ENCLOSURE

CALIBRATION OF EXCORE SYMMETRICAL OFFSET DETECTORS

AFFECTED PAGES

OF

TECHNICAL SPECIFICATION

3.10.2.2.2 or $F_Q(Z)$ shall be measured and a target axial flux difference re-established at least once every seven (7) effective full power days until two successive measurements indicate enthalpy rise hot channel factor, $F^N_{\Delta H}$, is not increasing.

3.10.2.3 The reference equilibrium-indicated axial flux difference as a function of power level (called the target flux difference) shall be determined in conjunction with the measurement of $F_Q(Z)$ as defined in Specification 3.10.2.1.1.*

3.10.2.4 The indicated axial flux difference shall be considered outside of the limits of Sections 3.10.2.5 through 3.10.2.9 when more than one of the operable excore channels are indicating the axial flux difference to be outside a limit.

3.10.2.5 Except during physics tests, and except as modified by 3.10.2.6 through 3.10.2.9 below, the indicated axial flux difference shall be maintained within the applicable target band about the target flux difference (defines the target band on axial flux difference).

3.10.2.6 At a power level greater than 90 percent of rated power, or 0.9 x APL** (whichever is less), if the indicated axial flux difference deviates from its target band, the flux difference shall be returned to the target band immediately or reactor power shall be reduced to a level no greater than 90 percent of rated power or 0.9 x APL (whichever is less).

3.10.2.7 At a power level between 50 percent and 90 percent of rated power, or 0.9 x APL (whichever is less).

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* 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.

** APL is the Allowable Power Level defined in Specification 3.10.2.2.2.

a. The indicated axial flux difference may deviate from its target band for a maximum of one hour (cumulative) in any 24-hour period provided the flux difference does not exceed the limits shown in Figure 3.10-5. If the cumulative time exceeds one hour, then the reactor power shall be reduced immediately to no greater than 50 percent of rated power and the high neutron flux setpoint reduced to no greater than 55 percent of rated power.

b. A power increase to a level greater than 90 percent of rated power or 0.9 x APL (whichever is less) is contingent upon the indicated axial flux difference being within its target band.

3.10.2.8 At a power level no greater than 50 percent of rated power

a. The indicated axial flux difference may deviate from its target band.

b. A power increase to a level greater than 50 percent of rated power is contingent upon the indicated axial flux difference not being outside its target band for more than two hours (cumulative) out of the preceding 24-hour period. One-half of the time the indicated axial flux difference is out of its target band up to 50 percent of rated power is to be counted as contributing to the one-hour cumulative maximum the flux difference may deviate from its target band at a power level less than or equal to 90 percent of rated power or 0.9 x APL (whichever is less).

3.10.2.9 Calibration of excore detectors will be performed under the following conditions:

a. at power levels greater than 90 percent of rated power or 0.9 x APL (whichever is less) provided the axial flux difference does not exceed the specified target bands, or

b. at power levels less than 90 percent of rated power or 0.9 x APL (whichever is less) provided the indicated axial flux difference does not exceed the limits shown in Figure 3.10-5.

3.10.2.10 Alarms shall normally be used to indicate non-conformance with the flux difference requirement of 3.10.2.6 or the flux difference-time requirement of 3.10.2.7.a. If the alarms are temporarily out of service, the axial flux difference shall be logged, and conformance with the limits assessed, every hour for the first 24 hours, and half-hourly thereafter.

3.10.2.11 The axial flux difference target band about the target axial flux difference shall be determined in conjunction with the measurement of $F_Q(Z)$ as specified in 3.10.2.1.1. The allowable values of the target band are shown in Figure 3.10-5. Redefinition of the target band from more restrictive to less restrictive ranges between determinations of the target axial flux difference is allowed when appropriate redefinitions of APL are made. Redefinition of the target band from less restrictive to more restrictive ranges is allowed only in conjunction with the determination of a new target axial flux difference.

3.10.3 Quadrant Power Tilt Limits

3.10.3.1 Except for physics tests and during power increases below 50 percent of rated power, whenever the indicated quadrant power tilt ratio exceeds 1.02, the tilt condition shall be eliminated within two hours or the following actions shall be taken:

a. Restrict core power level and reset the power range high flux setpoint to be less two percent of rated values for every percent of indicated power tilt ratio exceeding 1.0, and

b. If the tilt condition is not eliminated after 24 hours, the power range high flux setpoint shall be reset to 55 percent of rated power. Subsequent reactor operation would be permitted up to 50 percent of rated power for the purpose of measurement and testing to identify the cause of the tilt condition.

3.10.3.2 Except for low power physics tests, if the indicated quadrant tilt exceeds 1.09 and there is simultaneous indication of a misaligned rod:

a. The core power level shall be reduced by 2 percent of rated values for every 1 percent of indicated power tilt exceeding 1.0, and

b. If the tilt condition is not eliminated within two hours, the reactor shall be brought to a hot shutdown condition.

c. After correction of the misaligned rod, reactor operation will be permitted to 50 percent of rated power until the indicated quadrant tilt falls below 1.09.

3.10.3.3 If the indicated quadrant tilt exceeds 1.09 and there is not a simultaneous indication of rod misalignment, except as stated in Specification 3.10.3.2.c, the reactor shall immediately be brought to a hot shutdown condition.

Strict control of the flux difference is not possible during certain physics tests, control rod exercises, or during the required periodic excore calibration which require larger flux differences than permitted. Therefore, the specification on power distribution are not applicable during physics tests, control rod exercises, or excore calibrations; this is acceptable due to the extremely low probability of a significant accident occurring during these operations. Excore calibration includes that period of time necessary to return to equilibrium operating conditions. In some instances of rapid plant power reduction, automatic rod motion will cause the flux difference to deviate from the target band when the reduced power level is reached. This does not necessarily affect the xenon distribution sufficiently to change the envelope of peaking factors which can be reached on a subsequent return to full power within the target band; however, to simplify the specification, a limitation of one hour in any period of 24 hours is placed on operation outside the band. This ensures that the resulting xenon distributions are not significantly different from those resulting from operation within the target band. The instantaneous consequence of being outside the band, provided rod insertion limits are observed, is not worse than a 10 percent increment in peaking factor for flux difference in the allowable range shown in Figure 3.10-5 for 90 percent of rated power or 0.9 x APL (whichever is less). Therefore, while the deviation exists, the power level is limited to 90 percent of rated power or 0.9 x APL (whichever is less) or lower depending on the indicated flux difference.

If, for any reason, flux difference is not controlled with the target band for as long a period as one hour, then xenon distributions may be significantly changed and operation at 50 percent of rated power is required to protect against potentially more severe consequences of some accidents.

As discussed above, the essence of the limits is to maintain the xenon distribution in the core as close to the equilibrium full power condition as possible. This is accomplished by using the chemical volume control system to position the full length control rods to produce the required indication flux difference.

3.11 MOVABLE IN-CORE INSTRUMENTATION

Applicability

Applies to the operability of the movable detector instrumentation system.

Objective

To specify functional requirements on the use of the in-core instrumentation systems, for the calibration of the excore symmetrical offset detection system.

Specification

3.11.1 A minimum of 15 total accessible thimbles and at least 2 per quadrant sufficient movable in-core detectors shall be operable during recalibration of the excore symmetrical offset detection system.

3.11.2 Power shall be limited to 90% of rated power if recalibration requirements for the excore symmetrical offset detection system identified in Table 4.1-1 are not met.

Basis

The Movable In-Core Instrumentation System[1] has five drives, five detectors, and 48 thimbles in the core. Each detector can be routed to twenty or more thimbles. Consequently, the full system has a great deal more capability than would be needed for the calibration of the excore detectors.

To calibrate the excore detector system, it is only necessary that the Movable In-Core System be used to determined the gross power distribution in the core as indicated by the power balance between the top and bottom halves of the core. The thimbles shall be selected such that when reflected into a single quadrant, no assembly is more than a "king's move" away from a measurement. In other words, every assembly is either a measured assembly or touched by a

circle with a radius equal to $\sqrt{2}$ X (the assembly pitch) drawn from the center of the measured assembly. In addition, the number of eighth-core symmetric pairs should be minimized and measurements in every quadrant should be obtained.[2]

After the excore system is calibrated initially, recalibration is needed only infrequently to compensate for changes in the core, due, for example, to fuel depletion, and for changes in the detectors.

If the recalibration is not performed, the mandated power reduction assures safe operation of the reactor since it will compensate for an error of 10% in the excore protection system. Experience at the Beznau No. 1 and R. E. Ginna plants has shown that drift due to the core on instrument channels is very slight. Thus, limiting the operating levels to 90% of the rated power is very conservative.

Reference

(1) FSAR Section 7.7.1.5
(2) WCAP-8648-A, Excore Detector Recalibration Using Quarter-Core Flux Maps, June, 1976