCS, the valves are opened starting with the first

(continued)

BASES

BACKGROUND
(continued)

stage. The first stage valves can also be modulated to perform a partial RCS depressurization if required. ADS stage 1, 2, 3 valves may be manually operated under controlled conditions for testing purposes.

ADS stages 1, 2 and 3 valves are designed to open relatively slowly, from approximately 25 seconds for the first stage valves, to approximately 70 seconds for the second and third stage valves.

The ADS valves are powered by batteries. In the unlikely event that offsite and onsite AC power is lost for an extended period of time, a timer will actuate ADS within 24 hours of the time at which AC power is lost, before battery power has been degraded to the point where the valves cannot be opened.

The number and capacity of the ADS flow paths are selected so that adequate safety injection is provided from the accumulators, IRWST and containment recirculation for the limiting DBA loss of coolant accident (LOCA). For small break LOCAs the limiting single failure is the loss of one fourth stage flow path (Ref. 2). The PRA (Ref. 3) shows that adequate core cooling can be provided with the failure of two (or more) flow paths.

APPLICABLE
SAFETY ANALYSES

For non-LOCA events, use of the ADS is not required and is not anticipated. For these events, injection of borated water into the core from the CMTs may be required for makeup or boration. However, the amount of water necessary will not reduce the level in the CMTs to the point of ADS actuation.

For LOCA events, it is anticipated that the ADS will be actuated, allowing injection from the accumulators, the IRWST, and the containment recirculation sump if containment flooding occurs.

LCO

The requirement that the 16 ADS valves be OPERABLE ensures that upon actuation, the depressurization of the RCS will proceed smoothly and completely, as assumed in the DBA safety analyses.

(continued)

BASES

LCO
(continued) For the ADS to be considered OPERABLE, the 16 ADS valves must be closed and OPERABLE (capable of opening on an actuation signal). In addition, the stage 4 motor operated isolation valves must be open. These stage 4 motor operated isolation valves are not required to be OPERABLE because they are maintained open per SR 3.4.12.1.

APPLICABILITY In MODES 1, 2, 3 and 4 the ADS must be OPERABLE to mitigate the potential consequences of any event which causes a reduction in the RCS inventory, such as a LOCA.

The requirements for the ADS in MODES 5 and 6 are specified in LCO 3.4.13, "Automatic Depressurization System (ADS) – Shutdown, RCS Intact," and LCO 3.4.14, "Automatic Depressurization System – Shutdown, RCS Open."

ACTIONS

A.1

If any one, or if two flow paths, consisting of one stage 1 and one stage 2 or 3, are determined to be inoperable, the remaining OPERABLE ADS flow paths are adequate to perform the required safety function as long as a single failure does not also occur. A flow path is inoperable if one or two of the ADS valves in the flow path are determined to be inoperable. A Completion Time of 72 hours is reasonable based on the capability of the remaining ADS valves to perform the required safety functions assumed in the safety analyses and the low probability of a DBA during this time period. This Completion Time is the same as is used for two train ECCS systems which are capable of performing their safety function without a single failure.

B.1 and B.2

If the Required Actions and associated Completion Times are not met or the requirements of LCO 3.4.12 are not met for reasons other than Condition A, the plant must be brought to MODE 5 where the probability and consequences on an event are minimized. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner, without challenging plant systems.

(continued)

BASES (continued)

SURVEILLANCE
REQUIREMENTS

SR 3.4.12.1

Each stage 4 ADS isolation motor operated valve must be verified to be open every 12 hours. Note that these valves receive confirmatory open signals. The Surveillance Frequency is acceptable considering valve position is manually monitored in the control room.

SR 3.4.12.2

This Surveillance requires verification that each ADS stage 1, 2, 3 valve strokes to its fully open position. Note that this surveillance is performed during shutdown conditions.

The Surveillance Frequency for demonstrating valve OPERABILITY references the Inservice Testing Program.

SR 3.4.12.3

This Surveillance requires verification that each ADS stage 4 squib valve is OPERABLE in accordance with the Inservice Testing Program. The Surveillance Frequency for verifying valve OPERABILITY references the Inservice Testing Program.

The squib valves will be tested in accordance with ASME Section XI which specifies valve testing in accordance with the ASME OM Code. The applicable ASME OM Code squib valve requirements are specified in paragraph 4.6, Inservice Tests for Category D Explosively Actuated Valves. The requirements include actuation of a sample of the installed valves each 2 years and periodic replacement of charges.

REFERENCES

1. Section 6.3, "Passive Core Cooling System."
 2. Section 15.6, "Decrease in Reactor Coolant Inventory."
 3. AP600 Probabilistic Risk Assessment, Appendix A.
 4. Section 3.9.6, "Inservice Testing of Pumps and Valves."
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.13 Automatic Depressurization System (ADS) - Shutdown, RCS Intact

BASES

BACKGROUND A description of the ADS is provided in the Bases for LCO 3.4.12, "Automatic Depressurization System (ADS) - Operating."

APPLICABLE SAFETY ANALYSES For non-LOCA events, use of the ADS is not required and is not anticipated. For these events, injection of borated water into the core from the core makeup tanks (CMTs) may be required for makeup or boration. However, the amount of water necessary will not reduce the level in the CMTs to the point of ADS actuation.

For postulated shutdown events occurring in MODE 5 (as presented in Reference 2) it is anticipated that the ADS will be actuated, allowing injection from the in-containment refueling water storage tank (IRWST) and the containment recirculation sump if containment flooding occurs.

LCO The requirement that 9 ADS flow paths be OPERABLE assures that upon actuation, the depressurization of the RCS will proceed smoothly and completely, as assumed in the DBA safety analyses.

An ADS stage 1, 2, or 3 flow path is considered OPERABLE if both valves in the line are closed and OPERABLE (capable of opening on an actuation signal). In addition, an ADS stage 4 flow path is operable if the motor operated isolation valve is open and the squib valve is closed and OPERABLE (capable of opening on an actuation signal).

APPLICABILITY In MODE 5 with the reactor coolant pressure boundary (RCPB) intact, 9 flow paths of the ADS must be OPERABLE to mitigate the potential consequences of any event which causes a reduction in the RCS inventory, such as a LOCA.

(continued)

BASES

APPLICABILITY (continued) The requirements for the ADS in MODES 1 through 4 are specified in LCO 3.4.12, "Automatic Depressurization System (ADS) – Operating;" and in MODE 5 with the RCS pressure boundary open and MODE 6 in LCO 3.4.14, "Automatic Depressurization System (ADS) – Shutdown, RCS Open."

ACTIONS

A.1

If any one, or if two flow paths, consisting of one stage 1 and one stage 2 or 3, are determined to be inoperable, the remaining OPERABLE ADS flow paths are adequate to perform the required safety function. A flow path is inoperable if one or two of the ADS valves in the flow path are determined to be inoperable. A Completion Time of 72 hours is acceptable since the OPERABLE ADS paths can mitigate shutdown events without a single failure.

B.1

If the Required Actions and associated Completion Times are not met or the requirements of LCO 3.4.13 are not met for reasons other than Condition A, the plant must be placed in a MODE in which this LCO does not apply. Action must be initiated, immediately, to place the plant in MODE 5 with the RCS pressure boundary open and $\geq 20\%$ pressurizer level.

SURVEILLANCE REQUIREMENTS

SR 3.4.13.1

The LCO 3.4.12 Surveillance Requirements (SR 3.4.12.1) are applicable to the ADS valves required to be OPERABLE. The Frequencies associated with each specified SR are applicable. Refer to the corresponding Bases for LCO 3.4.12 for a discussion of each SR.

REFERENCES

1. AP600 Probabilistic Risk Assessment, Appendix A.
 2. WCAP-14837, "AP600 Shutdown Evaluation Report," Revision 3, March 1998.
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.14 Automatic Depressurization System (ADS) – Shutdown, RCS Open

BASES

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| BACKGROUND | A description of the ADS is provided in the Bases for LCO 3.4.12, "Automatic Depressurization System (ADS) – Operating." |
| APPLICABLE SAFETY ANALYSES | <p>When the plant is shutdown with the RCS depressurized, the core makeup tanks (CMTs) are isolated to prevent CMT injection. Since the ADS is actuated by low CMT level, automatic actuation of the ADS is not available. The required ADS stage 1, 2, and 3 vent paths are opened and two ADS stage 4 flow paths are OPERABLE to ensure that in-containment refueling water storage tank (IRWST) injection can occur, if needed to mitigate events requiring RCS makeup, boration or core cooling.</p> <p>The ADS vent path must be maintained until the upper internals are removed, providing an adequate vent path for IRWST injection.</p> |
| LCO | <p>The requirement that ADS stage 1, 2, and 3 flow paths be open, from the pressurizer through the spargers into the IRWST, and that two ADS stage 4 flow paths be OPERABLE assures that sufficient vent area is available to support IRWST injection.</p> <p>The Note allows closure of the RCS pressure boundary when the pressurizer level is < 20% to facilitate vacuum refill following mid-loop operations to establish a pressurizer water level ≥ 20%. Prior to closure of the ADS valves, compliance with LCO 3.4.13, ADS – Shutdown, RCS Intact, should be verified.</p> |
| APPLICABILITY | In MODE 5 with the reactor coolant system pressure boundary (RCPB) open or pressurizer level < 20% and in MODE 6 with the upper internals in place, the stage 1, 2, and 3 ADS vent paths must be open and two ADS stage 4 flow paths be OPERABLE. |

(continued)

BASES

APPLICABILITY
(continued)

The requirements for the ADS in MODES 1 through 4 are specified in LCO 3.4.12, "Automatic Depressurization System (ADS) – Operating;" and in MODE 5 with the RCPB intact in LCO 3.4.13, "Automatic Depressurization System (ADS) – Shutdown, RCS Intact."

ACTIONS

A.1 and A.2

If one required ADS stage 1, 2, or 3 flow path is closed, action must be taken to open the affected path or establish an alternative flow path within 72 hours. In this Condition the remaining open ADS stage 1, 2, and 3 flow paths and the OPERABLE ADS stage 4 flow paths are adequate to perform the required safety function without an additional single failure. The stage 4 valves would have to be opened by the operator in case of an event in this MODE. The required vent area may be restored by opening the affected ADS flow path or an alternate vent path with an equivalent area. Considering that the required function is available in this Condition a Completion Time of 72 hours is acceptable.

B.1 and B.2

If one required ADS stage 4 flow path is closed and inoperable, action must be taken to establish an alternative flow path, or restore at least two stage 4 flow paths to OPERABLE status within 36 hours. In this Condition the remaining open ADS stage 1, 2, and 3 flow paths and the one OPERABLE ADS stage 4 flow path are adequate to perform the required safety function without an additional single failure. The required vent area may be restored by opening an alternate vent path with an equivalent area. Alternatively, two stage 4 flow paths may be restored to OPERABLE status. Therefore a Completion Time of 36 hours is considered acceptable.

C.1 and C.2

If the Required Actions and associated Completion Times are not met or the requirements of LCO 3.4.14 are not met for reasons other than Conditions A or B while in MODE 5, the plant must be placed in a condition which minimizes the potential for requiring ADS venting and IRWST injection. The time to RCS boiling is maximized by increasing RCS inventory to $\geq 20\%$ pressurizer level and maintaining RCS temperature as low as practical.

(continued)

BASES

ACTIONS

C.1 and C.2 (continued)

Additionally, action to suspend positive reactivity additions is required to ensure that the shutdown margin is maintained. Sources of positive reactivity addition include boron dilution, withdrawal of reactivity control assemblies, and excessive cooling of the RCS.

D.1 and D.2

If the Required Actions and associated Completion Times are not met or the requirements of LCO 3.4.14 are not met for reasons other than Conditions A or B while in MODE 6, the plant must be placed in a condition which precludes the need for the ADS vent paths. Action must be initiated, immediately, to remove the upper internals, providing the required vent path. The time to RCS boiling is maximized by increasing RCS inventory and maintaining RCS temperature as low as practical. Additionally, action to suspend positive reactivity additions is required to ensure that the shutdown margin is maintained. Sources of positive reactivity addition include boron dilution, withdrawal of reactivity control assemblies, and excessive cooling of the RCS.

SURVEILLANCE
REQUIREMENTS

SR 3.4.14.1

Each required ADS flow path is verified to be open by verifying that the stage 1, 2, and 3 valves are in their fully open position every 12 hours, as indicated in the control room. This Surveillance Frequency is acceptable based on administrative controls which preclude repositioning the valves.

SR 3.4.14.2

The LCO 3.4.12 Surveillance Requirements (SR 3.4.12.1 and SR 3.4.12.3) are applicable to the stage 4 ADS valves required to be OPERABLE. The Frequencies associated with each specified SR are applicable. Refer to the corresponding Bases for LCO 3.4.12 for a discussion of each SR.

REFERENCES

None.

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.15 Low Temperature Overpressure Protection (LTOP) System

BASES

BACKGROUND

The LTOP System limits RCS pressure at low temperatures so that the integrity of the reactor coolant pressure boundary (RCPB) is not compromised by violating the pressure and temperature (P/T) limits of 10 CFR 50, Appendix G (Ref. 1). The reactor vessel is the limiting RCPB component for demonstrating such protection. The PTLR provides the limits which set the maximum allowable setpoints for the Normal Residual Heat Removal System (RNS) suction relief valve. LCO 3.4.3 provides the maximum RCS pressure for the existing RCS cold leg temperature during cooldown, shutdown, and heatup to meet the Reference 1 requirements during the LTOP MODES.

The reactor vessel material is less tough at low temperatures than at normal operating temperature. As the vessel neutron exposure accumulates, the material toughness decreases and becomes less resistant to pressure stress at low temperatures (Ref. 2). RCS pressure, therefore, is maintained low at low temperatures and is increased only as temperature is increased.

The potential for vessel overpressurization is most acute when the RCS is water solid, occurring only while shutdown; a pressure fluctuation can occur more quickly than an operator can react to relieve the condition. Exceeding the RCS P/T limits by a significant amount could cause brittle cracking of the reactor vessel. LCO 3.4.3, "RCS Pressure and Temperature (P/T) Limits," requires administrative control of RCS pressure and temperature during heatup and cooldown to prevent exceeding the PTLR limits.

This LCO provides RCS overpressure protection by having a maximum coolant input capability and having adequate pressure relief capacity. Limiting coolant input capability requires isolating the accumulators. The pressure relief capacity requires the RNS suction relief valve or a depressurized RCS and an RCS vent of sufficient size. The RNS suction relief valve or the open RCS vent is the overpressure protection device that acts to terminate an increasing pressure event.

(continued)

BASES

BACKGROUND
(continued)

RNS Suction Relief Valve Requirements

During the LTOP MODES, the RNS system is operated for decay heat removal. Therefore, the RNS suction isolation valves are open in the piping from the RCS hot legs to the inlet of the RNS system. While these valves are open, the RNS suction relief valve is exposed to the RCS and able to relieve pressure transients in the RCS.

The RNS suction relief valve is a spring loaded, water relief valve with a pressure tolerance and an accumulation limit established by Section III of the American Society of Mechanical Engineers (ASME) Code (Ref. 3) for Class 2 relief valves.

The RNS suction isolation valves must be open to make the RNS suction relief valves OPERABLE for RCS overpressure mitigation.

RCS Vent Requirements

Once the RCS is depressurized, a vent exposed to the containment atmosphere will maintain the RCS at containment ambient pressure in an RCS overpressure transient, if the relieving requirements of the transient do not exceed the capabilities of the vent. Thus, the vent path must be capable of relieving the flow resulting from the limiting LTOP mass or heat input transient, and maintaining pressure below the P/T limits. The required vent capacity may be provided by one or more vent paths.

For an RCS vent to meet the flow capacity requirement, it may require removing one or more pressurizer safety valves or manually opening one or more Automatic Depressurization System (ADS) valves. The vent path(s) must be above the level of reactor coolant, so as not to drain the RCS when open.

APPLICABLE
SAFETY ANALYSES

Safety analyses (Ref. 4) demonstrate that the reactor vessel is adequately protected against exceeding the Reference 1 P/T limits. In MODES 1, 2, and 3, and in MODE 4 with the RCS temperature above 275°F, the pressurizer safety valves will prevent RCS pressure from exceeding the Reference 1 limits. When the RNS is aligned and open to the

(continued)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

RCS, overpressure protection is provided by the RNS suction relief valve, or a depressurized RCS and a sufficiently sized open RCS vent.

The actual temperature at which the pressure in the P/T limit curve falls below the suction relief setpoint increases as the reactor vessel material toughness decreases due to neutron embrittlement. Each time the PTLR curves are revised, the LTOP System must be re-evaluated to ensure its functional requirements can still be met using the RNS suction relief valve, or the depressurized and vented RCS condition.

The PTLR contains the acceptance limits that define the LTOP requirements. Any change to the RCS must be evaluated against the Reference 4 analyses to determine the impact of the change on the LTOP acceptance limits.

Transients that are capable of overpressurizing the RCS are categorized as either mass or heat input transients. The events listed below were used in the analysis to size the RNS suction relief valve. Therefore, any events with a mass or heat input greater than the listed events cannot be accommodated and must be prevented.

Mass Input

- a. Makeup water flow rate to the RCS assuming both CVS makeup pumps are in operation and letdown is isolated.

Heat Input

- a. Restart of one reactor coolant pump (RCP) with water in the steam generator secondary side 50°F hotter than the primary side water, and the RCS water solid.

RNS Suction Relief Valve Performance

Since the RNS suction relief valve does not have a variable P/T lift setpoint, the analysis must show that with chosen setpoint, the relief valve will pass flow greater than that required for the limiting LTOP transient while maintaining RCS pressure less than the P/T limit curve. The current analysis shows that up to a temperature of 205°F, the mass input transient is limiting, and above this temperature the heat input transient is limiting.

(continued)

BASES

APPLICABLE
SAFETY ANALYSES
(continued)

To prevent the possibility of a heat input transient, and thereby limit the required flow rate of the RNS suction relief valve, an administrative requirement has been imposed that does not allow an RCP to be started with the pressurizer water level above 92% and the RCS temperature above 200°F. Under these imposed conditions, the transient created by the startup of an RCP when the RCS temperature is above 200°F can be accommodated without additional pressure relief.

RCS Vent Performance

With the RCS depressurized, a vent size of [5.4] square inches is capable of mitigating a limiting overpressure transient. The area of the vent is equivalent to the area of the inlet pipe to the RNS suction relief valve so the capacity of the vent is greater than the flow possible with either the mass or heat input transient, while maintaining the RCS pressure less than the maximum pressure on the P/T limit curve.

The required vent area may be obtained by opening one ADS flow path.

The RCS vent size will be reevaluated for compliance each time the P/T limit curves are revised based on the results of the vessel material surveillance.

The RCS vent is passive and is not subject to active failure.

The LTOP System satisfies Criterion 2 of the NRC Policy Statement.

LCO

This LCO requires that the LTOP System is OPERABLE. The LTOP System is OPERABLE when the maximum coolant input and minimum pressure relief capabilities are OPERABLE. Violation of this LCO could lead to the loss of low temperature overpressure mitigation and violation of the Reference 1 limits as a result of an operational transient.

To limit the coolant input capability, the LCO requires all accumulator discharge isolation valves closed and immobilized, when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS temperature allowed in the PTLR. (continued)

BASES

LCO
(continued)

The elements of the LCO that provide low temperature overpressure mitigation through pressure relief are:

- a. One OPERABLE RNS suction relief valve; or

An RNS suction relief valve is OPERABLE for LTOP when both RNS suction isolation valves in one flow path are open, its setpoint is within limits, and testing has proven its ability to open at this setpoint.

- b. A depressurized RCS and an RCS vent.

An RCS vent is OPERABLE when open with an area of \geq [5.4] square inches.

Each of these methods of overpressure prevention is capable of mitigating the limiting LTOP transient.

APPLICABILITY

This LCO is applicable in MODE 4 with the RCS temperature below 275°F, MODE 5, and in MODE 6 when the reactor vessel head is on. The pressurizer safety valves provide overpressure protection that meets the Reference 1 P/T limits above 275°F. In MODE 6, the reactor vessel head is off, and overpressurization cannot occur.

LCO 3.4.3 provides the operational P/T limits for all MODES. LCO 3.4.7, "Pressurizer Safety Valves," requires the OPERABILITY of the pressurizer safety valves that provide overpressure protection during MODES 1, 2, and 3, and MODE 4 with the RNS isolated or RCS temperature \geq 275°F.

Low temperature overpressure prevention is most critical during shutdown when the RCS is water solid, and a mass or heat input transient can cause a very rapid increase in RCS pressure with little or no time for operator action to mitigate the event.

The Applicability is modified by a Note stating that accumulator isolation is only required when the accumulator pressure is more than or at the maximum RCS pressure for the existing temperature, as allowed by the P/T limit curves.

This Note permits the accumulator discharge isolation valve Surveillance to be performed only under these pressure and temperature conditions.

(continued)

BASES (continued)

ACTIONS

A.1, B.1, and B.2

An unisolated accumulator requires isolation within 1 hour. This is only required when the accumulator pressure is at or more than the maximum RCS pressure for the existing temperature allowed by the P/T limit curves.

If isolation is needed and cannot be accomplished in 1 hour, Required Action B.1 and Required Action B.2 provide two options, either of which must be performed in the next 12 hours. By increasing the RCS temperature to > 275°F, the accumulator pressure cannot exceed the LTOP limits if the accumulators are fully injected. Depressurizing the accumulators below the LTOP limit from the PTLR also gives this protection.

The Completion Times are based on operating experience that these activities can be accomplished in these time periods and on engineering evaluations indicating that an event requiring LTOP is not likely in the allowed times.

C.1 and C.2

If the RNS suction relief valve is inoperable and the RCS is not depressurized, there is a potential to overpressurize the RCS and exceed the limits allowed in LCO 3.4.3. The suction relief valve is considered inoperable if the RNS isolation valves have isolated the RNS from the RCS in such a way that the suction relief valve cannot perform its intended safety function, or if the valve itself will not operate to perform its intended safety function.

Under these conditions, Required Actions C.1 or C.2 provide two options, either of which must be accomplished in 8 hours. If the RNS suction relief valve cannot be restored to operable status, the RCS must be depressurized and vented with a RCS vent which provides a flow area sufficient to mitigate any of the design low temperature overpressure events.

The 8 hour Completion Time represents a reasonable time to repair the relief valve, open the RNS isolation valves or otherwise restore the system to OPERABLE status, or depressurize and vent the RCS, without imposing a lengthy period when the LTOP system is not able to mitigate a low temperature overpressure event.

(continued)

BASES (continued)

SURVEILLANCE
REQUIREMENTS

SR 3.4.15.1

To minimize the potential for a low temperature overpressure event by limiting the mass input capability, the accumulator discharge isolation valves are verified closed and locked out. The Frequency of 12 hours is sufficient considering other indications and alarms available to the operator in the main control room to verify the required status of the equipment.

SR 3.4.15.2

The RNS suction relief valve shall be demonstrated OPERABLE by verifying two RNS suction isolation valves in one flow path are open. This Surveillance is only performed if the RNS suction relief valve is being used to satisfy this LCO.

The RNS suction isolation valves are verified to be opened every 12 hours. The Frequency is considered adequate in view of other administrative controls such as valve status indications available to the operator in the control room that verify the RNS suction isolation valves remain open.

SR 3.4.15.3

The RCS vent of \geq [5.4] square inches is proven OPERABLE by verifying its open condition either:

- a. Once every 12 hours for a valve that cannot be locked.
- b. Once every 31 days for a valve that is locked, sealed, or secured in position. A removed pressurizer safety is in this category.

The passive vent arrangement must only be open to be OPERABLE. This Surveillance is required to be performed if the vent is being used to satisfy the pressure relief requirements of the LCO 3.4.15b.

SR 3.4.15.4

The RNS suction relief valve shall be demonstrated OPERABLE by verifying that two RNS suction isolation valves in one flow path are open and by testing it in accordance with the

(continued)

BASES

SURVEILLANCE
REQUIREMENTS

SR 3.4.15.4 (continued)

Inservice Testing Program. (Refer to SR 3.4.15.2 for the RNS suction isolation valve Surveillance.) This Surveillance is only required to be performed if the RNS suction relief valve is being used to meet this LCO. The ASME Code, Section XI (Ref. 5), test per Inservice Testing Program verifies OPERABILITY by proving proper relief valve mechanical motion and by measuring and, if required, adjusting the lift setpoint.

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix G, "Fracture Toughness Requirements."
 2. Generic Letter 88-11, "NRC Position on Radiation Embrittlement of Reactor Vessel Materials and Its Impact on Plant Operation."
 3. ASME Boiler and Pressure Vessel Code, Section III.
 4. Section 5.2.2, "Overpressure Protection."
 5. ASME, Boiler and Pressure Vessel Code, Section XI.
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.16 RCS Pressure Isolation Valve (PIV) Integrity

BASES

BACKGROUND

10 CFR 50.2, 10 CFR 50.55a(c), and GDC 55 of 10 CFR 50, Appendix A (Refs. 1, 2, and 3), define the RCS pressure boundary as all those pressure containing components such as pressure vessels, piping, pumps, and valves which are connected to the reactor coolant system, up to and including the outermost containment isolation valve in system piping which penetrates primary reactor containment, the second of two valves normally closed during normal reactor operation in system piping which does not penetrate primary reactor containment, and the reactor coolant system safety and relief valves. This includes any two normally closed valves in series within the reactor coolant pressure boundary (RCPB), which separate the high pressure RCS from an attached low pressure system. During their lives, these valves can experience varying amounts of reactor coolant leakage through either normal operational wear or mechanical deterioration. The AP600 PIVs are listed in Chapter 3, Table 3.9-18. The RCS PIV Leakage LCO allows RCS high pressure operation when PIV leakage has been verified.

The purpose of this specification is to prevent overpressure failure or degradation of low pressure portions of connecting systems. The following criteria was used in identifying PIVs for inclusion in the specification. A valve was included in this specification if it's failure may result in:

1. Failure of low pressure portions of connected systems, such as a Loss of Coolant Accident (LOCA) outside of containment, which could place the plant in an unanalyzed condition.

(continued)

BASES

BACKGROUND
(continued)

2. Degradation of low pressure portions of connected systems, such as damage to a core cooling system, which could degrade a safety related function that mitigates a DBA.

Valves considered for inclusion in this specification are used to isolate the RCS from the following connected systems:

- a. Passive Core Cooling System (PXS) Accumulators;
- b. Normal Residual Heat Removal System (RNS); and
- c. Chemical and Volume Control System (CVS).

The RNS pressure boundary isolation valves are considered to meet the first criterion for inclusion in this specification. The PXS accumulator check valves were determined to meet the second PIV criteria for inclusion in this specification. It is determined that the CVS PIVs do not meet either criteria for inclusion in this specification.

The PIVs that are addressed by this specification are listed in Chapter 3, Table 3.9-18.

The CVS pressure isolation valves were not included in this specification based on the defined criteria. The justification for excluding the CVS PIVs is discussed in the following paragraph.

The CVS contains four high pressure / low pressure connections with the RCS. Since the portion of the CVS which is located inside reactor containment is designed to full RCS pressure, the high pressure / low pressure interfaces with the RCS are the lines that penetrate the reactor containment. The CVS lines that penetrate containment include the makeup line, the letdown line to the

(continued)

BASES

BACKGROUND
(continued)

Liquid Radwaste System, the hydrogen supply line, and the demineralizer resin sluice line used to transfer spent resins from the demineralizers to the Solid Radwaste System. These lines each contain two safety related containment isolation valves which are addressed by the Containment Isolation Specification (LCO 3.6.3). In addition to the containment isolation valves in each of the CVS lines that interface with the RCS, there are additional valves in each line that provide diverse isolation capability. Since more restrictive requirements are imposed by LCO 3.6.3, the CVS isolation valves are not included in this LCO.

Since the purpose of this LCO is to verify that the PIVs have not suffered gross failures, the valve leakage test in conjunction with tests specified in the IST program provide an acceptable method of determining valve integrity. The ability of the valves to transition from open to closed provides assurance that the valve can perform its' pressure isolation function as required. A small amount leakage through these valves is allowed, provided that the integrity of the valve was demonstrated.

Violation of this LCO could result in continued degradation of a PIV, which could lead to overpressurization of a low pressure system or the failure of a safety related function to mitigate a DBA.

APPLICABLE
SAFETY ANALYSES

Pressure isolation valve integrity is not considered in any design basis accident analyses. This specification provides for monitoring the condition of the reactor coolant pressure boundary to detect degradation which could lead to accidents or which could impair a connected system's ability to mitigate DBAs.

RCS PIV integrity satisfies, Criterion 2 of the NRC Policy Statement.

(continued)

BASES (continued)

LCO RCS PIV leakage is identified LEAKAGE into closed systems connected to the RCS. Isolation valve leakage is usually small. Leakage that increases significantly suggests that something is operationally wrong and corrective action must be taken.

The LCO PIV leakage limit is 0.5 gpm per inch nominal valve size up to a maximum of 5 gpm per valve. This limit is well within the makeup capability of the CVS makeup pumps. This leak rate will not result in the overpressure of a connected low pressure system. Reference 5 permits leakage testing at a lower pressure differential than between the specified maximum RCS pressure and the normal pressure of the connected system during RCS operation (the maximum pressure differential) in those types of valves in which the higher service pressure will tend to diminish the overall leakage of the valve. In such cases, the observed leakage rate at lower differential pressures can be assumed to be the leakage at the maximum pressure differential. Verification that the valve leakage diminishes with increasing pressure differential is sufficient to verify that the valve characteristics are such that higher service pressure results in a decrease in overall leakage.

APPLICABILITY In MODES 1, 2, and 3 and MODE 4, with RCS not being cooled by the RNS, this LCO applies when the RCS is pressurized.

In MODE 4, with RNS in operation, and MODES 5 and 6, the RCS pressure is reduced and is not sufficient to overpressurize the connected low pressure systems.

ACTIONS The Actions are modified by two Notes. Note 1 provides clarification that each flow path allows separate entry into a Condition. This is allowed based upon the functional independence of the flow path. Note 2 requires an evaluation of affected systems if a PIV is inoperable. The pressurization may have affected system operability, or isolation of an affected flow path with an alternate valve may have degraded the ability of the interconnected system to perform its safety function.

(continued)

BASES

ACTIONS
(continued)

A.1

With one or more PIVs inoperable, the affected flow path(s) must be isolated. Required Action A.1 is modified by a Note that the valves used for isolation must meet the same integrity requirements as the PIVs and must be within the RCPB or the high pressure portion of the system.

Required Action A.1 requires that the isolation with one valve must be performed within 8 hours. Eight hours provides time to verify IST compliance for the alternate isolation valve and isolate the flow path. The 8 hour Completion Time allows the actions and restricts the operation with inoperable isolation valves.

A.2

Required Action A.2 specifies that a second operable PIV can be shown to meet the leakage limits within 8 hours. This valve is required to be a check valve, or a closed valve, if it isolates a line that penetrates containment. For the accumulator valves, the normally open accumulator isolation valve is a suitable replacement PIV, but can remain open because leakage into the accumulator is continuously monitored. If leakage into the accumulators increased to the allowable operational leakage limit, then the valve could be used to isolate the accumulators from the RCS.

The 72 hour Completion Time allows the actions and restricts the operation with inoperable isolation valves.

B.1 and B.2

If PIV integrity cannot be restored, the system isolated, or the other Required Actions accomplished, the plant must be brought to a MODE in which the requirement does not apply. To achieve this status, the plant must be brought to MODE 3 within 6 hours and MODE 5 within 36 hours. This Action may reduce the leakage and reduces the potential for a LOCA outside containment.

(continued)

BASES (continued)

SURVEILLANCE
REQUIREMENTS

SR 3.4.16.1

Performance of leakage testing on each RCS PIV or isolation valve used to satisfy Required Action A.1 and Required Action A.2 is required to verify that leakage is below the specified limit and to identify each leaking valve. The leakage limit of 0.5 gpm per inch nominal valve size up to a minimum of 5 gpm applies to each valve. Leakage testing requires a stable pressure condition.

For the two PIVs in series, the leakage requirement applies to each valve individually and not to the combined leakage across both valves. If the PIVs are not individually leakage tested, one valve may have failed completely and not be detected if the other valve in series meets the leakage requirement. In this situation, the protection provided by redundant valves would be lost.

Testing shall be performed every 24 months, a typical refueling cycle. The 24 month Frequency is consistent with 10 CFR 50.55a(g) (Ref. 4) as contained in the Inservice Testing Program and is within frequency allowed by the American Society of Mechanical Engineers (ASME) Code, Section XI (Ref. 5).

REFERENCES

1. 10 CFR 50.2.
 2. 10 CFR 50.55a(c).
 3. 10 CFR 50, Appendix A, Section V, GDC 55.
 4. 10 CFR 50.55a(g).
 5. ASME, Boiler and Pressure Vessel Code, Section XI.
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.17 Reactor Vessel Head Vent (RVHV)

BASES

BACKGROUND

The reactor vessel head vent (RVHV) is designed to assure that long-term operation of the Core Makeup Tanks (CMTs) does not result in overflowing of the pressurizer during Condition II Design Basis Accidents (DBAs). The RVHV can be manually actuated by the operators in the main control room to reduce the pressurizer water level during long-term operation of the CMTs.

The RVHV consists of two parallel flow paths each containing two RVHV isolation valves in series. The RVHV valves are connected to the reactor vessel head via a common line. The outlets of the RVHV flow paths combine into one common discharge line which connects to a single ADS discharge header that discharges to spargers located in the incontainment refueling water storage tank (IRWST). The RVHV valves are 1 inch valves with DC solenoid operators.

The RVHV valves are designed to open when actuated by the operator, and to reclose when actuated by the operator from the main control room.

The number and capacity of the RVHV flow paths are selected so that letdown flow from the RCS is sufficient to prevent pressurizer overflow for events where extended operation of the CMTs causes the pressurizer water level to increase. Although realistic evaluations of the Condition II non-LOCA events does not result in pressurizer overflow, conservative analyses of some of these events can result in pressurizer overflow if no operator actions are assumed.

APPLICABLE
SAFETY ANALYSES

For Condition II non-LOCA events, such as inadvertent passive core cooling system operation and chemical and volume control system malfunction, the use of the RVHV may be required to prevent long-term pressurizer overflow (Reference 1).

For LOCA events, the RVHV is not required.

(continued)

BASES (continued)

LCO The requirement that all four RVHV valves be OPERABLE ensures that upon actuation, the RVHV can reduce the pressurizer water level as assumed in the DBA safety analyses.

For the RVHV to be considered OPERABLE, all four valves must be closed and OPERABLE (capable of opening from the main control room).

APPLICABILITY In MODES 1, 2, 3, and 4 with the RCS not being cooled by the RNS, the RVHV must be OPERABLE to mitigate the potential consequences of any event which causes an increase in the pressurizer water level that could otherwise result in overfilling of the pressurizer.

In MODE 4, with the RCS being cooled by the RNS, and in MODES 5 and 6, operation of the CMTs or CVS will not result in a pressurizer overfill event.

ACTIONS A.1

If one or two RVHV valves in a single flow path are determined to be inoperable, the flow path is inoperable. The remaining OPERABLE RVHV flow path is adequate to perform the required safety function. A Completion Time of 72 hours is acceptable since the OPERABLE RVHV paths can mitigate DBAs without a single failure.

B.1

If two flow paths are determined to be inoperable, the RVHV is degraded such that the remaining system capacity may not be adequate for some DBA non-LOCA analysis. A Completion Time of 6 hours is permitted to restore at least one flow path. This Completion Time is acceptable considering that the realistic analysis of these non-LOCA events do not result in pressurizer overfill.

(continued)

BASES

ACTIONS
(continued)

C.1 and C.2

If the Required Actions and associated Completion Times are not met or the requirements of LCO 3.4.17 are not met for reasons other than Conditions A or B, the plant must be brought to MODE 4 where the probability and consequences of an event are minimized. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 4 within 24 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, without challenging plant systems.

SURVEILLANCE
REQUIREMENTS

SR 3.4.17.1

The dedicated component level remote manual valve switches in the main control room shall be used to stroke each RVHV valve to demonstrate OPERABILITY of the controls.

This Surveillance requires verification that each RVHV valve strokes to its fully open position. The Surveillance Frequency for demonstrating valve OPERABILITY references the Inservice Testing Program.

REFERENCES

1. Section 15.5, "Increase in Reactor Coolant System Inventory."
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B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.18 Chemical and Volume Control System (CVS) Makeup Isolation Valves

BASES

BACKGROUND

One of the principle functions of the CVS system is to maintain the reactor coolant inventory by providing water makeup for reactor coolant system (RCS) leakage, shrinkage of the reactor coolant during cooldowns, and RCS boron concentration changes. In the automatic makeup mode of operation, the pressurizer water level starts and stops CVS makeup to the RCS.

Although the CVS is not considered a safety related system, certain isolation functions of the system are considered safety related functions. The appropriate isolation valves have been classified and designed as safety related. One of the safety related functions provided by the CVS is the termination of RCS makeup to prevent overfilling of the pressurizer during non-LOCA transients or to prevent steam generator overfilling during a steam generator tube rupture. The CVS makeup line containment isolation valves provide this RCS makeup isolation function.

APPLICABLE
SAFETY ANALYSES

One of the initial assumptions in the analysis of several non-LOCA events and during a steam generator tube rupture accident is that excessive CVS makeup to the RCS may aggravate the consequences of the accident. The need to isolate the CVS makeup to the RCS is detected by the pressurizer level instruments or the steam generator narrow range level instruments. These instruments will supply a signal to the makeup line containment isolation valves in the CVS causing these valves to close and terminate RCS makeup. Thus the CVS makeup isolation valves are components which function to mitigate an accident.

CVS isolation valves satisfy Criterion 3 of the NRC Policy Statement.

(continued)



BASES (continued)

LCO The requirement that at least two CVS makeup isolation valves be OPERABLE assures that there will be redundant means available to terminate CVS makeup to the RCS during a non-LOCA event or a steam generator tube rupture accident should that become necessary.

APPLICABILITY The requirement that at least two CVS makeup isolation valves be OPERABLE is applicable in MODES 1, 2, 3, and 4 with the normal residual heat removal system (RNS) suction to the RCS not open because a pressurizer overfill event or steam generator tube rupture accident is considered possible in these MODES, and the automatic closure of these valves is assumed in the safety analysis.

In the applicable MODES, the need to isolate the CVS makeup to the RCS is detected by the pressurizer level instruments (high 1 setpoint coincident with safeguards actuation or high 2 setpoint) or the steam generator narrow range level instruments (high 2 setpoint).

This isolation function is not required in MODE 4 with the RNS suction open to the RCS or in lower MODES. In such MODES, pressurizer or steam generator overfill is prevented by the RNS suction relief valve.

ACTIONS

A.1

If only one CVS makeup isolation valve is OPERABLE, the second valve must be restored to OPERABLE status in 72 hours. The allowed Completion Time assures expeditious action will be taken, and is acceptable because the safety function of automatically isolating RCS makeup can be accomplished by the redundant isolation valve.

B.1

If the Required Actions and associated Completion Time of Condition A are not met, or if both CVS makeup isolation valves are not OPERABLE (i.e., not able to be closed automatically), then the makeup flow path to the RCS must be isolated. Isolation can be accomplished by manually closing

(continued)

BASES

ACTIONS

B.1 (continued)

the CVS makeup isolation MOVs or alternatively, manual valve(s) in the makeup line between the makeup pumps and the RCS.

The Action is modified by a Note allowing the flow path to be unisolated intermittently under administrative controls. These administrative controls consist of stationing a dedicated operator at the valve controls, who is in continuous communication with the main control room. In this way, the flow path can be rapidly isolated when a need for isolation is indicated.

SURVEILLANCE
REQUIREMENTS

SR 3.4.18.1

Verification that the RCS makeup isolation valves are OPERABLE, by stroking each valve closed, demonstrates that the valves can perform their safety related function. The Frequency is in accordance with the Inservice Testing Program.

SR 3.4.18.2

Verification that the RCS makeup isolation valves closure times are less than that assumed in the safety analysis, is performed by measuring the time required for each valve to close. The Frequency is in accordance with the Inservice Testing Program.

REFERENCES

1. Chapter 15, "Accident Analysis."
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