REACTIVITY CONTROL SYSTEMS

MODERATOR TEMPERATURE COEFFICIENT

LIMITING CONDITION FOR OPERATION

3.1.1.3 The moderator temperature coefficient (MTC) shall be within the limits specified in the Core Operating Limits Report (COLR). The maximum upper limit shall be Less positive than +5 pcm/°F for power levels up to 70% RATED THERMAL POWER and a linear ramp from that point to 0 pcm/°F at 100% RATED THERMAL POWER for the all rods withdrawn, beginning of cycle life (BOL) condition. ~~and~~

~~b. Less negative than -4.1 x 10^{-4} Δk/k/°F for the all rods withdrawn, end of cycle life (EOL), RATED THERMAL POWER condition.~~

APPLICABILITY: Beginning of Cycle Life (BOL) Limit
~~Specification 3.1.1.3a.~~ - MODES 1 and 2*#.
~~Specification 3.1.1.3b.~~ - MODES 1, 2 and 3#.
End of Cycle Life (EOL) Limit

ACTION:

a. With the MTC more positive than the BOL limit specified in the COLR, ~~of Specification 3.1.1.3a. above,~~ operation in MODES 1 and 2 may proceed provided:

1. Control rod withdrawal limits are established and maintained sufficient to restore the MTC to within the ~~above limits~~ BOL limits, within 24 hours or be in HOT STANDBY within the next 6 hours. These withdrawal limits shall be in addition to the insertion limits of Specification 3.1.3.6; specified in the COLR

2. The control rods are maintained within the withdrawal limits established above until a subsequent calculation verifies that the MTC has been restored to within its limit for the all rods withdrawn condition; and

3. A Special Report is prepared and submitted to the Commission pursuant to Specification 6.9.2 within 10 days, describing the value of the measured MTC, the interim control rod withdrawal limits, and the predicted average core burnup necessary for restoring the positive MTC to within its limit for the all rods withdrawn condition.

b. With the MTC more negative than the EOL limit specified in the COLR ~~of Specification 3.1.1.3b. above,~~ be in HOT SHUTDOWN within 12 hours.

---

* With K_{eff} greater than or equal to 1.

See Special Test Exception Specification 3.10.3.

SURVEILLANCE REQUIREMENTS

4.2.2.1 The provisions of Specification 4.0.4 are not applicable.

4.2.2.2 For Normal Operation, $F_Q(z)$ shall be evaluated to determine if $F_Q(z)$ is within its limit by:

a. Using the movable incore detectors to obtain a power distribution map at any THERMAL POWER greater than 5% of RATED THERMAL POWER.

b. Increasing the measured $F_Q(z)$ component of the power distribution map by 3% to account for manufacturing tolerances and further increasing the value by 5% to account for measurement uncertainties.

c. Satisfying ~~the~~ following relationship:

$$F_Q^M(z) \leq \frac{F_Q^{RTP}}{P \times W(z)_{NO}} \text{ for } P > 0.5$$

$$F_Q^M(z) \leq \frac{F_Q^{RTP}}{W(z)_{NO} \times 0.5} \text{ for } P \leq 0.5$$

where $F_Q^M(z)$ is the measured $F_Q(z)$ increased by the allowances for manufacturing tolerances and measurement uncertainty, ~~2.50~~ is the F_Q limit, $K(z)$ is ~~given in Figure 3.2-2~~ the normalized $F_Q(z)$ as a function of Core height, P is the relative THERMAL POWER, and $W(z)_{NO}$ is the cycle dependent, Normal Operation function that accounts for power distribution transients encountered during Normal Operation. ~~This function is given~~ specified in the ~~Peaking Factor~~ Core Operating Limit Report as per Specification 6.9.1.~~3~~5.

F_Q^{RTP}, $K(z)$ and $W(z)_{NO}$ are

d. Measuring $F_Q^M(z)$ according to the following schedule:

1. Upon achieving equilibrium conditions after exceeding, by 10% or more of RATED THERMAL POWER, the THERMAL POWER at which $F_Q(z)$ was last determined,* or

2. At least once per 31 Effective Full Power Days (EFPD), whichever occurs first.

*During power escalation at the beginning of each cycle, power level may be increased until a power level for extended operation has been achieved and a power distribution map obtained.

SURVEILLANCE REQUIREMENTS (Continued)

4.2.2.3 RESTRICTED AFD OPERATION (RAFDO) is permitted at powers above APL^{ND} if the following conditions are satisfied:

a. Prior to entering RAFDO, maintain THERMAL POWER above APL^{ND} and less than or equal to that allowed by Specification 4.2.2.2 for at least the previous 24 hours. Maintain RAFDO surveillance (AFD within ~~±3% of target flux difference~~ the limits specified in the COLR) during this time period. RAFDO is then permitted providing THERMAL POWER is maintained between APL^{ND} and APL^{RAFDO} or between APL^{ND} and 100% (whichever is more limiting) and F_Q surveillance is maintained pursuant to Specification 4.2.2.4. APL^{RAFDO} is defined as:

$$APL^{RAFDO} = \text{minimum over } z \left[\frac{F_Q^{RTP}}{F_Q^M(z) \times W(z)} \right]_{RAFDO} \times 100\%$$

where: $F_Q^M(z)$ is the measured $F_Q(z)$ increased by the allowances for manufacturing tolerances and measurement uncertainty. The F_Q limit is F_Q^{RTP} specified in the COLR. ~~K(z) is given in Figure 3.2-2.~~ $W(z)_{RAFDO}$ is the cycle dependent function that accounts for limited power distribution transients encountered during RAFDO. ~~This function is given in the Peaking Factor~~ Limits Report as per Specification 6.9.1.9. F_Q^{RTP}, $K(z)$, and $W(z)_{RAFDO}$ are specified in the Core Operating Limits Report as per Specification 6.9.1.9.

b. During RAFDO, if the THERMAL POWER is decreased below APL^{ND} then the conditions of 4.2.2.3.a shall be satisfied before re-entering RAFDO.

4.2.2.4 During RAFDO, $F_Q(z)$ shall be evaluated to determine if $F_Q(z)$ is within its limits by:

a. Using the movable incore detectors to obtain a power distribution map at any THERMAL POWER above APL^{ND}.

b. Increasing the measured $F_Q(z)$ component of the power distribution map by 3% to account for manufacturing tolerances and further increasing the value by 5% to account for measurement uncertainties.

c. Satisfying the following relationship:

$$F_Q^M(z) \leq \frac{F_Q^{RTP}}{P \times W(z)_{RAFDO}} \quad \text{for } P > APL^{ND}$$

where: $F_Q^M(z)$ is the measured $F_Q(z)$. The F_Q limit is F_Q^{RTP} specified in the COLR. ~~K(z) is given in Figure 3.2-2.~~ P is the relative THERMAL POWER. $W(z)_{RAFDO}$ is the cycle dependent function that accounts for limited power distribution transients encountered during RAFDO. ~~This function is given~~ F_Q^{RTP}, $K(z)$, and $W(z)_{RAFDO}$ are specified in the Core Operating Limits Report as per Specification 6.9.1.9.

3/4.2.2 and 3/4.2.3 HEAT FLUX HOT CHANNEL FACTOR AND NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR (Continued)

(1.55 for VANTAGE 5 fuel) and the appropriate fuel rod bow DNBR penalty (less than 1.5% per WCAP-8691, Rev. 1). The margin between design and safety analysis DNBR limits of 6.3% for Optimized fuel and 17.4% for VANTAGE 5 fuel includes greater than 3% margin for both Optimized fuel and VANTAGE 5 fuel for plant design flexibility.

The hot channel factor $F_Q^M(z)$ is measured periodically and increased by a cycle and height dependent power factor appropriate to either Normal Operation or RESTRICTED AFD OPERATION, $W(z)_{NO}$ or $W(z)_{RAFDO}$, to provide assurance that the limit on the hot channel factor, $F_Q(z)$, is met. $W(z)_{NO}$ accounts for the effects of normal operation transients and was determined from expected power control maneuvers over the full range of burnup conditions in the core. $W(z)_{RAFDO}$ accounts for the more restrictive operating limits required by RESTRICTED AFD OPERATION which result in less severe transient values. The W(z) functions are ~~provided~~ specified in the ~~Peaking Factor~~ Core Operating Limits Report per Specification 6.9.1.9.

Provisions to account for the possibility of decreases in margin to the $F_Q(z)$ limit during intervals between surveillances are provided. Any decrease in the minimum margin to the $F_Q(z)$ limit compared to the minimum margin determined from the previous flux map is determined by comparing the ratio of:

$$\underset{\text{over } z}{\text{maximum}} \left(\frac{F_Q^M(z)}{K(z)} \right)$$

taken from the current map to the same ratio from the previous map. The ratios to be compared from the two flux maps do not need to be calculated at identical z locations. Increases in this ratio indicate that the minimum margin to the $F_Q(z)$ limit has decreased and that additional penalties must be applied to the measured $F_Q(z)$ to account for further decreases in margin that could occur before the next surveillance. More frequent surveillances may also be substituted for the additional penalty.

3/4.2.4 QUADRANT POWER TILT RATIO

The QUADRANT POWER TILT RATIO limit assures that the radial power distribution satisfies the design values used in the power capability analysis. Radial power distribution measurements are made during STARTUP testing and periodically during power operation.

The limit of 1.02, at which corrective action is required, provides DNB and linear heat generation rate protection with x-y plane power tilts. A