3/4.2.3 MINIMUM CRITICAL POWER RATIO

LIMITING CONDITION FOR OPERATION

3.2.3 The MINIMUM CRITICAL POWER RATIO (MCPR) as a function of average scram time shall be equal to or greater than shown in Figure 3.2.3-1 with all feedwater heaters in service or Figure 3.2-3-2 with feedwater heaters out of service, multiplied by the K_f shown in Figure 3.2.3-3, where:

$$\tau = 0 \text{ or } \left(\frac{\tau_{ave} - \tau_B}{\tau_A - \tau_B},\right) \text{ whichever is greater,}$$

τ_A = 1.096 sec (Specification 3.1.3.3 scram time limit to notch 36),

$$\tau_B = 0.834 + 1.65 \left[\frac{N_1}{\sum_{i=1}^{n} N_i}\right]^{\frac{1}{2}} (0.059),$$

$$\tau_{ave} = \frac{\sum_{i=1}^{n} N_i \tau_i}{\sum_{i=1}^{n} N_i}$$

n = number of surveillance tests performed to date in cycle,

N_i = number of active control rods measured in the i^{th} surveillance test,

τ_i = average scram time to notch 36 of all rods measured in the i^{th} surveillance test, and

N_1 = total number of active rods measured in 4.1.3.2.a.

APPLICABILITY: CONDITION 1, when THERMAL POWER ≥ 25% RATED THERMAL POWER

ACTION:

With MCPR less than the applicable limit determined from Figure 3.2.3-1 or Figure 3.2.3-2, initiate corrective action within 15 minutes and continue corrective action so that MCPR is equal to or greater than the applicable limit within 2 hours or reduce THERMAL POWER to less than 25% of RATED THERMAL POWER within the next 4 hours.

SURVEILLANCE REQUIREMENTS

4.2.3 The MCPR limit at rated core flow shall be determined for each type of fuel (8X8R and P8X8R):

a. from Figure 3.2.3-1 or Figure 3.2.3-2 as appropriate and τ = 1.0 prior to the initial scram time measurements for the cycle performed in accordance with Specification 4.1.3.2.a;

3/4.2.3 MINIMUM CRITICAL POWER RATIO

SURVEILLANCE REQUIREMENTS (CONTINUED)

b. within 72 hours of the conclusion of each scram time surveillance test required by Specification 4.1.3.2.a, using Figure 3.2.3-1 or Figure 3.2.3-2 and τ as defined in Specification 3.2.3; or

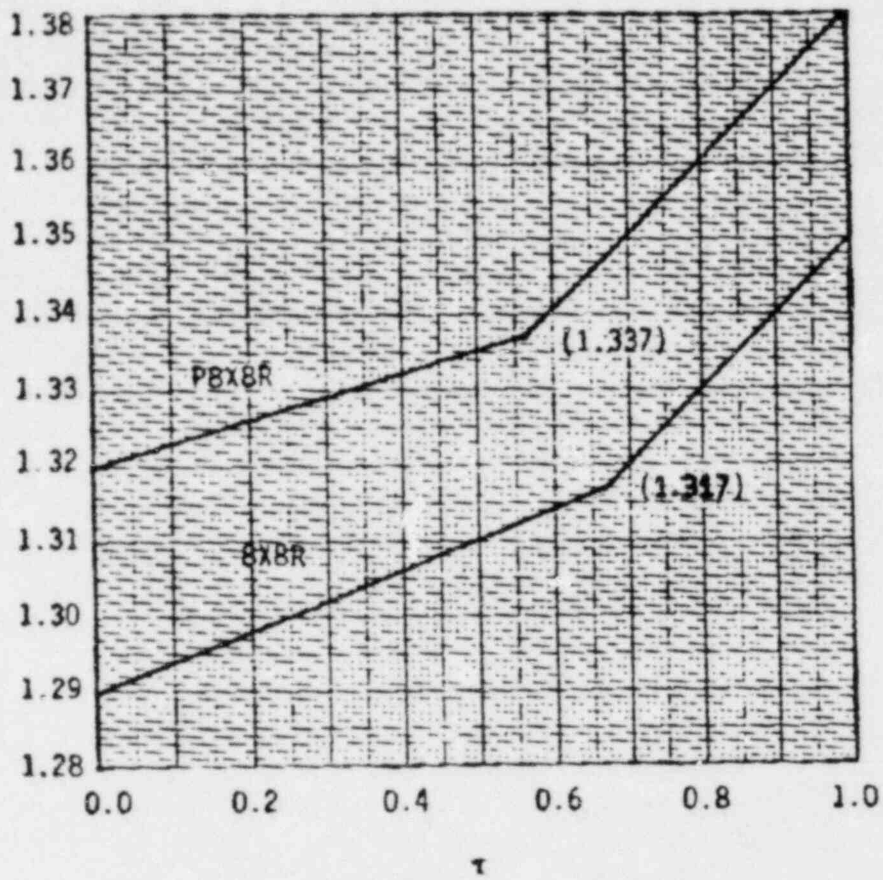
c. from Figure 3.2.3-2 using the appropriate value of τ defined in Specification 3.2.3 after any feedwater heaters are taken out of service or are declared inoperable. The feedwater temperature reduction resulting from this action shall not exceed that which wou'd be achieved by taking the fourth stage heaters out of service. Core flow shall not exceed rated core flow while feedwater heaters are out of service.

MCPR shall be determined to be equal to or greater than the applicable limit:

a. At least once per 24 hours,

b. Whenever THERMAL POWER has been increased by at least 15% of RATED THERMAL POWER and steady state operating conditions have been established, and

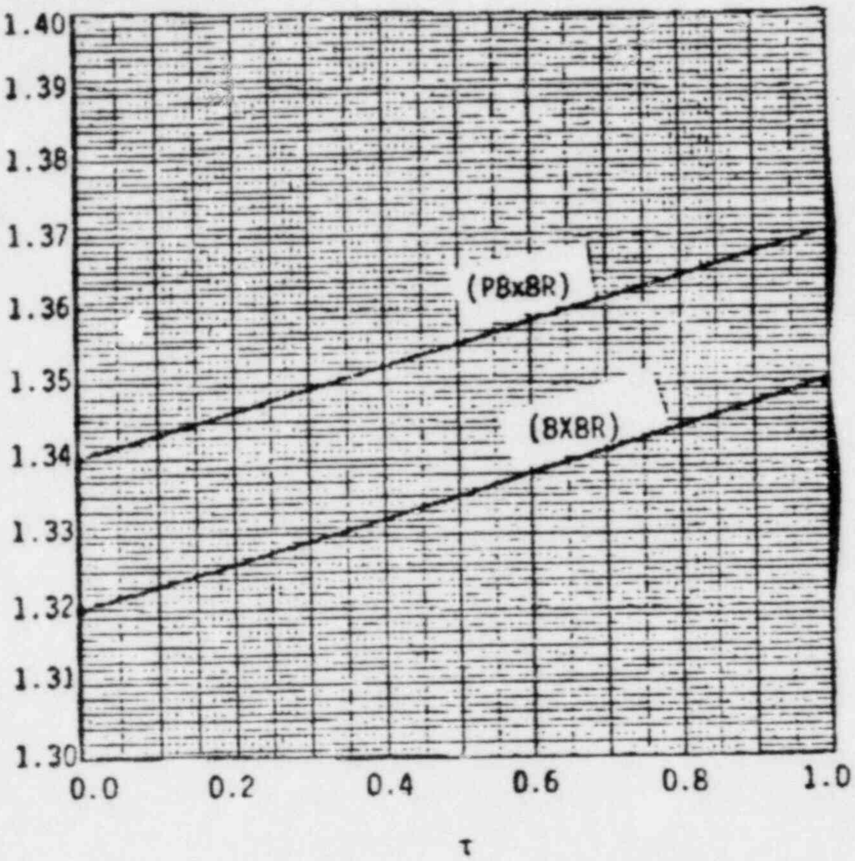
c. Initially and at least once per 12 hours when the reactor is operating with a LIMITING CONTROL ROD PATTERN for MCPR.



MCPR LIMIT WITH ALL FEEDWATER HEATERS IN SERVICE*

FIGURE 3.2.3-1

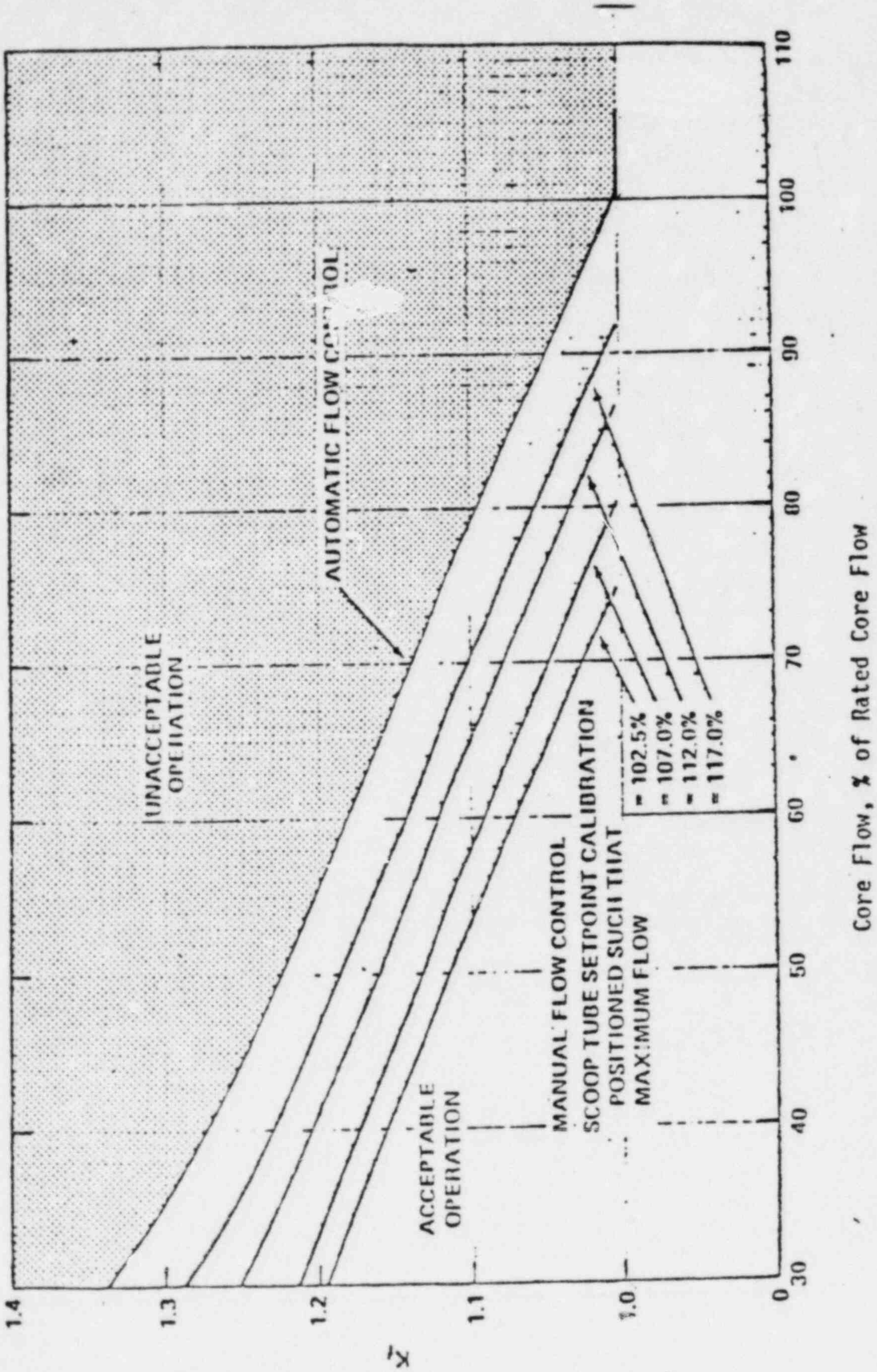
*Note: This graph is applicable at core flow rates up to and including 105% of rated core flow.



MCPR LIMIT WITH FEEDWATER HEATERS
OUT OF SERVICE*

FIGURE 3.2.3-2

*Note: This graph is applicable at core flow rates up to and including 100% of rated core flow.



K_F Factor

FIGURE 3.2.3-3

3/4.2.4 LINEAR HEAT GENERATION RATE

LIMITING CONDITION FOR OPERATION

3.2.4 All LINEAR HEAT GENERATION RATES (LHGRs) shall not exceed 13.4 Kw/ft.

APPLICABILITY: CONDITION 1, when THERMAL POWER ≥ 25% of RATED THERMAL POWER

ACTION:

With the LHGR of any fuel rod exceeding the limit, initiate corrective action within 15 minutes and continue corrective action so that the LHGR is within the limit within 2 hours or reduce THERMAL POWER to less then 25% of RATED THERMAL POWER within the next 4 hours.

SURVEILLANCE REQUIREMENTS

4.2.4 LHGRs shall be determined to be equal to or less than the limit;

a. At least once per 24 hours,

b. When THERMAL POWER has been increased by at least 15% of RATED THERMAL POWER and steady state operating conditions have been established, and

c. Initially and at least once per 12 hours when the reactor is operating on a LIMITING CONTROL ROD PATTERN for LHGR.

BASES

3/4.2.2 APRM SETPOINTS

The fuel cladding integrity Safety Limits of Specification 2.1 were based on a power distribution which would yield the design LHGR at RATED THERMAL POWER. The scram setting and rod block functions of the APRM instruments or APRM readings must be adjusted to ensure that the MCPR does not become less than 1.0 in the degraded situation. The scram settings and rod block settings or APRM readings are adjusted in accordance with the formula in this specification when the combination of THERMAL POWER and CMFLPD indicates a higher peaked power distribution to ensure tnat an LHGR transient would not be increased in the degraded condition.

3/4 2.3 MINIMUM CRITICAL POWER RATIO

The required operating limit MCPRs at steady state operating conditions as specified in Specification 3.2.3 are derived from the established fuel cladding integrity Safety Limit MCPR of 1.07, and an analysis of abnormal operational transients. For any abnormal operating transient analysis evaluation with the initial condition of the reactor being at the steady state operating limit, it is required that the resulting MCPR does not decrease below the Safety Limit MCPR at any time during the transient assuming instrument trip setting as given in Specification 2.2.1.

To assure that the fuel cladding integrity Safety Limits are not exceeded during any anticipated abnormal operational transient, the most limiting transients have been analyzed to determine which results in the largest reduction in CRITICAL POWER RATIO (CPR). The type of transients evaluated were loss of flow, increase in pressure and power, positive reactivity insertion, and coolant temperature decrease.

The limiting transient which determines the required steady state MCPR limit is a function of core flow, average control rod scram insertion time, feedwater temperature, and fuel type. The MCPR limits defined in Specification 3.2.3 are conservative for core flows up to 80.85×10^6 lb/hr (105% of rated) flow with all feedwater heaters in service. The MCPR limits are conservative for core flows up to 77.0×10^6 lb/hr (100% of rated flow) with feedwater heaters out of service. Because the MCPR limits for operation with all feedwater heaters in service are non-conservative for operation with heaters out of service, separate MCPR limit graphs are provided for the two types of operation.

In addition, the NRC allows credit to be taken in the transient analyses for actual control rod scram times which are faster than required by Technical Specification 3.1.3.3. The MCPR limit based on the actual scram times (sometimes called the Option B limit) is defined in Figures 3.2.3-1 and 3.2.3-2 by $\tau = 0$. The MCPR limit based on the scram time required by Specification 3.1.3.3 (called the Option A limit) is defined by $\tau = 1.0$ in the same figures. Specifications 3.2.3 and 4.2.3 explain the use of these figures for determining the MCPR limit.

MINIMUM CRITICAL POWER RATIO (Continued)

The limiting transients are given below:

	Option A	Option B
Feedwater heaters in service	Load rejection without bypass	Feedwater controller failure
Feedwater heaters out of service	Feedwater controller failure	Feedwater controller failure

The evaluation of a given transient begins with the system initial parameters shown in FSAR Table 15.1-6 that are input to a GE core dynamic behavior transient computer program. The outputs of this program along with the initial MCPR form the input for further analyses of the thermally limiting bundle with the single channel transient thermal hydraulic code TASC. The principle result of this evaluation is the reduction in MCPR caused by the transient.

The transients are evaluated based on an assumed feedwater temperature. Because the feedwater temperature affects the ΔCPR caused by the transient, separate operating limits are required to define the allowed operation with feedwater heaters out of service. The analyses were performed assuming the fourth-stage heaters were out of service. The resulting reduction in feedwater temperature from the nominal value was 63°F at 100% steam flow conditions. The analysis yields a MCPR operating limit which is conservative for operation with the fourth-stage heaters out of service. Other combinations of heaters are also allowed to be out of service as long as the resulting feedwater temperature reduction would not be greater than 63°F at full power.

The purpose of the K_f factor is to define operating limits at other than rated flow conditions. At less than 100% of rated flow, the required MCPR is the product of the operating limit MCPR and the K_f factor. Specifically, the K_f factor provides the required thermal margin to protect against a flow increase transient.

For operation in the automatic flow control mode, the K_f factors assure that the operating limit MCPR of Specification 3.2.3 will not be violated should the most limiting transient occur at less than rated flow. In the manual flow control mode, the K_f factors assure that the Safety Limit MCPR will not be violated should the most limiting transient occur at less than rated flow.

The k_f factor values shown in Figure 3.2.3-3 were developed generically and are applicable to all BWR/2, BWR/3, and BWR/4 reactors. The K_f factors were derived using the flow control line corresponding to RATED THERMAL POWER at rated core flow.

MINIMUM CRITICAL POWER RATIO (Continued)

For the manual flow control mode, the K_f factors were calculated such that for the maximum flow rate, as limited by the pump scoop tube setpoint and the corresponding THERMAL POWER along the rated flow control line, the limiting bundle's relative power was adjusted until the MCPR was slightly above the Safety Limit. Using this relative bundle power, the MCPRs were calculated at different points along the rated flow control line corresponding to different core flows. The ratio of the MCPR calculated at a given point of core flow, divided by the operating limit MCPR, determines the K_f. Therefore, K_f = 1.0 at flows greater than rated core flow.

For operation in the automatic flow control mode, the same procedure was employed except the initial power distribution was etablished such that the MCPR was equal to the operating limit MCPR at RATED THERMAL POWER and rated flow.

The K_f factors shown in Figure 3.2.3-3 are conservative for the Hatch-2 Plant operation because the operating limit MCPRs of Specification 3.2.3 are greater than the original 1.20 operating limit MCPR used for the generic derivation of K_f.

At THERMAL POWER levels less than or equal to 25% of RATED THERMAL POWER, the reactor will be operating at minimum recirculation pump speed and the moderator void content will be very small. For all designated control rod patterns which may be employed at this point, operating plant experience indicated that the resulting MCPR value is in excess of requirements by a considerable margin. With this low void content, any inadvertent core flow increase would only place operation in a more conservative mode relative to MCPR. During initial startup testing of the plant, an MCPR evaluation will be made at 25% of RATED THERMAL POER with minimum recirculation pump speed. The MCPR margin will thus be demonstrated such that future MCPR evaluation below this power level will be shown to be unnecessary. The daily requirement for calculating MCPR above 25% of RATED THERMAL POWER is sufficient since power distribution shifts are very slow when there have not been significant power or control rod changes. The requirement for calculating MCPR when a limiting control rod pattern is approached ensure that MCPR will be known following a change in THERMAL POWER or power shape, regardless of magnitude that could place operation at a thermal limit.

3/4.2.4 LINEAR HEAT GENERATION RATE

The LHGR specification assures that the linear heat generation rate in any rod is less than the design linear heat generation even if fuel pellet densification is postulated.

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SUPPLEMENTAL RELOAD LICENSING SUBMITTAL FOR HATCH NUCLEAR POWER STATION UNIT 2 RELOAD 2

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