

3.10.1.5 Except for physics tests, if a full length control rod is withdrawn as follows:

- at positions  $\geq 200$  steps and is  $>15$  inches out of alignment with its bank position, or
- at positions  $<200$  steps and is  $>7.5$  inches out of alignment with the average of its bank's position

then within two hours perform the following:

- a. Correct the situation, or
- b. Determine by measurement the hot channel factors and apply Specification 3.10.2.1, or
- c. Limit power to 70 percent of rated power for three-loop operation.

3.10.1.6 Insertion limits do not apply during physics tests or during periodic exercise of individual rods. However, the shutdown margin indicated in Figure 3.10-2 must be maintained except for the low power physics test to measure control rod worth and shutdown margin. For this test the reactor may be critical with all but one full length control rod inserted.

### 3.10.2 Power Distribution Limits

3.10.2.1 At all times except during low power physics tests, the hot channel factors defined in the basis must meet the following limits:

$$F_Q(Z) \leq (2.20/P) \times K(Z) \text{ for } P > .5$$

$$F_Q(Z) < (4.40) \times K(Z) \text{ for } P \leq .5$$

$$F_{\Delta H}^N < 1.55 (1 + 0.2(1-P))$$

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where  $P$  is the fraction of licensed power at which the core is operating,  $K(Z)$  is based on the function given in Figure 3.10-3, and  $Z$  is the core height location of  $F_Q$ .

shutdown margin. The specified control rod insertion limits meet the design basis criteria on (1) potential ejected control rod worth and peaking factor,<sup>(4)</sup> (2) radial power peaking factors,  $P_{\Delta H}$ , and (3) required margin shutdown.

The various control rod banks (shutdown banks, control banks) are each to be moved as a bank; that is, with all rods in the bank within one step (5/8 inch) of the bank position. Position indication is provided by two methods: a digital count of actuation pulses which shows the demand position of the banks, and a linear position indicator (LVDT) which indicates the actual rod position.<sup>(2)</sup> At rod positions  $\geq 200$  steps, full power reactivity worths of the control rods are sufficiently small such that a 15-inch indicated misalignment from the rod bank has no significant effect on the incore power distribution and is therefore allowable. For rod positions  $< 200$  steps, maintaining indicated rod position within 7.5 inches of the average of the indicated bank position provides an enforceable limit which assures design distribution is not exceeded. In the event that an LVDT is not in service, the effects of a malpositioned control rod are observable on nuclear and process information displayed in the control room and by core thermocouples and in-core movable detectors. The determination of the hot channel factors will be performed by means of the movable in-core detectors.

The two hours in 3.10.1.5 are acceptable because complete rod misalignment (control rod 12 feet out of alignment with its bank) does not result in exceeding core safety limits in steady state operation at rated power and is short with respect to probability of an independent accident. If the condition cannot be readily corrected, the specified reduction in power will ensure that design margins to core limits will be maintained under both steady state and anticipated transient conditions.

The intent of the test to measure control rod worth and shutdown margin (Specification 3.10.1.6) is to measure the worth of all rods less the worth of the worst case for an assumed stuck rod; that is, the most reactive rod. The measurement would be anticipated as part of the initial startup program and infrequently over the life of the plant, to be associated primarily with determinations of special interest such as end of life cooldown, or startup of fuel cycles which deviate from normal