

REACTIVITY CONTROL SYSTEMS

SHUTDOWN MARGIN - MODES 3, 4 AND 5

LIMITING CONDITION FOR OPERATION

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3.1.1.2 The SHUTDOWN MARGIN shall be greater than or equal to ~~2.0% delta k/k~~.

APPLICABILITY: MODES 3, 4 and 5.

↑ THE LIMITS SHOWN IN  
FIGURE 3.1-3.

ACTION:

With the SHUTDOWN MARGIN less than <sup>THE REQUIRED VALUE</sup> ~~2.0% delta k/k~~, immediately initiate and continue boration at greater than or equal to 30 gpm of a solution containing greater than or equal to 7000 ppm boron or equivalent until the required SHUTDOWN MARGIN is restored.

SURVEILLANCE REQUIREMENTS

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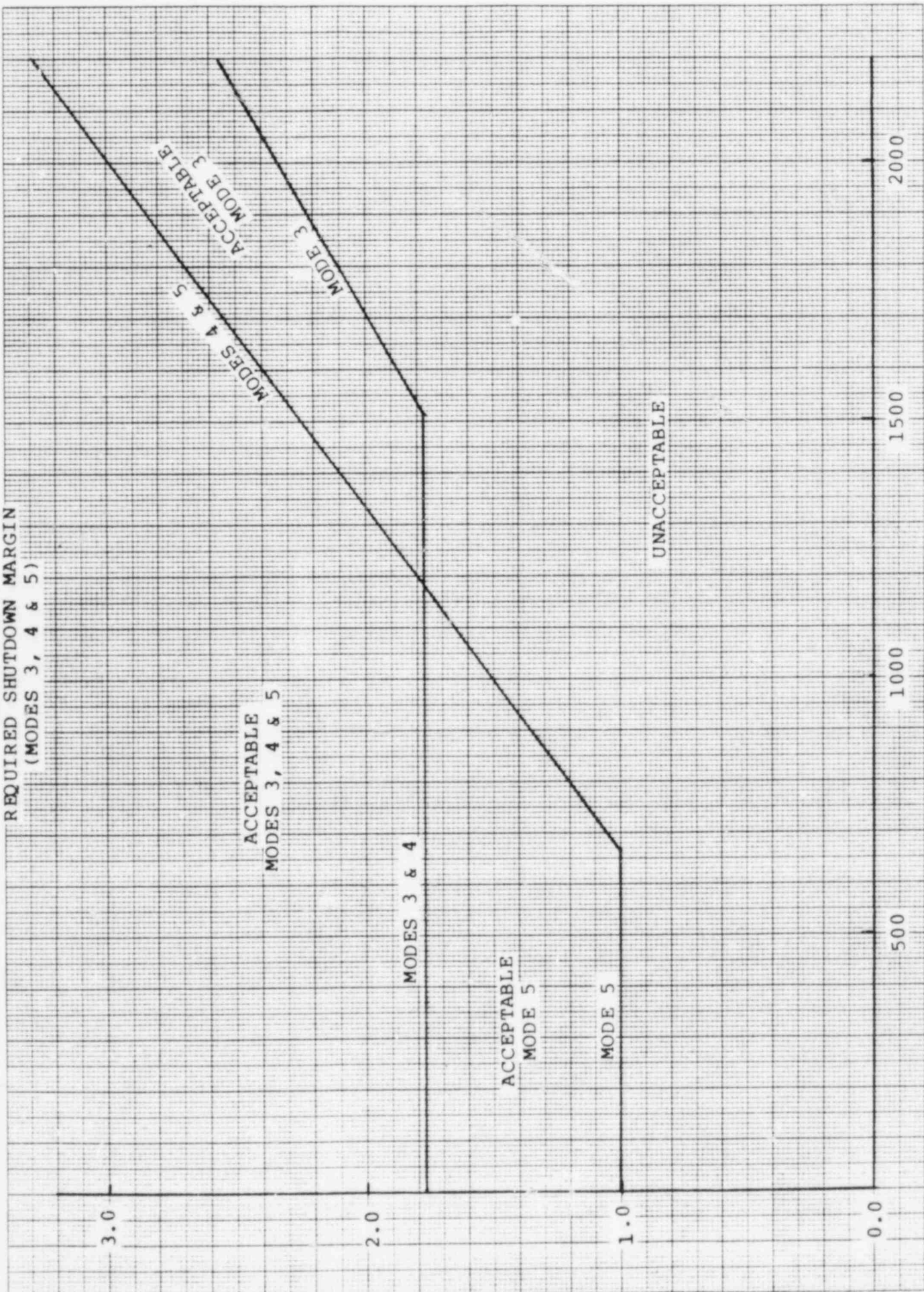
4.1.1.2 The SHUTDOWN MARGIN shall be determined to be greater than or equal to ~~2.0% delta k/k~~: <sup>THE REQUIRED VALUE</sup>

- a. Within one hour after detection of an inoperable control rod(s) and at least once per 12 hours thereafter while the rod(s) is inoperable. If the inoperable control rod is immovable or untrippable, the SHUTDOWN MARGIN shall be verified acceptable with an increased allowance for the withdrawn worth of the immovable or untrippable control rod(s).
- b. At least once per 24 hours by consideration of the following factors:
  1. Reactor coolant system boron concentration,
  2. Control rod position,
  3. Reactor coolant system average temperature,
  4. Fuel burnup based on gross thermal energy generation,
  5. Xenon concentration, and
  6. Samarium concentration.

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FIGURE 3.1-3

REQUIRED SHUTDOWN MARGIN  
(MODES 3, 4 & 5)



RCS BORON CONCENTRATION (ppm)

REQUIRED SHUTDOWN MARGIN,  $\Delta K/k$

### 3/4.1 REACTIVITY CONTROL SYSTEMS

#### BASES

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#### 3/4.1.1 BORATION CONTROL

##### 3/4.1.1.1 and 3/4.1.1.2 SHUTDOWN MARGIN

A sufficient SHUTDOWN MARGIN ensures that 1) the reactor can be made subcritical from all operating conditions, 2) the reactivity transients associated with postulated accident conditions are controllable within acceptable limits, and 3) the reactor will be maintained sufficiently subcritical to preclude inadvertent criticality in the shutdown condition.

SHUTDOWN MARGIN requirements vary throughout core life as a function of fuel depletion, RCS boron concentration, and RCS  $T_{avg}$ . In MODES 1 and 2 the most restrictive condition occurs at EOL, with  $T_{avg}$  at no load operating temperature, and is associated with a postulated steam line break accident and resulting uncontrolled RCS cooldown. In the analysis of this accident, a minimum SHUTDOWN MARGIN of 1.77 percent delta k/k is required to control the reactivity transient. Accordingly, the SHUTDOWN MARGIN requirement is based upon this limiting condition and is consistent with FSAR safety analysis assumptions. In MODES 3, 4 and 5 the most limiting accident is a boron dilution accident. A 2 percent <sup>THE</sup> delta k/k SHUTDOWN MARGIN provides adequate protection in these MODES.

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IS VARIED AS A FUNCTION OF AVERAGE  
RCS BORON CONCENTRATION IN ORDER TO

##### 3/4.1.1.3 MODERATOR TEMPERATURE COEFFICIENT

The limitations on moderator temperature coefficient (MTC) are provided to ensure that the value of this coefficient remains within the limiting condition assumed in the FSAR accident and transient analyses.

The MTC values of this specification are applicable to a specific set of plant conditions; accordingly, verification of MTC values at conditions other than those explicitly stated will require extrapolation to those conditions in order to permit an accurate comparison.

The most negative MTC value equivalent to the most positive moderator density coefficient (MDC), was obtained by incrementally correcting the MDC used in the FSAR analyses to nominal operating conditions. These corrections