B 3.3 INSTRUMENTATION

B 3.3.1 Protection System (PS)

BASES

BACKGROUND

The PS initiates a reactor trip to protect against violating the core specified acceptable fuel design limits and breaching the reactor coolant pressure boundary during anticipated operational occurrences (AOOs). The PS also initiates the Engineered Safety Features (ESF) actuations that are used to mitigating accidents. The ESF actuates necessary safety systems, based upon the values of selected unit parameters, to protect against violating core design limits, maintain the Reactor Coolant System (RCS) pressure boundary, and mitigate the consequences of accidents that could result in potential exposures comparable to the guidelines set forth in 10 CFR 100 during AOOs and ensures acceptable consequences during accidents.

The PS initiates and the Safety Automation System (SAS) controls the necessary safety systems to protect against violating core design limits, maintain the RCS pressure boundary, and mitigate the consequences of accidents that could result in potential exposures comparable to the guidelines set forth in 10 CFR 100 during anticipated operational occurrences and ensures acceptable consequences during postulated accidents.

The four redundant divisions of the PS are physically separated in their respective safeguard buildings. The four divisionally separated rooms containing the PS equipment are in different fire zones. Therefore, in general, the consequences of internal hazards (e.g., fire), would impact only one PS division.

The PS architecture is four-fold redundant for both reactor trip and ESF functions. A single failure during corrective or periodic maintenance, or a single failure and the effects of an internal hazard does not prevent performance of the safety functions. For the reactor trip functions, each PS division actuates one division of the reactor trip devices based on redundant processing performed in four divisions. For ESF functions, the redundancy of the safety function as a whole is defined by the redundancy of the ESF system mechanical trains. In general, this results in one PS division actuating one mechanical train of an ESF system based on redundant processing performed in four divisions. The PS not only supports the redundancy of the mechanical trains, but also enhances this redundancy through techniques such as redundant actuation voting.

BASES

BACKGROUND (continued)

Three of the four divisions are necessary to meet the redundancy and testability of GDC 21 in 10 CFR 50, Appendix A (Ref. 3). The fourth division provides additional flexibility by allowing one division to be removed from service for maintenance or testing while still maintaining a minimum two-out-of-three logic. Thus, even with a division inoperable, no single additional failure in the PS can either cause an inadvertent trip/ESF or prevent a required trip/ESF from occurring.

The protection and monitoring systems have been designed to ensure safe operation of the reactor. This is achieved by specifying limiting safety system settings (LSSS) in terms of parameters directly monitored by the PS, as well as LCOs on other reactor system parameters and equipment performance. The subset of LSSS that directly protect against violating the reactor core and RCS pressure boundary safety limits during AOOs are referred to as Safety Limit LSSS (SL-LSSS).

Technical Specifications are required by 10 CFR 50.36 to contain LSSS defined by the regulation as "...settings for automatic protective devices...so chosen that automatic protective actions will correct the abnormal situation before a Safety Limit (SL) is exceeded." The Analytical Limit is the limit of the process variable at which a safety action is initiated, as established by the safety analysis, to ensure that a SL is not exceeded. Any automatic protection action that occurs on reaching the Analytical Limit therefore ensures that the SL is not exceeded. However, in practice, the actual settings for automatic protective devices must be chosen to be more conservative than the Analytical Limit to account for instrument loop uncertainties related to the setting at which the automatic protective action would actually occur.

------------------------------- REVIEWER'S NOTE -----------------------------------
The term "Limiting Trip Setpoint (LTSP)" is generic terminology for the setpoint value calculated by means of the plant-specific setpoint methodology documented in a document controlled under 10 CFR 50.59. The term LTSP indicates that no additional margin has been added between the Analytical Limit and the calculated trip setting. Where margin is added between the Analytical Limit and trip setpoint, the term Nominal Trip Setpoint is preferred. The trip setpoint (field setting) may be more conservative than the Limiting or Nominal Trip Setpoint.

Where the LTSP is not included in Table 3.3.1-2 for the purpose of compliance with 10 CFR 50.36, the plant-specific term for the Limiting or Nominal Trip Setpoint must be cited in Note b of Table 3.3.1-2. The brackets indicate plant-specific terms may apply, as reviewed and approved by the NRC. The as-found and as-left tolerances will apply to the actual setpoint implemented in the Surveillance procedures to confirm channel performance.

BASES

BACKGROUND (continued)

Licensees are to insert the name of the document(s) controlled under 10 CFR 50.59 that contain the LTSP and the methodology for calculating the as-left and as-found tolerances, for the phrase "a document controlled under 10 CFR 50.59" in the specifications.

The LTSP is a predetermined setting for a protective device chosen to ensure automatic actuation prior to the process variable reaching the Analytical Limit and thus ensuring that the SL would not be exceeded. As such, the LTSP accounts for uncertainties in setting the device (e.g., CALIBRATION), uncertainties in how the device might actually perform (e.g., repeatability), changes in the point of action of the device over time (e.g., drift during surveillance intervals), and any other factors which may influence its actual performance (e.g., harsh accident environments). In this manner, the LTSP ensures that SLs are not exceeded. As such, the LTSP meets the definition of a SL-LSSS (Ref. 1).

Technical Specifications contain values related to the OPERABILITY of equipment required for safe operation of the facility. OPERABLE is defined in Technical Specifications as "...being capable of performing its safety function(s)." However, use of the LTSP to define OPERABILITY in Technical Specifications would be an overly restrictive requirement if it were applied as an OPERABILITY limit for the "as-found" value of a protective device setting during a Surveillance. This would result in Technical Specification compliance problems, as well as reports and corrective actions required by the rule which are not necessary to ensure safety. For example, an automatic protective device with a setting that has been found to be different from the LTSP due to some drift of the setting may still be OPERABLE since drift is to be expected. This expected drift would have been specifically accounted for in the setpoint methodology for calculating the LTSP and thus the automatic protective action would still have ensured that the SL would not be exceeded with the "as-found" setting of the protective device. Therefore, the device would still be OPERABLE since it would have performed its safety function and the only corrective action required would be to reset the device to the trip setpoint to account for further drift during the next surveillance interval.

However, there is also some point beyond which the device would have not been able to perform its function due, for example, to greater than expected drift. This LTSP specified in Table 3.3.1-2 is the least conservative value of the as-found setpoint that a channel can have during testing such that a channel is OPERABLE if the trip setpoint is found conservative with respect to the Allowable Value during a SENSOR

BASES

BACKGROUND (continued)

OPERATIONAL TEST (SOT). As such, the Allowable Value differs from the LTSP by an amount greater than or equal to the expected instrument channel uncertainties, such as drift, during the surveillance interval. In this manner, the actual setting of the device will ensure that an SL is not exceeded at any given point of time as long as the device has not drifted beyond that expected during the surveillance interval. Note that, although the channel is OPERABLE under these circumstances, the setpoint must be left adjusted to a value within the as-left tolerance, and confirmed to be operating within the statistical allowances of the uncertainty terms assigned (as-found). If the actual setting of the device is found to be non-conservative with respect to the Allowable Value, the device would be considered inoperable from a Technical Specification perspective. This requires corrective action including those actions required by 10 CFR 50.36 when automatic protective devices do not function as required.

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

- The departure from nucleate boiling ratio (DNBR) shall be maintained above the SL value to prevent departure from nucleate boiling (DNB),
- Fuel centerline melting shall not occur; and
- The RCS pressure SL of 2803 psia shall not be exceeded.

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

Accidents are events that are analyzed even though they are not expected to occur during the plant life. The acceptable limit during accidents is that the offsite dose shall be maintained within 10 CFR 100 limits. Meeting the acceptable dose limit for an accident category is considered having acceptable consequences for that event. However, these values and their associated LTSPs are not considered to be LSSS as defined in 10 CFR 50.36.

The PS is segmented into four interconnected modules and associated LCOs for the reactor trips and ESF functions. These modules are:

- Sensors, which include the associated instrumentation;
- Manual actuation switches;

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BACKGROUND (continued)

- Signal Processors, which include:
  - Remote Acquisition Units (RAUs), which acquire the signals from the Self-Powered Neutron Detectors (SPND) and distribute these signals;
  - Acquisition and Processing Units (APUs), which perform calculations and make setpoint comparisons; and
  - Actuation Logic Units (ALUs), which perform voting of the processing results from the redundant APUs in the different divisions and to issue actuation orders based on the voting results; and
- Actuation Devices, which includes the reactor trip breakers and contactors and the Priority Actuation and Control Systems (PACS) control modules for the Reactor Coolant Pump (RCP) bus and trip breakers..

The PS is a digital, integrated reactor protection system and engineered safety features actuation system. Individual sensors, signal processors, or the ALUs that provide the actuation signal voting function, can be associated with multiple reactor trip, ESF functions, and Permissives.

Sensors

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

The Power Density Detector System, which uses SPND and RAUs, provides the in-core monitoring function. The Power Range, Intermediate Range, and Source Range monitors provide the ex-core monitoring functions.

The instrument setpoint methodologies used for the US EPR were submitted to NRC in References 1 and 4. The majority of PS trips or protection functions are based on single channel inputs; therefore, the uncertainties identified in Section 3.1 of Reference 1 are applicable for the trip. Reference 4 addresses the protection system trips or protection functions that are based on multiple inputs. The uncertainty calculations for the SPNDs, incore instrumentation, high linear power density, high

BACKGROUND (continued)

core power level, low saturation margin, anti-dilution, and DNBR use the statistical methodology described in Reference 4. As described therein, the LTSP is the LSSS since all known errors are appropriately combined in the total loop uncertainty calculation.

LTSPs in accordance with the Allowable Value will ensure that SLs of Chapter 2.0, "Safety Limits (SLs)," are not violated during AOOs, and the consequences of postulated accidents will be acceptable, providing the plant is operated from within the LCOs at the onset of the AOO or postulated accident and the equipment functions as designed.

Note that the Allowable Values is the least conservative value of the as-found setpoint that a Trip/Actuation Function can have during a periodic CALIBRATION or SOT, such that a Trip/Actuation Function is OPERABLE if the as-found setpoint is conservative with respect to the Allowable Value.

Functional testing of the entire PS, from sensor input through the opening of individual sets of Reactor Trip Circuit Breakers (RTCB) or contactors, is performed each refueling cycle. Processing transmitter CALIBRATION is also normally performed on a refueling basis.

Trip Setpoints that directly protect against violating the reactor core or RCS pressure boundary Safety Limits during AOOs are SL-LSSS. Permissive setpoints allow bypass of trips when they are not required by the Safety Analysis. These permissives and interlocks ensure that the starting conditions are consistent with the safety analysis, before preventative or mitigating actions occur. Because these permissives or interlocks are only one of multiple conservative starting assumptions for the accident analysis, they are generally considered as nominal values without regard to measurement accuracy, (i.e. the value indicated is sufficiently close to the necessary value to ensure proper operation of the safety systems to turn the AOO). Therefore permissives and interlocks are not considered to be SL-LSSS.

Manual Actuation Switches

Manual controls necessary to perform the manual operator actions credited in the safety analysis are included within the scope of the Technical Specifications. Manual actuation switches are provided to initiate the reactor trip function from the main control room (MCR) and the remote shutdown station (RSS). The ability to manually initiate ESF systems is provided in the MCR. Manual actuation of ESF systems initiates all actions performed by the corresponding automatic actuation including starting auxiliary or supporting systems and performing required sequencing functions.

BASES

BACKGROUND (continued)

Signal Processors

The PS is a distributed, redundant computer system. It consists of four independent redundant data-processing automatic paths (divisions), each with layers of operation and running asynchronous with respect to each other. In addition to the computers associated with the automatic paths, there are two redundant message and service interface computers to interface with each division.

The measurement channels or signal acquisition layer (which includes the RAUs) in each division acquires analog and binary input signals from sensors in the plant (such as for temperature, pressure, and level measurements). Each signal acquisition computer distributes its acquired and preprocessed input signals to the PS logic and controls, which includes the data processing computers (APUs).

The data-processing computers (APUs) perform signal processing for plant protective functions such as signal online validation, limit value monitoring and closed-loop control calculations. Each PS division contains four ALUs, two assigned to each subsystem. Two ALUs of the same subsystem within a division are redundant and perform the same processing using the same inputs. The outputs of two redundant ALUs are combined in a hardwired “functional AND” logic for reactor trip functions and in a hardwired OR logic for ESF functions. This avoids both unavailability of ESF functions and spurious reactor trips. The data processing computers then send their outputs to two independent voter computer units (ALUs) in each division.

In the voter computers, the outputs of the data-processing computers of redundant (three or four) divisions are processed together. A voter computer controls a set of actuators. Each voter receives the actuation signal from each of the redundant data-processing computers. The voter's task is to compare this redundant information and compute a validated (voted) actuating signal, which is used for actuating the end devices.

Each PS division contains four ALUs, two assigned to each subsystem. The two ALUs of the same subsystem within a division are redundant and perform the same processing using the same inputs. The outputs of two redundant ALUs are combined in a hardwired “functional AND” logic for reactor trip functions and in a hardwired OR logic for ESF functions.

BASES

BACKGROUND (continued)

For the reactor trip function, both ALUs in a division, if OPERABLE, must vote for an actuation. This provides protection against spurious trips. However, if only one ALU in a division is OPERABLE, the division is still OPERABLE, and the single voting ALU will initiate a reactor trip. For the ESF functions, an actuation will occur if either of the ALUs in a division votes for an actuation. This provides protection against ESF unavailability.

Reactor Trip Logic

Critical plant parameters such as temperatures, pressures, and levels are sensed, acquired, and converted to electrical signals by the PS. These signals are sent to various reactor trip functions in the PS where they are processed. When prohibited operating conditions exist, a reactor trip signal is generated from the reactor trip functions. Besides being generated automatically from the PS, a reactor trip signal can also be generated from the following systems:

- Automatic reactor trip from SAS in the event that the PS is lost;
- Manual trip from the Safety Information and Control System (SICS) panel. Four reactor trip switches are provided, which correspond to each of the four divisions;
- Manual trip from the control room; and
- Manual trip from the RSS. Note that the RSS manual trip is not part of the required circuits for LCO 3.3.1.

The reactor trip functions will utilize voting logic in order to screen out potential upstream failures of sensors or processing units. The architecture of the PS, as well as logic implemented in the system, will guard against spurious reactor trip orders while ensuring that those orders will be available when needed.

Single failures upstream of the ALU layer that could result in an invalid signal being used in the reactor trip actuation are marked as faulted by modifying the vote in the ALU layer. For the reactor trip functions, the vote is always modified toward actuation.

BACKGROUND (continued)

ESF Trip Logic

The ESF trip logic senses accident situations and initiate the operation of necessary features. The ESF along with reactor trip ensure the following:

- The integrity of the reactor coolant pressure boundary;
- The capability to shut down the reactor and maintain it in a safe shutdown condition; and
- The capability to prevent or mitigate the consequences of accidents which could result in potential off-site exposures.

As with the reactor trip logic, critical plant parameters such as temperatures, pressures, and levels are sensed, acquired, and converted to electrical signals by the PS. When prohibited operating conditions exist, an ESF signal is generated from the PS. In addition to the automatic ESF actuation functions performed by the PS, the capability to manually initiate these functions is provided in the MCR. These manual functions are implemented at the system level and perform the same actions as the automatic functions. The implementation of manual system level actuation of ESF functions and the priority between the automatic functions of the PS and the manual system level initiation is determined on a case-by-case basis.

Single failures upstream of the ALU layer that could result in an invalid signal being used in the ESF actuation are marked as faulted by modifying the vote in the ALU layer. For the ESF functions, the vote is modified toward actuation except:

- The Main Steam Relief Train (MSRT) divisions, which degrade towards isolation; and
- Pressurizer Safety Relief Valve (PSRV) opening for cold overpressure protection, which degrades towards non-actuation.

<u>Actuation Devices</u>

Reactor Trip Actuation Devices

The reactor trip actuation is performed by interrupting electrical power to the Control Rod Drive Mechanisms (CRMD). Electrical power to the CRDM is delivered by the Control Rod Drive Power Supply System (CRDPSS). The CRDPSS consists of 220 V DC distribution boards which are fed from the Uninterruptible Power Supply System.

BASES

BACKGROUND (continued)

The power supply of the CDRM can be switched off via the following features:

- Four main trip breakers distributed in two electrical divisions. Two breakers are located in Division 2, two others in Division 3. The main trip breakers can be opened by two coils: one with a de-energized logic using an under voltage coil and the other with an energized logic using a shunt trip coil.

- Four trip contactors combined in a 2-out-of-4 logic feed a group of four CRDM. Division 1, 2, and 3 contains eleven groups of four CRDMs. Division 4 contains eleven groups of four CRDMs and one single CRDM for the central rod. There are a total of 92 contactors. Each trip contactor is switched off by a de-energized coil.

- The electronics of the RodPilot can switch-off the power supply of four CRDMs. Two groups of four commands can actuate this electronic module, one with low active and one with high active logic. The electronics of the RodPilot is a non-safety device of the reactor trip but is the fastest switching device and allows the contactors and the trip breaker to open without stress.

- The under voltage coil of the main trip breakers is actuated by the automatic reactor trip signals of the PS and the manual trip from the SICS panel. The shunt coil of the main trip breakers is actuated by the automatic reactor trip signal from the SAS and the manual trip signal from the RSS. The shunt coil of the trip breakers receives two different signals from SAS and RSS combined in an "OR" logic performed at the level of trip breakers.

The operator can manually close the breakers by individual controls. This control actuates the closing coil of the breaker via the SAS. In the electronics of the breaker, the opening of trip breaker must have priority to the closing.

The reactor trip signal generated automatically by the PS and the manual trip signal generated from the SICS panel can actuate the trip contactors.

Engineered Safety Features Actuation Devices

The ESF determines the need for actuation in each of the input divisions monitoring each actuation parameter. Once the need for actuation is determined, the condition is transmitted to automatic actuation output logic divisions, which perform the logic to determine the actuation of each end device. Each end device has its own automatic actuation logic.

BASES

BACKGROUND (continued)

Each of the PS sensors, signal processors, or actuation devices can be placed in lockout, which renders the component inoperable. The digital signals within the PS carry a value and a status. The signal status can be propagated through the software function blocks; therefore, if an input signal to a function block has a faulty status, the output of the function block also has a faulty status. When a signal with a faulty status reaches the voting function block, the signal is disregarded through modification of the voting logic. Individual function computers can be put into a testing and diagnostic mode via the service unit. The function processor that is being tested then behaves like a computer with a “detected fault” for the system. The signal outputs are disabled and those sent via the communication means are marked with the status “TEST” or “ERROR” and therefore masked by selection blocks with active status processing. In this case the receiving function processor behaves as if the transmitting function processor had failed.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

The PS is designed to ensure that the following operational criteria are met:

– The associated actuation will occur when the parameter monitored by each division reaches its setpoint and the specific coincidence logic is satisfied; and

– Separation and redundancy are maintained to permit a division to be out of service for testing or maintenance while still maintaining redundancy within the PS instrumentation network.

Each of the analyzed transients and accidents can be detected by one or more PS Functions. Each of the PS reactor trip and ESF Functions included in the Technical Specifications are credited as part of the primary success path in the accident analysis. Non-credited functions are purely equipment protective, and their use minimizes the potential for equipment damage. Non-credited functions are not included in the Technical Specifications. Refer to FSAR Sections 7.2 and 7.3.

The LCO requires the PS sensors, manual actuation switches, signal processors, and specified actuation devices to be OPERABLE. The LCO ensures that each of the following requirements is met:

– A reactor trip or ESF function will be initiated when necessary; and

– Sufficient redundancy is maintained to permit a component to be out of service for testing or maintenance.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

Failure of any sensors, signal processors, or actuation device reduces redundancy or renders the affected division(s) inoperable.

Trip Setpoints that directly protect against violating the reactor core or RCS pressure boundary SLs during AOOs are SL-LSSS. Permissive and interlock setpoints allow bypass of trips when they are not required by the Safety Analysis. These permissives and interlocks ensure that the starting conditions are consistent with the safety analysis, before preventative or mitigating actions occur. Because these permissives or interlocks are only one of multiple conservative starting assumptions for the accident analysis, they are generally considered as nominal values without regard to measurement accuracy, (i.e. the value indicated is sufficiently close to the necessary value to ensure proper operation of the safety systems to turn the AOO). Therefore permissives and interlocks are not considered to be SL-LSSS. Each LTSP specified is more conservative than the analytical limit assumed in the safety analysis in order to account for instrument uncertainties appropriate to the trip Function. The methodologies for considering uncertainties are defined in References 1 and 4.

The PS sensors, manual actuation switches, signal processors, and specified actuation devices satisfy Criterion 3 of 10 CFR 50.36(d)(2)(ii) .

The PS sensors, manual actuation switches, signal processors, and specified actuation devices that support reactor trips are required to be OPERABLE in MODES 1, 2 and/or 3 because the reactor is or can be made critical in these MODES. The automatic reactor trip functions are designed to take the reactor subcritical, which maintains the SLs during AOOs and assists the ESF in providing acceptable consequences during accidents. The PS sensors, manual actuation switches, signal processors, and specified actuation devices that support automatic reactor trip functions are not required to be OPERABLE in MODES 4 and 5. In MODES 4 and 5, the emphasis is placed on return to power events. The reactor is protected in these MODES by ensuring adequate SDM.

The PS sensors, manual actuation switches, signal processors, and specified actuation devices that support reactor trips are required to be OPERABLE in MODES 1, 2, 3 and/or 4 since there is sufficient energy in the primary and secondary systems to warrant automatic ESF System responses to:

- Close the MSIVs to preclude a positive reactivity addition,
- Actuate Emergency Feedwater (EFW) to preclude the loss of the SGs as a heat sink (in the event the normal feedwater system is not available),

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

- Actuate ESF systems to prevent or limit the release of fission product radioactivity to the environment by isolating containment and limiting the containment pressure from exceeding the containment design pressure during a design basis Loss of Coolant Accident (LOCA) or Main Steam Line Break (MSLB), and

- Actuate ESF systems to ensure sufficient borated inventory to permit adequate core cooling and reactivity control during a design basis LOCA or MSLB accident.

In MODES 5 and 6, automatic actuation of the ESF Functions is not normally required because adequate time is available to evaluate plant conditions and respond by manually operating the ESF components if required. Exceptions to this are:

- ESF 10.a - Emergency Diesel Generator (EDG) Start on Degraded Grid Voltage,

- ESF 10.b - EDG Start on Loss of Offsite Power (LOOP),

- ESF 11.b - Chemical and Volume Control System (CVCS) Charging Line Isolation on Anti-Dilution Mitigation (ADM) at Shutdown Condition (RCP not operating),

- ESF 11.c - CVCS Charging Line Isolation on ADM at Standard Shutdown Conditions,

- ESF 12.a and 12.b - PSRV Actuation - First and Second Valve, and

- ESF 13 - Control Room Heating, Ventilation and Air Conditioning (HVAC) Reconfiguration to Recirculation Mode on High Intake Activity.

These ESF functions are required to be OPERABLE in MODES 5 and 6 and during movement of irradiated fuel assemblies to ensure that:

- Systems to provide adequate coolant inventory makeup are available for the irradiated fuel assemblies in the core;

- Systems needed to mitigate a fuel handling accident are available; and

- Systems necessary to mitigate the effects of events that can lead to core damage during shutdown are available.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The specific safety analysis and OPERABILITY requirements applicable to each PS protective function is identified below.

A. REACTOR TRIPS

1. Low DNBR (Includes High Outlet Quality)

This function protects the fuel against the risk of departure from nucleate boiling during AOOs that lead to a decrease of the DNBR value. There are five Low DNBR trips:

a. Low DNBR,
b. Low DNBR and Imbalance or Rod Drop,
c. Variable Low DNBR and Rod Drop,
d. Low DNBR - High Quality, and
e. Low DNBR - High Quality and Imbalance or Rod Drop.

Together, these five trips protect against the following AOOs:

- Increase in heat removal by the secondary system,
- Decrease in heat removal by the secondary system,
- Reactivity and power distribution anomalies, and
- Decrease in reactor coolant inventory.

The Low DNBR (1.a) and High Quality (1.d) trips require four divisions of the following sensors and processors to be OPERABLE when the reactor power level is greater than or equal to 10% RTP:

- SPNDs,
- RCP speed sensor,
- Pressurizer Pressure (Narrow Range) sensor,
- Cold leg temperature (Narrow Range) sensor,
- RCS loop flow sensors,
- RAU,
- APUs, and
- ALUs.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The Low DNBR and Imbalance or Rod Drop (1.b), Variable Low DNBR and Rod Drop (1.c), and High Quality and Imbalance or Rod Drop (1.e) trips require four divisions of the following sensors and processors to be OPERABLE when the reactor power level is greater than or equal to 10% RTP:

- SPNDs,
- Rod Cluster Control Assembly (RCCA) position indicators,
- RCP speed sensor,
- Pressurizer Pressure (Narrow Range) sensor,
- Cold leg temperature (Narrow Range) sensor,
- RCS loop flow sensors,
- RAU,
- RCCA Unit,
- APU, and
- ALUs.

The LTSPs are high enough to provide an operating envelope that prevents an unnecessary low DNBR reactor trip. The LTSPs are low enough for the system to maintain a margin to unacceptable fuel cladding damage for AOOs that leads to an uncontrolled decrease of the DNBR value.

The P2 permissive automatically enables the five Low DNBR Trip signals when the neutron flux, as measured by the power range, is greater than or equal to 10% RTP. When nuclear power is below this threshold, the trips are also automatically disabled by Permissive P2.

2. High Linear Power Density

This function protects the fuel against the risk of melting at the center of the fuel pellet, during accidental transients, for events leading to an uncontrolled increase of the linear power density.

This trip protects against the following postulated accidents or AOOs:

- Increase in heat removal by the secondary system, and
- Reactivity and power distribution anomalies.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The High Linear Power Density Trip requires four divisions of the following sensors and processors to be OPERABLE when the reactor power level is greater than or equal to 10% RTP:

- SPNDs,
- RAU,
- APUs, and
- ALUs.

The LTSPs are high enough to provide an operating envelope that prevents unnecessary High Linear Power reactor trips. The LTSPs are low enough for the system to maintain a margin to unacceptable fuel centerline melt for any AOOs lead to an uncontrolled increase of the linear power density.

The P2 permissive automatically enables the Reactor Trip signal when the neutron flux, as measured by the power range, is greater than or equal to 10% RTP. When nuclear power is below this threshold, the trip is also automatically disabled by Permissive P2.

3. <u>High Neutron Flux Rate of Change (Power Range)</u>

This function limits the consequences of an excessive reactivity increase from an intermediate power level including nominal power. This trip protects against reactivity and power distribution anomalies.

The High Neutron Flux Rate of Change Trip requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2 and MODE 3 with the Reactor Control, Surveillance and Limitation (RCSL) System capable of withdrawing a RCCA or one or more RCCAs not fully inserted:

- Power Range sensors,
- APUs, and
- ALUs.

The LTSP is high enough to provide an operating envelope that prevents unnecessary Excore High Neutron Flux Rate of Change reactor trips. The LTSP is low enough for the system to maintain a margin to unacceptable fuel cladding damage due to an excessive reactivity increase from an intermediate power level including nominal power.

There are no permissives associated with this trip.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

4. High Core Power Level

This function limits the consequences of an excessive reactivity increase from an intermediate high power level including nominal power. This trip protects against the following postulated accidents or AOOs:

- Increase in heat removal by the secondary system, and
- Reactivity and power distribution anomalies.

The High Core Power Level Trip requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and in MODE 2 when the nuclear power level is greater than or equal to 10^{-5}% power as indicated on the Intermediate Range monitors:

- Cold Leg Temperature sensors (Wide Range),
- Hot Leg Temperature (Narrow Range) sensors,
- Hot Leg Pressure (Wide Range) sensors,
- RCS Loop Flow sensors,
- APUs, and
- ALUs.

The LTSP is high enough to provide an operating envelope that prevents an unnecessary High Core Power Level reactor trip. The LTSP is low enough for the system to maintain a margin to unacceptable fuel cladding damage due to an excessive reactivity increase from an intermediate high power level including nominal power.

The P5 permissive automatically enables the High Core Power Level Trip when the nuclear power level is greater than or equal to 10^{-5}% power. The P5 permissive also automatically disables the High Core Power Level Trip below this power.

5. Low Saturation Margin

This function limits the consequences of an excessive reactivity increase from an intermediate high power level including nominal power. This trip protects against the following postulated accidents or AOOs:

- Increase in heat removal by the secondary system, and
- Reactivity and power distribution anomalies.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The Low Saturation Margin Trip requires four divisions of the following sensors and processors to be OPERABLE in MODE 1 and MODE 2 when the nuclear power level is greater than or equal to 10^{-5}% power as indicated on the Intermediate Range monitors.:

- Cold Leg Temperature sensors (Wide Range),
- Hot Leg Temperature (Narrow Range) sensors,
- Hot Leg Pressure (Wide Range) sensors,
- RCS Loop Flow sensors,
- APUs, and
- ALUs.

The LTSP is high enough to provide an operating envelope that prevents an unnecessary Low Saturation Margin reactor trip. The LTSP is low enough for the system to maintain a margin to unacceptable fuel cladding damage during AOOs.

The P5 permissive automatically enables the Low Saturation Margin Trip when the nuclear power level is greater than or equal to 10^{-5}%. The P5 permissive also automatically disables the Low Saturation Margin Trip below this power.

6. RCS Loop Flow Rate

This function initiates a reactor trip and is inhibited below a certain level of nuclear power under which the protection is not necessary because DNB is no longer a risk in this condition. There are two trips:

a. Low-Low RCS Loop Flow Rate in One Loop, and
b. Low RCS Loop Flow Rate in Two Loops.

These trips protect against the following postulated accidents or AOOs:

- Decrease in heat removal by the secondary system, and
- Decrease in RCS flow rate.

The Low-Low RCS Loop Flow in One Loop Trip (6.a) requires four divisions of the following sensors and processors to be OPERABLE when the reactor power level is greater than or equal to 70% RTP:

- RCS Loop Flow sensors,
- APUs, and
- ALUs.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The LTSP is high enough to provide an operating envelope that prevents unnecessary Low-Low Loop Flow Rate reactor trips. The LTSP is low enough for the system to maintain a margin to ensure DNBR limits are met for AOOs and bounded for postulated accidents.

The P3 permissive automatically enables the Low-Low RCS Loop Flow Rate Trip (One Loop) when the nuclear power level is greater than or equal to 70% RTP. The P3 permissive also automatically disables the Low-Low RCS Loop Flow Rate Trip (One Loop) below this power.

The Low RCS Loop Flow in Two Loops Trip (6.b) requires four divisions of the following sensors and processors to be OPERABLE when the reactor power level is greater than or equal to 10% RTP:

- RCS Loop Flow sensors,
- APUs, and
- ALUs.

The LTSP is high enough to provide an operating envelope that prevents unnecessary Low Loop Flow Rate reactor trips. The LTSP is low enough for the system to maintain a margin to ensure DNBR limits are met for AOOs.

The P2 permissive automatically enables the Low RCS Loop Flow Rate Trip (Two Loops) when the nuclear power level is greater than or equal to 10% RTP. The P2 permissive also automatically disables the Low RCS Loop Flow Rate Trip (Two Loops) when the nuclear power level is below this power.

7. <u>Low RCP Speed</u>

Due to electrical transients that may affect the RCP's, a specific protection function is required. This function initiates a reactor trip and is inhibited below a low level of reactor power under which the protection is not necessary because DNB is no longer a risk.

This trip protects against the following postulated accidents or AOOs:

- Decrease in heat removal by the secondary system, and
- Decrease in RCS flow rate.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The Low RCP Speed Trip requires four divisions of the following sensors and processors to be OPERABLE when the reactor power level is greater than or equal to 10% RTP:

- RCP Speed Trip sensors,
- APUs, and
- ALUs.

The LTSP is high enough to provide an operating envelope that prevents unnecessary Low RCP Speed reactor trips. The LTSP is low enough for the system to maintain a margin to ensure DNBR limits are met for AOOs.

The P2 permissive automatically enables the Low RCP Speed Trip when the power level is greater than or equal to 10% RTP. When nuclear power is below this threshold, the trip is also automatically disabled by permissive function P2.

8. <u>High Neutron Flux (Intermediate Range)</u>

This function limits the consequences of an excessive reactivity increase when the reactor is started up from a sub-critical or low power start-up condition. This trip protects against reactivity and power distribution anomalies.

The High Neutron Flux Trip requires four divisions of the following sensors and processors to be OPERABLE in MODE 1 when RTP is less than or equal to 10%, MODE 2, and in MODE 3 when RCSL is capable of withdrawing a RCCA or one or more RCCAs not fully inserted:

- Intermediate Range sensors,
- APUs, and
- ALUs.

The LTSP is high enough to provide an operating envelope that prevents an unnecessary High Neutron Flux reactor trip. The LTSP is low enough for the system to maintain a margin to unacceptable fuel cladding damage for AOOs that leads to an uncontrolled increase of the linear power density.

The P6 permissive automatically enables the High Neutron Flux Intermediate Range reactor trip when the power level is less than or equal to 10% RTP.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

9. Low Doubling Time (Intermediate Range)

This function limits the consequences of an excessive reactivity increase when the reactor is started up from a sub-critical or low power start-up condition. This trip protects against reactivity and power distribution anomalies.

The Low Doubling Time Trip requires four divisions of the following sensors and processors to be OPERABLE in MODE 1 when RTP is less than or equal to 10%, MODE 2, and in MODE 3 when RCSL is capable of withdrawing a RCCA or one or more RCCAs not fully inserted:

- Intermediate Range sensors,
- APUs, and
- ALUs.

The LTSP is high enough to provide an operating envelope that prevents an unnecessary Low Doubling Time reactor trip. The LTSP is low enough for the system to maintain a margin to unacceptable fuel cladding damage for any postulated event that leads to an uncontrolled increase of the linear power density.

The P6 permissive automatically enables the Low Doubling Time reactor trip when the power level is less than or equal to 10% RTP.

10. Low Pressurizer Pressure

A RCS depressurization may lead to a risk of excessive boiling, thus a reactor trip is required to ensure fuel rod integrity and to adapt reactor power to the capacity of the safety systems. This trip protects against a decrease in reactor coolant inventory.

The Low Pressurizer Pressure Trip requires four divisions of the following sensors and processors to be OPERABLE when the reactor power level is greater than or equal to 10% RTP:

- Pressurizer Pressure (Narrow Range) sensors,
- APUs, and
- ALUs.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

A RCS depressurization may lead to a risk of excessive boiling, thus a reactor trip is required to ensure fuel rod integrity and to adapt reactor power to the capacity of the safety systems. The LTSP is sufficiently below the full load operating value for RCS pressure so as not to interfere with normal plant operation, but still high enough to provide the required protection in the event of an RCS depressurization.

The P2 permissive automatically enables the Low Pressurizer Pressure Trip when the power level is greater than or equal to 10% RTP. When nuclear power is below this threshold, the trip is automatically disabled by permissive function P2.

11. High Pressurizer Pressure

In case of a RCS overpressure, a reactor trip is required in order to:

- Adapt the reactor power to the capacity of the safety systems;
- Ensure RCS integrity; and
- Avoid opening of the Pressurizer safety valves in certain primary side overpressure analyses.

This trip protects against a decrease in heat removal by the secondary system.

The High Pressurizer Pressure Trip requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2:

- Three Pressurizer Pressure (Narrow Range) sensors,
- Three divisions of APUs, and
- Three divisions of ALUs.

The LTSP is set below the nominal lift setting of the Pressurizer code safety valves, and its operation avoids the undesirable operation of these valves during normal plant operation. In the event of a complete loss of electrical load from 100% power, this setpoint ensures the reactor trip will take place, thereby limiting further heat input to the RCS and consequent pressure rise. The PSRVs may lift to prevent over pressurization of the RCS.

There are no permissives associated with this trip.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

12. High Pressurizer Level

In case of increasing Pressurizer level, a reactor trip is required in order to avoid Pressurizer over filling and to prevent the PSRVs from relieving. This trip protects against increases in reactor coolant inventory.

The High Pressurizer Level Trip requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2:

- Pressurizer Level (Narrow Range) sensors,
- APUs, and
- ALUs.

The LTSP is set below the point where the associated transient would reach the nominal lift setting of the PSRVs, and its operation avoids the undesirable operation of these valves during normal plant operation. In the event of a CVCS malfunction, this setpoint ensures a timely reactor trip will take place in order to avoid filing the pressurizer. The PSRVs may lift to prevent over pressurization of the RCS.

The P12 permissive automatically enables the High Pressurizer Level Trip when the pressure is greater than or equal to 2005 psia.

13. Low Hot Leg Pressure

A RCS depressurization may lead to a risk of excessive boiling, thus a reactor trip is required to ensure fuel rod integrity and to adapt reactor power to the capacity of the safety systems. This trip protects against a decrease in reactor coolant inventory.

The Low Hot Leg Pressure Trip requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2 and in MODE 3 with the pressurizer pressure greater than or equal to 2005 psia, when the RCSL System is capable of withdrawing a RCCA, or one or more RCCAs are not fully inserted.

- Hot Leg Pressure (Wide Range) sensors,
- APUs, and
- ALUs.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

A RCS depressurization may lead to a risk of excessive boiling, thus a reactor trip is required to ensure fuel rod integrity and to adapt reactor power to the capacity of the safety systems. The LTSP is sufficiently below the full load operating value so as not to interfere with normal plant operation, but still high enough to provide the required protection in the event of abnormal conditions.

The P12 permissive automatically enables the Low Hot Leg Pressure Trip when the pressure is greater than or equal to 2005 psia.

14. Steam Generator Pressure Drop

In case of steam or feedwater system piping failure, the affected Steam Generator (SG) depressurizes leading to a RCS cooldown and hence a reactivity transient. A reactor trip is required in order to ensure the fuel rod integrity and to adapt the reactor power to the capacity of the safety systems. This trip protects against the following postulated accidents or AOOs:

- Increase in heat removal by the secondary system, and
- Decrease in heat removal by the secondary system.

The SG Pressure Drop Trip requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2:

- SG Pressure sensors,
- APUs, and
- ALUs.

In case of steam or feedwater system piping failure, the affected SG depressurizes leading to a RCS cooldown or heatup. A reactor trip is required in order to ensure the fuel rod integrity and to adapt the reactor power to the capacity of the safety systems. The LTSP is sufficiently below the full load operating value so as not to interfere with normal plant operation, but still high enough to provide the required protection in the event of a pipe break.

There are no permissives associated with this trip.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

15. Low SG Pressure

In case of steam or feedwater system piping failure, the affected SG depressurizes leading to a RCS cooldown and hence a criticality transient. For small breaks, the setpoint of the reactor trip on SG pressure drop may not be reached. Therefore, a reactor trip on low SG pressure is introduced in order to ensure fuel rod integrity and to adapt the reactor power to the capacity of safety systems. This trip protects against the following postulated accidents or AOOs:

- Increase in heat removal by the secondary system, and
- Decrease in heat removal by the secondary system.

The Low SG Pressure Trip requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2 and in MODE 3 with either the pressurizer pressure greater than or equal to 2005 psia, the RCSL System capable of withdrawing a RCCA, or one or more RCCAs not fully inserted:

- SG Pressure sensors,
- APUs, and
- ALUs.

In case of steam or feedwater system piping failure, the affected SG depressurizes leading to a RCS cooldown or heatup. For small breaks, the setpoint of the reactor trip on SG pressure drop may not be reached. Therefore, a reactor trip on low SG pressure is introduced in order to ensure fuel rod integrity and to adapt the reactor power to the capacity of safety systems. The LTSP is sufficiently below the full load operating value so as not to interfere with normal plant operation, but still high enough to provide the required protection in the event of a pipe break.

The P12 permissive automatically enables the Low SG Pressure Trip when the pressure is greater than or equal to 2005 psia.

16. High SG Pressure

In case of a loss of the main heat sink, the reactor has to be tripped in order to:

- Ensure fuel rods integrity at power;
- Adapt the reactor power to the capacity if safety systems; and
- Ensure SG integrity.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

This trip protects against a decrease in heat removal by the secondary system.

The High SG Pressure Trip requires four divisions of the following sensors and processors to be OPERABLE in MODE 1:

- SG Pressure sensors,
- APUs, and
- ALUs.

The LTSP is set high enough to avoid spurious operation. In case of a loss of the main heat sink, the setpoint is set low enough to trip the reactor in order to:

- Ensure fuel rod integrity at power,
- Adapt the reactor power to the capacity of safety systems, and
- Ensure SG integrity.

There are no permissives associated with this trip.

17. Low SG Level

This trip protects the reactor from a loss of heat sink in case of SG steam/feedwater flow mismatch. This trip protects against a decrease in heat removal by the secondary system.

The Low SG Level Trip requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2:

- SG Level (Narrow Range) sensors,
- APUs, and
- ALUs.

The purpose of this trip is to protect the reactor from a loss of heat sink in case of SG steam/feedwater flow mismatch. The LTSP is sufficiently below the full load operating value so as not to interfere with normal plant operation, but still high enough to provide the required protection in the event of a flow mismatch.

The P13 permissive automatically enables the Low SG Level Trip when the hot leg temperature is greater than or equal to 200ºF.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

18. High SG Level

This trip protects the turbine against an excessive humidity in case of a Main Feedwater (MFW) malfunction causing an increase in feedwater flow or in case of SG level increase. This reactor trip ensures core integrity during these transients since an increase in feedwater flow leads to a RCS overcooling event and hence a reactivity insertion. This trip protects against an increase in heat removal by the secondary system.

The High SG Level Trip requires the following sensors and processors to be OPERABLE in MODE 1 and in MODE 2:

- SG Level (Narrow Range) sensors
- APUs, and
- ALUs.

This reactor trip ensures core integrity during transients involving a MFW malfunction that results in an increase in feedwater flow or in case of a SG level increase. The LTSP is sufficiently below the full load operating value so as not to interfere with normal plant operation, but still high enough to provide the required protection in the event of an abnormal condition.

The P13 permissive automatically enables the High SG Level Trip when the hot leg temperature is greater than or equal to 200ºF.

19. High Containment Pressure

In case of a postulated initiating event leading to water or steam discharge into the containment, a reactor trip is performed in order to ensure containment integrity and to adapt the reactor power to the capacity of the safety systems. This trip protects against the following postulated accidents or AOOs:

- Decrease in heat removal by the secondary system, and
- Decrease in reactor coolant inventory.

The High SG Pressure Trip requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2:

- Containment Equipment Compartment and Containment Service Compartment pressure sensors,
- APUs, and
- ALUs.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

In case of a postulated initiating event leading to water or steam discharge into the containment, a reactor trip is performed in order to ensure containment integrity and to adapt the reactor power to the capacity of the safety systems. The LTSP is set high enough to allow for small pressure increases in containment expected during normal operation (i.e., plant heatup) and is not indicative of an abnormal condition. It is set low enough to initiate a reactor trip when an abnormal condition is indicated.

There are no permissives associated with this trip.

20. Manual Reactor Trip

A manual reactor trip signal can be generated from the SICS panel and the RSS. The manual trip signal from the RSS actuates a reactor trip through energizing the shunt coils of the main reactor trip breakers.

B. ENGINEERED SAFETY FEATURES ACTUATION SYSTEM (ESFAS) FUNCTIONS

Each of the analyzed accidents or AOOs can be detected by one or more ESF Functions. One of the ESF Functions is the primary actuation signal for that accident. An ESF Function may be the primary actuation signal for more than one type of accident. An ESF Function may also be the secondary, or backup, actuation signal for one or more other accidents. The ESF protective functions are described below.

1. Turbine Trip on Reactor Trip

A turbine trip is required following any reactor trip in order to avoid a mismatch between primary and secondary power, which would result in excessive RCS cooldown with a potential return to critical conditions and power excursion.

The automatic Turbine Trip on Reactor Trip requires four divisions of the following sensors and processors to be OPERABLE in MODE 1:

- RTCB Position Indication sensor,
- APUs, and
- ALUs.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

A turbine trip is required following any reactor trip in order to avoid a mismatch between primary and secondary power. Such a mismatch could result in an RCS cooldown transient, with a potential inadvertent return to critical conditions.

There are no automatic permissives associated with this function.

2. Main Feedwater

a. MFW Full Load Closure on Reactor Trip (All SGs)

After a reactor trip check-back, a MFW full load isolation is required. This avoids a mismatch between primary and secondary power. Such a mismatch could result in an RCS cooldown transient, with a potential inadvertent return to critical conditions.

The automatic MFW Full Load Closure on Reactor Trip function requires four divisions of the following processors to be OPERABLE in MODE 1 and MODE 2 except when the MFW full load isolation valves are closed:

- RTCB Position Indication sensor,
- APUs, and
- ALUs.

There are no automatic permissives associated with this function.

b. MFW Full Load Closure on High SG Level (Affected SG)

In the case of an increasing SG level event, the MFW supply to the affected SG is isolated in order to avoid filling the SG, and subsequently introducing water into Main Steam line and MSRT.

This function mitigates an increase in heat removal from the secondary system.

The automatic MFW Full Load Closure on High SG Level function requires four divisions of the following sensors and processors to be OPERABLE in MODE 1 and MODES 2 and 3, except when all MFW full load and low load isolation valves are closed:

- SG Level sensors,
- APUs, and
- ALUs.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The MFW Full Load Closure on High SG Level LTSP is set high enough to avoid spurious actuation but low enough in order to prevent water level in the SG from rising and entering the steam line.

The P13 permissive automatically enables the MFW Full Load Closure on High SG Level function when the hot leg temperature is greater than or equal to 200 ºF.

c. Startup and Shutdown Feedwater Isolation on SG Pressure Drop (All SGs)

The affected SG depressurizes for the listed events, a reactor trip is initiated on a SG pressure drop signal. Also, the Startup and Shutdown Feedwater (SSS) isolation and control valves close in all the SGs.

A complete Feedwater system isolation in the affected SG limits the coolant provided into the affected SG by the MFW/SSS. This action minimizes the mass and energy released into the containment and RCS cooldown.

This function mitigates the following postulated accidents or AOOs:

- Excessive increase in secondary steam flow,
- Steam system piping failure, and
- Feedwater system piping failure.

The automatic SSS Feedwater Isolation on SG Pressure Drop function requires four divisions of the following sensors and processors to be OPERABLE in MODE 1 and MODES 2 and 3, except when all MFW full load and low load isolation valves are closed:

- SG pressure sensors,
- APUs, and
- ALUs.

The LTSP is high enough to preclude spurious operation but low enough to terminate feedwater flow before overcooling of the primary system or depletion of secondary inventory.

There are no automatic permissives associated with this function.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

d. SSS Isolation on Low SG Pressure (All SGs)

The affected SG depressurizes in the event of a steam line or Feedwater pipe failure. In the event of a small secondary side break for which the SG pressure drop signal is never reached, this function also isolates the SSS supply to the affected SG. This action minimizes the mass and energy released into the containment.

This function mitigates the following postulated accidents or AOOs:

- Excessive increase in secondary steam flow,
- Steam system piping failure, and
- Feedwater system piping failure.

The automatic SSS Feedwater Isolation on Low SG Pressure function is required to be OPERABLE in:

– MODES 1,
– MODE 2, except when all MFW low load isolation valves are closed, and
– MODE 3 when the pressurizer pressure is greater than or equal to 2005 psia, except when all MFW low load isolation valves are closed.

The automatic SSS Feedwater Isolation on Low SG Pressure function requires four divisions of the following sensors and processors to be OPERABLE:

– SG pressure sensors,
– APUs, and
– ALUs.

The LTSP is high enough to preclude spurious operation but low enough to terminate feedwater flow before overcooling of the primary system or depletion of secondary inventory.

The P12 permissive automatically enables the SSS Isolation on Low SG Pressure function when the pressurizer pressure is greater than 2005 psia.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

e. SSS Isolation on High SG Level for Period of Time (Affected SGs)

During an increase in SG level after a reactor trip, the SSS systems are isolated in the affected SG in order to avoid the SG filling up and thus carryover of water into Main Steam line and subsequent water discharge by MSRT. This function mitigates Increase in Feedwater flow.

The automatic SSS Isolation on High SG Level for Period of Time function requires four divisions of the following sensors and processors to be OPERABLE in MODE 1 and MODES 2 and 3, except when all MFW low load isolation valves are closed:

- RTCB Position Indication,
- SG Level (Narrow Range) sensors,
- APUs, and
- ALUs.

The SSS Isolation on High SG Level for Period of Time LTSP is set high enough to avoid spurious actuation but low enough in order to prevent water level in the SGs from rising and entering the steam lines.

The P13 permissive automatically enables the SSS Isolation on High SG Level for Period of Time function when the hot leg temperature is greater than 200 ºF.

3. <u>Safety Injection System Actuation</u>

a. Low Pressurizer Pressure

In the event of a decrease in RCS water inventory, the makeup is supplied by the Medium Head Safety Injection (MHSI) in the high pressure phase of the event and the Low Head Safety Injection (LHSI) in the low pressure phase. For a potential overcooling event, the reactivity insertion is limited by the boron injection via the MHSI. Even if the boron injection is not required, MHSI injection is needed to stabilize the RCS pressure.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The Safety Injection System (SIS) Actuation function mitigates the following postulated accidents or AOOs:

- Excessive increase in secondary steam flow,
- MSLB,
- Feedwater Line Break,
- Inadvertent opening of a pressurizer pilot operated safety valve,
- Small break LOCA,
- Steam system piping failure, and
- Large break LOCA.

The automatic SIS Actuation on Low Pressurizer Pressure function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2 and MODE 3 with the pressurizer pressure greater than or equal to 2005 psia:

- Three Pressurizer Pressure (Narrow Range) sensors,
- Three divisions of APUs, and
- Three divisions of ALUs.

The LTSP for this function is set below the full load operating value for RCS pressure so as not to interfere with normal plant operation. However, the setting is high enough to provide an SIS actuation during an RCS depressurization.

The P12 permissive automatically enables the SIS Actuation on Low Pressurizer Pressure function when the pressurizer pressure is greater than or equal to 2005 psia.

The capability for manual initiation of the SIS is provided to the operator in the MCR. This manual initiation starts the four trains of SI. Four manual initiation controls are provided, any two of which will start the four SIS trains.

b. Low Delta P_{sat}

This function ensures SIS actuation in the hot and cold shutdown conditions with LHSI / Residual Heat Removal (RHR) in operation and at least one RCP operating.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

This function mitigates the following postulated accidents or AOOs:

- Small break LOCA,
- Large break LOCA,
- Spurious opening of one Main Steam relief or safety valve,
- Inadvertent opening of a pressurizer pilot operated safety valve,
- Excessive increase in secondary steam flow, and
- MSLB.

The automatic SIS Actuation on Low Delta P_{sa} function requires four divisions of the following sensors and processors:

- Hot Leg Pressure (Wide Range) sensors,
- Hot Leg Temperature (Wide Range) sensors,
- APUs, and
- ALUs.

These sensors and processors are required to be OPERABLE in MODE 3 when Trip/Actuation Function B.3.a, SIS Actuation on Low Pressurizer Pressure, is disabled.

This function ensures SIS actuation in the hot and cold shutdown conditions with LHSI/RHR in operation and at least one of the RCPs are operating.

The LTSP for the Low Delta P_{sat} function is set high enough to avoid spurious operation but low enough to maintain core coverage in the event of an RCS pipe break.

The P12 permissive automatically enables the SIS Actuation on Low Delta P_{sat} function when the pressurizer pressure is less than or equal to 2005 psia. The P15 permissive automatically enables the SIS Actuation on Low Delta P_{sat} function when at least two RCPs are running, the hot leg pressure is greater than or equal to 464 psia, and when the hot leg temperature is greater than or equal to 356ºF.

The capability for manual initiation of the SIS is provided to the operator in the MCR. This manual initiation starts the four trains of SI. Four manual initiation controls are provided, any two of which will start the four SIS trains.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

4. RCP Trip on Low Delta-Pressure across the RCP with SIS Actuation

In case of LOCA in combination with a SIS actuation, the RCPs are tripped to prevent their operation in scenarios where timing of the pump trip is related to maintaining core cooling.

This function mitigates the following postulated accidents or AOOs:

- Inadvertent opening of a PSRV, and
- Small break LOCA.

The automatic RCP Trip on Low Delta-Pressure across RCP with SIS Actuation function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, and 3:

- RCP Delta-Pressure sensors,
- RCP Current sensors,
- APUs, and
- ALUs.

The LTSP for the RCP Trip on Low Delta-Pressure across RCP with SIS Actuation function is set high enough to avoid spurious operation but low enough to ensure core cooling is maintained.

There are no automatic permissives associated with this function.

5. Partial Cooldown on SIS Actuation

The partial cooldown consists of lowering the MSRT setpoint down to allow depressurization of the RCS by heat removal of the SGs. This function mitigates the following postulated accidents or AOOs:

- Excessive increase in secondary steam flow,
- MSLB,
- Inadvertent opening of a Pressurizer pilot operated safety valve, and
- Small break LOCA.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The automatic Partial Cooldown on SIS Actuation function requires four divisions of the following processors to be OPERABLE in MODES 1, 2, and 3:

- APUs, and
- ALUs.

The LTSP for the Partial Cooldown Actuation on SIS Actuation function is set high enough to avoid spurious operation but low enough to ensure adequate flow from the MHSI pumps to maintain core cooling.

The P14 permissive automatically enables the Partial Cooldown on SIS Actuation function when the hot leg pressure is greater than or equal to 464 psia and the hot leg temperature is greater than or equal to 356 ºF.

6. Emergency Feedwater System

a. Actuation on Low-Low SG Level (All SGs)

In case of loss of MFW, the Emergency Feedwater System (EFWS) is actuated to remove residual heat via secondary side. With an EFWS actuation signal, SG blowdown is also isolated to conserve SG inventory. This function mitigates the following postulated accidents or AOOs:

- Loss of normal feedwater flow,
- Feedwater system piping failure, and
- LOOP.

The automatic EFWS Actuation on Low-Low SG Level function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2 and 3:

- SG level (Wide Range) sensors,
- APUs, and
- ALUs.

This function ensures heat is removed from the primary system through the SGs in the event of a loss of MFW or feedwater line break, as indicated by low SG level. The LTSP is high enough to provide an operating envelope that prevents unnecessary actuations but low enough to ensure sufficient make-up is provided to the SGs.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The P13 permissive automatically enables the EFWS Actuation on Low-Low SG Level function when the hot leg temperature is greater than or equal to 200ºF.

b. Actuation on LOOP and SIS Actuation (All SGs)

The LOOP results in a trip of the turbine, RCPs, and MFW pumps. The MFW and SSS supply cut off leads to a decrease in secondary side heat removal and the primary flow coast down further reduces the capacity of the primary coolant to remove heat from the core. As a result, primary and secondary pressures and temperatures increase. The heat is removed via MSRT and EFWS. With an EFWS actuation signal, SG blowdown is also isolated to conserve SG inventory.

This function mitigates the consequences of a Small Break LOCA.

The automatic EFWS Actuation on LOOP and SIS function requires four divisions of the following processors to be OPERABLE in MODES 1 and 2:

- 6.9 kV Bus Voltage sensors,
- APUs, and
- ALUs.

This function ensures heat is removed from the primary system through the SGs in the event of a LOCA concurrent with a LOOP.

There are no automatic permissives associated with this function.

c. Isolation on High SG Level (Affected SG)

In the case of an increasing SG level event, the EFWS supply to the affected SG is isolated in order to avoid filling the SG, and subsequently introducing water into Main Steam line and MSRT. This function precludes overfilling of the SG.

The automatic EFWS Isolation on High SG Level function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2 and 3:

- SG level (Wide Range) sensors,
- APUs, and
- ALUs.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

This function ensures the SGs are not overfilled, which could allow radioactive water to be discharged through the MSRTs. The LTSP is high enough to provide an operating envelope that prevents unnecessary isolations but low enough to ensure the SGs are not over-filled.

The P13 permissive automatically enables the EFWS Isolation on High SG Level function when the hot leg temperature is greater than or equal to 200 ºF.

7. Main Steam Relief Train

a. Actuation on High SG Pressure

In the event of a loss of the secondary side heat sink, the residual heat is removed through the steam relief valves to the atmosphere. This is done by the MSRT. The MSRT also ensures SG overpressure protection, minimizes the actuation of the Main Steam Safety Valves (MSSVs), which reduces the risk of a stuck open safety relief valve.

This function mitigates the following postulated accidents or AOOs:

- Excessive increase in secondary steam flow,
- Total loss of load and/or turbine trip
- Loss of main heat sink (condenser),
- Inadvertent closure of a Main Steam Isolation Valve (MSIV),
- MSLB,
- RCP seizure (locked rotor) or RCP shaft break., and
- Feedwater system piping failure.

The automatic MSRT Actuation on High SG Pressure function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, and 3:

- SG Pressure sensors,
- APUs, and
- ALUs.

The LTSP for the MSRT Actuation on High SG Pressure function is set high enough to avoid spurious operation and low enough to open and relieve SG pressure before over pressurization limits are reached.

There are no automatic permissives associated with this function.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

b. Isolation on Low SG Pressure

The Main Steam Relief Isolation Valves (MSRIVs) are opened during events in order to control pressure in the SGs. In order to prevent a stuck open Main Steam Relief Control Valve from causing an RCS cooldown and a risk of return to critical conditions, the MSRT is isolated.

This function mitigates the following postulated accidents or AOOs:

- Excessive increase in secondary steam flow,
- Loss of main heat sink (condenser),
- Inadvertent Opening of SG Safety or Relief Valve, and
- MSLB.

The automatic MSRT Isolation on Low SG Pressure function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2 and MODE 3 with the pressurizer pressure is greater than or equal to 2005 psia:

- SG pressure sensors,
- APUs, and
- ALUs.

The LTSP for the MSRT Isolation on Low SG Pressure function is set low enough to avoid spurious operation and high enough to limit the rate of RCS cooldown.

The P12 permissive automatically enables the MSRT Isolation on Low SG Pressure function when the pressure is greater than or equal to 2005 psia.

8. <u>MSIV Closure</u>

a. Closure on SG Pressure Drop (All SGs)

In case of a secondary side Steam Line or Feedwater system pipe break, the affected SG depressurizes. This function isolates all four SGs in order to:

- Prevent draining of unaffected SG,
- Limit return to criticality conditions due to a overcooling transient,
- Limit the release of radioactivity, and
- Limit mass and energy releases into the containment.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

This function mitigates the following postulated accidents or AOOs:

- Excessive increase in secondary steam flow,
- Spurious opening of one SG safety or relief valve,
- Steam system piping failure, and
- Feedwater system piping failure.

The automatic MSIV Closure on SG Pressure Drop function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, and 3:

- SG Pressure sensors,
- APUs, and
- ALUs.

The LTSP for the MSIV Closure on SG Pressure Drop function is set high enough to avoid SG pressure fluctuations during normal operation and low enough to isolate a SG and limit the blowdown to the value assumed in the safety analysis.

There are no automatic permissives associated with this function.

b. Closure on Low SG Pressure (All SGs)

For most Main Steam Line or Feedwater pipe breaks, the affected SG depressurizes. For small breaks, the setpoint for MSIV closure on SG pressure drop may not be reached. This function isolates all four SG on the main steam side in the event of a secondary side break in order to:

- Prevent draining of unaffected SGs,
- Limit the return to critical conditions due to a overcooling transient,
- Limit the release of radioactivity, and
- Limit mass and energy releases into the containment.

This function mitigates the following postulated accidents or AOOs:

- Excessive increase in secondary steam flow,
- Spurious opening of one SG safety or relief valve,
- Steam system piping failure, and
- Feedwater system piping failure.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The automatic MSIV Closure on Low SG Pressure function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2 and MODE 3, except when all MSIVs are closed:

- SG pressure sensors,
- APUs, and
- ALUs.

The LTSP for the MSIV Closure on Low SG Pressure function is set high enough to avoid SG pressure fluctuations during normal operation and low enough to isolate a SG and limit the blowdown to the value assumed in the safety analysis.

The P12 permissive automatically enables the MSIV Closure on Low SG Pressure function when the pressurizer pressure is greater than or equal to 2005 psia.

9. Containment Isolation

a. Isolation (Stage 1) on High Containment Pressure

In case of a LOCA, the containment has to be isolated in order to prevent release of radioactivity to the environment. Safeguards Building HVAC is also reconfigured to process air through High Efficiency Particulate Air (HEPA) filters to ensure 10 CFR 50.34 and 10 CFR 100.21 limits are not exceeded.

The automatic Stage 1 Containment Isolation on High Containment Pressure function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, and 3:

- Containment Service Compartment Pressure monitors,
- Containment Equipment Compartment Pressure monitors,
- APUs, and
- ALUs.

The LTSP for the Stage 1 Containment Isolation on High Containment Pressure function is set high enough to avoid spurious operation but low enough to ensure offsite dose consequences are maintained below 10 CFR 50.34 and 10 CFR 100.21 limits.

There are no automatic permissives associated with this function.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

b. Isolation (Stage 1) on SIS Actuation

In case of the listed events, the containment has to be isolated in order to prevent release of radioactivity to the environment. Safeguards Building HVAC is also reconfigured to process air through HEPA filters to ensure 10 CFR 50.34 and 10 CFR 100.21 limits are not exceeded.

This function mitigates the following postulated accidents or AOOs:

- Inadvertent opening of a pressurizer pilot operated safety valve, and
- LOCA.

The automatic Stage 1 Containment Isolation on SIS Actuation function requires four divisions of the following processors to be OPERABLE in MODES 1, 2, 3, and 4:

- APUs, and
- ALUs.

There are no automatic permissives associated with this function.

c. Isolation (Stage 2) on High-High Containment Pressure

In case of a LOCA, the containment has to be isolated in order to prevent release of radioactivity to the environment.

This function mitigates the following postulated accidents or AOOs:

- Inadvertent opening of a pressurizer pilot operated safety valve, and
- LOCA.

The automatic Stage 2 Containment Isolation on High-High Containment Pressure function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, and 3:

- Containment Service Compartment Pressure monitors,
- Containment Equipment Compartment Pressure monitors,
- APUs, and
- ALUs.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The LTSP for the Stage 2 Containment Isolation on High-High Containment Pressure function is set high enough to avoid spurious operation but low enough to ensure offsite dose consequences are maintained below 10 CFR 50.34 and 10 CFR 100.21 limits.

There are no automatic permissives associated with this function.

d. Isolation (Stage 1) on High Containment Radiation

In case of a significant release of radioactivity into the containment, the containment is isolated to ensure 10 CFR 50.34 and 10 CFR 100.21 limits are not exceeded.

This function mitigates the following postulated accidents or AOOs:

- Rod ejections,
- LOCA,
- MSLB inside containment, and
- Feedwater line break inside containment.

The automatic Stage 1 Containment Isolation on High Containment Radiation function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, 3, and 4:

- Containment High Range radiation monitors,
- APUs, and
- ALUs.

The LTSP for the Stage 1 Containment Isolation on High Containment Radiation function is set high enough to avoid spurious operation but low enough to ensure offsite dose consequences are maintained below 10 CFR 50.34 and 10 CFR 100.21 limits.

There are no automatic permissives associated with this function.

10. <u>Emergency Diesel Generator</u>

a. Start on Degraded Grid Voltage

Following the detection of degraded voltage for a period of time on one 6.9 kV bus, the EDG associated with that bus is automatically started. This function mitigates a LOOP, which is assumed to occur independently or concurrently with postulated accidents and AOOs.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The automatic EDG Start on Degraded Grid Voltage requires four divisions of the following processors to be OPERABLE in MODES 1, 2, 3, and 4 or when the associated EDG is required to be OPERABLE in accordance with LCO 3.8.2, “AC Sources - Shutdown”:

- 6.9 kV voltage sensors,
- APUs, and
- ALUs.

This function ensures AC Power is available to mitigate a postulated concurrent design basis event.

The LTSP for the EDG Start on Degraded Grid Voltage is set high enough to avoid spurious operation but low enough to ensure that power is provide to ESF functions in the time-frame assumed in the accident analyses.

There are no automatic permissives associated with this function.

b. Start on LOOP

Following a LOOP on one 6.9 kV bus, the EDG associated with that bus is automatically started. This function mitigates a LOOP, which is assumed to occur independently or concurrently with postulated accidents and AOOs.

The automatic EDG Start on LOOP requires four divisions of the following processors to be OPERABLE in MODES 1, 2, 3, and 4 or when the associated EDG is required to be OPERABLE in accordance with LCO 3.8.2, “AC Sources - Shutdown”:

- 6.9 kV voltage sensors,
- APUs, and
- ALUs.

This function ensures AC Power is available to mitigate a postulated concurrent design basis event.

The LTSP for the EDG Start on LOOP is set high enough to avoid spurious operation but low enough to ensure that power is provide to ESF functions in the time-frame assumed in the accident analyses.

There are no automatic permissives associated with this function.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

11. Chemical and Volume Control System Charging Line Isolation

a. Isolation on High-High Pressurizer Level

The isolation of the CVCS Charging Line on High-High Pressurizer Level is required to avoid filling of the pressurizer and subsequent water overflow through the safety valves.

This function protects against a CVCS malfunction that causes an increase in RCS water inventory.

The automatic CVCS Charging Line Isolation on High-High Pressurizer Level function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, and 3:

- Pressurizer Level (Narrow Range) sensors,
- APUs, and
- ALUs.

The LTSP is low enough to initiate appropriate mitigative actions in time to prevent the pressurizer from overfilling during the CVCS Malfunction event that may increases RCS inventory, but high enough to prevent spurious operations.

The P17 permissive automatically disables the CVCS Charging Line Isolation on High-High Pressurizer Level function when the cold leg temperature is less than or equal to 248 ºF.

b. Isolation on ADM - Shutdown Condition (RCP not operating)

The ADM function in the Shutdown Condition mitigates a dilution event where no RCPs are in operation. This function ensures that:

- The dilution is stopped when the protection is actuated, and
- The core remains sub-critical.

The automatic CVCS Charging Line Isolation on ADM - Shutdown Condition (RCP not operating) function is required to be OPERABLE in:

- MODES 5, with two or less RCPs in operation, and
- MODES 6.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The automatic CVCS Charging Line Isolation on ADM - Shutdown Condition (RCP not operating) function requires the following sensors and processors:

- Boron Concentration - CVCS Charging Line sensors (4 divisions),
- Boron Temperature - CVCS Charging Line sensors (4 divisions),
- APUs (4 divisions), and
- ALUs (Divisions 1 and 4).

The LTSP is high enough to provide an operating envelope that prevents unnecessary isolations but low enough to mitigate a dilution event in the shutdown condition where the RCPs are not in operation.

This function is required to be accompanied by Permissive P7, which represents a RCP speed shutdown condition, or an ATWS signal.

c. Isolation on ADM - Standard Shutdown Conditions

This function mitigates a homogeneous dilution event in the standard shutdown states where the RCPs are in operation. This function ensures that:

- The dilution is stopped when the protection is actuated, and
- The core remains sub-critical.

The automatic CVCS Charging Line Isolation on ADM - Standard Shutdown Conditions function is required to be OPERABLE in:

- MODES 3, with thee or more RCPs in operation,
- MODES 4, with thee or more RCPs in operation, and
- MODES 5, with thee or more RCPs in operation.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The automatic CVCS Charging Line Isolation on ADM - Standard Shutdown Conditions function requires the following sensors and processors:

- Boron Concentration - CVCS Charging Line sensors (4 divisions),
- Boron Temperature - CVCS Charging Line sensors (4 divisions),
- CVCS Charging Line Flow sensors (4 divisions),
- Cold Leg Temperature (Wide Range) sensors (4 divisions),
- APUs (4 divisions), and
- ALUs (Divisions 1 and 4).

The LTSP is high enough to provide an operating envelope that prevents unnecessary isolations but low enough to mitigate a dilution event in the shutdown condition where the RCPs are in operation.

This function is required to be accompanied by a permissive signal, P8, which represents a reactor shutdown condition as indicated by RCCA position indication and disabled by the Permissive P7, which represents a RCP shutdown condition.

12.a and 12.b. <u>PSRV Actuation - First and Second Valve</u>

The integrity of the reactor pressure vessel must be ensured under all plant conditions. At low coolant temperature, the cylindrical part of the vessel could fail by brittle fracture before the design pressure of the RCS is reached. Therefore the low-temperature overpressure protection (LTOP) is ensured by opening of the PSRVs.

This function mitigates a low temperature overpressure event.

The automatic PSRVs Actuation function requires four divisions of the following processors to be OPERABLE when the PSRVs are required to be OPERABLE by LCO 3.4.11, "Low Temperature Overpressure Protection (LTOP)"

- Hot Leg Pressure (Wide Range) sensors,
- APUs, and
- ALUs.

The LTSPs for the PSRV Actuation function are high enough to prevent spurious operation but low enough to prevent RCS over pressurization.

The P17 permissive automatically enables the PSRV Actuation function when the cold leg temperature is less than or equal to 248º F.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

13. Control Room HVAC Reconfiguration to Recirculation Mode on High Intake Activity

In case of a significant release of radioactivity, the Control Room HVAC is reconfigured to ensure 10 CFR 50.34 limits are not exceeded.

This function mitigates the following postulated accidents or AOOs:

- Rod ejections,
- LOCA, and
- Line breaks outside containment.

The automatic Control Room HVAC Reconfiguration to Recirculation Mode on High Intake Activity function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, 3, 4, 5, 6, and during the movement of irradiated fuel assemblies:

- Control Room HVAC Intake Activity radiation monitors,
- APUs, and
- ALUs.

The LTSP for the Control Room HVAC Reconfiguration to Recirculation Mode on High Intake Activity function is set high enough to avoid spurious operation but low enough to ensure offsite dose consequences are maintained below 10 CFR 50.34 limits.

There are no automatic permissives associated with this function.

C. PROTECTION SYSTEM PERMISSIVES

Protection System permissives are provided to ensure reactor trips and ESF are in the correct configuration for the current unit status. They back up operator actions to ensure Functions are not bypassed during unit conditions under which the safety analysis assumes the Functions are not bypassed. Therefore, the permissive Functions do not need to be OPERABLE when the associated reactor trip or ESF functions are outside the applicable MODES. The automatic permissives are:

1. P2 - Flux (Power Range) Measurement Higher than First Threshold

The P2 permissive is representative of PRD neutron flux measurements higher than a low-power setpoint value. The P2 setpoint value corresponds to the value below which transients do not lead to risk of DNB (10% RTP).

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The P2 permissive is utilized in the following reactor trips or ESF functions:

- Reactor Trip 1.a - Low DNBR,
- Reactor Trip 1.b - Low DNBR and Imbalance or Rod Drop,
- Reactor Trip 1.c - Variable Low DNBR and Rod Drop,
- Reactor Trip 1.d - Low DNBR - High Quality,
- Reactor Trip 1.e - Low DNBR - High Quality and Imbalance or Rod Drop,
- Reactor Trip 2 - High Linear Power Density,
- Reactor Trip 6.b - Low RCS Flow Rate in Two Loops,
- Reactor Trip 7 - Low RCP Speed, and
- Reactor Trip 10 - Low Pressurizer Pressure.

To generate the permissive, neutron flux measurements from the PRDs are compared to the setpoint. When two out of four measurements are greater than the setpoint, the permissive is validated. Otherwise, it is inhibited.

The value of the permissive was selected such that AOOs do not challenge the DNBR or centerline melt limits when they occur at a core power level below the permissive value.

2. <u>P3 - Flux (Power Range) Measurement Higher than Second Threshold</u>

The P3 permissive is representative of PRD neutron flux measurements higher than an intermediate power setpoint value. The P3 setpoint value corresponds to the value below which loss of one reactor coolant pump does not lead to risk of DNB (70% Nuclear Power).

The P3 permissive is utilized in Reactor Trip 6.a - Low-Low RCS Flow Rate in One Loop.

To generate the permissive, neutron flux measurements from the PRDs are compared to the setpoint. When two out of four measurements are greater than the setpoint, the permissive is validated.

The value of the permissive was selected such that AOOs and postulated accidents that consider a loss of one RCP do not challenge the DNBR limit when they occur at a core power level below the permissive value (70% RTP).

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

3. P5 - Flux (Intermediate Range) Measurement Higher than Threshold

The P5 permissive is representative of intermediate range detector (IRD) neutron flux measurements above a low-power setpoint value. The P5 setpoint value corresponds to the boundary between the operating ranges of the source range detectors and intermediate range detectors (greater than or equal to 10^{-5}% power as shown on the IRDs).

The P5 permissive is utilized in the following reactor trips or ESF functions:

- Reactor Trip 4 - High Core Power Level, and
- Reactor Trip 5 - Low Saturation Margin.

To generate the permissive, neutron flux measurements from the IRDs are compared to the setpoint. When two out of four of the measurements are greater than the setpoint, the permissive is validated.

The value of the permissive defines the boundary between the operating range of the source range detectors and the operating range of the intermediate range detectors.

4. P6 - Thermal Core Power Higher than Threshold

The P6 permissive is representative of core thermal power above a low-power setpoint value corresponding to the boundary between the operating ranges of the IRDs and the PRDs (10% RTP).

The P6 permissive is utilized in the following reactor trips or ESF functions:

- Reactor Trip 8 - High Neutron Flux (Intermediate Range), and
- Reactor Trip 9 - Low Doubling Time (Intermediate Range).

Hot leg pressure measurements, hot leg temperature measurements, and cold leg temperature measurements are used to calculate core thermal power. These calculated core thermal power levels are compared to the setpoint. When three out of four of the calculated core thermal power levels are greater than the setpoint, the operator is prompted to manually validate the permissive.

The value of the permissive was selected at the boundary between the operating range of the intermediate range detectors and the power range detectors.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

5. P7 - RCP Speed Lower than Threshold

The P7 permissive defines when reactor coolant pumps (RCPs) are no longer in operation. The P7 permissive is utilized in the following reactor trips or ESF functions:

- ESF 11.b - CVCS Charging Line Isolation on ADM at Shutdown Condition (RCP not operating), and
- ESF 11.c - CVCS Charging Line Isolation on ADM at Standard Shutdown Conditions.

The RCP speed measurements (one per RCP) are compared to a setpoint (91% nominal speed). When two out of four of the measurements are less than the setpoint, the permissive is validated (i.e., indicates that two or more RCPs are turned off).

The value of the permissive was selected to establish the requirements for anti-dilution mitigation in a timely manner.

6. P8 - Shutdown RCCA Position Lower than Threshold

The P8 permissive defines the shutdown state with all rods in (ARI). The P8 permissive is utilized in ESF 11.c - CVCS Charging Line Isolation on ADM at Standard Shutdown Conditions.

RCCA Bottom Position Indicator sensors are acquired in four different electrical divisions. For each division, when all rods in the shutdown banks reach the lower end position, a signal is generated. When two out of four of divisions indicate all rods in, the permissive is validated.

The P8 Permissive is characteristic of a shutdown state with ARI. With an ARI condition, this permissive enables the Anti-dilution in Standard Shutdown States function and inhibits the Anti-dilution in Power Condition" function.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

7. P12 - Pressurizer Pressure Lower than Threshold

The P12 permissive defines the transition from hot shutdown to cold shutdown with respect to RCS pressure. The P12 permissive is utilized in the following reactor trips or ESF functions:

- Reactor Trip 12 - High Pressurizer Level,
- Reactor Trip 13 - Low Hot Leg Pressure,
- Reactor Trip 15 - Low SG Pressure Trip,
- ESF 2.d - SSS Isolation on Low SG Pressure (All SGs),
- ESF 3.a - SIS Actuation on Low Pressurizer Pressure,
- ESF 3.b - SIS Actuation on Low Delta Psat,
- ESF 7.b - MSRT Isolation on Low SG Pressure
- ESF 8.b - MSIV Closure on Low SG Pressure (All SGs), and
- ESF 9.b - Containment Isolation (Stage 1) on SIS Actuation.

Pressurizer pressure measurements are compared to the P12 setpoint (2005 psia). The low SG pressure and low hot leg pressure reactor trip functions are automatically activated when the pressurizer pressure rises above the P12 permissive value.

The Permissive P12 reflects the transition from hot shutdown to cold shutdown. P12 ensures cooling by Main Steam Bypass or MSRT down to the LHSI/RHR connection temperature and to be able to depressurize the reactor coolant system to LHSI/RHR connection pressure without actuation of SIS.

8. P13 - Hot Leg Temperature Lower than Threshold

The P13 permissive defines when steam generator draining and filling operations are allowed. The P13 permissive is utilized in the following reactor trips or ESF functions:

- Reactor Trip17 - Low SG Level,
- Reactor Trip 18 - High SG Level,
- ESF 2.b - MFW Full Load Closure on High SG Level (Affected SGs)
- ESF 2.e - SSS Isolation on High SG Level for Period of Time (Affected SGs),
- ESF 6.a - EFWS Actuation on Low-Low SG Level (All SGs), and
- ESF 6.c - EFWS Isolation on High SG Level (Affected SG).

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

Hot leg temperature (WR) measurements are compared to the P13 setpoint (200ºF).

The value of the permissive was selected in order to permit draining and filling operations during shutdown and LHSI/RHR in operation without generating protection signals.

9. P14 - Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds

The P14 permissive defines when the residual heat removal system is allowed to be connected to the RCS. The P14 permissive is utilized in ESF 5 - Partial Cooldown Actuation on SIS Actuation.

At pressures and temperatures below the setting of the P14 permissive (464 psia and 356 ºF), operation of the LHSI/RHR system is allowed.

This permissive is manually controlled.

10. P15 - RCPs Shutdown and P14

The P15 permissive defines when SI actuation due to delta Psat is disabled and SI actuation due to low loop level is enabled.

The P15 permissive is utilized in the following reactor trips or ESF functions:

- ESF 3.b - SIS Actuation on Low Delta Psat, and
- ESF 9.b - Containment Isolation (Stage 1) on SIS Actuation.

The value for Permissive P15 (50% no load current and P14 is true) represents the threshold for switching from the SIS Actuation on Low Delta P_{sat} protection to protection via the SIS Actuation on Low RCS Loop Level.

11. P17 - Cold Leg Temperature Lower than Threshold

The P17 permissive corresponds to the temperature conditions where brittle fracture protection is required. The P17 permissive is utilized in the following reactor trips or ESF functions:

- ESF 12.a - PSRV Actuation - First Valve, and
- ESF 12.b - PSRV Actuation - Second Valve.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The value for Permissive P17 is the threshold for activation of cold overpressure mitigation systems.

D. SENSORS, MANUAL ACTUATION SWITCHES, SIGNAL PROCESSORS, AND ACTUATION DEVICES

The relationship between sensors, manual actuation switches, signal processors, and actuation devices is provided below:

SENSORS

1. 6.9 kV Bus Voltage

Three 6.9 kV Bus Voltage sensors per EDG are required to be OPERABLE in MODES 1, 2, 3, 4, and when the associated EDG is required to be OPERABLE by LCO 3.8.2. These sensors support the following functions:

- ESF 6.b: EFWS Actuation on LOOP and SIS Actuation (All SGs),
- ESF 10.a: EDG Start on Degraded Grid Voltage, and
- ESF 10.b: EDG Start on LOOP.

2. Boron Concentration - CVCS Charging Line

Four Boron Concentration - CVCS Charging Line sensors are required to be OPERABLE in MODES 3 and 4 with three or more RCPs in operation and in MODES 5 and 6. These sensors support the following functions:

- ESF 11.b: CVCS Charging Line Isolation on ADM at Shutdown Condition (RCP not operating), and
- ESF 11.c: CVCS Charging Line Isolation on ADM at Standard Shutdown Conditions.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

3. Boron Temperature - CVCS Charging Line

Four Boron Temperature - CVCS Charging Line sensors are required to be OPERABLE in MODES 3 and 4 with three or more RCPs in operation and in MODES 5 and 6. These sensors support the following functions:

- ESF 11.b: CVCS Charging Line Isolation on ADM at Shutdown Condition (RCP not operating), and
- ESF 11.c: CVCS Charging Line Isolation on ADM at Standard Shutdown Conditions.

4. CVCS Charging Line Flow

Four CVCS Charging Line Flow sensors are required to be OPERABLE in MODES 3, 4, and 5 when three or more RCPs are in operation. These sensors support ESF 11.c: CVCS Charging Line Isolation on ADM at Standard Shutdown Conditions.

5. Cold Leg Temperature (Narrow Range)

Four Cold Leg Temperature (Narrow Range) sensors are required to be OPERABLE when RTP is greater than or equal to 10%. These sensors support the following functions and Permissives:

- Reactor Trip 1.a: Low DNBR,
- Reactor Trip 1.b: Low DNBR and Imbalance or Rod Drop,
- Reactor Trip 1.c: Variable Low DNBR and Rod Drop,
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and Imbalance or Rod Drop, and
- Permissive P6: Thermal Core Power Higher than Threshold.

6. Cold Leg Temperature (Wide Range)

Four Cold Leg Temperature (Wide Range) sensors are required to be OPERABLE in:

- MODE 1,
- MODE 2, when power is greater than or equal to 10^{-5}% as shown on the intermediate range detectors, and in
- MODES 3, 4, 5, and 6 with three or more RCPs in operation.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

These sensors support the following functions and Permissives:

- Reactor Trip 4: High Core Power Level,
- Reactor Trip 5: Low Saturation Margin,
- ESF 11.c: CVCS Charging Line Isolation on ADM at Standard Shutdown Conditions, and
- Permissive P17: Cold Leg Temperature Lower than Threshold.

7. Containment Pressure

Four Containment Equipment Compartment Containment and Service Compartment Pressure sensors per area are required to be OPERABLE in MODES 1, 2, and 3. These sensors support the following functions:

- Reactor Trip 19: High Containment Pressure,
- ESF 9.a: Containment Isolation (Stage 1) on High Containment Pressure, and
- ESF 9.c: Containment Isolation (Stage 2) on High-High Containment Pressure.

8. Hot Leg Pressure (Wide Range)

Four Hot Leg Pressure (Wide Range) sensors are required to be OPERABLE in Modes 1, 2, and 3, and when the PSRVs are required to be OPERABLE per LCO 3.4.11, "Low Temperature Overpressure Protection (LTOP)." These sensors support the following functions and Permissives:

- Reactor Trip 4: High Core Power Level,
- Reactor Trip 5: Low Saturation Margin,
- Reactor Trip 13: Low Hot Leg Pressure,
- ESF 3.b: SIS Actuation on Low Delta P_{sat},
- ESF 12.a: PSRV Actuation - First Valve,
- ESF 12.b: PSRV Actuation - Second Valve,
- Permissive P6: Thermal Core Power Higher than Threshold,
- Permissive P14: Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds, and
- Permissive P15: RCPs Shutdown and P14.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

9. Hot Leg Temperature (Narrow Range)

Four Hot Leg Temperature (Narrow Range) sensors in each of four divisions (16 total) are required to be OPERABLE in MODE 1 and MODE 2 when power is greater than or equal to 10^{-5}% as shown on the intermediate range detectors. These sensors support the following functions and Permissives:

- Reactor Trip 4: High Core Power Level,
- Reactor Trip 5: Low Saturation Margin, and
- Permissive P6: Thermal Core Power Higher than Threshold.

10. Hot Leg Temperature (Wide Range)

Four Hot Leg Temperature (Wide Range) sensors are required to be OPERABLE in MODE 3 when Trip/Actuation Function B.3.a, SIS Actuation on Low Pressurizer Pressure, is disabled. These sensors support the following functions and Permissives:

- ESF 3.b: SIS Actuation on Low Delta P_{sat},
- Permissive P13: Hot Leg Temperature Lower than Threshold,
- Permissive P14: Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds, and

11. Intermediate Range

Four Intermediate Range sensors are required to be OPERABLE in:

- MODE 1, when power is less than or equal to 10% RTP,
- MODE 2, and in
- MODES 3 with the RCSL System capable of withdrawing a RCCA or one or more RCCAs not fully inserted.

These sensors support the following functions and Permissives:

- Reactor Trip 8: High Neutron Flux (Intermediate Range),
- Reactor Trip 9: Low Doubling Time (Intermediate Range), and
- Permissive P5: Flux (Intermediate Range) Measurement Higher than Threshold.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

12. Power Range

Two Power Range sensors per division (8 total) are required to be OPERABLE in MODES 1 and 2, and in MODE 3 with the RCSL System capable of withdrawing a RCCA or one or more RCCAs not fully inserted. These sensors support the following functions and Permissives:

- Reactor Trip 3: High Neutron Flux Rate of Change,
- Permissive P2: Flux (Power Range) Measurement Higher than First Threshold, and
- Permissive P3: Flux Measurement (Power Range) Higher than Second Threshold.

13. Pressurizer Level (Narrow Range)

Four Pressurizer Level (Narrow Range) sensors are required to be OPERABLE in MODES 1, 2, and 3. These sensors support the following functions:

- Reactor Trip 12: High Pressurizer Level, and
- ESF 11.a: CVCS Charging Line Isolation on High-High Pressurizer Level.

14. Pressurizer Pressure (Narrow Range)

Four Pressurizer Pressure (Narrow Range) sensors are required to be OPERABLE in MODES 1 and 2 and MODE 3 when the pressurizer pressure is less than or equal to 2005 psia. These sensors support the following functions and Permissives:

- Reactor Trip 1.a: Low DNBR,
- Reactor Trip 1.b: Low DNBR and Imbalance or Rod Drop,
- Reactor Trip 1.c: Variable Low DNBR and Rod Drop,
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and Imbalance or Rod Drop,
- Reactor Trip 10: Low Pressurizer Pressure,
- Reactor Trip 11: High Pressurizer Pressure,
- ESF 3.a: SIS Actuation on Low Pressurizer Pressure, and
- Permissive P12: Pressurizer Pressure Lower than Threshold.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

15. Radiation Monitor - Containment High Range

Four Containment High Range Radiation Monitors are required to be OPERABLE in MODES 1, 2, 3, and 4. These sensors support ESF 9.d: Containment Isolation (Stage 1) on High Containment Radiation.

16. Radiation Monitor - Control Room HVAC Intake Activity

Four Control Room HVAC Intake Activity Radiation Monitors are required to be OPERABLE in MODES 1, 2, 3, 4, 5, 6, and during the movement of irradiated fuel assemblies. The monitors are not required to be OPERABLE when the associated train is in the recirculation mode. These sensors support ESF 13: Control Room HVAC Reconfiguration to Recirculation Mode on High Intake Activity.

17. RCP Current

Three RCP Current sensors per RCP (12 total) are required to be OPERABLE in MODES 1, 2, and 3. These sensors support the following functions and Permissives:

- ESF 4: RCP Trip on Low Delta P across RCP with SIS Actuation, and
- Permissive P15: Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds and Reactor Coolant Pumps Shutdown.

18. RCP Delta P Sensors

Two RCP Delta-Pressure sensors per pump (8 total) are required to be OPERABLE in MODES 1, 2, and 3. These sensors support ESF 4: RCP Trip on Low Delta P across RCP with SIS Actuation.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

19. RCP Speed

Four RCP Speed sensors are required to be OPERABLE when RTP is greater than or equal to 10%. These sensors support the following functions and Permissives:

- Reactor Trip 1.a: Low DNBR,
- Reactor Trip 1.b: Low DNBR and Imbalance or Rod Drop,
- Reactor Trip 1.c: Variable Low DNBR and Rod Drop,
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and Imbalance or Rod Drop,
- Reactor Trip 7: Low RCP Speed, and
- Permissive P7: RCP Speed Lower than Threshold.

20. RCS Loop Flow

Four RCS Loop Flow sensors per loop (16 total) are required to be OPERABLE in MODE 1 and in MODE 2 when power is greater than or equal to 10^{-5}% as shown on the intermediate range detectors. These sensors support the following functions and Permissives:

- Reactor Trip 1.a: Low DNBR,
- Reactor Trip 1.b: Low DNBR and Imbalance or Rod Drop,
- Reactor Trip 1.c: Variable Low DNBR and Rod Drop,
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and Imbalance or Rod Drop,
- Reactor Trip 4: High Core Power Level,
- Reactor Trip 5: Low Saturation Margin,
- Reactor Trip 6a: Low-Low RCS Loop Flow Rate in One Loop,
- Reactor Trip 6b: Low RCS Loop Flow Rate in Two Loops, and
- Permissive P6: Thermal Core Power Higher than Threshold.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

21. RTCB Position Indication

Four RTCB Position Indication sensors are required to be OPERABLE in MODE 1 and in MODES 2 and 3 with the RCSL System capable of withdrawing a RCCA or one or more RCCAs not fully inserted. These sensors support the following functions:

- ESF 1: Turbine Trip on Reactor Trip,
- ESF 2.a: MFW Full Load Closure on Reactor Trip (All SGs), and
- ESF 2.e: MFW and SSS Isolation on High SG Level for Period of Time (Affected SGs).

22. Self-Powered Neutron Detectors

Seventy two SPNDs are required to be OPERABLE when RTP is greater than or equal to 10%. These sensors support the following functions:

- Reactor Trip 1.a: Low DNBR,
- Reactor Trip 1.b: Low DNBR and Imbalance or Rod Drop,
- Reactor Trip 1.c: Variable Low DNBR and Rod Drop,
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and Imbalance or Rod Drop, and
- Reactor Trip 2: High Linear Power Density.

23. SG Level (Narrow Range)

Four SG Level (Narrow Range) sensors per SG (16 total) are required to be OPERABLE in MODE 1 and in MODES 2 and 3, except when all MFW isolation valves are closed. These sensors support the following functions:

- Reactor Trip 17: Low SG Level,
- Reactor Trip 18: High SG Level,
- ESF 2.b: MFW Full Load Closure on High SG Level (Affected SGs), and
- ESF 2.e: SSS Isolation on High SG Level for Period of Time (Affected SGs).

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

24. SG Level (Wide Range)

Four SG Level (Wide Range) sensors per SG (16 total) are required to be OPERABLE in MODES 1, 2, and 3. These sensors support the following functions:

- ESF 6.a: EFWS Actuation on Low-Low SG Level (All SGs), and
- ESF 6.c: EFWS Isolation on High SG Level (Affected SG).

25. SG Pressure

Four SG Pressure sensors per SG (16 total) are required to be OPERABLE in MODES 1, 2, and 3. These sensors support the following functions:

- Reactor Trip 14: SG Pressure Drop,
- Reactor Trip 15: Low SG Pressure,
- Reactor Trip 16: High SG Pressure,
- ESF 2.c: SSS Isolation on SG Pressure Drop (All SGs),
- ESF 2.d: SSS Isolation on Low SG Pressure (All SGs),
- ESF 7.a: MSRT Actuation on High SG Pressure,
- ESF 7.b: MSRT Isolation on Low SG Pressure,
- ESF 8.a: MSIV Closure on SG Pressure Drop (All SGs), and
- ESF 8.b: MSIV Closure on Low SG Pressure (All SGs).

MANUAL ACTUATION SWITCHES

1. Reactor Trip

Four manual Reactor Trip switches are required to be OPERABLE in MODES 1 and 2 and in MODES 3, 4, and 5 with the RCSL System capable of withdrawing a RCCA or one or more RCCAs not fully inserted. These sensors support all reactor trip functions.

2. SIS Actuation

Four manual SIS Actuation switches are required to be OPERABLE in MODES 1, 2, 3, and 4. These sensors support the following functions:

- ESF 3.a: SIS Actuation on Low Pressurizer Pressure,
- ESF 3.b: SIS Actuation on Low Delta P_{sat}.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

3. <u>SG Isolation</u>

Four manual SG Isolation switches per SG (16 total) are required to be OPERABLE in MODES 1, 2, and 3. These sensors support the following functions:

- ESF 2.b: MFW Full Load Closure on High SG Level (Affected SGs);
- ESF 2.c. SSS Isolation on SG Pressure Drop (All SGs);
- ESF 5: Partial Cooldown Actuation on SIS Actuation;
- ESF 6.a: EFWS Actuation on Low-Low SG Level (All SGs);
- ESF 6.c. EEFWS Isolation on High SG Level (Affected SG); and
- ESF 8.a: MSIV Closure on SG Pressure Drop (All SGs).

SIGNAL PROCESSORS

1. <u>Remote Acquisition Units</u>

Two RAUs per division (8 total) are required to be OPERABLE when RTP is greater than or equal to 10%. These signal processors support the following functions:

- Reactor Trip 1.a: Low DNBR,
- Reactor Trip 1.b: Low DNBR and Imbalance or Rod Drop,
- Reactor Trip 1.c: Variable Low DNBR and Rod Drop,
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and Imbalance or Rod Drop, and
- Reactor Trip 2: High Linear Power Density.

2. <u>Acquisition and Processing Units</u>

Five APUs per division (20 total) are required to be OPERABLE in accordance with the supported functions as shown in Table 3.3.1-2. These signal processors support the reactor trip, ESF functions, and Permissives.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

3. Actuation Logic Units

Four ALUs per division (16 total) are required to be OPERABLE in MODES 1, 2, 3, 4, 5, 6, and during the movement of irradiated fuel assemblies. These signal processors support the reactor trip, ESF functions and Permissives.

ACTUATION DEVICES

1. RCP Bus and Trip Breakers

Two RCP Bus and Trip Breakers per pump (8 total) are required to be OPERABLE in MODES 1, 2, 3, and 4. These actuation devices support ESF 4: RCP Trip on Low Delta P across RCP with SIS.

2. Reactor Trip Circuit Breakers

Four RTCBs are required to be OPERABLE in MODES 1 and 2 and in MODE 3 with the RCSL System capable of withdrawing a RCCA or one or more RCCAs not fully inserted. These actuation devices support the reactor trip functions.

3. Reactor Trip Contactors

Twenty three sets of four Reactor Trip Contactors (92 total) are required to be OPERABLE in MODES 1 and 2 and in MODE 3 with the RCSL System capable of withdrawing a RCCA or one or more RCCAs not fully inserted. These actuation devices support the reactor trip functions.

ACTIONS

The most common causes of division inoperability are outright failure or drift of the sensor sufficient to exceed the tolerance allowed by the plant specific setpoint analysis. Typically, the drift is found to be small and results in a delay of actuation rather than a total loss of function. This determination is generally made during the performance of a CALIBRATION when the sensor is set up for adjustment to bring it to within specification. If the trip setpoint is non-conservative with respect to the Allowable Value, the division is declared inoperable immediately, and the appropriate Condition(s) must be entered immediately.

BASES

ACTIONS (continued)

In the event a functions trip setpoint is found non-conservative with respect to the Allowable Value, or the sensors, signal processors, Actuation Signal Voting processors, or actuation devices are found inoperable, then all affected functions provided by that division must be declared inoperable, and the unit must enter any applicable Condition for the particular protection Function affected.

When the number of inoperable sensors or signal processors in a reactor trip or ESF function exceeds that specified in any related Condition, redundancy is lost and actions must be taken to restore the required redundancy.

A Note has been added to the ACTIONS. The Note has been added to clarify the application of the Completion Time rules. The Conditions of this Specification may be entered independently for each PS sensor, manual actuation switch, signal processor, and actuation device. The Completion Times of each inoperable sensor, manual actuation switch, signal processor, and actuation device will be tracked separately, starting from the time the Condition was entered for that sensor, manual actuation switch, signal processor, and actuation device.

A.1 and A.2

Condition A applies to the failure of one or more sensors. Condition A.1 applies only to the RTCB Position Indication sensors. If one or more of these sensors is inoperable, the inoperable sensor(s) must be placed in the tripped condition in 1 hour. The Completion Time of 1 hour is based on operating experience and the minimum amount of time allowed for manual operator action. Condition A.2 applies to all other PS sensors. If one or more of these sensors is inoperable, the inoperable sensor is placed in lockout in 4 hours. The 4 hour allotted timeframe is sufficient to allow the operator to take all appropriate actions for the failed sensor and still ensures that the risk involved in operating with the failure is acceptable.

B.1

Condition B applies to the failure of one or more manual actuation switches. In this condition, the minimum functional capability for manual actuation may not maintained. Restoring the manual initiation capability to OPERABLE status within 48 hours is reasonable considering the availability of automatic actuation, the low probability of an AOO or postulated accident occurring during this time, and the time necessary for repairs.

ACTIONS (continued)

C.1 and C.2

Condition C applies to one or more APUs inoperable due to the LTSP for one or more Trip/Actuation Functions not met. In this condition, the hardware is still functional. The sensors have been calibrated and the ADOTs and SOTs have checked the function from sensor to actuation device. The manual actuation capability would be unaffected. If the inoperability affects the LTSP for either the EDG Start on Degraded Grid Voltage or the EDG Start on LOOP (Trip/Actuation Functions B.10.a or B.10.b), Required Action C.1 directs entry into the applicable Conditions and Required Actions of LCO 3.8.1, "AC Sources - Operating," and LCO 3.8.2, "AC Sources - Shutdown." The Completion Time of 1 hour is a reasonable time to allow the operator to diagnose and potentially correct the issue that caused the inoperability prior to entering LCO 3.8.1 or LCO 3.8.2. Restoring the LTSP to OPERABLE status within 24 hours for all other Trip/Actuation Functions is a reasonable timeframe considering the time necessary to change the setpoint parameter, load corrected software, or replace the unit. If the LTSP cannot be restored to OPERABLE status, the associated Trip/Actuation Function must be placed in lockout in the associated APU.

D.1 and D.2

Condition D applies to one or more signal processors inoperable for reasons other than Condition C. If the inoperability affects the APU associated with the EDG Start on Degraded Grid Voltage or the EDG Start on LOOP (Trip/Actuation Functions B.10.a or B.10.b), Required Action D.1 directs entry into the applicable Conditions and Required Actions of LCO 3.8.1, "AC Sources - Operating," and LCO 3.8.2, "AC Sources - Shutdown." The Completion Time of 1 hour is a reasonable time to allow the operator to diagnose and potentially correct the issue that caused the inoperability prior to entering LCO 3.8.1 or LCO 3.8.2. Restoring the Signal processor to OPERABLE status within 4 hours for all other Trip/Actuation Functions is a reasonable timeframe considering the time necessary to restore the signal processor to OPERABLE status. If the signal processor cannot be restored to OPERABLE status, the signal processor must be placed in lockout.

ACTIONS (continued)

E.1

Condition E applies to the RCP Bus and Trip Breakers, RTCBs, and Reactor Trip Contactors. With one ore more actuation devices inoperable, the actuation device must be restored to OPERABLE status within 48 hours. The Completion Time of 48 hours is reasonable considering that there are two automatic actuation divisions and the low probability of an event occurring during this interval.

F.1

If the Required Action and associated Completion Time of Condition A, B, C, D, or E or if the minimum functional capability (the value where the supported functions would not actuate during an AOO or postulated event coupled with a single failure) of the sensors, manual actuation switches, signal processors or actuation devices specified in Table 3.3.1-1 are not met, then the unit must be brought to a MODE in which the supported reactor trips or ESF functions are not required to be OPERABLE and any other specified actions must be taken.. The applicable Condition referenced in the table is sensor, manual actuation switch, signal processor, actuation device, and MODE dependent. Condition F is entered to provide for transfer to the appropriate subsequent Condition. Required Action C.1 directs entry into the appropriate Condition referenced in Table 3.3.1-1.

G.1

If Table 3.3.1-1 directs entry into Condition G, the unit must be brought to a condition in which the Low-Low RCS Loop Flow Rate in One Loop function (Trip/Actuation Function A.6.a) is not required to be OPERABLE. The allowed Completion Time of 2 hours is reasonable, based on operating experience, to reduce THERMAL POWER from full power to less than 70% in an orderly manner and without challenging unit systems.

H.1

If Table 3.3.1-1 directs entry into Condition H, the unit must be brought to a condition in which the supported reactor trips or ESF functions are not required to be OPERABLE. The allowed Completion Time of 6 hours is reasonable, based on operating experience, to reduce THERMAL POWER from full power to less than 10% in an orderly manner and without challenging unit systems.

ACTIONS (continued)

I.1

If Table 3.3.1-1 directs entry into Condition I, the unit must be brought to a MODE in which the supported reactor trips or ESF functions are not required to be OPERABLE. The allowed Completion Time of 8 hours is reasonable, based on operating experience, to reach MODE 2 from full power conditions in an orderly manner and without challenging unit systems.

J.1

If Table 3.3.1-1 directs entry into Condition J, the unit must be brought to a MODE in which the supported reactor trips or ESF functions are not required to be OPERABLE. The allowed Completion Time of 6 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging unit systems.

K.1 and K.2

If Table 3.3.1-1 directs entry into Condition K, the unit must be brought to a MODE in which the supported reactor trips or ESF functions are not required to be OPERABLE. The allowed Completion Time of 6 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and open the reactor trip breakers without challenging unit systems.

L.1 and L.2

If Table 3.3.1-1 directs entry into Condition L, the unit must be brought to a MODE in which the supported reactor trips or ESF functions are not required to be OPERABLE. The allowed Completion Time of 6 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and then reduce the pressurizer pressure to less than 2005 psia without challenging unit systems.

BASES

ACTIONS (continued)

M.1 and M.2

If Table 3.3.1-1 directs entry into Condition M, the unit must be brought to a MODE in which the supported reactor trips or ESF functions are not required to be OPERABLE. The allowed Completion Time of 6 hours to reach MODE 3 and 12 hours to reach MODE 4 is reasonable, based on operating experience, to reach the required MODES from full power conditions in an orderly manner and without challenging unit systems.

N.1 and N.2

If Table 3.3.1-1 directs entry into Condition N, the unit must be brought to a MODE in which the supported reactor trips or ESF functions are not required to be OPERABLE. The allowed Completion Time of 6 hours to reach MODE 3 and 36 hours to reach MODE 5 is reasonable, based on operating experience, to reach the required MODES from full power conditions in an orderly manner and without challenging unit systems.

O.1

If Table 3.3.1-1 directs entry into Condition O, the Conditions specified in LCO 3.8.1, "AC Sources - Operating," or LCO 3.8.2, "AC Sources - Shutdown," for the EDG made inoperable by failure of the 6.9 kV Bus Voltage sensors are required to be entered immediately. The actions of those LCOs provide adequate compensatory actions to assure unit safety.

P.1

If Table 3.3.1-1 directs entry into Condition P, the associated CVCS isolation valves are immediately declared inoperable. The actions of LCO 3.4.9, "Pressurizer," provide adequate compensatory actions to assure unit safety.

Q.1

If Table 3.3.1-1 directs entry into Condition Q, the associated PSRVs are immediately declared inoperable. The actions of LCO 3.4.10, "Pressurizer Safety Relief Valves," provide adequate compensatory actions to assure unit safety.

BASES

ACTIONS (continued)

R.1

If Table 3.3.1-1 directs entry into Condition R, both Control Room Emergency Filtration trains are immediately declared inoperable. The actions of LCO 3.7.10, "Control Room Emergency Filtration (CREF)," provide adequate compensatory actions to assure unit safety.

S.1

If Table 3.3.1-1 directs entry into Condition S, the manual Reactor Trip switches are inoperable. If the switches cannot be returned to OPERABLE status within one hour, actions must be taken to ensure all RCCAs are inserted and the reactor must be placed in a condition where the RCCA can not be withdrawn. This is accomplished by opening the reactor trip breakers. The Completion Time of 1 hour is based on operating experience and the minimum amount of time allowed for manual operator action.

T.1

If Table 3.3.1-1 directs entry into Condition T, the associated ALUs must be immediately declared inoperable. If the ALUs cannot be returned to OPERABLE status within one hour, actions must be taken to ensure all RCCAs are inserted and the reactor must be placed in a condition where the RCCA can not be withdrawn. This is accomplished by opening the reactor trip breakers. The Completion Time of 1 hour is based on operating experience and the minimum amount of time allowed for manual operator action.

SURVEILLANCE REQUIREMENTS

The SRs for any particular PS sensor, manual actuation switch, signal processor, or actuation device are found in the SR column of Table 3.3.1-1 for that sensor, manual actuation switch, signal processor, or actuation device.

-------------------------------- REVIEWER'S NOTE ----------------------------------
In order for a plant to take credit for topical reports as the basis for justifying Frequencies, topical reports must be supported by an NRC staff SER that establishes the acceptability of each topical report for that unit.

BASES

SURVEILLANCE REQUIREMENTS (continued)

-------------------------------- REVIEWER'S NOTE ----------------------------------
The Notes in Table 3.3.1-1 requiring reset of the division to a predefined as-left tolerance and the verification of the as-found tolerance are only associated with SL-LSSS values. Therefore, the Notes are placed at the top of the LTSP column in the Table and applied to all Functions with LTSPs in the table. The Notes may be applied to specific SRs for the associated functions in the SR column only.

------------------------------- REVIEWER'S NOTE -----------------------------------
Notes b and c are applied to the setpoint verification Surveillances for all SL-LSSS Functions unless one or more of the following exclusions apply:

1. Notes b and c are not applied to SL-LSSS Functions which utilize mechanical components to sense the trip setpoint or to manual initiation circuits (the latter are not explicitly modeled in the accident analysis). Examples of mechanical components are limit switches, float switches, proximity detectors, manual actuation switches, and other such devices that are normally only checked on a "go/no go" basis. Note 1 requires a comparison of the periodic surveillance requirement results to provide an indication of Trip/Actuation Function (or individual device) performance. This comparison is not valid for most mechanical components. While it is possible to verify that a limit switch functions at a point of travel, a change in the surveillance result probably indicates that the switch has moved, not that the input/output relationship has changed. Therefore, a comparison of surveillance requirement results would not provide an indication of the Trip/Actuation Function or component performance.

2. Notes b and c are not applied to Technical Specifications associated with mechanically operated safety relief valves. The performance of these components is already controlled (i.e., trended with as-left and as-found limits) under the ASME Section XI testing program.

3. Notes b and c are not applied to SL-LSSS Functions and Surveillances which test only digital components. For purely digital components, such as actuation logic circuits and associated relays, there is no expected change in result between surveillance performances other than measurement and test errors (M&TE) and, therefore, comparison of Surveillance results does not provide an indication of Trip/Actuation Function or component performance.

BASES

SURVEILLANCE REQUIREMENTS (continued)

An evaluation of the potential SL-LSSS Functions resulted in Notes b and c being applied to the Functions shown in the TS markups. Each licensee proposing to fully adopt this TSTF must review the potential SL-LSSS Functions to identify which of the identified functions are SL-LSSS according to the definition of SL-LSSS and their plant specific safety analysis. The two TSTF Notes are not required to be applied to any of the listed Functions which meet any of the exclusion criteria or are not SL-LSSS based on the plant specific design and analysis.

The Limiting Trip Setpoint column for reactor trip functions is modified by two Footnotes as identified in Table 3.3.1-2. The selected Functions are those Functions that are LSSS for protection system instrument functions that protect reactor core or RCS pressure boundary SLs. Some components (e.g., mechanical devices which have an on or off output or an open/close position such as limit switches, float switches, and proximity detectors) are not calibrated in the traditional sense and do not have as-left or as-found conditions that would indicate drift of the component setpoint. These devices are considered not trendable and the requirements of the Notes are not required to be applied to the mechanical portion of the functions. Where a non-trendable component provides signal input to other Trip/Actuation Function components that can be trended, the remaining components must be evaluated in accordance with the Notes.

The first Note requires evaluation of Trip/Actuation Function's performance for the condition where the as-found setting for the setpoint is outside its as-found tolerance but conservative with respect to the Allowable Value. For digital channel components, the as-found tolerance may be identical to the as-left tolerance since drift may not be an expected error. In these cases a Trip/Actuation Function's as-found value outside the as-left condition may be cause for component assessment. Evaluation of instrument performance will verify that the instrument will continue to behave in accordance with design-basis assumptions. The purpose of the assessment is to ensure confidence in the instrument performance prior to returning the instrument to service. These conditions will also be identified in the Corrective Action Program. Entry into the Corrective Action Program will ensure required review and documentation of the condition for continued OPERABILITY.

The second Footnote requires that the as-left setting for the instrument be returned to within the as-left tolerance of the LTSP. Where a setpoint more conservative than the LTSP is used in the plant surveillance procedures, the as-left and as-found tolerances, as applicable, will be applied to the surveillance procedure setpoint. This will ensure that

BASES

SURVEILLANCE REQUIREMENTS (continued)

sufficient margin to the SL and/or Analytical Limit is maintained. If the as-left instrument setting cannot be returned to a setting within the as-left tolerance, then the Trip/Actuation Function shall be declared inoperable. The second Note also requires that the LTSP and the methodologies for calculating the as-left and the as-found tolerances be in a document controlled under 10 CFR 50.59.

The digital PS provides continual online automatic monitoring of each of the input signal in each division, perform software limit checking (signal online validation) against required acceptance criteria, and provide hardware functional validation so that a division check is continuously being performed. If any PS input signal is identified to be in a failure status, this condition is alarmed in the Control Room. As such, a periodic "channel check" is no longer necessary.

<u>SR 3.3.1.1</u>

SR 3.3.1.2 compares the calorimetric heat balance calculation to the power range division output every 24 hours. If the calorimetric heat balance calculation results exceed the power range division output by more than 2% RTP, the power range division is not declared inoperable, but must be adjusted. The power range division output shall be adjusted consistent with the calorimetric heat balance calculation results if the calorimetric calculation exceed the power range division output by more than + 2% RTP. If the power range division output cannot be properly adjusted, the division I is declared inoperable.

If the calorimetric is performed at part power (< 70% RTP), adjusting the power range division indication in the increasing power direction will assure a reactor trip below the safety analysis limit (< 11% RTP). Making no adjustment to the power range division in the decreasing power direction due to a part power calorimetric assures a reactor trip consistent with the safety analyses.

This allowance does not preclude making indicated power adjustments, if desired, when the calorimetric heat balance calculation is less than the power range division output. To provide close agreement between indicated power and to preserve operating margin, the power range divisions are normally adjusted when operating at or near full power during steady-state conditions. However, discretion must be exercised if the power range division output is adjusted in the decreasing power direction due to a part power calorimetric (< 70% RTP). This action may introduce a non-conservative bias at higher power levels. The cause of

BASES

SURVEILLANCE REQUIREMENTS (continued)

the potential non-conservative bias is the decreased accuracy of the calorimetric at reduced power conditions. The primary error contributor to the instrument uncertainty for a secondary side power calorimetric measurement is the feedwater flow measurement, which is typically a delta P measurement across a feedwater venturi. While the measurement uncertainty remains constant in delta P as power decreases, when translated into flow, the uncertainty increases as a square term. Thus a 1% flow error at 100% power can approach a 10% flow error at 30% RTP even though the delta P error has not changed. An evaluation of extended operation at part power conditions would conclude that it is prudent to administratively adjust the setpoint of the High Neutron Flux Rate of Change when: 1) the power range division output is adjusted in the decreasing power direction due to a part power calorimetric below 70% RTP; or 2) for a post refueling startup. The evaluation of extended operation at part power conditions would also conclude that the potential need to adjust the indication of the High Neutron Flux Rate of Change in the decreasing power direction is quite small, primarily to address operation in the intermediate range about 10% RTP to allow enabling of the High Neutron Flux Rate of Change reactor trips. Before the High Neutron Flux Rate of Change setpoint is reset, the power range division adjustment must be confirmed based on a calorimetric performed at ≥ 70% RTP.

The Note clarifies that 12 hours are allowed for performing the first Surveillance after reaching 20% RTP. A power level of 20% RTP is chosen based on plant stability, (i.e., automatic rod control capability and turbine generator synchronized to the grid). The Frequency of every 24 hours is adequate. It is based on unit operating experience, considering instrument reliability and operating history data for instrument drift. Together these factors demonstrate that a difference between the calorimetric heat balance calculation and the power range division output of more than +2% RTP is not expected in any 24 hour period.

SR 3.3.1.2

Space- and time- dependent power density distribution of the U.S. EPR is accurately assessed using the SPNDs inside the core. For neutron flux measurement, incore neutron detectors are more accurate than excore neutron detectors. CALIBRATION of SPND instrumentation is performed to compensate for a decrease in SPND sensitivity during the fuel cycle and to account for peak power density factor change over the fuel cycle. The Aeroball Measurement System (AMS) assists in generating the measured relative neutron flux density in the core, which is used in

BASES

SURVEILLANCE REQUIREMENTS (continued)

conjunction with the predicted power distribution based on actual core operation to calibrate the incore SPND instrumentation. Because both the power-to-signal ratio of an SPND and the reference power distribution change with core burnup, SPND signals are matched to reference signals provided by the AMS every 15 EFPD (Ref. 7).

The Note clarifies that 12 hours are allowed for performing the first Surveillance after reaching 20% RTP. A power level of 20% RTP is chosen based on plant stability, (i.e., automatic rod control capability and turbine generator synchronized to the grid).

SR 3.3.1.3

SR 3.3.1.3 is the performance of a ADOT every 31 days. This test shall verify OPERABILITY by actuation of the Reactor Trip Circuit Breakers and Reactor Trip Contactors. The ADOT may be performed by means of any series of sequential, overlapping, or total steps.

SR 3.3.1.4

The online boron meters are a half shell design and are not in contact with the reactor coolant. The concentration of boron is measured by using the neutron absorption effect of B^{10}. The boron concentration is calculated using the measured count rate. To improve the accuracy of the measurement, the temperature of the rector coolant at the measuring point is used to adjust the boron concentration. The temperature instruments are not included as part of this Surveillance. The frequency of the boron meter CALIBRATION is conservative considering instrument reliability.

SR 3.3.1.5

A SOT on each required reactor trip actuation device is performed every 24 months to ensure the devices will perform their intended function when needed. A SOT shall be the injection of a simulated or actual signal into the division as close to the sensor as practicable to verify OPERABILITY of all devices in the division required for division OPERABILITY. The SOT shall include the verification of the accuracy and time constants of the analog input modules.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The maximum permissible response time for analog input modules is prescribed by the process engineering of the specific application. Thus for each applicable PS function, the limiting response times will be shown to be consistent with the safety requirements.

The response time testing is performed in overlapping steps:

- Verification of time constants of the input divisions during input module tests, and

- Verification of the signal propagation time within the digital system.

The response time of the analog input divisions are tested periodically by injection of test signals in the input circuits. For this purpose, an external test computer is temporarily connected to the I&C system via permanently installed test plugs. While the input from the process is deactivated (by switching off the associated division(s) power supply), a binary input is provided to the data acquisition computers. The signal distribution to other computers is designed in the application software in the same way as for the normal measuring signals. Separate outputs are provided in the voting computers for each path. During the response time tests, the test machine connected to the I&C system generates a start signal and measures the reaction time of each signal path separately to verify that it does not exceed the worst case conditions specified for the specific system configuration. The measurements are performed a number of times to determine the statistical characteristics of each signal path.

The SOT may be performed by means of any series of sequential, overlapping, or total steps.

<u>SR 3.3.1.6</u>

A CALIBRATION of each PS sensor (except neutron detectors) every 24 months ensures that each instrument division is reading accurately and within tolerance. A CALIBRATION shall be the adjustment, as necessary, of the sensor output such that it responds within the necessary range and accuracy to known values of the parameter that the sensor monitors. The CALIBRATION shall encompass all devices in the division required for sensor OPERABILITY. CALIBRATION of instrument divisions with resistance temperature detector (RTD) or thermocouple sensors may consist of an in-place qualitative assessment of sensor behavior and normal CALIBRATION of the remaining adjustable devices in the division. The CALIBRATION may be performed by means of any series of sequential, overlapping, or total steps.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.7

The features of continuous self-monitoring of the PS system are described in Reference 8. Additional tests, which require the processor to be inoperable are not normally performed during operation. These EXTENDED SELF TESTS are performed at start-up of a computer each cycle. The startup sequence is as follows:

- Hardware basic test using the internal diagnosis monitor,
- Start-up self test of the operating system, and
- Switch over to normal operation after approximately two minutes.

Additional information is provided in Section 3 of Reference 8.

SR 3.3.1.8

SR 3.3.1.8 is the performance of a ADOT every 31 days. This test shall verify OPERABILITY by actuation of the RCP Bus and Trip Breakers. The ADOT may be performed by means of any series of sequential, overlapping, or total steps.

SR 3.3.1.9

SR 3.3.1.9 verifies that the Limiting Trip Setpoint and Permissive values have been properly loaded into the applicable APU.

REFERENCES

1. ANP-10275P, Revision 0, U.S. EPR Instrument Setpoint Methodology Topical Report, March 2007.
2. 10 CFR 100.
3. 10 CFR 50, Appendix A, GDC 21.
4. ANP-10287, Incore Trip Setpoint and Transient Methodology for U.S. EPR, November 2007.
5. FSAR Chapter 15.

BASES

REFERENCES (continued)

6. 10 CFR 50.49.

7. ANP-10271P, Revision 0, US EPR Nuclear Incore Instrumentation Systems Report, December 2006.

8. EMF-2341(P), Revision 1, Generic Strategy for Periodic Surveillance Testing of TELEPERM XS System in U.S. Nuclear Generating Stations, March 2000.

Table B 3.3.1-1 (page 1 of 7)
Protection System (PS) Functional Dependencies

TRIP/ACTUATION FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	COMPLETE DIVISIONS FOR FUNCTIONAL CAPABILITY SENSORS / PROCESSORS	DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
A. REACTOR TRIPS						
1. Low Departure from Nucleate Boiling Ratio (DNBR) a. Low DNBR d. High Quality	≥ 10% RTP	3	A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump Speed (1 of 2) Reactor Coolant System Loop Flow (3 of 4) / One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit	A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump Speed (1 of 2) Reactor Coolant System Loop Flow (3 of 4) / One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit	A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump Speed (1 of 2) Reactor Coolant System Loop Flow (3 of 4) / One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit	A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump Speed (1 of 2) Reactor Coolant System Loop Flow (3 of 4) / One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit

Table B 3.3.1-1 (page 2 of 7)
Protection System (PS) Functional Dependencies

	TRIP/ACTUATION FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	COMPLETE DIVISIONS FOR FUNCTIONAL CAPABILITY SENSORS / PROCESSORS	DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
1.	Low Departure from Nucleate Boiling Ratio (DNBR) b. Low DNBR and (Imbalance or Rod Drop) c. Variable Low DNBR and Rod Drop e. High Quality and Imbalance or Rod Drop	≥ 10% RTP	3	A total of 65 RCCA Position Indicators in any of the four divisions A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump Speed (1 of 2) Reactor Coolant System Loop Flow (3 of 4) / One RCCA Unit per division with a required OPERABLE RCCA position indicator One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit	A total of 65 RCCA Position Indicators in any of the four divisions A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump Speed (1 of 2) Reactor Coolant System Loop Flow (3 of 4) / One RCCA Unit per division with a required OPERABLE RCCA position indicator One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit	A total of 65 RCCA Position Indicators in any of the four divisions A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump Speed (1 of 2) Reactor Coolant System Loop Flow (3 of 4) / One RCCA Unit per division with a required OPERABLE RCCA position indicator One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit	A total of 65 RCCA Position Indicators in any of the four divisions A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump Speed (1 of 2) Reactor Coolant System Loop Flow (3 of 4) / One RCCA Unit per division with a required OPERABLE RCCA position indicator One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit

Table B 3.3.1-1 (page 3 of 7)
Protection System (PS) Functional Dependencies

	TRIP/ACTUATION FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	COMPLETE DIVISIONS FOR FUNCTIONAL CAPABILITY SENSORS / PROCESSORS	DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
2.	High Linear Power Density	≥ 10% RTP	3	A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions / One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit	A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions / One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit	A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions / One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit	A total of 51 Self-Powered Neutron Detectors (SPND) in any of the four divisions / One Remote Acquisition Unit per division with a required OPERABLE SPND Acquisition and Processing Unit
4.	High Core Power Level	1,2[(a)]	3	Cold Leg Temperature (WR) Hot Leg Temperature (NR) (3 of 4) Hot Leg Pressure (WR) Reactor Coolant System Loop Flow (3 of 4) / Acquisition and Processing Unit	Cold Leg Temperature (WR) Hot Leg Temperature (NR) (3 of 4) Hot Leg Pressure (WR) Reactor Coolant System Loop Flow (3 of 4) / Acquisition and Processing Unit	Cold Leg Temperature (WR) Hot Leg Temperature (NR) (3 of 4) Hot Leg Pressure (WR) Reactor Coolant System Loop Flow (3 of 4) / Acquisition and Processing Unit	Cold Leg Temperature (WR) Hot Leg Temperature (NR) (3 of 4) Hot Leg Pressure (WR) Reactor Coolant System Loop Flow (3 of 4) / Acquisition and Processing Unit

(a) ≥ 10-5% power on the intermediate range detectors.

Table B 3.3.1-1 (page 4 of 7)
Protection System (PS) Functional Dependencies

TRIP/ACTUATION FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	COMPLETE DIVISIONS FOR FUNCTIONAL CAPABILITY SENSORS / PROCESSORS	DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
5. Low Saturation Margin	1,2[(a)]	3	Cold Leg Temperature (WR) Hot Leg Temperature (NR) Hot Leg Pressure (WR) Reactor Coolant System Loop Flow (3 of 4) / Acquisition and Processing Unit	Cold Leg Temperature (WR) Hot Leg Temperature (NR) Hot Leg Pressure (WR) Reactor Coolant System Loop Flow (3 of 4) / Acquisition and Processing Unit	Cold Leg Temperature (WR) Hot Leg Temperature (NR) Hot Leg Pressure (WR) Reactor Coolant System Loop Flow (3 of 4) / Acquisition and Processing Unit	Cold Leg Temperature (WR) Hot Leg Temperature (NR) Hot Leg Pressure (WR) Reactor Coolant System Loop Flow (3 of 4) / Acquisition and Processing Unit

(a) ≥ 10-5% power on the intermediate range detectors.

Table B 3.3.1-1 (page 5 of 7)
Protection System (PS) Functional Dependencies

	TRIP/ACTUATION FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	COMPLETE DIVISIONS FOR FUNCTIONAL CAPABILITY SENSORS / PROCESSORS	DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
B.	ENGINEERED SAFETY FEATURES ACTUATION SYSTEM (ESFAS) SIGNALS						
2.e.	Main Feedwater / Startup and Shutdown Feedwater Isolation on Steam Generator Level High for Period of Time (Affected Steam Generators)	1,2[(b)],3[(b)]	3	Steam Generator Level (NR) Reactor Trip Circuit Breaker Position Indication / Acquisition and Processing Unit	Steam Generator Level (NR) Reactor Trip Circuit Breaker Position Indication / Acquisition and Processing Unit	Steam Generator Level (NR) Reactor Trip Circuit Breaker Position Indication / Acquisition and Processing Unit	Steam Generator Level (NR) Reactor Trip Circuit Breaker Position Indication / Acquisition and Processing Unit
3.b.	ESF - Safety Injection System (SIS) Actuation on Low Delta P_{sat}	3[(c)]	3	Hot Leg Pressure (WR) Hot Leg Temperature (WR) / Acquisition and Processing Unit	Hot Leg Pressure (WR) Hot Leg Temperature (WR) / Acquisition and Processing Unit	Hot Leg Pressure (WR) Hot Leg Temperature (WR) / Acquisition and Processing Unit	Hot Leg Pressure (WR) Hot Leg Temperature (WR) / Acquisition and Processing Unit

(b) Except when all MFW low load isolation valves are closed.

(c) When Trip/Actuation Function B.3.a, SIS Actuation on Low Pressurizer Pressure, is disabled.

Table B 3.3.1-1 (page 6 of 7)
Protection System (PS) Functional Dependencies

TRIP/ACTUATION FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	COMPLETE DIVISIONS FOR FUNCTIONAL CAPABILITY SENSORS / PROCESSORS	DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
4. ESF - Reactor Coolant Pump (RCP) Trip on Low Delta P across RCP with Safety Injection System Actuation	1,2,3	3	RCP Current (2 of 3) RCP Delta P (1 of 2) / Acquisition and Processing Unit	RCP Current (2 of 3) RCP Delta P (1 of 2) / Acquisition and Processing Unit	RCP Current (2 of 3) RCP Delta P (1 of 2) / Acquisition and Processing Unit	RCP Current (2 of 3) RCP Delta P (1 of 2) / Acquisition and Processing Unit
11a. ESF - Chemical and Volume Control System (CVCS) Charging Line Isolation on High-High Pressurizer Level	1,2,3	3	Pressurizer Level / Acquisition and Processing Unit	Pressurizer Level / Acquisition and Processing Unit	Pressurizer Level / Acquisition and Processing Unit	Pressurizer Level / Acquisition and Processing Unit
	1,2,3	2	Actuation Logic Unit (1 of 2)			Actuation Logic Unit (1 of 2)

Table B 3.3.1-1 (page 7 of 7)
Protection System (PS) Functional Dependencies

TRIP/ACTUATION FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	COMPLETE DIVISIONS FOR FUNCTIONAL CAPABILITY SENSORS / PROCESSORS	DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
11b. ESF - Chemical and Volume Control System (CVCS) Charging Line Isolation on Anti-Dilution Mitigation (ADM) at Shutdown Condition (RCP not operating)	5[(d)],6	3	Boron Concentration Boron Temperature / Acquisition and Processing Unit	Boron Concentration Boron Temperature / Acquisition and Processing Unit	Boron Concentration Boron Temperature / Acquisition and Processing Unit	Boron Concentration Boron Temperature / Acquisition and Processing Unit
	5[(d)],6	2	Actuation Logic Unit (1 of 2)			Actuation Logic Unit (1 of 2)
11c. ESF - Chemical and Volume Control System (CVCS) Charging Line Isolation on ADM at Standard Shutdown Conditions	3,4[(e)],5[(e)]	3	Boron Concentration Boron Temperature Chemical and Volume Control System (CVCS) Charging Line Flow Cold Leg Temperature (WR) / Acquisition and Processing Unit	Boron Concentration Boron Temperature Chemical and Volume Control System (CVCS) Charging Line Flow Cold Leg Temperature (WR) / Acquisition and Processing Unit	Boron Concentration Boron Temperature Chemical and Volume Control System (CVCS) Charging Line Flow Cold Leg Temperature (WR) / Acquisition and Processing Unit	Boron Concentration Boron Temperature Chemical and Volume Control System (CVCS) Charging Line Flow Cold Leg Temperature (WR) / Acquisition and Processing Unit
	3,4[(e)],5[(e)]	2	Actuation Logic Unit (1 of 2)			Actuation Logic Unit (1 of 2)

(d) With two or less RCPs in operation.

(e) With three or more RCPs in operation.

B 3.3 INSTRUMENTATION

B 3.3.2 Post Accident Monitoring (PAM) Instrumentation

BASES

BACKGROUND

The primary purpose of the PAM instrumentation is to provide operators with information that is needed during accidents.

The OPERABILITY of PAM instrumentation ensures that there is sufficient information available on selected plant parameters to monitor and assess plant status and behavior following accidents and transients when the use of the Emergency Operating Procedures (EOPs) is required.

The PAM instruments included in Table 3.3.2-1, Postaccident Monitoring Instrumentation, are required for the following reasons:

1. Perform the diagnosis specified in the emergency operating procedures (these variables are restricted to preplanned actions for the primary success path of DBAs), e.g., loss of coolant accident (LOCA);

2. Take the specified, pre-planned, manually controlled actions, for which no automatic control is provided, and that are required for safety systems to accomplish their safety function;

3. Provide information to indicate whether plant safety functions are being accomplished for reactivity control, core cooling, maintaining reactor coolant system integrity, and maintaining containment integrity (including radioactive effluent control);

4. Provide information to indicate the potential for being breached or the actual breach of the barriers to fission product releases (i.e., fuel cladding, primary coolant pressure boundary, and containment); and

5. Enable the operator to recognize which heat transfer symptom is occurring: 1) loss of subcooling margin, 2) lack of heat transfer, 3) excessive heat transfer, and 4) Steam Generator Tube Rupture.

The PAM instrumentation is displayed through the Safety Information and Control Systems (SICS), which includes the Qualified Display System (QDS). The Safety Automation System (SAS) communication with the QDS (as part of SICS) is realized through the Monitoring and Service Interfaces (MSI), and the Panel Interfaces (PI). The PI's are part of the SICS, the MSI's are part of the SAS. The SAS also provides outputs for analog meters, illuminated buttons etc., and receives inputs from Conventional Instrumentation and Controls which is included in the SICS.

BASES

BACKGROUND (continued)

The SICS calculates a margin to saturation by using the safety grade inputs of RCS Hot Leg Pressure, RCS Hot Leg Temperature, and Incore Thermocouples. The margin, both positive and negative, is available for diagnosis of plant transients. As long as adequate subcooling margin exists, core cooling is ensured. If subcooling margin is lost, actions are required to ensure core cooling and restore adequate subcooling margin. Superheat is used for Inadequate Core Cooling (ICC) determination and initiation of more severe mitigation guidance to restore saturated and ultimately subcooled coolant conditions.

APPLICABLE SAFETY ANALYSES

The PAM instrumentation ensures the OPERABILITY of certain Regulatory Guide 1.97 variables, so that the control room operating staff can:

- Recognize when a heat transfer symptom is occurring that would require performance of the appropriate section in the emergency operating procedures.

- Perform the diagnosis specified in the emergency operating procedures (these variables are restricted to preplanned actions for the primary success path of postulated accidents), e.g., loss of coolant accident (LOCA);

- Take the specified, pre-planned, manually controlled actions, for which no automatic control is provided, and that are required for safety systems to accomplish their safety function;

- Determine whether systems important to safety are performing their intended functions for reactivity control, core cooling, maintaining reactor coolant system integrity and maintaining containment integrity,

- 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.

BASES

APPLICABLE SAFETY ANALYSES (continued)

PAM instrumentation used to support pre-planned, manually controlled actions satisfy Criterion 3 of 10 CFR 50.36(d)(2)(ii)(C). The other PAM instrumentation that perform certain functions related to verification of key safety functions and monitoring key barriers for potential breach must be retained in TS because it is intended to assist operators in minimizing the consequences of accidents. Therefore, these variables are important for reducing public risk.

LCO

The PAM instrumentation LCO provides OPERABILITY requirements for Regulatory Guide 1.97 monitors that provide information required by the control room operators to perform certain manual actions specified in the unit Emergency Operating Procedures. These manual actions ensure that a system can accomplish its safety function, and are credited in the safety analyses. Additionally, this LCO addresses Regulatory Guide 1.97 instruments that perform certain functions related to verification of key safety functions and monitoring key barriers for potential breach.

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

LCO 3.3.2 requires two OPERABLE divisions for most Functions. Two OPERABLE divisions ensure no single failure prevents operators from getting the information necessary for them to determine the safety status of the unit, and to bring the unit to and maintain it in a safe condition following an accident.

Furthermore, OPERABILITY of two divisions allows for a comparison during the post accident phase to confirm the validity of displayed information.

The exception to the two division requirement is Penetration Flow Path Containment Isolation Valve (CIV) Position. In this case, the important information is the status of the containment penetrations. The LCO requires one position indicator for each active CIV. This is sufficient to redundantly verify the isolation status of each isolable penetration either via indicated status of the active valve and prior knowledge of a passive valve, or via system boundary status. If a normally active CIV is known to be closed and deactivated, position indication is not needed to determine status. Therefore, the position indication for valves in this state is not required to be OPERABLE.

BASES

LCO (continued)

PAM variables are required to meet 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 3.3.2-1.

1. Cold Leg Temperature (Wide Range)

The key variables for monitoring core cooling are Hot Leg Temperature, Core Exit Temperature, and Steam Generator Pressure. Cold Leg Temperature provides backup temperature monitoring to Hot Leg Temperature and Core Exit Temperature when forced or verified natural circulation exists. Cold Leg Temperature is used with Hot Leg Temperature and Core Exit Temperature to verify natural circulation. Cold Leg Temperature is compared to the saturation temperature for steam generator pressure (Tsat) to determine primary to secondary loop coupling.

2. Containment Isolation Valve Position Indication

Containment isolation valve position verifies Containment isolation and is required to ensure Containment integrity in event of a LOCA.

3. Containment Pressure

Containment pressure is a key measurement used for detection of a LOCA, verification of Engineered Safety Features mitigation, and detection of a potential breach of Containment.

4. Emergency Feedwater Storage Pool Level

Emergency feedwater pool level is a key variable to ensure adequate EFW pump net positive suction head (NPSH) is satisfied.

BASES

LCO (continued)

5. Emergency Feedwater System Flow

Emergency Feedwater flow indication is required when throttling feedwater flow to the steam generators. Control of flow is required to control the rate of steam generator heat removal to maintain Reactor Coolant temperature profiles within limits for cooldown.

6. Extra Boration System Flow

The Extra Boration System flow provides verification that the appropriate system alignment has been completed. The negative reactivity additions performed by this system require verfication of correct system operation.

7. Hot Leg Injection Flow

Hot Leg Injection flow provides verification that the appropriate system alignment has been completed. Hot leg injection is required to prevent the buildup of sufficient boron concentration in the core coolant channels to impede long term core cooling.

8. Hot Leg Pressure (Wide Range)

RCS pressure is required to monitor reactor coolant integrity and assess core cooling. RCS pressure and either RCS hot leg or incore temperature is used to determine subcooling margin if the calcuation is not available.

9. Hot Leg Temperature (Wide Range)

Hot Leg Temperature is required to monitor core cooling, to verify natural circulation, and to verify primary to secondary loop coupling along with steam generator pressure. Hot Leg temperature and RCS pressure are used to determine loop subcooling margin if the calculation is not available.

BASES

LCO (continued)

10. In-containment Refueling Water Storage Tank Level

In-Containment storage tank level is monitored during operation to ensure that adequate pump NPSH is maintained during the recirculation phase of LOCA mitigation for long term core cooling requirements. In addition, level instrumentation is used to assess level loss due to leakage on Safety Injection piping located outside of Containment and interfacing systems (Inter-system LOCA) as well as level rise due to dilution mechanisms.

11. Incore Temperature

Core cooling is monitored by RCS and incore thermocouple temperatures. Loss of subcooling margin (SCM) is identified by a combination of RCS pressure and either hot leg temperature or incore thermocouple temperature depending on plant conditions, (e.g., RCPs on/off). Incore Temperature is monitored for verification and surveillance of long term core cooling and to detect potential breach of fuel cladding.

12. Power Range Monitors

Power Range Neutron Flux is used to verify that reactor trip has resulted in "Reactor Shutdown". Once "Reactor Shutdown" is verified following reactor trip, all subsequent EOP action is based on a shutdown reactor. Power Range indication is used during a steam generator tube rupture to determine when core power is within the Main Steam bypass capability, at which point a reactor trip can be performed without challenge to the Main Steam relief capabilities.

13. Pressurizer Level

Pressurizer level provides information for the operator to maintain RCS pressure and inventory control, with the exception of a few accident situations, such as large break LOCA. Pressurizer level is a key variable required to ensure proper operation of the pressurizer heaters to maintain the pressurizer in a saturated state.

BASES

LCO (continued)

14. Radiation Monitor - Containment High Range Activity

Containment high range radiation instrumentation is used to assess the potential for significant radiation releases and to provide release assessment for determining the need to invoke site emergency plans.

15. Radiation Monitor - Main Steam Line Activity

Main Steam Line radiation levels are a key variable for detection of a breach between the primary to secondary loop boundary.

16. Source Range Monitors

Source Range instrumentation is used to ensure that the reactor remains subcritical. Once "Reactor Shutdown" is verified following reactor trip, all subsequent EOP action is based on a shutdown reactor. Source range can be used to assess if a return to critical condition is approached during plant cooldown and whether mitigation efforts are required to maintain the reactor in a shutdown condition.

17. Steam Generator Level (Wide Range)

Both steam generator level and pressure are monitored to assess primary to secondary heat transfer. An upper level limit is specified to prevent moisture carryover into the steam lines which could damage control components used for controlling RCS cooldown.

18. Steam Generator Pressure

Steam Generator pressure is a key parameter used to identify upsets in heat transfer and evaluate primary-to-secondary heat transfer.

APPLICABILITY

The PAM instrumentation LCO is applicable in MODES 1, 2, and 3. These variables are related to the diagnosis and preplanned actions required to mitigate postulated accidents. The applicable postulated accidents 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 occurring that would require PAM instrumentation is low; therefore, PAM instrumentation is not required to be OPERABLE in these MODES.

BASES

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 in Table 3.3.2-1. The Completion Time(s) of the inoperable division(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 division that is inoperable, the required inoperable division 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 division (or in the case of a Function that has only one required division, other non-Regulatory Guide 1.97 instrument divisions 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

This Required Action specifies initiation of actions in accordance with Specification 5.6.5, which requires a written report to be submitted to the Nuclear Regulatory Commission. This report discusses the results of the root cause evaluation of the inoperability and identifies proposed restorative Required Actions. This Required Action is appropriate in lieu of a shutdown requirement, given the likelihood of plant conditions that would require information provided by this instrumentation. Also, alternative Required Actions are identified before a loss of functional capability condition occurs.

C.1

When one or more Functions have two required divisions inoperable (i.e., two divisions inoperable in the same Function), one division 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 instrumentation operation and the availability of alternate means to obtain the required information. Continuous operation with two required divisions 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 division of the Function limits the risk that the PAM Function will be in a degraded condition should an accident occur.

BASES

ACTIONS (continued)

D.1 and D.2

If the Required Action and associated Completion Time of Condition C are not met and Table 3.3.2-1 directs entry into Condition E, 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 3 within 6 hours and to MODE 4 within 12 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

A Note at the beginning of the SR Table specifies that the following SR applies to each PAM instrumentation Function found in Table 3.3.2-1.

SR 3.3.2.1

A CALIBRATION is performed every 24 months or approximately every refueling. CALIBRATION is a complete check of the instrument division including the sensor. The Surveillance verifies the function responds to the measured parameter within the necessary range and accuracy. A Note allows exclusion of the neutron detectors from the CALIBRATION. The requirements for CALIBRATION of neutron detectors is Specified in Specification 3.3.1," Protection System and Safety Automation System".

The Frequency is based upon operating experience and consistency with the typical industry refueling cycle and is justified by the assumption of a 24 month CALIBRATION interval for the determination of the magnitude of equipment drift.

SR 3.3.2.2

A SOT on each Safety Information and Control System performing the PAM functions listed in Table 3.3.2-1 is performed every 24 months to ensure the entire division will perform its intended function when needed. A SOT shall be the injection of a simulated or actual signal into the division as close to the sensor as practicable to verify OPERABILITY of all devices in the division required for division OPERABILITY. The SOT shall include adjustments, as necessary, of the required alarm, interlock, and trip setpoints required for division OPERABILITY such that the setpoints are within the necessary range and accuracy. The SOT may be performed by means of any series of sequential, overlapping, or total steps.

BASES

REFERENCES

1. NUREG 0737, Supplement 1.

B 3.3 INSTRUMENTATION

B 3.3.3 Remote Shutdown System (RSS)

BASES

BACKGROUND

The RSS provides the control room operator with sufficient instrumentation and controls to place and maintain the unit in a safe shutdown condition from a location other than the control room. This capability is necessary to protect against the possibility that the control room becomes inaccessible. A safe shutdown condition is defined as Hot Standby (MODE 3). With the unit in MODE 3, the Emergency Feedwater (EFW) System and Main Steam Relief Train (MSRT) can be used to remove core decay heat and meet all safety requirements. The long term supply of water for the EFW System and the ability to borate the Reactor Coolant System (RCS) from outside the control room allow extended operation in MODE 3.

The RSS contains Human Machine Interface (HMI) workstations necessary to bring the plant to and maintain it in a safe shutdown state. The HMI (control) functions of the RSS are isolated as long as the Main Control Room (MCR) is available. The HMI workstations will continue to display all parameters available on each workstation while the control functions are isolated. These workstations contain Process Information and Control System (PICS) equipment, Safety Information and Control System (SICS) equipment, and select communication equipment.

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

The OPERABILITY of the RSS control and instrumentation Functions ensures that there is sufficient information available on selected plant parameters to bring the plant to, and maintain it in, MODE 3 should the control room become inaccessible.

BASES

APPLICABLE SAFETY ANALYSES	The RSS is required to provide equipment at appropriate locations outside the control room with a capability to promptly shut down the plant and maintain it in a safe condition in MODE 3. The criteria governing the design and the specific system requirements of the RSS are located in 10 CFR 50, Appendix A, GDC 19 (Ref. 1). The RSS satisfies Criterion 4 of 10 CFR 50.36(d)(2)(ii).

LCO

The RSS LCO provides the requirements for the OPERABILITY of the instrumentation and controls necessary to place and maintain the plant in MODE 3 from a location other than the control room. The instrumentation and controls required are listed in Table B 3.3.3-1.

The controls, instrumentation, and transfer switches necessary to reach MODE 3 are those required for:

- Reactivity Control (initial and long term),
- Reactor Coolant Make-up
- RCS Pressure Control,
- Decay Heat Removal, and
- Safety support systems for the above Functions, as well as service water, component cooling water, and onsite power including the Emergency Diesel Generators.

The systems are controlled by the Safety Automation System (LCO 3.3.1, "Protection System and Safety Automation System").

A Function of a RSS is OPERABLE if all instruments and controls needed to support the Remote Shutdown System Function are OPERABLE.

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

BASES

APPLICABILITY

The RSS LCO is applicable in MODES 1, 2, and 3. This is required so that the unit can be placed and maintained in MODE 3 for an extended period of time from a location other than the control room.

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

ACTIONS

A RSS division is inoperable when each Function is not accomplished by at least one designated RSS division that satisfies the OPERABILITY criteria for the division's Function. These criteria are outlined in the LCO section of the Bases.

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

A.1

Condition A addresses the situation where one or more functions of the RSS are inoperable. This includes the control and transfer switches for any required Function.

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

B.1 and B.2

If the Required Action and associated Completion Time of Condition A are not met, 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 3 within 6 hours and to MODE 4 within 12 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required MODE from full power conditions in an orderly manner and without challenging plant systems.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.3.1

SR 3.3.3.1 verifies that each required RSS transfer switch and control circuit performs its intended function. This verification is performed from the reactor shutdown panel and locally, as appropriate. Operation of the equipment from the remote shutdown panel is not necessary. Displays in the MCR and RSS contain real-time plant data prior to, during, and after control transfer from one station to the other. The RSS data is populated from the same information busses that supply data to the MCR. During the time control is transferred from the MCR to the RSS or vice versa, the operator will have seamless transfer of control and data will not be interrupted. The operators will have an indication via the control system that RSS control has been established. This will ensure that if the control room becomes inaccessible, the plant can be brought to and maintained in MODE 3 from the reactor shutdown panel and the local control stations. The 24 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. Operating experience demonstrates that RSS control usually pass the Surveillance when performed at a Frequency of once every 24 months.

SR 3.3.3.2

A CALIBRATION of each instrument display function on the RSS every 24 months ensures that each instrument division is reading accurately and within tolerance. A CALIBRATION is a complete check of the instrument division, including the sensor. The test verifies that the division responds to the measured parameter within the necessary range and accuracy. CALIBRATION leaves the division adjusted to account for instrument drift to ensure that the division remains operational between successive tests.

SR 3.3.3.3

A SOT on each division performing the RSS functions is performed every 24 months to ensure the entire division will perform its intended function when needed. A SOT shall be the injection of a simulated or actual signal into the division as close to the sensor as practicable to verify OPERABILITY of all devices in the division required for division OPERABILITY. The SOT shall include adjustments, as necessary, of the required alarm, interlock, and trip setpoints required for division OPERABILITY such that the setpoints are within the necessary range and accuracy. The SOT may be performed by means of any series of sequential, overlapping, or total steps.

BASES

REFERENCES	1.	10 CFR 50, Appendix A, GDC 19.

Table B 3.3.3-1 (page 1 of 2)
Remote Shutdown System Instrumentation and Controls

FUNCTION / INSTRUMENT OR CONTROL PARAMETER	REQUIRED NUMBER OF FUNCTIONS
Source Range Neutron Flux	1
Control Rod Drive Mechanism (CRDM) Bottom Position Indications	1 per CRDM
Reactor Trip Breakers	1 per trip breaker
Reactor Coolant Pump Trip	1 per pump
RCS Hot Leg Pressure Wide Range	1 per loop
RCS Hot Leg Temperature (Wide Range)	1 per loop
RCS Cold Leg Temperature (Wide Range)	1 per loop
Pressurizer Pressure	1
Pressurizer Pressure Setpoint Reset	1
Low Temperature Overpressure Alarm	1
Pressurizer Level	1
Pressurizer Level Variable Setpoints	1
Pressurizer Safety Relief Valves (incl. Actuators and Position Sensors	1 per valve
Steam Generator Pressure	1 per loop
Steam Generator Pressure Variable Setpoints	1 per loop
Steam Generator Pressure Setpoint Reset	1 per loop
Steam Generator (Wide Range) Levels	1 per loop
Main Steam Isolation Valves	1 per valve
Main Steam Relief Isolation Valves	1 per valve
Main Steam Relief Control Valves	1 per valve
In Containment Refueling Water Storage Tank (IRWST) Level	1
Low Head Safety Injection (LHSI) Pumps	1 per pump
Residual Heat Removal (RHR) Heat Exchanger Main Control Valves	1 per loop
RHR Heat Exchanger Bypass Control Valves	1 per loop
RHR Heat Exchanger Inlet Temperatures	1 per loop
RHR Heat Exchanger Outlet Temperatures	1 per loop
RHR Suction Line Isolation Valves	1 per loop
RHR Suction Line Isolation Valve Interlock Status	1 per loop
RHR Warm-Up / Conditioning Valves	1 per loop
Essential Service Water Pumps	1 per loop
Component Cooling Water (CCW) Pumps	1 per pump
CCW Surge Tank Level	1 per tank
Emergency Diesel Generator (EDG)	1 per EDG
CVCS Letdown Isolation Valves	1 per valve
EBS Boric Acid Storage Tank Levels	1
EBS Injection Line Isolation Valves	1 per valve
EBS Pumps	1 per pump

Table B 3.3.3-1 (page 2 of 2)
Remote Shutdown System Instrumentation and Controls

FUNCTION / INSTRUMENT OR CONTROL PARAMETER	REQUIRED NUMBER OF FUNCTIONS
EBS Containment Isolation Valves	1 per valve
Emergency Feedwater Pumps	1 per pump
Emergency Feedwater Pool Levels (WR)	1 per pool
P12 Permissive	1
P14 Permissive	1
P15 Permissive	1
P17 Permissive	1