

POWER DISTRIBUTION LIMITS

3/4.2.3 RCS FLOW RATE AND R

LIMITING CONDITION FOR OPERATION

3.2.3 The combination of indicated Reactor Coolant System (RCS) total flow rate and  $R_1$ ,  $R_2$  shall be maintained within the region of allowable operation shown on Figure 3.2-3 for 4 loop operation.

where:

a.  $R_1 = \frac{F_{\Delta H}^N}{1.49 [1.0 + 0.3 (1.0-P)]}$

b.  $R_2 = \frac{R_1}{[1-RBP(BU)]}$

c.  $P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$ , and

d.  $F_{\Delta H}^N$  = Measured values of  $F_{\Delta H}^N$  obtained by using the movable incore detectors to obtain a power distribution map. The measured values of  $F_{\Delta H}^N$  shall be used to calculate R since Figure 3.2-3 includes penalties for undetected feedwater venturi fouling of 0.1% and for measurement uncertainties of 2.2% for flow and 4% for incore measurement of  $F_{\Delta H}^N$ .

e. RBP(BU) = Rod Bow Penalty as a function of region average burnup as shown in Figure 3.2-4, where a region is defined as those assemblies with the same loading date (reloads) or enrichment (first core).

APPLICABILITY: MODE 1

ACTION:

With the combination of RCS total flow rate and  $R_1$ ,  $R_2$  outside the region of acceptable operation shown on Figure 3.2-3:

- a. Within 2 hours:
1. Either restore the combination of RCS total flow rate and  $R_1$ ,  $R_2$  to within the above limits, or
  2. Reduce THERMAL POWER to less than 50% of RATED THERMAL POWER and reduce the Power Range Neutron Flux - High trip setpoint to less than or equal to 55% of RATED THERMAL POWER within the next 4 hours.

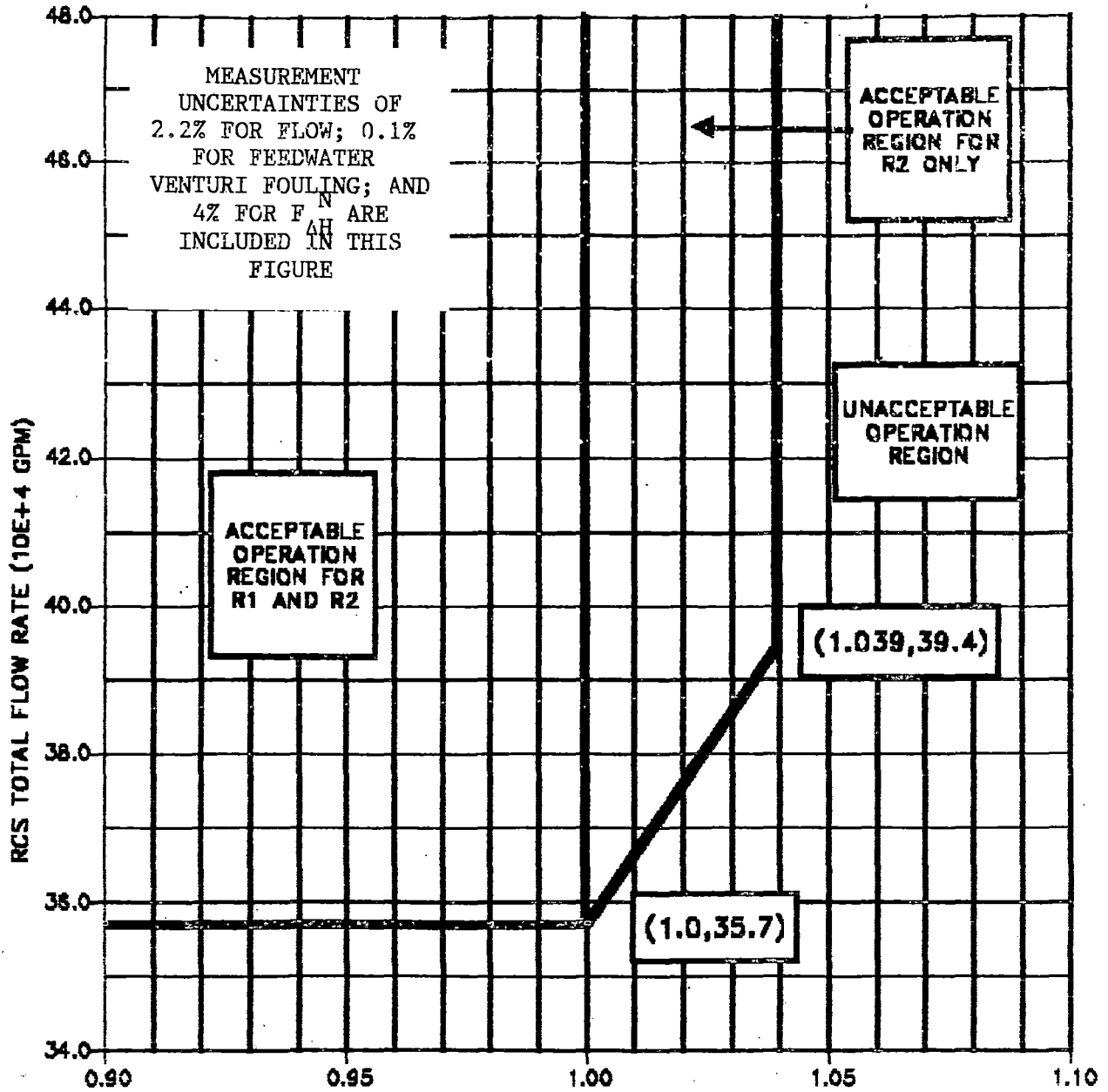
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### LIMITING CONDITION FOR OPERATION

- b. Within 24 hours of initially being outside the above limits, verify through incore flux mapping and RCS total flow rate comparison that the combination of  $R_1$ ,  $R_2$  and RCS total flow rate are restored to within the above limits, or reduce THERMAL POWER to less than 5% of RATED THERMAL POWER within the next 2 hours.
- c. Identify and correct the cause of the out-of-limit condition prior to increasing THERMAL POWER above the reduced THERMAL POWER limit required by ACTION items a.2 and/or b., above; subsequent POWER OPERATION may proceed provided that the combination of  $R_1$ ,  $R_2$  and indicated RCS total flow rate are demonstrated, through incore flux mapping and RCS total flow rate comparison, to be within the region of acceptable operation shown on Figure 3.2-3 prior to exceeding the following THERMAL POWER levels:
  1. A nominal 50% of RATED THERMAL POWER,
  2. A nominal 75% of RATED THERMAL POWER, and
  3. Within 24 hours of attaining greater than or equal to 95% of RATED THERMAL POWER.

### SURVEILLANCE REQUIREMENTS

- 4.2.3.1 The provisions of Specification 4.0.4 are not applicable.
- 4.2.3.2 The combination of indicated RCS total flow rate and  $R_1$ ,  $R_2$  shall be determined to be within the region of acceptable operation of Figure 3.2-3:
  - a. Prior to operation above 75% of RATED THERMAL POWER after each fuel loading, and
  - b. At least once per 31 Effective Full Power Days.
- 4.2.3.3 The indicated RCS total flow rate shall be verified to be within the region of acceptable operation of Figure 3.2-3 at least once per 12 hours when the values of  $R_1$  and  $R_2$  obtained per Specification 4.2.3.2 are assumed to exist.
- 4.2.3.4 The RCS total flow rate indicators shall be subjected to a CHANNEL CALIBRATION at least once per 18 months.
- 4.2.3.5 The RCS total flow rate shall be determined by measurement at least once per 18 months.



$$R1 = F_{\Delta H}^N / 1.49 [1.0 + 0.3(1.0 - P)]$$

$$R2 = R1 / [1 - RBP(BU)]$$

Figure 3.2-3  
RCS TOTAL FLOWRATE VERSUS R - FOUR LOOPS  
IN OPERATION

## POWER DISTRIBUTION LIMITS

### BASES

#### 3/4.2.2 and 3/4.2.3 HEAT FLUX HOT CHANNEL FACTOR $F_{\Delta H}^N(Z)$ , RCS FLOW RATE AND NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR

The limits on heat flux and nuclear enthalpy hot channel factors and RCS flow rate ensure that 1) the design limits on peak local power density and minimum DNBR are not exceeded and 2) in the event of a LOCA the peak fuel clad temperature will not exceed the 2200°F ECCS acceptance criteria limit.

Each of these is measurable but will normally only be determined periodically as specified in Specifications 4.2.2 and 4.2.3. This periodic surveillance is sufficient to insure that the limits are maintained provided:

- a. Control rod in a single group move together with no individual rod insertion differing by more than  $\pm 12$  steps from the group demand position.
- b. Control rod groups are sequenced with overlapping groups as described in Specification 3.1.3.5.
- c. The control rod insertion limits of Specifications 3.1.3.4 and 3.1.3.5 are maintained.
- d. The axial power distribution, expressed in terms of AXIAL FLUX DIFFERENCE, is maintained within the limits.

$F_{\Delta H}^N$  will be maintained within its limits provided conditions a. through d., above, are maintained. As noted in Figure 3.2-3, RCS flow rate and  $F_{\Delta H}^N$  may be "traded off" against one another (i.e., a low measured RCS flow rate is acceptable if the measured  $F_{\Delta H}^N$  is also low) to ensure that the calculated DNBR will not be below the design DNBR value. The relaxation of  $F_{\Delta H}^N$  as a function of THERMAL POWER allows changes in the radial power shape for all permissible rod insertion limits.

$R_1$ , as calculated in 3.2.3 and used in Figure 3.2-3, accounts for  $F_{\Delta H}^N$  less than or equal to 1.49. This value is used in the various accident analyses where  $F_{\Delta H}^N$  influences parameters other than DNBR, e.g., peak clad temperature, and thus is the maximum "as measured" value allowed.  $R_2$ , as defined, allows for the inclusion of a penalty for rod bow on DNBR only, thus knowing the "as measured" values of  $F_{\Delta H}^N$  and RCS flow allows for "tradeoffs" in excess of  $R$  equal to 1.0 for the purpose of offsetting the rod bow DNBR penalty.

Fuel rod bowing reduces the value of DNB ratio. Sufficient credit is available to offset this reduction. This credit comes from generic design margins totaling 9.1% and 3% margin in the difference between the 1.3 DNBR safety limit and the minimum DNBR calculated for the Complete Loss of Flow

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### BASES

#### 3/4.2.2 and 3/4.2.3 HEAT FLUX HOT CHANNEL FACTOR $F_{\Delta H}^N(Z)$ , RCS FLOW RATE AND NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR (Continued)

event. The penalties applied to  $F_{\Delta H}^N$  to account for Rod Bow (Figure 3.2-4) as a function of burnup are consistent with those described in Mr. John F. Stolz's (NRC) letter to T. M. Anderson (Westinghouse) dated April 5, 1979 and W 8691 Rev. 1 (partial rod bow test data).

When an  $F_O$  measurement is taken, an allowance for both experimental error and manufacturing tolerance must be made. An allowance of 5% is appropriate for a full core map taken with the incore detector flux mapping system and a 3% allowance is appropriate for manufacturing tolerance.

When RCS flow rate and  $F_{\Delta H}^N$  are measured, no additional allowances are necessary prior to comparison with the limits of Figure 3.2-3. Measurement errors of 2.2% for Reactor Coolant System total flow rate, 0.1% for feedwater venturi fouling, and 4% for  $F_{\Delta H}^N$  have been allowed for in the determination of the design DNBR value.

The measurement error for Reactor Coolant System total flow rate is based upon performing a precision heat balance and using the result to calibrate the RCS flow rate indicators. Potential fouling of the feedwater venturi which might not be detected could bias the result from the precision heat balance in a nonconservative manner. Therefore, a penalty of 0.1% for undetected fouling of the feedwater venturi is included in Figure 3.2-3. Any fouling which might bias the RCS flow rate measurement greater than 0.1% can be detected by monitoring and trending various plant performance parameters. If detected, action shall be taken before performing subsequent precision heat balance measurements, i.e., either the effect of the fouling shall be quantified and compensated for in the RCS flow rate measurement or the venturi shall be cleaned to eliminate the fouling.

The 12 hour period surveillance of indicated RCS flow is sufficient to detect only flow degradation which could lead to operation outside the acceptable region of operation shown in Figure 3.2-3.

The radial peaking factor  $F_{xy}^N(Z)$  is measured periodically to provide assurance that the hot channel factor  $F_{xy}^N(Z)$ , remains within its limit. The  $F_{xy}^N$  limit for RATED THERMAL POWER ( $F_{RTP}^{xy}$ ), as provided in the Radial Peaking Factor Limit Report per specification 6.9.1.10, was determined from expected power control maneuvers over the full range of burnup conditions in the core.

#### 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.