

TABLE 2.2-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

NOTATION

NOTE 1: OVERTEMPERATURE  $\Delta T$

$$\Delta T \left( \frac{1 + \tau_1 S}{1 + \tau_2 S} \right) \left( \frac{1}{1 + \tau_3 S} \right) \leq \Delta T_0 \left\{ K_1 - K_2 \left( \frac{1 + \tau_4 S}{1 + \tau_5 S} \right) \left[ T \left( \frac{1}{1 + \tau_6 S} \right) - T' \right] + K_3 (P - P') - f_1(\Delta T) \right\}$$

- Where:
- $\Delta T$  = Measured  $\Delta T$  by RTD Manifold Instrumentation,
  - $\frac{1 + \tau_1 S}{1 + \tau_2 S}$  = Lead-lag compensator on measured  $\Delta T$ ,
  - $\tau_1, \tau_2$  = Time constants utilized in the lead-lag controller for  $\Delta T$ ,  $\tau_1 \geq 8$  sec.,  $\tau_2 \leq 3$  sec.,
  - $\frac{1}{1 + \tau_3 S}$  = Lag compensator on measured  $\Delta T$ ,
  - $\tau_3$  = Time constants utilized in the lag compensator for  $\Delta T$ ,  $\tau_3 \leq 2$  sec.
  - $\Delta T_0$  = Indicated  $\Delta T$  at RATED THERMAL POWER,
  - $K_1$   $\leq$  1.200,
  - $K_2$  = 0.0222
  - $\frac{1 + \tau_4 S}{1 + \tau_5 S}$  = The function generated by the lead-lag controller for  $T_{avg}$  dynamic compensation,
  - $\tau_4, \tau_5$  = Time constants utilized in the lead-lag controller for  $T_{avg}$ ,  $\tau_4 \geq 28$  sec.,  $\tau_5 \leq 4$  sec.,
  - $T$  = Average temperature, °F,
  - $\frac{1}{1 + \tau_6 S}$  = Lag compensator on measured  $T_{avg}$ ,

TABLE 2.2-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

NOTATION (Continued)

NOTE 1: (Continued)

- $\tau_6$  = Time constant utilized in the measured  $T_{avg}$  lag compensator,  $\tau_6 \leq 2$  sec
- $T'$  =  $\leq 588.2^\circ\text{F}$  Reference  $T_{avg}$  at RATED THERMAL POWER,
- $K_3$  = 0.001095,
- $P$  = Pressurizer pressure, psig,
- $P'$  = 2235 psig (Nominal RCS operating pressure),
- $S$  = Laplace transform operator,  $\text{sec}^{-1}$ ,

and  $f_1(\Delta I)$  is a function of the indicated difference between top and bottom detectors of the power-range nuclear ion chambers; with gains to be selected based on measured instrument response during plant startup tests such that:

- (i) for  $q_t - q_b$  between -29% and +9.0%;  $f_1(\Delta I) = 0$ , where  $q_t$  and  $q_b$  are percent RATED THERMAL POWER in the top and bottom halves of the core respectively, and  $q_t + q_b$  is total THERMAL POWER in percent of RATED THERMAL POWER;
- (ii) for each percent that the magnitude of  $q_t - q_b$  exceeds -29%, the  $\Delta T$  Trip Setpoint shall be automatically reduced by 3.151% of its value at RATED THERMAL POWER; and
- (iii) for each percent that the magnitude of  $q_t - q_b$  exceeds +9.0%, the  $\Delta T$  Trip Setpoint shall be automatically reduced by 1.50% of its value at RATED THERMAL POWER.

## LIMITING SAFETY SYSTEM SETTINGS

### BASES (With Bypass System Removed; RTDs in Thermowells)

#### Overtemperature $\Delta T$

The Overtemperature Delta T 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 thermal delays associated with the RTDs mounted in thermowells (about 5 seconds), 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.

#### Overpower $\Delta T$

The Overpower Delta T 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 delta T protection, and provides a backup to the High Neutron Flux trip. The Setpoint is automatically varied with: (1) coolant temperature to correct for temperature induced changes in density and heat capacity of water, (2) rate of change of temperature for dynamic compensation for instrumentation delays associated with the loop temperature detectors, and (3) axial power distribution, to ensure that the allowable heat generation rate (kW/ft) is not exceeded. The Overpower  $\Delta T$  trip provides protection to mitigate the consequences of various size steam breaks as reported in WCAP 9226, "Reactor Core Response to Excessive Secondary Steam Break."