Intermediate and Source Range, Neutron Flux

The Intermediate and Source Range, Neutron Flux trips provide core protection during reactor startup to mitigate the consequences of an uncontrolled rod cluster control assembly bank withdrawal from a subcritical condition. These trips provide redundant protection to the Low Setpoint trip of the Power Range, Neutron Flux channels. The Source Range channels will initiate a Reactor trip at about 10^5 counts per second unless manually blocked when P-6 becomes active. The Intermediate Range channels will initiate a Reactor trip at a current level equivalent to approximately 25% of RATED THERMAL POWER unless manually blocked when P-10 becomes active.

Overtemperature ΔT

The Overtemperature ΔT trip provides core protection to prevent DNB for all combinations of pressure, power, coolant temperature, and axial power distribution, provided that the transient is slow with respect to piping transit delays from the core to the temperature detectors, and pressure is within the range between the Pressurizer High and Low Pressure trips. The Setpoint is automatically varied with: (1) coolant temperature to correct for temperature induced changes in density and heat capacity of water and includes dynamic compensation for piping delays from the core to the loop temperature detectors, (2) pressurizer pressure, and (3) axial power distribution. With normal axial power distribution, this Reactor Trip limit is always below the core Safety Limit as shown in Figure 2.1-1. If axial peaks are greater than design, as indicated by the difference between top and bottom power range nuclear detectors, the Reactor trip is automatically reduced according to the notations in Table 2.2-1.

Delta-T_o, as used in the Overtemperature and Overpower ΔT trips, represents the 100% RTP value as measured by the plant for each loop. For the startup of a refueled core until measured at 100% Rated Thermal Power (RTP), Delta T_o is initially assumed at a value which is conservatively lower than the last measured 100% RTP Delta T_o for each loop. This normalizes each loop's ΔT trips to the actual operating conditions existing at the time of measurement, thus forcing the trip to reflect the equivalent full power conditions as assumed in the accident analyses. These differences in vessel ΔT can arise due to several factors, the most prevalent being measured RCS loop flows greater than Minimum Measured Flow, and slightly asymmetric power distributions between quadrants. While RCS loop flows are not expected to change with cycle life, radial power redistribution between quadrants may occur, resulting in small changes in loop specific vessel ΔT values. Accurate determination of the loop specific vessel ΔT value should be made when performing the Incore/Excore quarterly recalibration and under steady state conditions (i.e., power distributions not affected by Xe or other transient conditions).

Overpower ΔT

The Overpower ΔT trip provides assurance of fuel integrity (e.g., no fuel pellet melting and less than 1% cladding strain) under all possible overpower conditions, limits the required range for Overtemperature ΔT trip, and provides a backup to the High Neutron Flux Trip.

Steam Generator Water Level

The Steam Generator Water Level Low-Low trip protects the reactor from loss of heat sink in the event of a sustained steam/feedwater flow mismatch resulting from loss of normal feedwater or a feedwater system pipe break, inside or outside of containment. This function also provides input to the steam generator level control system, therefore, the actuation logic must be able to withstand both an input failure to the control system (which may then require the protective function actuation) and a single failure in the remaining channels providing the protection function actuation. This results in a 2/4 actuation logic. With the transmitters (d/p cells) located inside containment and thus possibly experiencing adverse environmental conditions (due to a feedline break), the Environmental Allowance Modifier (EAM) was devised. The EAM function (Containment Pressure with a setpoint of $\leq$ 1.5 psig) senses the presence of adverse containment conditions (elevated pressure) and enables the Steam Generator Water Level - Low-Low trip setpoint (Adverse) which reflects the increased transmitter uncertainties due to this environment. The EAM allows the use of a lower Steam Generator Water Level - Low-Low trip setpoint (Normal) when these conditions are not present, thus allowing more margin to trip for normal operating conditions. The Trip Time Delay (TTD) creates additional operational margin when the plant needs it most, during early escalation to power, by allowing the operator time to recover level when the primary side load is sufficiently small to allow such action. The TTD is based on the continuous monitoring of primary side power through the use of Vessel ΔT. Scaling of the Vessel Delta-T channels is dependent on the loop-specific values for Delta T_o, discussed under the OTDT and OPDT trips. For the startup of a refueled core until measured at 100% Rated Thermal Power (RTP), Delta T_o is initially assumed at a value which is conservatively lower than the last measured 100% RTP Delta T_o for each loop. Two time delays are possible, based on the primary side power level, the magnitude of the trip delay decreasing with increasing power. In the event that the EAM or TTD functions do not meet the minimum channels operable requirements, it is acceptable to place the inoperable channels in the Tripped Condition and continue operation. Placing the inoperable channels in this mode will result in the enabling of the Steam Generator Water Level - Low-Low (Adverse) function, for the EAM, or in the removal of the trip delay, for the TTD. In the event that the Steam Generator Water Level - Low-Low (Normal) function does not meet the minimum channels operable requirement, it is acceptable to place the associated EAM channels in the Tripped Condition and continue operation. Performing this action will result in the enabling of the Steam Generator Water Level - Low-Low (Adverse) function which has a more conservative (higher level) trip setpoint. At this time it would also be acceptable to place the inoperable Steam Generator Water Level - Low-Low channels in the Bypassed Condition to prevent an inadvertent Reactor Trip or ESFAS actuation.

Undervoltage and Underfrequency - Reactor Coolant Pump Busses

The Undervoltage and Underfrequency Reactor Coolant Pump Bus trips provide core protection against DNB as a result of complete loss of forced coolant flow. The specified Setpoints assure a Reactor trip signal is generated before the Low Flow Trip Setpoint is reached. Time delays are incorporated in the Underfrequency and Undervoltage trips to prevent spurious Reactor trips from momentary electrical power transients. For undervoltage, the delay is set so that the time required