

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 mitigate 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

BASES

BACKGROUND (continued)

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.

In general, 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.

Table B 3.3.1-1 "Protection System (PS) Functional Dependencies," was compiled to identify functions that could be impacted by the cumulative failures of different sensors in different divisions and those functions that do not have four divisions of Actuation Logic Units (ALU). In general, when a sensor becomes inoperable, the Acquisition and Processing Unit (APU) that receives the signal from that sensor marks that signal as being invalid. When APU marks a signal invalid, the ALUs change the voting logic to disregard the invalid signal. Table B 3.3.1-1 may be used as an aid to assess OPERABILITY in applying Table 3.3.1-2 Footnote (a), which states that "A division is OPERABLE provided: a) the minimum sensors required for functional capability for all sensors providing input to the Trip/Actuation Function/Permissive are OPERABLE; and b) the associated signal processors are OPERABLE."

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.

BASES

BACKGROUND (continued)

-----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 c of Table 3.3.1-2. The as-found and as-left tolerances will apply to the actual setpoint implemented in the Surveillance procedures to confirm division performance.

Licenses 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 (Ref. 6)). In this manner, the LTSP ensures that SLs are not exceeded. As such, the LTSP meets the definition of a SL-LSSS (Ref. 1). The LTSPs are determined as part of the safety analysis (Ref. 5).

BASES

BACKGROUND (continued)

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. The Allowable Value is the least conservative value of the as-found setpoint that a division can have when tested such that a division is OPERABLE if the as-found setpoint is conservative with respect to the Allowable Value during a CALIBRATION. As such, the Allowable Value differs from the Nominal Trip Setpoint 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 division 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.

BASES

BACKGROUND (continued)

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 an acceptable fraction of 10 CFR 100 limits. Different accident categories are allowed a different fraction of these limits, based on probability of occurrence. Meeting the acceptable dose limit for an accident category is considered having acceptable consequences for that event. 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 signal conditioning;
- Manual actuation switches;
- Signal Processors, which include:
 - Remote Acquisition Units (RAU), which acquire the signals from the SPNDs and distribute these signals;
 - APUs, which perform calculations and make setpoint comparisons;
 - 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
 - Rod Cluster Control Assembly Units (RCCAUs), which acquire rod position information and distribute these signals;

BASES

BACKGROUND (continued)

- Actuation Devices, which includes the reactor trip breakers and contactors and 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 divisions, consisting of field transmitters or process sensors and associated signal conditioning, provide a measurable electronic signal based upon the physical characteristics of the parameter being measured.

The Incore Instrumentation System, which uses SPNDs 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 U.S. EPR were submitted to NRC in References 1 and 4. The majority of PS trips or protection functions are based on single division 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 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 Value 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.

BASES

BACKGROUND (continued)

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. Process 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 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.

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 message and service interface computers to interface with each division.

The measurement divisions or signal acquisition layer (which includes the RAUs and RCCAUs) 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).

BASES

BACKGROUND (continued)

The data-processing computers (APUs) perform signal processing for plant protective functions such as signal online validation, limit value monitoring and 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 (ALUs), the outputs of the data-processing computers of redundant 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.

When an APU, RAU, or RCCA unit is placed in lockout, network outputs are marked as invalid and are disregarded in downstream processing. For example, a two out of four voting function that receives one faulty input votes two out of three on the remaining non-faulty inputs. Hardwired outputs (i.e., ALU outputs) are forced to a no output state, resulting in a “reactor trip output” and no ESF actuation. No manual actions, beyond placing the signal processor in lockout, are required for the downstream processing to properly accommodate the signal processor in a lockout condition.

For the reactor trip function, both ALUs in a subsystem, if OPERABLE, must vote for an actuation. This provides protection against spurious trips. However, if only one ALU in a subsystem is OPERABLE, the subsystem 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.

BASES

BACKGROUND (continued)

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 the Diverse Actuation System (DAS) in the unlikely event of a software common cause failure of the PS;
- 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 accommodated by modifying the vote in the ALU layer. For the reactor trip functions, the vote is always modified toward actuation.

The reactor trip outputs of the two redundant ALUs in a subsystem are combined in a hardwired functional AND configuration. This requires both ALUs to output the reactor trip order for the associated reactor trip device to be actuated. The outputs of the functional AND from both subsystems within a division are combined in a functional OR logic. The functional AND provides protection against spurious reactor trip while maintaining the ability to actuate a trip if an ALU has failed.

BASES

BACKGROUND (continued)

ESF Trip Logic

The ESF trip logic senses accident situations and initiates 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.

Single failures upstream of the ALU layer that could result in an invalid signal being used in the ESF actuation are accommodated by modifying the vote in the ALU layer. Each ESF actuation function is evaluated on a case-by-case basis to determine whether the vote is modified toward actuation or no actuation. In cases where inappropriate actuation of an ESF function could challenge plant safety, the function is modified toward no actuation. Otherwise, the function is modified toward actuation.

The ESF actuation signals of the redundant ALUs in each subsystem are combined in a hardwired logical OR; therefore, either of the redundant ALU in a division can actuate an ESF function.

BASES

BACKGROUND (continued)

Actuation Devices

Reactor Trip Actuation Devices

The reactor trip actuation is performed by interrupting electrical power to the Control Rod Drive Mechanism (CRDM). 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.

The power supply of the CRDM 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.
 - 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 Safety Information and Control System (SICS) panel. The shunt coil of the main trip breakers is actuated by the automatic reactor trip signal from the DAS and the manual trip signal from the RSS.
 - The reactor trip signal generated automatically by the PS and the manual trip signal generated from the SICS panel can actuate the trip contactors.
- There are 23 sets of four trip contactors, each set capable of removing power to four CRDM power supplies. Eleven sets of contactors are located in physical division one and twelve sets are located in physical division four. Each division of the PS is assigned to one contactor in each of the 23 sets. Each set of four contactors is arranged to require two out of four PS reactor trip orders to drop the rods assigned to the contactor set.
- The electronics of the Control Rod Drive Control System (CRDCS) can switch-off the power supply of four CRDMs. The electronics of the CRDCS are non-safety but are the fastest switching device and allow the contactors and the trip breaker to open without stress.

Once open, the reactor trip breakers require manual closure and they cannot be manually closed until the reactor trip signal is cleared by the PS.

BASES

BACKGROUND (continued)

Engineered Safety Features Actuation Devices

The PS determines the need for ESF 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 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
- In general, 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 not included in the Technical Specifications. Refer to FSAR Sections 7.2 and 7.3 for a description of the reactor trip and ESF functions, respectively. Credited functions are included in FSAR Tables 15.0-7, 15.0-8, and 15.0-9.

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.

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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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

In general, 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 AOs and assists the ESF in providing acceptable consequences during accidents. The PS sensors, signal processors, and specified actuation devices that support automatic reactor trip functions are not required to be OPERABLE in MODES 4 and 5 when all RCCAs are fully inserted, and only if the Reactor Control, Surveillance and Limitation (RCSL) System is placed in a configuration whereby inadvertent RCCA withdrawal is precluded. 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.

In general, the PS sensors, manual actuation switches, signal processors, and specified actuation devices that support ESF Functions 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 Main Steam Isolation Valves (MSIVs) to preclude a positive reactivity addition,
- Actuate Emergency Feedwater (EFW) to preclude the loss of the Steam Generators (SG) as a heat sink (in the event the normal feedwater system is not available),
- 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 3.c: SIS Actuation on Low RCS Loop Level,
- 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) Isolation on Anti-Dilution Mitigation (ADM) at Shutdown Condition (RCP not operating),
- ESF 11.c: CVCS 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The specific safety analysis and OPERABILITY requirements applicable to each PS protective function is identified below. Permissives that enable a credited function will be included in the Technical Specifications. Permissives that disable a reactor trip or ESF function are not part of a primary success path of a safety sequence analysis. While their failure may lead to a spurious reactor trip or ESF actuation, their functioning is not credited to mitigate an accident of anticipated operational occurrence, nor to keep the plant in an analyzed condition.

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 (1/4)),
- c. Low DNBR and Rod Drop (2/4),
- d. Low DNBR - High Quality, and
- e. Low DNBR - High Quality and (Imbalance or Rod Drop (1/4)).

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 Low DNBR-High Quality (1.d) trips require four divisions of the following sensors and processors to be OPERABLE in MODE 1 when the reactor power level is greater than or equal to approximately 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The Low DNBR and (Imbalance or Rod Drop (1/4)) (1.b), Low DNBR and Rod Drop (2/4) (1.c), and Low DNBR-High Quality and (Imbalance or Rod Drop (1/4)) (1.e) trips require four divisions of the following sensors and processors to be OPERABLE in MODE 1 when the reactor power level is greater than or equal to approximately 10% RTP:

- SPNDs,
- Rod Cluster Control Assembly (RCCA) Analog 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 low enough to provide an operating envelope that prevents an unnecessary low DNBR reactor trip. The LTSPs are high 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.

Validating 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 approximately 10% RTP. When nuclear power is below this threshold, the trips are also automatically disabled by inhibiting 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 AOOs that lead 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.

BASES

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 in MODE 1 when the reactor power level is greater than or equal to approximately 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 that lead to an uncontrolled increase of the linear power density.

Validating 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 approximately 10% RTP. When nuclear power is below this threshold, the trip is also automatically disabled by inhibiting Permissive P2.

3. High Neutron Flux Rate of Change (Power Range)

This function limits the consequences of an excessive reactivity increase from a range in power levels, including RTP. 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 RCSL System capable of withdrawing a RCCA or one or more RCCAs not fully inserted:

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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.

There are no permissives associated with this trip.

4. High Core Power Level

This function limits the consequences of an excessive reactivity increase from a range in power levels, including RTP. 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 approximately 10^{-5} % power as indicated on the Intermediate Range monitors:

- Cold Leg Temperature (Wide Range) sensors,
- 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 a range in power levels, including RTP.

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

5. Low Saturation Margin

The Low Saturation Margin trip function provides a reactor trip before saturation occurs in a hot leg. The High Core Power Level trip function relies on loop temperature measurements as part of the calculation of thermal and hydraulic conditions. The High Core Power Level calculation would not be valid if saturation were to occur in a hot leg. Therefore, the Low Saturation Margin reactor trip function assures that the High Core Power Level trip function is not invalidated.

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 approximately $10^{-5}\%$ power as indicated on the Intermediate Range Detectors:

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

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

Validating the P5 permissive automatically enables the Low Saturation Margin Trip when the nuclear power level is greater than or equal to approximately $10^{-5}\%$. Inhibiting 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 in MODE 1 when the reactor power level is greater than or equal to approximately 70% RTP:

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

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

Validating 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 approximately 70% RTP. Inhibiting the P3 permissive also automatically disables the Low-Low RCS Loop Flow Rate Trip (One Loop) below this power.

The Low RCS Loop Flow Rate 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 approximately 10% RTP:

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

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

Validating 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 approximately 10% RTP. Inhibiting the P2 permissive also automatically disables the Low RCS Loop Flow Rate Trip (Two Loops) when the nuclear power level is below this power.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

7. Low RCP Speed

Due to electrical transients that may affect the RCPs, 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.

The Low RCP Speed Trip requires four divisions of the following sensors and processors to be OPERABLE in MODE 1 when the reactor power level is greater than or equal to approximately 10% RTP:

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

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

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

8. High Neutron Flux (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 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 approximately 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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.

Inhibiting the P6 permissive enables the High Neutron Flux (Intermediate Range) reactor trip when the power level is less than or equal to approximately 10% RTP. When nuclear power is below this threshold, the trip is disabled by validating Permissive P6.

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 approximately 10%, MODE 2, and in MODE 3 with the RCSL System 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.

Inhibiting the P6 permissive enables the Low Doubling Time reactor trip when the power level is less than or equal to approximately 10% RTP. When nuclear power is below this threshold, the trip is disabled by validating Permissive P6.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 approximately 10% RTP:

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

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.

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

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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

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

The LTSP is set below the nominal lift setting of the Pressurizer Safety Relief Valves (PSRV), 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.

12. High Pressurizer Level

In case of increasing Pressurizer level, a reactor trip is required in order to avoid Pressurizer overfilling. 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 filling the pressurizer. The PSRVs may lift to prevent over pressurization of the RCS.

Inhibiting the P12 permissive enables the High Pressurizer Level Trip when the pressure is greater than or equal to approximately 2005 psia. When below this threshold, the trip is disabled by validating Permissive P12.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 approximately 2005 psia, when the RCSL System capable of withdrawing a RCCA or one or more RCCAs are not fully inserted.

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

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.

Inhibiting the P12 permissive enables the Low Hot Leg Pressure Trip when the pressure is greater than or equal to approximately 2005 psia. When below this threshold, the trip is disabled by validating Permissive P12.

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 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. 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The SG Pressure Drop Trip requires four divisions of the following sensors and processors 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:

- 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 condition to be detected is an SG pressure drop greater than a specified value (Max1p). This is accomplished by using a variable low setpoint. The value of the variable setpoint is maintained lower than the measured pressure by a fixed amount, with a limitation placed on the rate of decrease of the setpoint value. The measured pressure will only fall below the setpoint if it decreases at a rate greater than that of the rate-limited setpoint for a given amount of time.

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.

15. Low SG Pressure

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. 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 the pressurizer pressure greater than or equal to approximately 2005 psia and 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.

Inhibiting the P12 permissive enables the Low SG Pressure Trip when the pressure is greater than or equal to approximately 2005 psia. When below this threshold, the trip is disabled by validating Permissive P12.

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.

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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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.

Inhibiting the P13 permissive enables the Low SG Level Trip when the hot leg temperature is greater than or equal to approximately 200°F. When below this threshold, the trip is disabled by validating Permissive P13.

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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The High SG Level Trip requires the following sensors and processors to be OPERABLE in MODES 1 and 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 an SG level increase. The LTSP is sufficiently above the full load operating value so as not to interfere with normal plant operation, but still low enough to provide the required protection in the event of an abnormal condition.

Inhibiting the P13 permissive enables the High SG Level Trip when the hot leg temperature is greater than or equal to approximately 200°F. When below this threshold, the trip is disabled by validating Permissive P13.

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:

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

This function is also necessary to actuate the Containment Isolation (Stage1) on High Containment Pressure Engineered Safety Feature (ESF) function.

The High Containment Pressure Trip requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, 3, and 4.

- Containment Equipment Compartment Pressure sensors,
- Containment Service Compartment Pressure (Narrow Range) sensors,
- APUs, and
- ALUs.

BASES

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.

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.

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 permissives associated with this function.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

2. Main Feedwater

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

After a reactor trip confirmation signal, 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 Isolation on Reactor Trip function is required to be OPERABLE in:

- MODE 1, and
- MODES 2 and 3, except when all MFW full load lines are isolated.

The MFW Full Load Isolation on Reactor Trip function requires four divisions of the following sensors and processors to be OPERABLE:

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

There are no permissives associated with this function.

b. MFW Full Load Isolation 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 Main Steam Relief Train (MSRT).

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The automatic MFW Full Load Isolation on High SG Level function is required to be OPERABLE in:

- MODE 1, and
- MODES 2 and 3, except when all MFW full load lines are isolated.

The MFW Full Load Isolation on High SG Level function requires four divisions of the following sensors and processors to be OPERABLE:

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

The MFW Full Load Isolation 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.

Inhibiting the P13 permissive enables the MFW Full Load Isolation on High SG Level function when the hot leg temperature is greater than or equal to approximately 200°F. When below this threshold, the function is disabled by validating Permissive P13.

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

The affected SG depressurizes for excessive increase in secondary steam flow, steam system piping failure, and Feedwater System piping failure. Also, the Startup and Shutdown System (SSS) isolation and control valves close in the affected SG.

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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 SSS Isolation on SG Pressure Drop function is required to be OPERABLE in:

- MODE 1, and
- MODES 2 and 3, except when all MFW full and low load lines are isolated.

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

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

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

The condition to be detected is an SG pressure drop greater than a specified value (Max1p). This is accomplished by using a variable low setpoint. The value of the variable setpoint is maintained lower than the measured pressure by a fixed amount, with a limitation placed on the rate of decrease of the setpoint value. The measured pressure will only fall below the setpoint if it decreases at a rate greater than that of the rate-limited setpoint for a given amount of time.

There are no permissives associated with this function.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

d. SSS Isolation on Low SG Pressure (Affected 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 Isolation on Low SG Pressure function is required to be OPERABLE in:

- MODE 1,
- MODE 2, except when all MFW full load and low load lines are isolated, and
- MODE 3 when the pressurizer pressure is greater than or equal to approximately 2005 psia, except when all MFW full load and low load lines are isolated.

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

Inhibiting the P12 permissive enables the SSS Isolation on Low SG Pressure function when the pressurizer pressure is greater than approximately 2005 psia. When below the threshold, the function is disabled by validating Permissive P12.

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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The automatic SSS Isolation on High SG Level for Period of Time function is required to be OPERABLE in:

- MODE 1, and
- MODES 2 and 3, except when all MFW full load and low load lines are isolated.

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:

- RTCB Position Indication sensors,
- 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.

Inhibiting the P13 permissive enables the SSS Isolation on High SG Level for Period of Time function when the hot leg temperature is greater than approximately 200°F. When below this threshold, the function is disabled by validating Permissive P13.

3. Safety Injection System Actuation

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 on Low Pressurizer Pressure 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 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 in MODE 3 with the pressurizer pressure greater than or equal to approximately 2005 psia:

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

Inhibiting the P12 permissive enables the SIS Actuation on Low Pressurizer Pressure function when the pressurizer pressure is greater than approximately 2005 psia. When below this threshold, the function is disabled by validating Permissive P12.

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

The automatic SIS Actuation on Low Delta P_{sat} function requires four divisions of the following sensors and processors to be OPERABLE in MODE 3 when the pressurizer pressure is less than approximately 2005 psia, and in MODE 4 when at least one RCP is running, the hot leg pressure is greater than or equal to approximately 464 psia, and the hot leg temperature is greater than or equal to approximately 350°F:

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

This function ensures SIS actuation 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 low enough to avoid spurious operation but high enough to maintain core coverage in the event of an RCS pipe break.

Validating the P12 permissive enables the SIS Actuation on Low Delta P_{sat} function when the pressurizer pressure is less than or equal to approximately 2005 psia. Inhibiting the P15 permissive disables the SIS Actuation on Low Delta P_{sat} function when no RCPs are running, the hot leg pressure is less than approximately 464 psia, or the hot leg temperature is less than approximately 350°F.

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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

c. Low RCS Loop Level

The SIS Actuation on Low RCS Loop Level function mitigates the following postulated accidents or AOs:

- Loss of Residual Heat Removal during mid-loop operations,
- Uncontrolled loss of RCS inventory,
- Small break LOCA, and
- Large break LOCA.

The automatic SIS Actuation on Low RCS Loop Level function is required to be OPERABLE in:

- MODE 4 when no RCPs are running, the hot leg pressure is less than approximately 464 psia, and the hot leg temperature is less than approximately 350°F, and
- MODES 5 and 6.

The SIS Actuation on Low RCS Loop Level function requires four divisions of the following sensors and processors:

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

Validating the P15 Permissive enables the SIS Actuation on Low RCS Loop Level function when no RCPs are running, the hot leg pressure is less than approximately 464 psia, and the hot leg temperature is less than approximately 350°F.

4. RCP Trip on Low Delta Pressure across 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

This function mitigates the following postulated accidents or AOOs:

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

The 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, 3, and 4:

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

The sensors required to generate the SIS actuation signal are identified under each separate ESF function: SIS on Low Pressurizer Pressure (Function B.3.a), SIS on Low Delta P_{sat} (Function B.3.b), and SIS Actuation on Low RCS Loop Level (Function B.3.c).

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

BASES

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 sensors required to generate the SIS Actuation signal are identified under each separate ESF function: SIS on Low Pressurizer Pressure (Function B.3.a), and SIS on Low Delta P_{sat} (Function B.3.b), and SIS Actuation on Low RCS Loop Level (Function B.3.c).

Inhibiting the P14 permissive enables the Partial Cooldown on SIS Actuation function when the hot leg pressure is greater than or equal to approximately 464 psia or the hot leg temperature is greater than or equal to approximately 350°F. Validating the P14 permissive disables the function when the hot leg pressure is less than approximately 464 psia and the hot leg temperature is less than approximately 350°F.

6. Emergency Feedwater System

a. Actuation on Low-Low SG Level (Affected 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 low enough to provide an operating envelope that prevents unnecessary actuations but high enough to ensure sufficient make-up is provided to the SGs.

Inhibiting the P13 permissive enables the EFWS Actuation on Low-Low SG Level function when the hot leg temperature is greater than or equal to approximately 200°F. When below this threshold, the function is disabled by validating Permissive P13.

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:

- APUs, and
- ALUs.

The sensors required to generate the SIS Actuation signal are identified under each separate ESF function: SIS on Low Pressurizer Pressure (Function B.3.a), SIS on Low Delta P_{sat} (Function B.3.b), and SIS Actuation on Low RCS Loop Level (Function B.3.c).

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

Inhibiting the P13 permissive enables the EFWS Actuation on LOOP and SIS Actuation function when the hot leg temperature is greater than or equal to approximately 200°F. When below this threshold, the function is disabled by validating Permissive P13.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

7. Main Steam Relief Train (Affected SG)

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:

- Total loss of load and/or turbine trip,
- Loss of main heat sink (condenser),
- Inadvertent closure of a MSIV,
- 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, 3, and in MODE 4 when the SGs are relied upon for heat removal:

- SG Pressure sensors,
- Hot Leg Temperature (Wide Range) sensors (for setpoint control),
- Hot Leg Pressure (Wide Range) sensors (for setpoint control),
- 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.

Permissive P14 is utilized for setpoint selection.

BASES

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 in MODE 3 with the pressurizer pressure is greater than or equal to approximately 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.

Inhibiting the P12 permissive enables the MSRT Isolation on Low SG Pressure function when the pressure is greater than or equal to approximately 2005 psia. When below this threshold, the function is disabled by validating Permissive P12.

8. MSIV Isolation

a. Isolation 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 MSIV Isolation on SG Pressure Drop function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2, and in MODE 3 except when all MSIVs are closed:

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

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

An SG pressure drop is detected by using a variable low setpoint equal to the actual SG pressure minus a fixed value, with a limitation placed on the rate of decrease of the setpoint. There are no automatic permissives associated with this function.

b. Isolation 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 Isolation 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.

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 Isolation on Low SG Pressure function requires four divisions of the following sensors and processors to be OPERABLE in MODES 1 and 2, and in MODE 3 when the pressurizer pressure is greater than or equal to approximately 2005 psia except when all MSIVs are closed:

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

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

Inhibiting P12 permissive enables the MSIV Isolation on Low SG Pressure function when the pressurizer pressure is greater than or equal to approximately 2005 psia. When below this threshold, the function is disabled by validating Permissive P12.

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.

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, 3, and 4:

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

- Containment Service Compartment Pressure (Wide Range) sensors,
- 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 permissives associated with this function.

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.

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.

The sensors required to generate the SIS Actuation signal are identified under each separate ESF function: SIS on Low Pressurizer Pressure (Function B.3.a), SIS on Low Delta P_{sat} (Function B.3.b), and SIS Actuation on Low RCS Loop Level (Function B.3.c).

There are no 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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, 3 and 4:

- Containment Service Compartment Pressure (Wide Range) sensors,
- APUs, and
- ALUs.

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 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 permissives associated with this function.

10. Emergency Diesel Generator

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.

The automatic EDG Start on Degraded Grid Voltage requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6, and during movement of irradiated fuel assemblies:

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 low enough to avoid spurious operation but high enough to ensure that power is provided to ESF functions in the time-frame assumed in the accident analyses.

There are no 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 sensors and processors to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6, and during movement of irradiated fuel assemblies:

- 6.9 kV Bus 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 low enough to avoid spurious operation but high enough to ensure that power is provided to ESF functions in the time-frame assumed in the accident analyses.

There are no permissives associated with this function.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

11. Chemical and Volume Control System 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 the following sensors and processors to be OPERABLE in MODES 1, 2, 3, and 4:

- Pressurizer Level (Narrow Range) sensors (4 divisions),
- APUs (4 divisions), and
- ALUs (Divisions 1 and 4).

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

Inhibiting the P17 permissive disables the CVCS Charging Line Isolation on High-High Pressurizer Level function when the cold leg temperature is less than or equal to approximately 248°F. When above this threshold, the function is disabled by validating Permissive P12.

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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The automatic CVCS Isolation on ADM - Shutdown Condition (RCP not operating) function is required to be OPERABLE in MODES 3, 4, and 5 with no RCPs in operation, and in MODE 6.

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

Validating the P7 permissive automatically enables the CVCS Isolation on ADM – Shutdown Condition (RCP not operating) function when all RCP's are not in operation. When any RCP is operating, the function is automatically disabled by inhibiting Permissive P7.

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 Isolation on ADM - Standard Shutdown Conditions function is required to be OPERABLE in MODES 3, 4, and 5 with one or more RCPs in operation.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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

Validating the P8 permissive automatically enables the CVCS Isolation on ADM – Standard Shutdown Conditions function when all RCCA Bottom Position Indicators show the RCCAs are inserted. When all RCPs are not operating, the function is disabled by inhibiting Permissive P7.

d. Isolation on ADM - At Power

This function mitigates a homogeneous dilution event at power conditions. This function ensures that the dilution is stopped when the protection is actuated.

The automatic CVCS Isolation on ADM - At Power function requires the following sensors and processors in MODES 1 and 2:

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

The LTSP is low enough to provide an operating envelope that prevents unnecessary isolations but high enough to mitigate a dilution event at power.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

Inhibiting the P8 permissive automatically enables the CVCS Isolation on ADM at Power function when any of the RCCA Bottom Position Indicators show an RCCA is not inserted.

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

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 sensors and 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.

Validating the P17 permissive enables the PSRV Actuation function when the cold leg temperature is less than or equal to approximately 248°F. When above this threshold, the function is disabled by inhibiting Permissive P17.

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:

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

- 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 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 permissives are:

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

The P2 permissive is representative of Power Range Detector (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 (approximately 10% RTP).

BASES

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 (1/4)),
- Reactor Trip 1.c: Low DNBR and Rod Drop (2/4),
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and (Imbalance or Rod Drop (1/4)),
- 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.

The P2 permissive requires four divisions of the following sensors and processors to be OPERABLE in MODE 1 when the reactor power level is greater than or equal to approximately 10% RTP:

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

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. P3 - Flux (Power Range) Measurement Higher than Second Threshold

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 (approximately 70% RTP).

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The P3 permissive requires four divisions of the following sensors and processors to be OPERABLE in MODE 1 when the reactor power level is greater than or equal to approximately 70% RTP:

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

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 (approximately 70% RTP).

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 approximately 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.

The P5 permissive requires four divisions of the following sensors and processors to be OPERABLE in MODE 1 and in MODE 2 when the reactor power level is greater than or equal to approximately 10⁻⁵% RTP:

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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 (approximately 10% RTP).

The P6 permissive is utilized to disable 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.

Permissives that disable a reactor trip or ESF function are not part of a primary success path of a safety sequence analysis. While their failure may lead to a spurious reactor trip or ESF actuation, their functioning is not credited to mitigate an accident or anticipated operational occurrence, nor to keep the plant in an analyzed condition. Since Permissive P6 only disables functions when the permissive is validated, it is not within the scope of 10 CFR 50.36, Criterion 3.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

5. P7 - RCP Not in Operation

The P7 permissive facilitates plant heat-up and cooldown by disabling certain ESF functions. The P7 permissive is utilized in the following reactor trips or ESF functions:

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

The P7 permissive requires four divisions of the following sensors and processors to be OPERABLE in MODES 3, 4, 5, and 6 with no RCPs in operation:

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

The RCP current measurements (three per RCP) from different pumps are compared to a setpoint (less than approximately 50% no load current). When two out of three of the measurements taken from all four divisions are less than the setpoint, the permissive is validated (i.e., indicates that the RCPs are not in operation).

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 Isolation on ADM at Standard Shutdown Conditions, and
- ESF 11.d - CVCS Isolation on ADM at Power.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The P8 permissive requires four divisions of the following sensors and processors to be OPERABLE in MODES 3, 4, and 5 with one or more RCPs in operation:

- RCCA Bottom Position Indicator sensors,
- RCCAUs,
- APUs, and
- ALUs.

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 at Power Condition function.

7. P12 - Pressurizer Pressure Lower than Threshold

The P12 permissive facilitates plant heat-up and cooldown by disabling certain ESF functions. 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,
- ESF 2.d: SSS Isolation on Low SG Pressure (Affected SGs),
- ESF 3.a: SIS Actuation on Low Pressurizer Pressure,
- ESF 3.b: SIS Actuation on Low Delta P_{sat} ,
- ESF 7.b: MSRT Isolation on Low SG Pressure (Affected SG), and
- ESF 8.b: MSIV Isolation on Low SG Pressure (All SGs).

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The P12 permissive requires four divisions of the following sensors and processors to be OPERABLE in MODE 3 with RCS pressure less than or equal to approximately 2005 psia, and in MODE 4 when at least one RCP is running, the hot leg pressure is greater than or equal to approximately 464 psia, or the hot leg temperature is greater than or equal to approximately 350°F:

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

The Permissive P12 facilitates plant heatup or cooldown by disabling certain ESF functions. P12 allows 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 Trip 17: Low SG Level,
- Reactor Trip 18: High SG Level,
- ESF 2.b: MFW Full Load Isolation 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 (Affected SGs), and
- ESF 6.b: EFWS Actuation on LOOP and SIS Actuation (All SGs).

Hot Leg Temperature (WR) measurements are compared to the P13 setpoint (approximately 200°F).

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

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.

Permissives that disable a reactor trip or ESF function are not part of a primary success path of a safety sequence analysis. While their failure may lead to a spurious reactor trip or ESF actuation, their functioning is not credited to mitigate an accident or anticipated operational occurrence, nor to keep the plant in an analyzed condition. Since Permissive P13 only disables functions when the permissive is validated, it is not within the scope of 10 CFR 50.36.

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 the following reactor trip or ESF functions:

- ESF 5 - Partial Cooldown Actuation on SIS Actuation, and
- ESF 7.a - MSRT Actuation on High SG Pressure (Affected SG) (for setpoint control).

At pressures and temperatures below the setting of the P14 permissive (approximately 464 psia and approximately 350 °F), operation of the LHSI/RHR system is allowed.

The P14 permissive requires four divisions of the following sensors and processors to be OPERABLE in MODES 1, 2, 3, and in MODE 4 when the SGs are relied upon for heat removal:

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

This permissive is manually controlled.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

10. P15 - Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds and RCPs Shutdown

The P15 permissive defines when SI actuation due to Delta P_{sat} is disabled and SI actuation due to Low RCS 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 P_{sat} , and
- ESF 3.c: SIS Actuation on Low RCS Loop Level.

The P15 permissive requires four divisions of the following sensors and processors to be OPERABLE in MODES 4, 5, and 6:

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

The value for Permissive P15 (RCS temperature less than or equal to approximately 350°F, RCS pressure less than or equal to approximately 464 psia, and less than or equal to approximately 50% no load current on all RCPs) 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. P16 - Hot Leg Pressure and Delta P_{sat} Lower than Thresholds, RCP Not in Operation, and Time Elapsed since Safety Injection Start

The P16 permissive defines when Safety Injection may be aligned from the cold leg to the hot leg to mitigate the consequences of a LOCA. The P16 permissive requires four division of the following sensors and processors to be OPERABLE in MODES 1, 2, 3, and 4:

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

The value for Permissive P16 (Hot leg pressure below approximately 290 psia, Delta P_{sat} below approximately 73 psi, less than approximately 50% no load current on all RCPs, and approximately 1.5 hours since Safety Injection initiated) represents the threshold for switching from cold leg injection to hot leg injection.

12. 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 11.a: CVCS Charging Line Isolation on High-High Pressure Level,
- ESF 12.a: PSRV Actuation - First Valve, and
- ESF 12.b: PSRV Actuation - Second Valve.

The P17 permissive requires four divisions of the following sensors and processors to be OPERABLE when Pressurizer Safety Relief Valve OPERABILITY is required by LCO 3.4.11, "Low Temperature Overpressure Protection (LTOP)":

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

The value for Permissive P17 is the threshold for actuation 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:

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)**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, 5, 6, and during movement of irradiated fuel assemblies. These sensors support the following functions:

- 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 1, 2, 3, 4, 5, and in MODE 6 with no RCPs in operation. These sensors support the following functions:

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

3. Boron Temperature - CVCS Charging Line

Four Boron Temperature - CVCS Charging Line sensors are required to be OPERABLE in MODES 1, 2, 3, 4, 5, and in MODE 6 with no RCPs in operation. These sensors support the following functions:

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)**4. CVCS Charging Line Flow**

Four CVCS Charging Line Flow sensors are required to be OPERABLE in MODES 1 and 2, and in MODES 3, 4, and 5 with one or more RCPs in operation. These sensors support the following functions:

- ESF 11.c: CVCS Isolation on ADM at Standard Shutdown Conditions, and
- ESF 11.d: CVCS Isolation on ADM at Power.

5. Cold Leg Temperature (Narrow Range)

Four Cold Leg Temperature (Narrow Range) sensors are required to be OPERABLE in MODE 1 when RTP is greater than or equal to approximately 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 (1/4)),
- Reactor Trip 1.c: Low DNBR and Rod Drop (2/4),
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and (Imbalance or Rod Drop (1/4)), 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 approximately $10^{-5}\%$ as shown on the Intermediate Range Detectors,
- MODES 3, 4, and 5 with one or more RCPs in operation, and
- When PSRV OPERABILITY is required by LCO 3.4.11, "Low Temperature Overpressure Protection (LTOP)".

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 Isolation on ADM at Standard Shutdown Conditions, and
- Permissive P17: Cold Leg Temperature Lower than Threshold.

7. Containment Equipment Compartment Pressure

Four Containment Equipment Compartment Pressure sensors are required to be OPERABLE in MODES 1, 2, 3 and 4. These sensors support Reactor Trip 19: High Containment Pressure function, which in turn supports ESF 9a: Containment Isolation (Stage 1) on High Containment Pressure.

8. Containment Service Compartment Pressure (Narrow Range)

Four Containment Service Compartment Pressure (Narrow Range) sensors are required to be OPERABLE in MODES 1, 2, 3 and 4. These sensors support Reactor Trip 19: High Containment Pressure function, which in turn supports ESF 9a: Containment Isolation (Stage 1) on High Containment Pressure.

9. Containment Service Compartment Pressure (Wide Range)

Four Containment Service Compartment Pressure (Wide Range) sensors are required to be OPERABLE in MODES 1, 2, 3, and 4. These sensors support the following functions:

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

10. Hot Leg Pressure (Wide Range)

Four Hot Leg Pressure (Wide Range) sensors are required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6, 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 7.a: MSRT Actuation on High SG Pressure (Affected SG) (for setpoint control),
- 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,
- Permissive P15: Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds and RCPs Shutdown, and
- Permissive P16: Hot Leg Pressure and Delta P_{sat} Lower than Thresholds, RCP Not in Operation, and Time Elapsed since Safety Injection Start.

11. 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 approximately $10^{-5}\%$ 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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

12. Hot Leg Temperature (Wide Range)

Four Hot Leg Temperature (Wide Range) sensors are required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6. These sensors support the following functions and Permissives:

- ESF 3.b: SIS Actuation on Low Delta P_{sat} ,
- ESF 7.a: MSRT Actuation on High SG Pressure (Affected SG) (for setpoint control),
- Permissive P13: Hot Leg Temperature Lower than Threshold,
- Permissive P14: Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds,
- Permissive P15: Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds and RCPs Shutdown, and
- Permissive P16: Hot Leg Pressure and Delta P_{sat} Lower than Thresholds, RCP Not in Operation, and Time Elapsed since Safety Injection Start.

13. Intermediate Range

Four Intermediate Range sensors are required to be OPERABLE in:

- MODE 1,
- MODE 2, and
- 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 8: High Neutron Flux (Intermediate Range),
- Reactor Trip 9: Low Doubling Time (Intermediate Range), and
- Permissive P5: Flux (Intermediate Range) Measurement Higher than Threshold.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

14. 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 (Power Range) Measurement Higher than Second Threshold.

15. Pressurizer Level (Narrow Range)

Four Pressurizer Level (Narrow Range) sensors are required to be OPERABLE in MODES 1, 2, 3, and 4. 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.

16. Pressurizer Pressure (Narrow Range)

Four Pressurizer Pressure (Narrow Range) sensors are required to be OPERABLE in MODES 1, 2, 3, and in MODE 4 with RCS temperature greater than or equal to approximately 350°F, RCS pressure greater than or equal to approximately 464 psia, or greater than approximately 50% no load current on all RCPs. 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 (1/4)),
- Reactor Trip 1.c: Low DNBR and Rod Drop (2/4),
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and (Imbalance or Rod Drop (1/4)),
- 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)

17. 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 function.

18. 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 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 function.

19. RCP Current

Three RCP Current sensors per RCP (12 total) are required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6. These sensors support the following functions and Permissives:

- ESF 4: RCP Trip on Low Delta Pressure across RCP with SIS Actuation,
- Permissive P7: RCP Not in Operation, and
- Permissive P15: Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds and RCPs Shutdown.

20. RCP Delta Pressure

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

21. RCP Speed

Four RCP Speed sensors are required to be OPERABLE in MODE 1 when RTP is greater than or equal to approximately 10%. These sensors support the following functions:

- Reactor Trip 1.a: Low DNBR
- Reactor Trip 1.b: Low DNBR and (Imbalance or Rod Drop (1/4)),
- Reactor Trip 1.c: Low DNBR and Rod Drop (2/4),
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and (Imbalance or Rod Drop (1/4)), and
- Reactor Trip 7: Low RCP Speed.

22. 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 RTP is greater than or equal to approximately 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 1/4)),
- Reactor Trip 1.c: Low DNBR and Rod Drop (2/4),
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and (Imbalance or Rod Drop (1/4)),
- 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.

23. RCS Loop Level

Four RCS Loop Level sensors are required to be OPERABLE in:

- MODE 4 when no RCPs are running, the hot leg pressure is less than approximately 464 psia, and the hot leg temperature is less than approximately 350°F, and
- MODES 5 and 6.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

These sensors support ESF 3.c: SIS Actuation on Low RCS Loop Level function.

24. RTCB Position Indication

Four RTCB Position Indication sensors are required to be OPERABLE in MODE 1, and in MODES 2 and 3 except when all MFW Full Load and Low Load lines are isolated. These sensors support the following functions:

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

25. Rod Cluster Control Assembly (RCCA) Analog Position Indicator

Eighty-nine RCCA Analog Position Indicator sensors are required to be OPERABLE in MODE 1 when RTP is greater than or equal to approximately 10%.

These sensors support the following functions:

- Reactor Trip 1.b: Low DNBR and (Imbalance or Rod Drop (1/4)),
- Reactor Trip 1.c: Low DNBR and Rod Drop (2/4), and
- Reactor Trip 1.e: Low DNBR – High quality and (Imbalance or Rod Drop (1/4)).

26. RCCA Bottom Position Indicator

Eighty-nine RCCA Bottom Position Indicator sensors are required to be OPERABLE in:

- MODE 3, with one or more RCPs in operation,
- MODE 4, with one or more RCPs in operation, and
- MODE 5, with one or more RCPs in operation.
- These sensors support Permissive P8: Shutdown RCCA Position Lower than Threshold.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)**27. Self-Powered Neutron Detectors**

Seventy-two SPNDs are required to be OPERABLE in MODE 1 when RTP is greater than or equal to approximately 10%. These sensors support the following functions:

- Reactor Trip 1.a: Low DNBR,
- Reactor Trip 1.b: Low DNBR and (Imbalance or Rod Drop (1/4)),
- Reactor Trip 1.c: Low DNBR and Rod Drop (2/4),
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and (Imbalance or Rod Drop (1/4)), and
- Reactor Trip 2: High Linear Power Density.

28. SG Level (Narrow Range)

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

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

29. 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 ESF 6.a: EFWS Actuation on Low-Low SG Level (Affected SGs).

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

30. SG Pressure

Four SG Pressure sensors per SG (16 total) are required to be OPERABLE in MODES 1, 2, 3, and in MODE 4 when the SGs are relied upon for heat removal. 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 (Affected SGs),
- ESF 2.d: SSS Isolation on Low SG Pressure (Affected SGs),
- ESF 7.a: MSRT Actuation on High SG Pressure (Affected SGs),
- ESF 7.b: MSRT Isolation on Low SG Pressure (Affected SGs),
- ESF 8.a: MSIV Isolation on SG Pressure Drop (All SGs), and
- ESF 8.b: MSIV Isolation 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
- MODES 3, 4, and 5 with the RCSL System capable of withdrawing a RCCA or one or more RCCAs not fully inserted.

These switches support all reactor trip functions.

2. SIS Actuation

Four manual SIS Actuation switches are required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6. These switches support the following functions:

- ESF 3.a: SIS Actuation on Low Pressurizer Pressure,
- ESF 3.b: SIS Actuation on Low Delta P_{sat} , and
- ESF 3.c: SIS Actuation on Low RCS Loop Level.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

3. SG Isolation

Four manual SG Isolation switches per SG (16 total) are required to be OPERABLE in MODES 1, 2, and 3, and in MODE 4 when the SGs are relied upon for heat removal. These switches support the following functions:

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

SIGNAL PROCESSORS

1. Acquisition and Processing Units

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.

2. Actuation Logic Units

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

3. Remote Acquisition Units

Two RAUs per division (8 total) are required to be OPERABLE in MODE 1 when RTP is greater than or equal to approximately 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 (1/4)),
- Reactor Trip 1.c: Low DNBR and Rod Drop (2/4),
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and (Imbalance or Rod Drop (1/4)), and
- Reactor Trip 2: High Linear Power Density.

4. Rod Cluster Control Assembly Units

Four RCCA Units are required to be OPERABLE in:

- MODE 1 when RTP is greater than or equal to approximately 10%, and
- MODES 3, 4, and 5 with one or more RCPs in operation.

These signal processors support the following functions and Permissives:

- Reactor Trip 1.a: Low DNBR,
- Reactor Trip 1.b: Low DNBR and (Imbalance or Rod Drop (1/4)),
- Reactor Trip 1.c: Low DNBR and Rod Drop (2/4),
- Reactor Trip 1.d: Low DNBR - High Quality,
- Reactor Trip 1.e: Low DNBR - High Quality and (Imbalance or Rod Drop (1/4)), and
- Permissive P8: Shutdown RCCA Position Lower than Threshold.

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.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

2. Reactor Trip Circuit Breakers

Four RTCBs are required to be OPERABLE in:

- MODES 1 and 2, and
- MODES 3, 4, and 5 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
- MODE 3, 4, and 5 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.

BASES

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.

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.

BASES

ACTIONS (continued)

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 be 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.

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 APU must be placed in lockout or the Condition referenced in Table 3.3.1-2 for the associated function must be entered.

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 or ALU 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

BASES

ACTIONS (continued)

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 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.

E.1

Condition E applies to the RCP Bus and Trip Breakers, RTCBs, and Reactor Trip Contactors. With one or 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 F.1 directs entry into the appropriate Condition referenced in Table 3.3.1-1.

G.1

If Table 3.3.1-2 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) or associated Permissive P3 are 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% RTP in an orderly manner and without challenging plant systems.

BASES

ACTIONS (continued)

H.1

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition H, the unit must be brought to a condition in which the supported reactor trips or Permissives 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% RTP in an orderly manner and without challenging plant systems.

I.1

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition I, the unit must be brought to a MODE in which the supported reactor trips are not required to be OPERABLE. The allowed Completion Time of 6 hours is reasonable, based on operating experience, to reach MODE 2 from full power conditions in an orderly manner and without challenging plant systems.

J.1

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition J, the unit must be brought to a MODE in which the supported reactor trips, ESF functions, or Permissives 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 plant systems.

K.1 and K.2

If Table 3.3.1-1 or Table 3.3.1-2 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 plant systems.

BASES

ACTIONS (continued)

L.1 and L.2

If Table 3.3.1-1 or Table 3.3.1-2 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 Times are 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 plant systems.

M.1 and M.2

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition M, the unit must be brought to a MODE in which the supported 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 plant systems.

N.1 and N.2

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition N, the unit must be brought to a MODE in which the supported reactor trips, ESF functions, or Permissives 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 plant systems.

O.1

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition O, the unit must be brought to a MODE in which the supported ESF functions or Permissives are not required to be OPERABLE. The allowed Completion Time of 36 hours to reach MODE 5 is reasonable, based on operating experience, to reach the required MODE in an orderly manner and without challenging plant systems.

BASES

ACTIONS (continued)

P.1 and P.2

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition P, 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.

Q.1

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition Q, the automatic mitigation of dilution events may have been impacted. Operations involving positive reactivity additions that could result in loss of required SDM or boron concentration shall be suspended immediately. Suspending positive reactivity additions that could result in failure to meet the minimum SDM or boron concentration limit is required to assure continued safe operation. Introduction of coolant inventory must be from sources that have a boron concentration greater than that what would be required in the RCS for minimum SDM or refueling boron concentration. This may result in an overall reduction in RCS boron concentration, but provides acceptable margin to maintaining subcritical operation. Introduction of temperature changes including temperature increases when operating with a positive MTC must also be evaluated to ensure they do not result in a loss of required SDM. Suspension of these activities does not preclude completion of actions to establish a safe conservative condition. These actions minimize the probability or the occurrence of postulated events. The Completion Time of immediately is consistent with the required times for actions requiring prompt attention.

R.1

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition R, the automatic mitigation of events in MODES 5 and 6 that could result in a decrease in RCS inventory may have been impacted. Operations that could reduce RCS inventory shall be suspended immediately. The Completion Time of immediately is consistent with the required times for actions requiring prompt attention.

BASES

ACTIONS (continued)S.1 and S.2

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition S, the associated PSRVs are immediately declared inoperable. The actions of LCO 3.4.11, "Low Temperature Overpressure Protection (LTOP)," provide adequate compensatory actions to assure unit safety.

T.1 and T.2

If Table 3.3.1-1 or Table 3.3.1-2 directs entry into Condition T, the associated 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.

U.1 and U.2

If Table 3.3.1-1 directs entry into Condition U, the RCCA Analog Position Indicator sensors are immediately declared inoperable. During power operations, the actions of LCO 3.1.7, "Rod Control Cluster Assembly (RCCA) Position Indication," provide adequate compensatory actions to assure unit safety.

V.1

If Table 3.3.1-1 directs entry into Condition V, actions must be taken to ensure the reactor trip functions remain OPERABLE. This is accomplished by opening the associated division's reactor trip breaker. The Completion Time of 1 hour is based on operating experience and the minimum amount of time allowed for manual operator action.

W.1

If Table 3.3.1-1 directs entry into Condition W, the manual Reactor Trip switches or trip actuation devices are inoperable. If the switches or trip actuation devices 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.

BASES

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-----

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.

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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The Limiting Trip Setpoint column for reactor trip functions is modified by two Notes 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 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 Note 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 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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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.

The Surveillances are modified by a Note to indicate that when a sensor, manual actuation switch, signal processor, or actuation device is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours provided the associated Trip/Actuation Function maintains functional capability. Upon completion of the Surveillance, or expiration of the 6 hour allowance, the sensor, manual actuation switch, signal processor, or actuation device must be returned to OPERABLE status or the applicable Condition entered and Required Actions taken. This Note is based on the overall system reliability and an assumption of the average time required to perform a Surveillance. The 6 hour testing allowance does not significantly reduce the probability that the PS will actuate when required.

SR 3.3.1.1

SR 3.3.1.1 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 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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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 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 $\geq 70\%$ 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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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 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 reactor 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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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 sensor OPERABILITY. The SOT shall include the verification of the accuracy and time constants of the analog input modules.

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

SR 3.3.1.6

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 division 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.

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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.8

SR 3.3.1.8 is the performance of an ADOT every 24 months. 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, Design Limits, and Permissive values have been properly loaded into the applicable APU.

SR 3.3.1.10

SR 3.3.1.10 verifies that the individual division actuation response times are less than or equal to the maximum values assumed in the accident analysis. Response time testing acceptance criteria are included in a document controlled under 10 CFR 50.59. Individual component response times are not modeled in the analyses.

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

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

-----REVIEWER'S NOTE-----
Applicable portions of NRC approved Topical Reports may be utilized to modify the requirements for response time surveillance testing. These applicable portions of NRC approved Topical Reports should be referenced and discussed.

BASES

SURVEILLANCE REQUIREMENTS (continued)

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

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

The Protection System has been designed to meet the guidance contained in BTP 7-21 (Reference 9). The design features that provide for real-time deterministic behavior are described in EMF-2110 (NP)(A) (Reference 10).

As appropriate, each division's response must be verified every 24 months on a STAGGERED TEST BASIS. Testing of the final actuation devices is included in the testing. Response times cannot be determined during unit operation because equipment operation is required to measure response times. Experience has shown that these components usually pass this surveillance when performed at the 24 month Frequency. Therefore, the Frequency was concluded to be acceptable from a reliability standpoint.

SR 3.3.1.10 is modified by a Note stating that neutron detectors are excluded from PS RESPONSE TIME testing. The Note is necessary because of the difficulty in generating an appropriate detector input signal. Excluding the detectors is acceptable because the principles of detector operation ensure a virtually instantaneous response.

BASES

- REFERENCES
1. ANP-10275P-A, "U.S. EPR Instrument Setpoint Methodology Topical Report," February 2008.
 2. 10 CFR 100.
 3. 10 CFR 50, Appendix A, GDC 21.
 4. ANP-10287P, "Incore Trip Setpoint and Transient Methodology for U.S. EPR Topical Report," November 2007.
 5. FSAR Chapter 15.
 6. 10 CFR 50.49.
 7. ANP-10282P, "POWERTRAX/E Online Core Monitoring Software for the U.S. EPR Technical Report," November 2007.
 8. EMF-2341(P), Revision 1, "Generic Strategy for Periodic Surveillance Testing of TELEPERM XS Systems in U.S. Nuclear Generating Stations," March 2000.
 9. BTP 7-21, "Guidance on Digital Computer Real-Time Performance," U.S. Nuclear Regulatory Commission, Standard Review Plan, Branch Technical Position, Rev. 3, March 2007.
 10. EMF-2110(NP)(A), Revision 1, "TELEPERM XS: A Digital Reactor Protection System," Siemens Power Corporation, July 2000.
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Table B 3.3.1-1 (page 1 of 11)
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
			REACTOR TRIP FUNCTIONS			
A.1. Low Departure from Nucleate Boiling Ration (DNBR) a. Low DNBR d. Low DNBR - High Quality	1 ^(d)	3	A total of 67 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump (RCP) Speed RCS Loop Flow (3 of 4 per loop) / Remote Acquisition Unit (1 of 2) Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	A total of 67 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump (RCP) Speed RCS Loop Flow (3 of 4 per loop) / Remote Acquisition Unit (1 of 2) Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	A total of 67 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump (RCP) Speed RCS Loop Flow (3 of 4 per loop) / Remote Acquisition Unit (1 of 2) Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	A total of 67 Self-Powered Neutron Detectors (SPND) in any of the four divisions Pressurizer Pressure (NR) Cold Leg Temperature (NR) Reactor Coolant Pump (RCP) Speed RCS Loop Flow (3 of 4 per loop) / Remote Acquisition Unit (1 of 2) Acquisition and Processing Unit Actuation Logic Unit (3 of 4)

(d) With Permissive P2 validated

Table B 3.3.1-1 (page 2 of 11)
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.1. Low Departure from Nucleate Boiling Ration (DNBR)	1 ^(d)	3	22 RCCA Position Indicators A total of 67 Self-Powered Neutron Detectors (SPND) in any of the four divisions
b. Low DNBR and (Imbalance or Rod Drop (1/4))			Pressurizer Pressure (NR)	Pressurizer Pressure (NR)	Pressurizer Pressure (NR)	Pressurizer Pressure (NR)
c. Low DNBR and Rod Drop (2/4)			Cold Leg Temperature (NR)	Cold Leg Temperature (NR)	Cold Leg Temperature (NR)	Cold Leg Temperature (NR)
e. High Quality and (Imbalance or Rod Drop (1/4))			RCP Speed	RCP Speed	RCP Speed	RCP Speed
			RCS Loop Flow (3 of 4)	RCS Loop Flow (3 of 4)	RCS Loop Flow (3 of 4)	RCS Loop Flow (3 of 4)
			/	/	/	/
			RCCA Unit	RCCA Unit	RCCA Unit	RCCA Unit
			Remote Acquisition Unit (1 of 2)	Remote Acquisition Unit (1 of 2)	Remote Acquisition Unit (1 of 2)	Remote Acquisition Unit (1 of 2)
			Acquisition and Processing Unit	Acquisition and Processing Unit	Acquisition and Processing Unit	Acquisition and Processing Unit
			Actuation Logic Unit (3 of 4)	Actuation Logic Unit (3 of 4)	Actuation Logic Unit (3 of 4)	Actuation Logic Unit (3 of 4)

(d) With Permissive P2 validated.

Table B 3.3.1-1 (page 3 of 11)
Protection System (PS) Functional Dependencies

TRIP/ACTUATION FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	COMPLETE DIVISIONS FOR FUNCTIONAL CAPABILITY	DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
		SENSORS / PROCESSORS				
A.2. High Linear Power Density	1 ^(d)	3	<p>A total of 67 Self-Powered Neutron Detectors (SPND) in any of the four divisions</p> <p>/</p> <p>Two Remote Acquisition Units</p> <p>Acquisition and Processing Unit</p> <p>Actuation Logic Unit (3 of 4)</p>	<p>A total of 67 Self-Powered Neutron Detectors (SPND) in any of the four divisions</p> <p>/</p> <p>Two Remote Acquisition Units</p> <p>Acquisition and Processing Unit</p> <p>Actuation Logic Unit (3 of 4)</p>	<p>A total of 67 Self-Powered Neutron Detectors (SPND) in any of the four divisions</p> <p>/</p> <p>Two Remote Acquisition Units</p> <p>Acquisition and Processing Unit</p> <p>Actuation Logic Unit (3 of 4)</p>	<p>A total of 67 Self-Powered Neutron Detectors (SPND) in any of the four divisions</p> <p>/</p> <p>Two Remote Acquisition Units</p> <p>Acquisition and Processing Unit</p> <p>Actuation Logic Unit (3 of 4)</p>
A.4. High Core Power Level	1,2 ^(g)	3	<p>Cold Leg Temperature (WR)</p> <p>Hot Leg Temperature (NR) (3 of 4)</p> <p>Hot Leg Pressure (WR)</p> <p>RCS Loop Flow (3 of 4)</p> <p>/</p> <p>Acquisition and Processing Unit</p> <p>Actuation Logic Unit (3 of 4)</p>	<p>Cold Leg Temperature (WR)</p> <p>Hot Leg Temperature (NR) (3 of 4)</p> <p>Hot Leg Pressure (WR)</p> <p>RCS Loop Flow (3 of 4)</p> <p>/</p> <p>Acquisition and Processing Unit</p> <p>Actuation Logic Unit (3 of 4)</p>	<p>Cold Leg Temperature (WR)</p> <p>Hot Leg Temperature (NR) (3 of 4)</p> <p>Hot Leg Pressure (WR)</p> <p>RCS Loop Flow (3 of 4)</p> <p>/</p> <p>Acquisition and Processing Unit</p> <p>Actuation Logic Unit (3 of 4)</p>	<p>Cold Leg Temperature (WR)</p> <p>Hot Leg Temperature (NR) (3 of 4)</p> <p>Hot Leg Pressure (WR)</p> <p>RCS Loop Flow (3 of 4)</p> <p>/</p> <p>Acquisition and Processing Unit</p> <p>Actuation Logic Unit (3 of 4)</p>

(d) With Permissive P2 validated.

(g) With Permissive P5 validated.

Table B 3.3.1-1 (page 4 of 11)
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.5. Low Saturation Margin	1,2 ^(g)	3	Cold Leg Temperature (WR) Hot Leg Temperature (NR) (3 of 4) Hot Leg Pressure (WR) RCS Loop Flow (3 of 4) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)

(g) With Permissive P5 validated.

Table B 3.3.1-1 (page 5 of 11)
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.19. High Containment Pressure	1,2,3,4	3	Containment Equipment Compartment Pressure Containment Service Compartment Pressure (NR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Containment Equipment Compartment Pressure Containment Service Compartment Pressure (NR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Containment Equipment Compartment Pressure Containment Service Compartment Pressure (NR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Containment Equipment Compartment Pressure Containment Service Compartment Pressure (NR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)
B. ENGINEERED SAFETY FEATURES ACTUATION SYSTEM (ESFAS) FUNCTIONS						
2.e. Startup and Shutdown Feedwater Isolation on Steam Generator Level High for Period of Time (Affected SGs)	1,2 ^(l) ,3 ^(l)	3	Steam Generator Level (NR) Reactor Trip Circuit Breaker Position Indication / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Steam Generator Level (NR) Reactor Trip Circuit Breaker Position Indication / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Steam Generator Level (NR) Reactor Trip Circuit Breaker Position Indication / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Steam Generator Level (NR) Reactor Trip Circuit Breaker Position Indication / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)

(l) Except when all MFW full load and low load lines are isolated.

Table B 3.3.1-1 (page 6 of 11)
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
			3.b. SIS Actuation on Low Delta P _{sat}	3 ^(m) ,4 ⁽ⁿ⁾	3	Hot Leg Pressure (WR) Hot Leg Temperature (WR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)
4. Reactor Coolant Pump (RCP) Trip on Low Delta P across RCP with Safety Injection System Actuation	1,2,3,4	3	RCP Delta P (1 of 2) RCP 1 Current #1 RCP 3 Current #1 RCP 4 Current #1 / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	RCP Delta P (1 of 2) RCP 1 Current #2 RCP 2 Current #1 RCP 4 Current #2 / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	RCP Delta P (1 of 2) RCP 1 Current #3 RCP 2 Current #2 RCP 3 Current #2 / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	RCP Delta P (1 of 2) RCP 2 Current #3 RCP 3 Current #3 RCP 4 Current #3 / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)

(m) With Permissive P12 validated.

(n) With Permissive P15 inhibited.

Table B 3.3.1-1 (page 7 of 11)
Protection System (PS) Functional Dependencies

TRIP/ACTUATION FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	COMPLETE DIVISIONS FOR FUNCTIONAL CAPABILITY	DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
		SENSORS / PROCESSORS				
7.a. MSRT Actuation on High SG Pressure (Affected SG)	1,2,3,4 ^(p)	3	SG Pressure Hot Leg Temperature (WR) Hot Leg Pressure (WR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	SG Pressure Hot Leg Temperature (WR) Hot Leg Pressure (WR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	SG Pressure Hot Leg Temperature (WR) Hot Leg Pressure (WR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	SG Pressure Hot Leg Temperature (WR) Hot Leg Pressure (WR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)
11.a. CVCS Charging Line Isolation on High-High Pressurizer Level	1,2,3,4	3	Pressurizer Level / Acquisition and Processing Unit			
	----- 1,2,3,4	----- 2	----- Actuation Logic Unit (3 of 4)	-----	-----	----- Actuation Logic Unit (3 of 4)

(p) When the SGs are relied upon for heat removal.

Table B 3.3.1-1 (page 8 of 11)
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
			11.b. CVCS Isolation on Anti-Dilution Mitigation (ADM) at Shutdown Condition (RCP not operating)	3 ^(s) ,4 ^(s) , 5 ^(s) ,6	3	Boron Concentration Boron Temperature / Acquisition and Processing Unit
	3 ^(s) ,4 ^(s) , 5 ^(s) ,6	2	Actuation Logic Unit (3 of 4)			Actuation Logic Unit (3 of 4)
11.c. CVCS Isolation on ADM at Standard Shutdown Conditions	3 ^(t) ,4 ^(t) , 5 ^(t)	3	Boron Concentration Boron Temperature CVCS Charging Line Flow Cold Leg Temperature (WR) / Acquisition and Processing Unit	Boron Concentration Boron Temperature CVCS Charging Line Flow Cold Leg Temperature (WR) / Acquisition and Processing Unit	Boron Concentration Boron Temperature CVCS Charging Line Flow Cold Leg Temperature (WR) / Acquisition and Processing Unit	Boron Concentration Boron Temperature CVCS Charging Line Flow Cold Leg Temperature (WR) / Acquisition and Processing Unit
	3 ^(t) ,4 ^(t) , 5 ^(t)	2	Actuation Logic Unit (3 of 4)			Actuation Logic Unit (3 of 4)

(s) With Permissive P7 validated (no RCPs in operation).

(t) With Permissive P7 inhibited (one or more RCPs in operation).

Table B 3.3.1-1 (page 9 of 11)
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
			11.d. CVCS Isolation on ADM at Power	1,2	3	Boron Concentration Boron Temperature CVCS Charging Line Flow / Acquisition and Processing Unit
	1,2	2	Actuation Logic Unit (3 of 4)			Actuation Logic Unit (3 of 4)
C. PERMISSIVES						
Permissive P8 - Shutdown RCCA Position Lower than Threshold	3 ^(t) , 4 ^(t) , 5 ^(t)	3 2	22 RCCA Bottom Position Indicators / Two Remote Acquisition Units per division Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	22 RCCA Bottom Position Indicators / Two Remote Acquisition Units per division Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	22 RCCA Bottom Position Indicators / Two Remote Acquisition Units per division Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	23 RCCA Bottom Position Indicators / Two Remote Acquisition Units per division Acquisition and Processing Unit Actuation Logic Unit (3 of 4)

(d) With Permissive P2 validated.

(t) With Permissive P7 inhibited (one or more RCPs in operation).

Table B 3.3.1-1 (page 10 of 11)
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
			Permissive P14 - Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds	1,2,3,4 ^(p)	3	Hot Leg Pressure (WR) Hot Leg Temperature (WR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)
Permissive P15 - Hot Leg Pressure and Hot Leg Temperature Lower than Thresholds and RCPs Shutdown	4 5,6	3 2	Hot Leg Pressure (WR) Hot Leg Temperature (WR) RCP 1 Current #1 RCP 3 Current #1 RCP 4 Current #1 / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Hot Leg Pressure (WR) Hot Leg Temperature (WR) RCP 1 Current #2 RCP 2 Current #1 RCP 4 Current #2 / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Hot Leg Pressure (WR) Hot Leg Temperature (WR) RCP 1 Current #3 RCP 2 Current #2 RCP 3 Current #2 / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Hot Leg Pressure (WR) Hot Leg Temperature (WR) RCP 2 Current #3 RCP 3 Current #3 RCP 4 Current #3 / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)

(p) When the SGs are relied upon for heat removal.

Table B 3.3.1-1 (page 11 of 11)
Protection System (PS) Functional Dependencies

TRIP/ACTUATION FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	COMPLETE DIVISIONS FOR FUNCTIONAL CAPABILITY	DIVISION 1	DIVISION 2	DIVISION 3	DIVISION 4
		SENSORS / PROCESSORS				
Permissive P16 - Hot Leg Pressure and Delta P _{sat} Lower than Thresholds, RCP Not in Operation, and Time Elapsed since Safety Injection Start	1,2,3,4	3	Hot Leg Pressure (WR) Hot Leg Temperature (WR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Hot Leg Pressure (WR) Hot Leg Temperature (WR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Hot Leg Pressure (WR) Hot Leg Temperature (WR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)	Hot Leg Pressure (WR) Hot Leg Temperature (WR) / Acquisition and Processing Unit Actuation Logic Unit (3 of 4)

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 as discussed in NUREG-0737, Supplement 1 (Reference 1).

The PAM instruments 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 PIs are part of the SICS, the MSIs 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)

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.

-----REVIEWER'S NOTE-----
Table 3.3.2-1 provides a list of variables identified by the unit specific Regulatory Guide 1.97 analyses. Table 3.3.2-1 in unit specific Technical Specifications (TS) shall list all Types A, B, and C variables identified by the unit specific Regulatory Guide 1.97 analyses, as amended by the NRC's Safety Evaluation Report (SER).

The following PAM instrumentation is included in LCO 3.3.2, however, more restrictive operability requirements for the associated components are contained in LCO 3.3.1, "Protection System":

- Containment Service Compartment Pressure (Wide Range),
- Hot Leg Pressure (Wide Range),
- Hot Leg Temperature (Wide Range),
- Intermediate Range,
- Radiation Monitor - Containment High Range,
- Steam Generator (SG) Level (Wide Range),
- SG Pressure.

The specific instrument Functions listed in Table 3.3.2-1 are discussed in the LCO section.

APPLICABLE
SAFETY
ANALYSES

The PAM instrumentation ensures the OPERABILITY of certain Regulatory Guide 1.97 (Reference 2) / IEEE Standard 497-2002 (Reference 3) 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;

BASES

APPLICABLE SAFETY ANALYSIS (continued)

- 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.

PAM instrumentation used to support pre-planned, manually controlled actions satisfy Criterion 3 of 10 CFR 50.36(c)(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.

BASES

LCO (continued)

The exception to the two division requirement is Containment Isolation Valve (CIV) Position Indication. 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.

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.

Table 3.3.2-1 provides a list of variables identified by the Regulatory Guide 1.97 (Ref. 1) analyses. Type A, B, and C variables are required to meet Regulatory Guide 1.97 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 Cold Leg Temperature (Wide Range) instrumentation is used to support a credited operator manual action to control the extended partial cooldown during a Steam Generator Tube Rupture (SGTR) event when forced flow exists. It is also used to initiate actions to prevent violating reactor coolant system pressure-temperature limits and low temperature overpressure protection limits.

Four divisions of wide range cold leg temperature are provided with a range of 32°F to 662°F.

BASES

LCO (continued)

2. Containment Isolation Valve Position Indication

The Containment Isolation Valve (CIV) position indication is used to assess containment integrity.

In the case of CIV position, the important information is the isolation status of the containment penetration. One division of valve position indication is required to be available in the control room for each active CIV in a containment penetration flow path, (i.e., two total divisions of CIV position indication for a penetration flow path with two active valves). For penetrations with only one active CIV having control room indication, Note (b) of Table 3.3.2-1 requires a single division of valves position indication. This is to redundantly verify the isolation status of each isolable penetration via indicated status of the active valve, as applicable, and prior knowledge of passive or system boundary status. If a penetration flow path is isolated, position indication for the CIV(s) in the associated penetration flow path is not needed to determine status. Therefore, the position indication for valves in an isolated penetration flow path is not required. Each penetration is treated separately and each penetration flow path is considered a separate function. Therefore, separate Condition entry is allowed for each inoperable penetration flow path.

3. Containment Service Compartment Pressure (Wide Range)

Containment service compartment pressure indication is used to assess the potential challenge to containment integrity and for verification of adequate containment cooling function.

Four containment wide range pressure indications are available and have a range of -5 to 220 psig.

4. Core Outlet Thermocouples (Wide Range)

Core Outlet Thermocouples are provided for monitoring RCS temperature at the outlet of the core. These thermocouples are used to evaluate the status of reactor core cooling and to indicate the potential for breach of the fuel cladding.

Three thermocouples are provided for each core quadrant and each have a range of 32°F to 2300°F.

BASES

LCO (continued)

5. Emergency Feedwater System Flow

Emergency Feedwater (EFW) flow indication is used by the operator to identify which SGs are supplied by EFW in order to determine which reactor coolant pumps should be stopped during a Feedwater Line Break event. They are also used to determine the status of core heat removal.

Each EFW train has two EFW flow indicators with a range of 0 to 545 gpm.

6. Hot Leg Pressure (Wide Range)

RCS hot leg pressure is used to control RCS pressure during the extended partial cooldown and subsequent cooldown, and in management of the Medium Head Safety Injection (MHSI) system, during a SGTR event. This instrument is also used to control RCS pressure during post accident cooldown to Residual Heat Removal (RHR) conditions, and to detect RHR entry conditions.

RCS hot leg pressure is also used in conjunction to RCS cold leg temperature (Tcold) to detect conditions approaching RCS Nil Ductility Transition or Pressurized Thermal Shock limits, and in conjunction with core outlet thermocouples to detect inadequate core cooling.

RCS hot leg pressure is also used to provide extended range primary information to the control room operators to indicate potential or actual breach of the RCS pressure boundary.

Four channels of RCS hot leg pressure are provided with a range of 0 to 3000 psig.

7. Hot Leg Temperature (Wide Range)

Hot Leg Temperature (Wide Range) is used to detect RHR entry conditions to support manual operator actions to initiate RHR operation during post accident cooldown.

Four channels of wide range hot leg temperature are provided with a range of 32°F to 662°F.

BASES

LCO (continued)

8. Intermediate Range

Intermediate range nuclear instrumentation is used to detect Anticipated Transient Without Scram events to support contingency actions to manually actuate the Extra Boration System within 30 minutes. This instrumentation is also used post-trip to verify the reactor is shut down.

Four channels of Intermediate Range Detectors are available. They provide an indication of reactor power over a range of 5×10^{-6} to 60% RTP.

9. Low Head Safety Injection Flow (Wide Range)

Low Head Safety Injection (LHSI) flow is the primary indicator of LHSI performance; it is used for initiation of contingency actions for insufficient LHSI flow. Safety Injection performance is the only valid indication of sufficient core cooling during loss of subcooling margin.

Two wide range flow indications are available for each of the four LHSI trains. They have a range of 0 to 530 lb_m/sec.

10. Medium Head Safety Injection Flow (Wide Range)

Medium Head Safety Injection (MHSI) flow is the primary indicator of MHSI performance; it is used for initiation of contingency actions for insufficient MHSI flow. Safety Injection performance is the only valid indication of sufficient core cooling during loss of subcooling margin.

Two wide range flow indications are available for each of the four MHSI trains. These indications have a range of 0 to 180 lb_m /sec.

11. Pressurizer Level

Pressurizer level indication is used to support credited operator manual actions to manage MHSI during a SGTR, and to detect an RCS inventory control upset during the Extra Boration System malfunction event. Pressurizer level is also used to provide information to the operator on the magnitude of an RCS pressure boundary breach in order to support Safety Injection management actions.

Four divisions of pressurizer level (1 per division) are available and have a range of 0 to 100%.

BASES

LCO (continued)

12. Radiation Monitor - Annulus Ventilation System Gamma Activity

These monitors are used to determine the activity present in the exhaust air from the annulus extraction system downstream of the filters to detect a breach of the containment building. This monitor is used for fission product barrier breach detection.

Two monitors with gamma-sensitive detectors are provided with a range of 1E-4 to 1E+4 rad/hr.

13. Radiation Monitor - Containment High Range

Containment high range radiation monitors support the Radioactive Effluent Control Critical Safety Function by providing indication of the potential release source. Containment high range radiation monitors also indicate the potential for breach or the actual breach of the fuel cladding and primary coolant boundary.

Four containment high range radiation monitors are available and have a range of 1E-1 to 1E+7 rad/hr.

14. Radiation Monitor - Main Steam Line

These monitors are used to detect a SGTR at power and to identify the affected SG in order to support credited operator manual actions for SGTR mitigation.

Four radiation monitors are provided for each steam line and have a range of 1E-4 to 1E+4 $\mu\text{Ci/cc}$.

BASES

LCO (continued)

15. Steam Generator Level (Wide Range)

SG Level (Wide Range) is used to detect SG overfill and to initiate actions to prevent liquid relief through the Main Steam Safety Valves and Main Steam Relief Trains during a SGTR event. This indication is also one of the instruments utilized to detect a loss of secondary heat sink, which requires the operator to initiate Feed and Bleed cooling.

SG Level (Wide Range) is also provided to aid in the monitoring of primary to secondary heat transfer, to determine the need for EFW actuation, and to monitor the performance of SG level control. This instrumentation is also used to initiate actions to mitigate upsets in these functions.

Four wide range level indications are available per SG and have a range of 0 to 100%.

16. Steam Generator Pressure

SG Pressure indication is used to support manual operator actions during a Feedwater Line Break (FWLB). This instrument is also used to determine required SG pressure and to control SG pressure, when establishing SGs as a heat sink. SG Pressure instrumentation is also provided to aid in the monitoring and control of primary to secondary heat transfer, in the verification that the SG is available as a heat sink, and to determine when SG isolation is required.

Four SG Pressure indications are available per SG and have a range of 0 to 1600 psig.

17. Source Range

Source Range Detectors provide for long term surveillance of core reactivity to assess: 1) whether a return to criticality is approached during plant Cooldown, 2) the need for mitigation efforts to maintain the reactor in a shutdown condition.

The Source Range Detectors consist of 3 divisions. They provide an indication of neutron flux over a range of 0.05 to $5E+4$ n/cm²-s.

BASES

LCO (continued)

18. Subcooling Margin

Subcooling margin instrumentation supports manual actions to align hot leg injection after a Loss of Coolant Accident and to manage MHSI after a SGTR. Subcooling margin is also used to determine when conditions requiring full MHSI are present, and to determine if the conditions that require hot leg injection exist.

Four divisions of Subcooling Margin monitoring instrumentation are provided with a range of 611°F Subcooling Margin to 2088°F Superheat.

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. 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

BASES

ACTIONS (continued)

ACTIONS risk that the PAM Function will be in a degraded condition should an accident occur.

D.1

Condition D applies when the Required Action and associated Completion Time of Condition C is not met. Required Action D.1 requires entering the appropriate Condition referenced in Table 3.3.2-1 for the division immediately. The applicable Condition referenced in the Table is Function dependent. Each time an inoperable division has not met the Required Action of Condition C, and the associated Completion Time has expired, Condition D is entered for that division and provides for transfer to the appropriate subsequent Condition.

E.1 and E.2

If the Required Action and associated Completion Time of Condition C is 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.

F.1

For this plant, Core Outlet Thermocouples (Wide Range), EFW Flow, LHSI Flow, MHSI Flow, SG Pressure, SG Level (Wide Range), and Subcooling Margin provide means of monitoring core cooling. The remaining instrumentation may be temporarily utilized if a normal PAM division of the Core Outlet Thermocouples (Wide Range), LHSI Flow, or MHSI Flow cannot be restored to OPERABLE status within the allotted time. If these temporary means are used, the Required Action is not to

BASES

ACTIONS (continued)

shut down the unit but rather to follow the directions of Specification 5.6.5 in the Administrative Controls section of the TS. The report provided to the NRC should discuss the means used, describe the degree to which the means are equivalent to the installed PAM divisions, justify the areas in which they are not equivalent, and provide a schedule for restoring the normal PAM divisions.

SURVEILLANCE
REQUIREMENTS

A Note at the beginning of the SR Table specifies that the following SR applies to each PAM instrumentation Function.

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. This SR is modified by a Note that excludes neutron detectors. The calibration method for neutron detectors is specified in the Bases of LCO 3.3.1, "Protection System (PS)."

Whenever a sensing element is replaced, the next required CHANNEL CALIBRATION of the Core Exit thermocouple sensors is accomplished by an in-place cross calibration that compares the other sensing elements with the recently installed sensing element.

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.

REFERENCES

1. NUREG 0737, Supplement 1.
 2. Regulatory Guide 1.97, Revision 4, June 2006.
 3. IEEE 497-2002.
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B 3.3 INSTRUMENTATION

B 3.3.3 Remote Shutdown Station (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 (manual reactor trip switches), 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 RSS. 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 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 located 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(c)(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 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 displays and controls at the RSS are functionally the same as the displays and controls normally used by the operator to achieve and maintain MODE 3 from the MCR. The PICS consists of primarily of processing units (PU), external units (XU), operator workstations, plant overview panels (POP), and a firewall. The PICS is used to control both safety-related and non-safety-related process systems. The plant annunciator is integrated into the PICS operating and monitoring system. Special screens display and organize alarms and warnings based on their status and relative level of importance.

BASES

LCO (continued)

Transfer of Control

In the event of a condition requiring MCR evacuation, operators will transfer control from the MCR to the RSS via the control transfer switches. The RSS control transfer switches disable MCR controls and enable control functions from the RSS. In the event that the MCR is not available and evacuation is necessary, the PICS is designed to achieve and maintain safe shutdown conditions from the RSS. The Operator Terminals for the Operator Workstations (OWS) installed in the MCR will be disabled and the operators will transfer control to the OWS in the RSS. This will prevent simultaneous or unauthorized control from the MCR OWS.

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.

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.

BASES

ACTIONS

A.1

Condition A addresses the situation where the RSS is inoperable. This includes the control and transfer switches.

The Required Action is to restore the RSS 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.

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. 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 passes the Surveillance when performed at a Frequency of once every 24 months.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.3.2

A CALIBRATION of each required 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

This Surveillance verifies that the RSS communicates controls and indications with each division of the Plant Information and Control System (PICS). The operator can select the controls and indications available through each PICS division. The Frequency is based on the known reliability of the Functions and the redundancy available, and has been shown to be acceptable through operating experience.

SR 3.3.3.4

SR 3.3.3.4 verifies the OPERABILITY of the RSS hardware and software by performing diagnostics to show that operator displays are capable of being called up and displayed to an operator at the RSS. The RSS has video display units which can be used by the operator. The operator can display information on the video display units in the same manner in which the information is displayed in the control room. The operator normally selects an appropriate set of displays based on the particular operational goals being controlled by the operator at the time. The Frequency of 24 months is based on the use of the data display capability in the control room as part of the normal unit operation and the availability of multiple video display units at the RSS. The Frequency of 24 months is based upon operating experience and consistency with control room hardware and software.

REFERENCES

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