

ATTACHMENT "B"

TECHNICAL SPECIFICATION REVISIONS

D. C. COOK UNIT 2

AEP:NRC:0575

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### 3/4.2 POWER DISTRIBUTION LIMITS

#### AXIAL FLUX DIFFERENCE (AFD)

#### LIMITING CONDITION FOR OPERATION

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3.2.1 The indicated AXIAL FLUX DIFFERENCE (AFD) shall be maintained within a  $\pm 5\%$  target band (flux difference units) about a target flux difference.

APPLICABILITY: MODE 1 above 50% RATED THERMAL POWER\*

#### ACTION:

- a. With the indicated AXIAL FLUX DIFFERENCE outside of the  $\pm 5\%$  target band about the target flux difference and with THERMAL POWER:
  1. Above 90% or  $0.9 \times \text{APL}^{**}$  (whichever is less) of RATED THERMAL POWER, within 15 minutes:
    - a) Either restore the indicated AFD to within the target band limits, or
    - b) Reduce THERMAL POWER to less than 90% or  $0.9 \times \text{APL}$  (whichever is less) of RATED THERMAL POWER.
  2. Between 50% and 90% or  $0.9 \times \text{APL}$  (whichever is less) of RATED THERMAL POWER:
    - a) POWER OPERATION may continue provided:
      - 1) The indicated AFD has not been outside of the  $\pm 5\%$  target band for more than 1 hour penalty deviation cumulative during the previous 24 hours, and
      - 2) The indicated AFD is within the limits shown on Figure 3.2-1. Otherwise, reduce THERMAL POWER to less than 50% of RATED THERMAL POWER within 30 minutes and reduce the Power Range Neutron Flux-High Trip Setpoints to  $< 55\%$  of RATED THERMAL POWER within the next 4 hours.
    - b) Surveillance testing of the Power Range Neutron Flux Channels may be performed pursuant to Specification 4.3.1.1.1 provided the indicated AFD is maintained within the limits of Figure 3.2-1. A total of 16 hours operation may be accumulated with the AFD outside of the target band during this testing without penalty deviation.

\* See Special Test Exception 3.10.2

\*\* APL is the Allowable Power Level defined in Specification 3.2.6

## POWER DISTRIBUTION LIMITS

### ACTION: (continued)

- c) Surveillance testing of the APDMS may be performed pursuant to Specification 4.3.3.7.1 provided the indicated AFD is maintained within the limits of Figure 3.2-1. A total of 6 hours of operation may be accumulated with the AFD outside of the target band during this testing without penalty deviation.
- b. THERMAL POWER shall not be increased above 90% or  $0.9 \times \text{APL}$  (whichever is less) of RATED THERMAL POWER unless the indicated AFD is within the  $\pm 5\%$  target band and ACTION 2.a) 1), above has been satisfied.
- c. THERMAL POWER shall not be increased above 50% of RATED THERMAL POWER unless the indicated AFD has not been outside of the  $\pm 5\%$  target band for more than 1 hour penalty deviation cumulative during the previous 24 hours.

## SURVEILLANCE REQUIREMENTS

4.2.1.1 The indicated AXIAL FLUX DIFFERENCE shall be determined to be within its limits during POWER OPERATION above 15% of RATED THERMAL POWER by:

- a. Monitoring the indicated AFD for each OPERABLE excore channel:
  - 1. At least once per 7 days when the AFD Monitor Alarm is OPERABLE, and
  - 2. At least once per hour for the first 24 hours after restoring the AFD Monitor Alarm to OPERABLE status.
- b. Monitoring and logging the indicated AXIAL FLUX DIFFERENCE for each OPERABLE excore channel at least once per hour for the first 24 hours and at least once per 30 minutes thereafter, when the AXIAL FLUX DIFFERENCE Monitor Alarm is inoperable. The logged values of the indicated AXIAL FLUX DIFFERENCE shall be assumed to exist during the interval preceding each logging.

## POWER DISTRIBUTION LIMITS

### SURVEILLANCE REQUIREMENTS (continued)

4.2.1.2 The indicated AFD shall be considered outside of its +5% target band when at least 2 of 4 or 2 of 3 OPERABLE excore channels are indicating the AFD to be outside the target band. Penalty deviation outside of the +5% target band shall be accumulated on a time basis of:

- a. A penalty deviation of one minute for each one minute of POWER OPERATION outside of the target band at THERMAL POWER levels equal to or above 50% of RATED THERMAL POWER, and
- b. A penalty deviation of one half minute for each one minute of POWER OPERATION outside of the target band at THERMAL POWER levels between 15% and 50% of RATED THERMAL POWER.

4.2.1.3 The target axial flux difference of each OPERABLE excore channel shall be determined in conjunction with the measurement of  $F_Q^M(z)$  as defined in Specification 4.2.2.2.c. The provisions of Specification 4.0.4 are not applicable.

% of Minimum [Rated Thermal Power, APLx Rated Thermal Power]

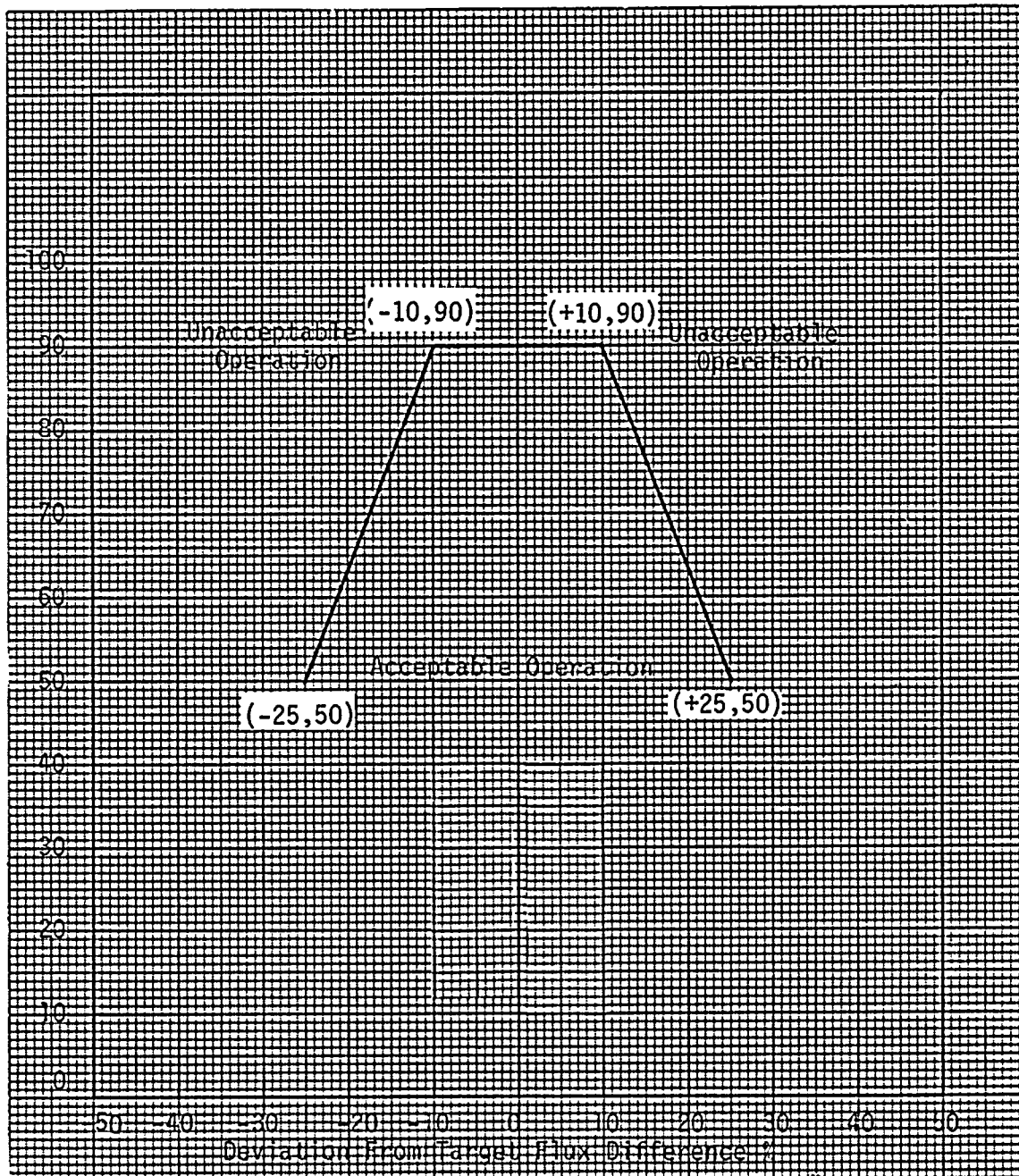


Figure 3.2-1 ALLOWABLE DEVIATION FROM TARGET FLUX DIFFERENCE

## POWER DISTRIBUTION LIMITS

### SURVEILLANCE REQUIREMENTS

4.2.2.1 The provisions of Specification 4.0.4 are not applicable.

4.2.2.2  $F_Q(Z)$  shall be determined to be 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 at the time of the target flux determination.

$$F_Q^M(Z) \leq \frac{1.99}{P} [K(Z)] / [V(Z)] \quad \text{for } P > .5$$

$$F_Q^M(Z) \leq 3.98 [K(Z)] / [V(Z)] \quad \text{for } P \leq .5$$

where

$F_Q^M(Z)$  is the measured total peaking as a function of core height.

$V(Z)$  is the function defined in Figure 3.2-3,  $K(Z)$  is defined in Figure 3.2-2,  $P$  is the fraction of RATED THERMAL POWER.

- d. Measuring  $F_Q(Z)$  in conjunction with a target flux difference determination, 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, whichever occurs first.

\*During power escalation at the beginning of each cycle, the design target may be used until a power level for extended operation has been achieved.

## POWER DISTRIBUTION LIMITS

### SURVEILLANCE REQUIREMENTS

- e. With successive measurements indicating an increase in peak pin power,  $F_{\Delta H}$ , with exposure, either of the following additional actions shall be taken.

1.  $F_Q^M(Z)$  shall be increased by 2% over that specified in 4.2.2.2.c, or
2.  $F_Q^M(Z)$  shall be measured and a target axial flux difference reestablished at least once per 7 effective full power days until 2 successive maps indicate that the peak pin power,  $F_{\Delta H}$ , is not increasing.

- f. With the relationship specified in 4.2.2.2.c not being satisfied either of the following actions shall be taken:

1. Place the core in an equilibrium condition where the limit in 4.2.2.2.c is satisfied and remeasure the target axial flux difference.
2. Comply with the requirements of Specification 3.2.2 for  $F_Q(Z)$  exceeding its limit by the percent calculated with the following expression:

$$\left[ \left[ \text{max. over } Z \text{ of } \frac{F_Q^M(Z) \times V(Z)}{\frac{1.99}{P} \times [K(Z)]} \right] - 1 \right] \times 100 \quad P \geq .5$$

- g. The limits specified in 4.2.2.2c and 4.2.2.2f above are not applicable in the following core plane regions:

1. Lower core region 0 to 10% inclusive.
2. Upper core region 90% to 100% inclusive.

- 4.2.2.3 When  $F_Q(Z)$  is measured for reasons other than meeting the requirements of Specification 4.2.2.2, an overall measured  $F_Q(Z)$  shall be obtained from a power distribution map and increased by 3% to account for manufacturing tolerances and further increased by 5% to account for measurement uncertainty.

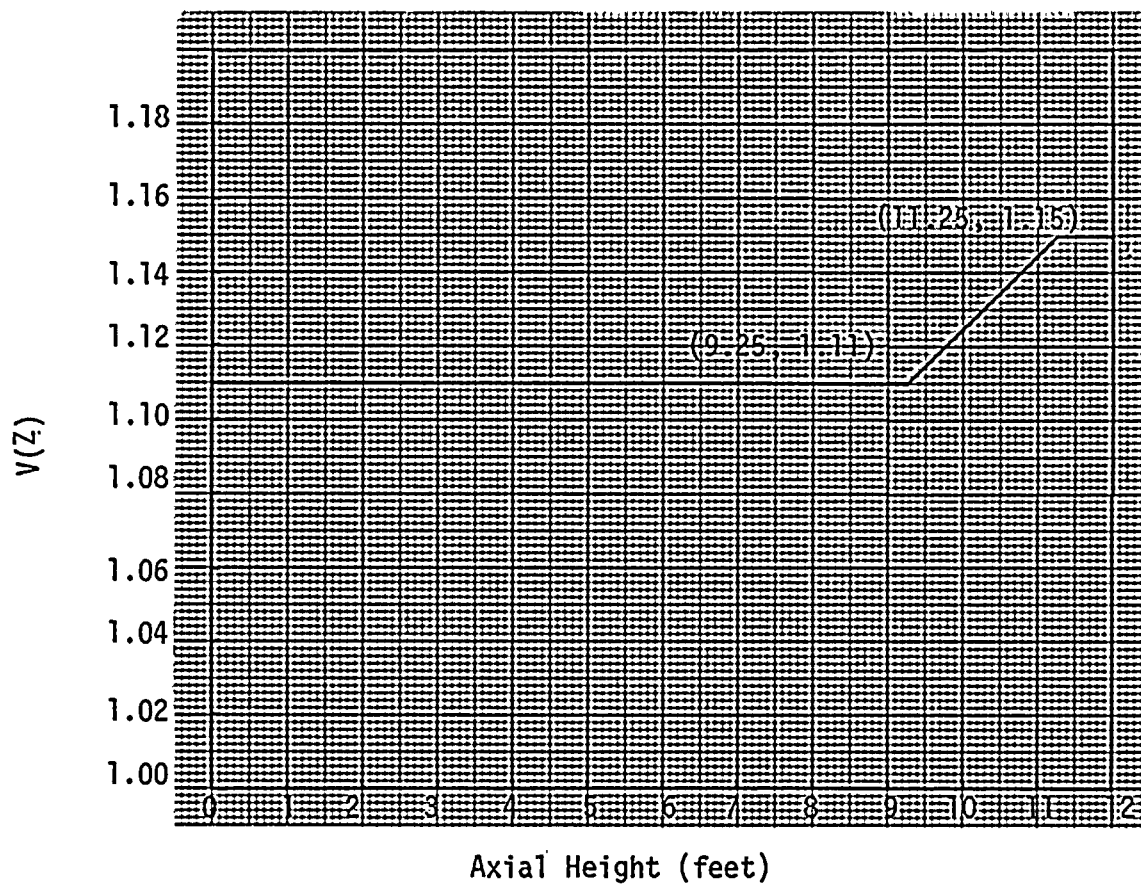


Figure 3.2-3  $V(Z)$  As A Function Of Core Height



## POWER DISTRIBUTION LIMITS

### AXIAL POWER DISTRIBUTION

#### LIMITING CONDITION FOR OPERATION

3.2.6 The axial power distribution shall be limited by the following relationship:

$$[F_j(Z)]_S = \frac{[1.99] [K(Z)]}{(\bar{R}_j)(P_L)(1.03)(1 + \sigma_j)(1.07)}$$

where:

- $F_j(Z)$  is the normalized axial power distribution from thimble  $j$  at core elevation  $Z$ .
- $P_L$  is the fraction of RATED THERMAL POWER.
- $K(Z)$  is the function obtained from Figure 3.2-2 for a given core height location.
- $\bar{R}_j$ , for thimble  $j$ , is determined from at least  $n=6$  in-core flux maps covering the full configuration of permissible rod patterns at 100% or APL (whichever is less) of RATED THERMAL POWER in accordance with:

$$\bar{R}_j = \frac{1}{n} \sum_{i=1}^n R_{ij}$$

where:

$$R_{ij} = \frac{F_{Q_i}^{\text{Meas}}}{[F_{ij}(Z)]_{\text{Max}}}$$

and  $[F_{ij}(Z)]_{\text{Max}}$  is the maximum value of the normalized axial distribution at elevation  $Z$  from thimble  $j$  in map  $i$  which had a measured peaking factor without uncertainties or densification allowance of  $F_Q^{\text{Meas}}$ .

## POWER DISTRIBUTION LIMITS

### LIMITING CONDITION FOR OPERATION (Continued)

$\sigma_j$  is the standard deviation associated with thimble  $j$ , expressed as a fraction or percentage of  $\bar{R}_j$ , and is derived from  $n$  flux maps from the relationship below, or 0.02, (2%) whichever is greater.

$$\sigma_j = \frac{\left[ \frac{1}{n-1} \sum_{i=1}^n (\bar{R}_j - R_{ij})^2 \right]^{1/2}}{\bar{R}_j}$$

The factor 1.07 is comprised of 1.02 and 1.05 to account for the axial power distribution instrumentation accuracy and the measurement uncertainty associated with  $F_Q$  using the movable detector system respectively.

The factor 1.03 is the engineering uncertainty factor.

APPLICABILITY: Mode 1 above the percent of RATED THERMAL POWER indicated by the relationship. #

$$\text{APL} = \min \text{ over } Z \text{ of } \frac{1.99 K(Z)}{F_Q(Z) \times V(Z)} \times 100\% \quad P > .5$$

where  $F_Q(Z)$  is the measured  $F_Q(Z)$ , including a 3% manufacturing tolerance uncertainty and a 5% measurement uncertainty, at the time of target flux determination from a power distribution map using the movable incore detectors. The above limit is not applicable in the following core plane regions.

- 1) Lower core region 0% to 10% inclusive.
- 2) Upper core region 90% to 100% inclusive.

#### ACTION:

- a. With a  $F_j(Z)$  factor exceeding  $[F_j(Z)]_S$  by  $\leq 4$  percent, reduce THERMAL POWER one percent for every percent by which the  $F_j(Z)$  factor exceeds its limit within 15 minutes and within the next two hours either reduce the  $F_j(Z)$  factor to within its limit or reduce THERMAL POWER to APL or less of RATED THERMAL POWER.
- b. With a  $F_j(Z)$  factor exceeding  $[F_j(Z)]_S$  by  $> 4$  percent, reduce THERMAL POWER to APL or less of RATED THERMAL POWER within 15 minutes.

# The APDMS may be out of service when surveillance for determining power distribution maps is being performed.

## POWER DISTRIBUTION LIMITS

### SURVEILLANCE REQUIREMENTS

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4.2.6.1  $F_j(Z)$  shall be determined to be within its limit by:

- a. Either using the APDMS to monitor the thimbles required per Specification 3.3.3.6 at the following frequencies.
  1. At least once per 8 hours, and
  2. Immediately and at intervals of 10, 30, 60, 90, 120, 240 and 480 minutes following:
    - a) Increasing the THERMAL POWER above APL of RATED THERMAL POWER, or
    - b) Movement of control bank "D" more than an accumulated total of 5 steps in any one direction.
- b. Or using the movable incore detectors at the following frequencies when the APDMS is inoperable:
  1. At least once per 8 hours, and
  2. At intervals of 30, 60, 90, 120, 240 and 480 minutes following:
    - a) Increasing the THERMAL POWER above APL of RATED THERMAL POWER, or
    - b) Movement of control bank "D" more than an accumulated total of 5 steps in any one direction.

4.2.6.2 When the movable incore detectors are used to monitor  $F_j(Z)$ , at least 2 thimbles shall be monitored and an  $F_j(Z)$  accuracy equivalent to that obtained from the APDMS shall be maintained.

### 3/4.2 POWER DISTRIBUTION LIMITS

#### BASES

The specifications of this section provide assurance of fuel integrity during Condition I (Normal Operation) and II (Incidents of Moderate Frequency) events by: (a) maintaining the calculated DNBR in the core at or above design during normal operation and in short term transients, and (b) limiting the fission gas release, fuel pellet temperature and cladding mechanical properties to within assumed design criteria. In addition, limiting the peak linear power density during Condition I events provides assurance that the initial conditions assumed for the LOCA analyses are met and the ECCS acceptance criteria limit of 2200°F is not exceeded.

The definitions of certain hot channel and peaking factors as used in these specifications are as follows:

$F_Q(Z)$  Heat Flux Hot Channel Factor, is defined as the maximum local heat flux on the surface of a fuel rod at core elevation Z divided by the average fuel rod heat flux, allowing for manufacturing tolerances on fuel pellets and rods.

$F_{\Delta H}^N$  Nuclear Enthalpy Rise Hot Channel Factor, is defined as the ratio of the integral of linear power along the rod with the highest integrated power to the average rod power.

#### 3/4.2.1 AXIAL FLUX DIFFERENCE (AFD)

The limits on AXIAL FLUX DIFFERENCE assure that the  $F_Q(Z)$  upper bound envelope of 1.99 times the normalized axial peaking factor is not exceeded during either normal operation or in the event of xenon redistribution following power changes.

Target flux difference is determined at equilibrium xenon conditions. The full length rods may be positioned within the core in accordance with their respective insertion limits and should be inserted near their normal position for steady state operation at high power levels. The value of the target flux difference obtained under these conditions divided by the fraction of RATED THERMAL POWER is the target flux difference at RATED THERMAL POWER for the associated core burnup conditions. Target flux differences for other THERMAL POWER levels are obtained by multiplying the RATED THERMAL POWER value by the appropriate fractional THERMAL POWER level. The periodic updating of the target flux difference value is necessary to reflect core burnup considerations.

## POWER DISTRIBUTION LIMITS

### BASES

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Although it is intended that the plant will be operated with the AXIAL FLUX DIFFERENCE within the  $\pm 5\%$  target band about the target flux difference, during rapid plant THERMAL POWER reductions, control rod motion will cause the AFD to deviate outside of the target band at reduced THERMAL POWER levels. This deviation will not affect the xenon redistribution sufficiently to change the envelope of peaking factors which may be reached on a subsequent return to RATED THERMAL POWER (with the AFD within the target band) provided the time duration of the deviation is limited. Accordingly, a 1 hour penalty deviation limit cumulative during the previous 24 hours is provided for operation outside of the target band but within the limits of Figure 3.2-1 while at THERMAL POWER levels above 50% of RATED THERMAL POWER. For THERMAL POWER levels between 15% and 50% of RATED THERMAL POWER, deviations the AFD outside of the target band are less significant. The penalty of 2 hours actual time reflects this reduced significant.

Provisions for monitoring the AFD on an automatic basis are derived from the plant process computer through the AFD Monitor Alarm. The computer determines the one minute average of each of the OPERABLE excore detector outputs and provides an alarm message if the AFD for at least 2 of 4 or 2 of 3 OPERABLE excore channels are outside the target band and the THERMAL POWER is greater than 90% or  $0.9 \times \text{APL}$  of RATED THERMAL POWER (whichever is less). During operation at THERMAL POWER levels between 50% and 90% or  $0.9 \times \text{APL}$  of RATED THERMAL POWER (whichever is less) and between 15% and 50% RATED THERMAL POWER, the computer outputs an alarm message when the penalty deviation accumulates beyond the limits of 1 hour and 2 hours, respectively.

Figure B 3/4 2-1 shows a typical monthly target band.

The bases and methodology for establishing these limits is presented in topical report XN-NF-77-57, "Exxon Nuclear Power Distribution Control for PWR's-Phase II" and Supplement 1 to that report.

## POWER DISTRIBUTION LIMITS

### BASES

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#### 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.

The two-hour time allowance for operation with a tilt condition greater than 1.02 but less than 1.09 is provided to allow identification and correction of a dropped or misaligned rod. In the event such action does not correct the tilt, the margin for uncertainty of  $F_Q$  is reinstated by reducing the power by 3 percent from RATED THERMAL POWER for each percent of tilt in excess of 1.0.

#### 3/4.2.5 DNB PARAMETERS

The limits on the DNB related parameters assure that each of the parameters are maintained within the normal steady state envelope of operation assumed in the transient and accident analyses. The limits are consistent with the initial FSAR assumptions and have been analytically demonstrated adequate to maintain design DNBR throughout each analyzed transient.

The 12 hour periodic surveillance of these parameters thru instrument readout is sufficient to ensure that the parameters are restored within their limits following load changes and other expected transient operation.

#### 3/4.2.6 AXIAL POWER DISTRIBUTION

The limit on axial power distribution ensures that  $F_Q$  will be controlled and monitored on a more exact basis through use of the APDMS when operating above APL of RATED THERMAL POWER. This additional limitation on  $F_Q$  is necessary in order to provide assurance that peak clad temperatures will remain below the ECCS acceptance criteria limit of 2200°F in the event of a LOCA.