

ATTACHMENT 1

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POWER DISTRIBUTION LIMITS

HEAT FLUX HOT CHANNEL FACTOR- $F_Q(Z)$

LIMITING CONDITION FOR OPERATION

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3.2.2  $F_Q(Z)$  shall be limited by the following relationships:

$$F_Q(Z) \quad \left[ \frac{2.20}{P} \right] [K(Z)] \text{ for } P > 0.5$$

$$F_Q(Z) \quad [4.40] [K(Z)] \text{ for } P \leq 0.5$$

$$\text{where } P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$$

and  $K(Z)$  is the function obtained from Figure 3.2-2 for a given core height location.

APPLICABILITY: MODE 1.

ACTION:

With  $F_Q(Z)$  exceeding its limit:

a. Comply with either of the following ACTIONS:

1. Reduce THERMAL POWER at least 1% for each 1%  $F_Q(Z)$  exceeds the limit within 15 minutes and similarly reduce the Power Range Neutron Flux-High Trip Setpoints within the next 4 hours; POWER OPERATION may proceed for up to a total of 72 hours; subsequent POWER OPERATION may proceed provided the Overpower  $\Delta T$  Trip Setpoints have been reduced at least 1% for each 1%  $F_Q(Z)$  exceeds the limit. The Overpower  $\Delta T$  Trip Setpoint reduction shall be performed with the reactor in at least HOT STANDBY.
2. Reduce THERMAL POWER as necessary to meet the limits of Specification 3.2.6 using the APDMS with the latest incore map and updated  $\bar{R}$ .

b. Identify and correct the cause of the out of limit condition prior to increasing THERMAL POWER above the reduced limit required by a, above; THERMAL POWER may then be increased provided  $F_Q(Z)$  is demonstrated through incore mapping (see Specification 3.3.3.2.1) to be within its limit.

## POWER DISTRIBUTION LIMITS

### SURVEILLANCE REQUIREMENTS

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- 4.2.2.1 The provisions of Specification 4.0.4 are not applicable.
- 4.2.2.2  $F_{xy}$  shall be evaluated to determine if  $F_Q(Z)$  is within its limit by:
- Using the movable incore detectors to obtain a power distribution map at any THERMAL POWER greater than 5% of RATED THERMAL POWER.
  - Increasing the measured  $F_{xy}$  component of the power distribution map by 3% to account for manufacturing tolerances and further increasing the value by 5% to account for measurement uncertainties when at least 38 thimbles are used (see Specification 3.3.3.2.1). If less than 38 but at least 26 thimbles are used (see Specification 3.3.3.2.2) the measured  $F_{xy}$  component shall be further increased by 1%.
  - Comparing the  $F_{xy}$  computed ( $F_{xy}^C$ ) obtained in b, above to:
    - The  $F_{xy}$  limits for RATED THERMAL POWER ( $F_{xy}^{RTP}$ ) for the appropriate measured core planes given in e and f, below, and
    - The relationship:

$$F_{xy}^L = F_{xy}^{RTP} [1 + 0.2(1-P)]$$

where  $F_{xy}^L$  is the limit for fractional THERMAL POWER operation expressed as a function of  $F_{xy}^{RTP}$  and P is the fraction of RATED THERMAL POWER at which  $F_{xy}^{xy}$  was measured.

- Remeasuring  $F_{xy}$  according to the following schedule:
  - When  $F_{xy}^C$  is greater than the  $F_{xy}^{RTP}$  limit for the appropriate measured core plane but less than the  $F_{xy}^L$  relationship, additional power distribution maps shall be taken (see Specification 3.3.3.2.1 and 3.3.3.2.2) and  $F_{xy}^C$  compared to  $F_{xy}^{RTP}$  and  $F_{xy}^L$ :
    - Either within 24 hours after exceeding by 20% of RATED THERMAL POWER or greater, the THERMAL POWER at which  $F_{xy}^C$  was last determined, or

POWER DISTRIBUTION LIMITS

SURVEILLANCE REQUIREMENTS (Continued)

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- (b) At least once per 31 EFPD, whichever occurs first.
2. When the  $F_{xy}^C$  is less than or equal to the  $F_{xy}^{RTP}$  limit for the appropriate measured core plane, additional power distribution maps shall be taken and  $F_{xy}^C$  compared to  $F_{xy}^{RTP}$  and  $F_{xy}^L$  at least once per 31 EFPD.
- e. The  $F_{xy}$  limits for Rated Thermal Power ( $F_{xy}^{RTP}$ ) shall be provided for all core planes containing Bank "D" control rods and all unrodded core planes, in a Core Surveillance Report per Technical Specification 6.9.1.10.
- f. The  $F_{xy}$  limits of e, above, are not applicable in the following core plane regions as measured in percent of core height from the bottom of the fuel:
1. Lower core region from 0 to 15%, inclusive.
  2. Upper core region from 85 to 100%, inclusive.
  3. Grid plane regions at 17.8 ±2%, 32.1 ±2%, 46.4±2%, 60.6 ±2% and 74.9 ±2%, inclusive (17 x 17 fuel elements).
  4. Core plane regions within ±2% of core height (±2.88 inches) about the bank demand position of the bank "D" control rods.
- g. With  $F_{xy}^C$  exceeding  $F_{xy}^L$  the effects of  $F_{xy}$  on  $F_Q(Z)$  shall be evaluated to determine if  $F_Q(Z)$  is within its limit.

4.2.2.3 When  $F_Q(Z)$  is measured by at least 38 thimbles (see Specification 3.3.3.2.1) for other than  $F_{xy}$  determination, an overall measured  $F_Q(Z)$  shall be obtained from a power distribution map and increased by 3% to account for manufacturing tolerances and further increased by 5% to account for measurement uncertainty. When an  $F_Q(Z)$  measurement is taken for monthly surveillance with less than 38 but with at least 26 thimbles (see Specification 3.3.3.2.2), the measured value of  $F_Q(Z)$  shall be further increased by 2%.

POWER DISTRIBUTION LIMITS

NUCLEAR ENTHALPY HOT CHANNEL FACTOR -  $F_{\Delta H}^N$

LIMITING CONDITION FOR OPERATION

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3.2.3  $F_{\Delta H}^N$  shall be limited by the following relationship:

$$F_{\Delta H}^N \leq 1.55 [1 + 0.3 (1-P)] [1-RBP (BU)]$$

where:  $P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$

RBP (BU) - Rod Bow Penalty as a function of region average burnup as shown in Figure 3.2-3, where a region is defined as those assemblies with the same loading date (reloads) or enrichment (first cores).

APPLICABILITY: MODE 1.

ACTION:

With  $F_{\Delta H}^N$  exceeding its limit:

- a. Reduce THERMAL POWER to less than 50% of RATED THERMAL POWER within 2 hours and reduce the Power Range Neutron Flux-High Trip Setpoints  $\leq$  55% of RATED THERMAL POWER within the next 4 hours,
- b. Demonstrate through in-core mapping (see Specification 3.3.3.2.1) that  $F_{\Delta H}^N$  is within its limit within 24 hours after exceeding the limit or reduce THERMAL POWER to less than 5% of RATED THERMAL POWER within the next 2 hours, and
- c. Identify and correct the cause of the out of limit condition prior to increasing THERMAL POWER above the reduced limit required by a or b, above; subsequent POWER OPERATION may proceed provided that  $F_{\Delta H}^N$  is demonstrated through in-core mapping (see Specification 3.3.3.2.1) to be within its limit at a nominal 50% of RATED THERMAL POWER prior to exceeding this THERMAL POWER, at a nominal 75% of RATED THERMAL POWER prior to exceeding this THERMAL POWER and within 24 hours after attaining 95% or greater RATED THERMAL POWER.

POWER DISTRIBUTION LIMITS

SURVEILLANCE REQUIREMENTS

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4.2.3.1.  $F_{\Delta H}^N$  shall be determined to be within its limit by using the movable incore detectors to obtain a power distribution map (see Specifications 3.3.3.2.1 and 3.3.3.2.2):

- 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.
- c. The provisions of Specification 4.0.4 are not applicable.

4.2.3.2 The measured  $F_{\Delta H}^N$  of 4.2.3.1 above, shall be increased by 4% for measurement uncertainty when at least 38 thimbles are used (see Specification 3.3.3.2.1). If less than 38 but at least 26 thimbles are used (see Specification 3.3.3.2.2) the measured  $F_{\Delta H}^N$  shall be further increased by 1%.

## POWER DISTRIBUTION

### LIMITING CONDITION FOR OPERATION (Continued)

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reduce THERMAL POWER to less than 50% of RATED THERMAL POWER within the next 2 hours and reduce the Power Range Neutron Flux-High Trip Setpoints to  $\leq 55\%$  of RATED THERMAL POWER within the next 4 hours.

3. Identify and correct the cause of the out of limit condition prior to increasing THERMAL POWER; subsequent POWER OPERATION above 50% of RATED THERMAL POWER may proceed provided that the QUADRANT POWER TILT RATIO is verified within its limit at least once per hour for 12 hours or until verified acceptable at 95% or greater RATED THERMAL POWER.
- c. With the QUADRANT POWER TILT RATIO determined to exceed 1.09 due to causes other than the misalignment of either a shut-down or control rod:
1. Reduce THERMAL POWER to less than 50% of RATED THERMAL POWER within 2 hours and reduce the Power Range Neutron Flux-High Trip Setpoints to  $\leq 55\%$  of RATED THERMAL POWER within the next 4 hours.
  2. Identify and correct the cause of the out of limit condition prior to increasing THERMAL POWER; subsequent POWER OPERATION above 50% of RATED THERMAL POWER may proceed provided that the QUADRANT POWER TILT RATIO is verified within its limit at least once per hour for 12 hours or until verified as 95% or greater RATED THERMAL POWER.

### SURVEILLANCE REQUIREMENTS

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4.2.4.1 The QUADRANT POWER TILT RATIO shall be determined to be within the limit above 50% of RATED THERMAL POWER by:

- a. Calculating the ratio at least once per 7 days when the alarm is OPERABLE.
- b. Calculating the ratio at least once per 12 hours during steady state operation when the alarm is inoperable.

4.2.4.2 The QUADRANT POWER TILT RATIO shall be determined to be within the limit when above 75 percent of RATED THERMAL POWER with one Power Range Channel inoperable by using the movable incore detectors to confirm that the normalized symmetric power distribution, obtained from 2 sets of 4 symmetric thimble locations or a full-core flux map (see Specification 3.3.3.2.1) is consistent with the indicated QUADRANT POWER TILT RATIO at least once per 12 hours.

## INSTRUMENTATION

### MOVABLE INCORE DETECTORS (AT LEAST 38 DETECTOR THIMBLES)

#### LIMITING CONDITION FOR OPERATION

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3.3.3.2.1 The movable incore detection system shall be OPERABLE with:

- a. At least 75% of the detector thimbles,
- b. A minimum of 2 detector thimbles per core quadrant, and
- c. Sufficient movable detectors, drives, and readout equipment to map these thimbles.

#### APPLICABILITY:

When the movable incore detection system is used for:

- a. Recalibration of the excore neutron flux detection system,
- b. Monitoring the QUADRANT POWER TILT RATIO, or
- c. Measurement of  $F_{\Delta H}^N$ ,  $F_Q(Z)$  and  $F_{xy}(Z)$

#### ACTION:

With the movable incore detection system inoperable, do not use the system for the above applicable monitoring or calibration functions. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

#### SURVEILLANCE REQUIREMENTS

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4.3.3.2.1 The movable incore detection system shall be demonstrated OPERABLE by normalizing each detector output to be used during its use when required for:

- a. Recalibration of the excore neutron flux detection system, or
- b. Monitoring the QUADRANT POWER TILT RATIO, or
- c. Measurement of  $F_{\Delta H}^N$ ,  $F_Q(Z)$  and  $F_{xy}(Z)$

## INSTRUMENTATION

### MOVABLE INCORE DETECTORS (AT LEAST 26 BUT LESS THAN 38 DETECTOR THIMBLES)

#### LIMITING CONDITION FOR OPERATION

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3.3.3.2.2 The movable incore detection system shall be OPERABLE with:

- a. At least 52% of the detector thimbles (26 thimbles),
- b. A minimum of 4 detector thimbles per core quadrant, and
- c. Sufficient movable detectors, drives, and readout equipment to map these thimbles.

#### APPLICABILITY:

When all full length (shutdown and control) rods are OPERABLE and positioned within  $\pm 12$  steps (indicated position) of their group step counter demand position and less than 38 thimbles are operable, the movable incore detection system can be used to satisfy the routine surveillance requirements for:

- a. Recalibration of the excore neutron flux detection system,
- b. Monitoring the QUADRANT POWER TILT RATIO, or
- c. Measurement of  $F_{\Delta H}^N$ ,  $F_Q(Z)$  and  $F_{xy}(Z)$

#### ACTION:

With the movable incore detection system inoperable, do not use the system for the above applicable monitoring or calibration functions. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

#### SURVEILLANCE REQUIREMENTS

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4.3.3.2.2 The movable incore detection system shall be demonstrated OPERABLE by normalizing each detector output to be used during its use when required for:

- a. Recalibration of the excore neutron flux detection system, or
- b. Monitoring the QUADRANT POWER TILT RATIO, or
- c. Measurement of  $F_{\Delta H}^N$ ,  $F_Q(Z)$  and  $F_{xy}(Z)$

## POWER DISTRIBUTION LIMITS

### BASES

#### 3/4.2.2 and 3/4.2.3 HEAT FLUX AND NUCLEAR ENTHALPY HOT CHANNEL FACTORS - $F_Q(Z)$ and $F_{\Delta H}^N$

The limits on heat flux and nuclear enthalpy hot channel factors 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 hot channel factors are 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 hot channel factor 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 3.1.3.6.
- c. The control rod insertion limits of Specifications 3.1.3.5 and 3.1.3.6 are maintained.
- d. The axial power distribution, expressed in terms of AXIAL FLUX DIFFERENCE, is maintained within the limits.

The relaxation in  $F_{\Delta H}^N$  as a function of THERMAL POWER allows changes in the radial power shape for all permissible rod insertion limits.  $F_{\Delta H}^N$  will be maintained within its limits provided conditions a thru d above, are maintained.

When an  $F_Q$  measurement is taken, both experimental error and manufacturing tolerance must be allowed for. 5% is the appropriate allowance for a full core map of at least 38 thimbles taken with the incore detector flux mapping system and 3% is the appropriate allowance for manufacturing tolerance. 7% is the appropriate allowance for a core map of less than 38 thimbles, but with at least 26 thimbles, taken with the incore detector flux mapping system and 3% is the appropriate allowance for manufacturing tolerance.

When  $F_{\Delta H}^N$  is measured with at least 38 thimbles experimental error must be allowed for and 4% is the appropriate allowance for a full core map of at least 38 thimbles taken with the incore detection system. When  $F_{\Delta H}^N$  is measured with less than 38 thimbles but with at least 26 thimbles, experimental error must be allowed for and 5% is the appropriate allowance for a core map of at least 26 thimbles taken with the incore detection system. The specified limit for  $F_{\Delta H}^N$  also contains an 8% allowance for uncertainties which mean that normal operation will result in  $F_{\Delta H}^N \leq 1.55/1.08$ . The 8% allowance is based on the following consideration:

## POWER DISTRIBUTION LIMITS

### BASES

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- a. abnormal perturbations in the radial power shape, such as from rod misalignment, effect  $F_{\Delta H}^N$  more directly than  $F_Q$ ,
- b. although rod movement has a direct influence upon limiting  $F_Q$  to within its limit, such control is not readily available to limit  $F_{\Delta H}^N$ , and
- c. errors in prediction for control power shape detected during startup physics tests can be compensated for in  $F_Q$  by restricting axial flux distributions. This compensation for  $F_{\Delta H}^N$  is less readily available.

### 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 start-up testing and periodically during power operation.

The limit of 1.02 at which corrective action is required provides DNB and linear heat generation rate protection with x-y plane power tilts.

The two hour time allowance for operation with a tilt condition greater than 1.02 but less than 1.09 is provided to allow identification and correction of a dropped or misaligned rod. In the event such action does not correct the tilt, the margin for uncertainty on  $F_Q$  is reinstated by reducing the power by 3 percent for each percent of tilt in excess of 1.0.

For purposes of monitoring QUADRANT POWER TILT RATIO when one excore detector is inoperable, the moveable incore detectors are used to confirm that the normalized symmetric power distribution is consistent with the QUADRANT POWER TILT RATIO. The incore detector monitoring is done with a full incore flux map of at least 38 thimbles or two sets of 4 symmetric thimbles. The two sets of 4 symmetric thimbles is a unique set of 8 detector locations. These locations are C-8, E-5, E-11, H-3, H-13, L-5, L-11, and N-8.

## INSTRUMENTATION

### BASES

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#### RADIATION MONITORING INSTRUMENTATION (Continued)

by the individual channels and 2) the alarm or automatic action is initiated when the radiation level trip setpoint is exceeded.

#### 3/4.3.3.2 MOVABLE INCORE DETECTORS

The OPERABILITY of the movable incore detectors with the specified minimum complement of equipment ensures that the measurements obtained from use of this system accurately represent the spatial neutron flux distribution of the reactor core. The OPERABILITY of this system is demonstrated by irradiating each detector used and normalizing its respective output.

For the purpose of the monthly surveillance measuring of  $F_Q(Z)$  or  $F_{\Delta H}^N$ , an incore map of at least 26 detector thimbles but less than 38 thimbles or a map of at least 38 thimbles may be used, as specified in sections 3.3.3.2.1 and 3.3.3.2.2. When  $F_Q(Z)$  or  $F_{\Delta H}^N$  have exceeded their limits, measuring of  $F_Q(Z)$  or  $F_{\Delta H}^N$  must be made with a full incore map of at least 38 thimbles. Quarter-core flux maps, as defined in WCAP-8648, June 1976, may be used in recalibration of the excore neutron flux detection system, and full incore flux maps of at least 38 thimbles or symmetric incore thimbles may be used for monitoring the QUADRANT POWER TILT RATIO when one Power Range Channel is inoperable.

#### 3/4.3.3.3 SEISMIC INSTRUMENTATION

The OPERABILITY of the seismic instrumentation ensures that sufficient capability is available to promptly determine the magnitude of a seismic event and evaluate the response of those features important to safety. This capability is required to permit comparison of the measured response to that used in the design basis for the facility to determine if plant shutdown is required pursuant to Appendix "A" of 10 CFR Part 100. The instrumentation is generally consistent with the recommendations of Regulatory Guide 1.12, "Instrumentation for Earthquakes," April 1974.

#### 3/4.3.3.4 METEOROLOGICAL INSTRUMENTATION

The OPERABILITY of the meteorological instrumentation ensures that sufficient meteorological data is available for estimating potential radiation doses to the public as a result of routine or accidental release of radioactive materials to the atmosphere. This capability is required to evaluate the need for initiating protective measures to protect the health and safety of the public and is consistent with the recommendations of Regulatory Guide 1.23, "Onsite Meteorological Programs," February 1972. A meteorological data collection program as described above is necessary to meet the requirements of subparagraph 50.36(a)(2) of 10 CFR Part 50, Appendix E to 10 CFR Part 50, and 10 CFR Part 51.

ATTACHMENT 2

POWER DISTRIBUTION LIMITS

HEAT FLUX HOT CHANNEL FACTOR- $F_Q(Z)$

LIMITING CONDITION FOR OPERATION

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3.2.2  $F_Q(Z)$  shall be limited by the following relationships:

$$F_Q(Z) \leq \left[ \frac{2.20}{P} \right] [K(Z)] \text{ for } P > 0.5$$

$$F_Q(Z) \leq [4.40] [K(Z)] \text{ for } P \leq 0.5$$

$$\text{where } P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$$

and  $K(Z)$  is the function obtained from Figure 3.2-2 for a given core height location.

APPLICABILITY: MODE 1.

ACTION:

With  $F_Q(Z)$  exceeding its limit:

a. Comply with either of the following ACTIONS:

1. Reduce THERMAL POWER at least 1% for each 1%  $F_Q(Z)$  exceeds the limit within 15 minutes and similarly reduce the Power Range Neutron Flux-High Trip Setpoints within the next 4 hours; POWER OPERATION may proceed for up to a total of 72 hours; subsequent POWER OPERATION may proceed provided the Overpower  $\Delta T$  Trip Setpoints have been reduced at least 1% for each 1%  $F_Q(Z)$  exceeds the limit. The Overpower  $\Delta T$  Trip Setpoint reduction shall be performed with the reactor in at least HOT STANDBY.
2. Reduce THERMAL POWER as necessary to meet the limits of Specification 3.2.6 using the APDMS with the latest incore map and updated  $\bar{R}$ .

- b. Identify and correct the cause of the out of limit condition prior to increasing THERMAL POWER above the reduced limit required by a, above; THERMAL POWER may then be increased provided  $F_Q(Z)$  is demonstrated through incore mapping (see Specification 3.3.3.2.1) to be within its limit.

POWER DISTRIBUTION LIMITS

SURVEILLANCE REQUIREMENTS

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4.2.2.1 The provisions of Specification 4.0.4 are not applicable.

4.2.2.2  $F_{xy}$  shall be evaluated to determine if  $F_Q(Z)$  is within its limit by:

- a. Using the movable incore detectors to obtain a power distribution map at any THERMAL POWER greater than 5% of RATED THERMAL POWER.
- b. Increasing the measured  $F_{xy}$  component of the power distribution map by 3% to account for manufacturing tolerances and further increasing the value by 5% to account for measurement uncertainties when at least 38 thimbles are used (see Specification 3.3.3.2.1.). If less than 38 but at least 26 thimbles are used (see Specification 3.3.3.2.2) the measured  $F_{xy}$  component shall be further increased by 1%.
- c. Comparing the  $F_{xy}$  computed ( $F_{xy}^C$ ) obtained in b, above to:
  1. The  $F_{xy}$  limits for RATED THERMAL POWER ( $F_{xy}^{RTP}$ ) for the appropriate measured core planes given in e and f, below, and
  2. The relationship:

$$F_{xy}^L = F_{xy}^{RTP} [1 + 0.2(1-P)]$$

where  $F_{xy}^L$  is the limit for fractional THERMAL POWER operation expressed as a function of  $F_{xy}^{RTP}$  and P is the fraction of RATED THERMAL POWER at which  $F_{xy}^{xy}$  was measured.

d. Remeasuring  $F_{xy}$  according to the following schedule:

1. When  $F_{xy}^C$  is greater than the  $F_{xy}^{RTP}$  limit for the appropriate measured core plane but less than the  $F_{xy}^L$  relationship, additional power distribution maps shall be taken (see Specifications 3.3.3.2.1 and 3.3.3.2.2) and  $F_{xy}^C$  compared to  $F_{xy}^{RTP}$  and  $F_{xy}^L$ :
  - a) Either within 24 hours after exceeding by 20% of RATED THERMAL POWER or greater, the THERMAL POWER at which  $F_{xy}^C$  was last determined, or

POWER DISTRIBUTION LIMITS

SURVEILLANCE REQUIREMENTS (Continued)

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- (b) At least once per 31 EFPD, whichever occurs first.
2. When the  $F_{xy}^C$  is less than or equal to the  $F_{xy}^{RTP}$  limit for the appropriate measured core plane, additional power distribution maps shall be taken and  $F_{xy}^C$  compared to  $F_{xy}^{RTP}$  and  $F_{xy}^L$  at least once per 31 EFPD.
- e. The  $F_{xy}$  limits for Rated Thermal Power ( $F_{xy}^{RTP}$ ) shall be provided for all core planes containing Bank "D" control rods and all unrodded core planes, in a Core Surveillance Report per Technical Specification 6.9.1.10.
- f. The  $F_{xy}$  limits of e, above, are not applicable in the following core plane regions as measured in percent of core height from the bottom of the fuel:
1. Lower core region from 0 to 15%, inclusive.
  2. Upper core region from 85 to 100%, inclusive.
  3. Grid plane regions at 17.8 ±2%, 32.1 ±2%, 46.4±2%, 60.6 ±2% and 74.9 ±2%, inclusive (17 x 17 fuel elements).
  4. Core plane regions within ±2% of core height (±2.88 inches) about the bank demand position of the bank "D" control rods.
- g. With  $F_{xy}^C$  exceeding  $F_{xy}^L$
1. The effects of  $F_{xy}^C$  on  $F_Q(Z)$  shall be evaluated to determine if  $F_Q(Z)$  is within its limit.

4.2.2.3 When  $F_Q(Z)$  is measured by at least 38 thimbles (see Specification 3.3.3.2.1) for other than  $F_{xy}$  determination, an overall measured  $F_Q(Z)$  shall be obtained from a power distribution map and increased by 3% to account for manufacturing tolerances and further increased by 5% to account for measurement uncertainty. When an  $F_Q(Z)$  measurement is taken for monthly surveillance with less than 38 but with at least 26 thimbles (see Specification 3.3.3.2.2), the measured value of  $F_Q(Z)$  shall be further increased by 2%.

POWER DISTRIBUTION LIMITS

NUCLEAR ENTHALPY HOT CHANNEL FACTOR -  $F_{\Delta H}^N$

LIMITING CONDITION FOR OPERATION

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3.2.3  $F_{\Delta H}^N$  shall be limited by the following relationship:

$$F_{\Delta H}^N \leq 1.55 [1 + 0.3 (1-P)] [1-RBP (BU)]$$

where:  $P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$

RBP (BU) - Rod Bow Penalty as a function of region average burnup as shown in Figure 3.2-3, where a region is defined as those assemblies with the same loading date (reloads) or enrichment (first cores).

APPLICABILITY: MODE 1.

ACTION:

With  $F_{\Delta H}^N$  exceeding its limit:

- a. Reduce THERMAL POWER to less than 50% of RATED THERMAL POWER within 2 hours and reduce the Power Range Neutron Flux-High Trip Setpoints to less than or equal to 55% of RATED THERMAL POWER within the next 4 hours,
- b. Demonstrate through in-core mapping (see Specification 3.3.3.2.1) that  $F_{\Delta H}^N$  is within its limit within 24 hours after exceeding the limit or reduce THERMAL POWER to less than 5% of RATED THERMAL POWER within the next 2 hours, and
- c. Identify and correct the cause of the out of limit condition prior to increasing THERMAL POWER above the reduced limit required by a or b, above; subsequent POWER OPERATION may proceed provided that  $F_{\Delta H}^N$  is demonstrated through in-core mapping (see Specification 3.3.3.2.1) to be within its limit at a nominal 50% of RATED THERMAL POWER prior to exceeding this THERMAL POWER, at a nominal 75% of RATED THERMAL POWER prior to

## POWER DISTRIBUTION LIMITS

### ACTION (Continued)

exceeding this THERMAL POWER and within 24 hours after attaining 95% or later RATED THERMAL POWER.

## SURVEILLANCE REQUIREMENTS

4.2.3.1.  $F_{\Delta H}^N$  shall be determined to be within its limit by using the movable incore detectors to obtain a power distribution map (see Specifications 3.3.3.2.1 and 3.3.3.2.2):

- 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.
- c. The provisions of Specification 4.0.4 are not applicable.

4.2.3.2 The measured  $F_{\Delta H}^N$  of 4.2.3.1 above, shall be increased by 4% for measurement uncertainty when at least 38 thimbles are used (see Specification 3.3.3.2.1). If less than 38 but at least 26 thimbles are used (see Specification 3.3.3.2.2) the measured  $F_{\Delta H}^N$  shall be further increased by 1%.

## POWER DISTRIBUTION

### LIMITING CONDITION FOR OPERATION (Continued)

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- c. With the QUADRANT POWER TILT RATIO determined to exceed 1.09 due to causes other than the misalignment of either a shutdown or control rod:
  1. Calculate the QUADRANT POWER TILT RATIO at least once per hour until:
    - (a) Either the QUADRANT POWER TILT RATIO is reduced to within its limit, or
    - (b) THERMAL POWER is reduced to less than 50% of RATED THERMAL POWER.
  2. Reduce THERMAL POWER to less than 50% of RATED THERMAL POWER within 2 hours and reduce the Power Range Neutron Flux-High Trip Setpoints to less than or equal to 55% of RATED THERMAL POWER within the next 4 hours.
  3. Identify and correct the cause of the out of limit condition prior to increasing THERMAL POWER; subsequent POWER OPERATION above 50% of RATED THERMAL POWER may proceed provided that the QUADRANT POWER TILT RATIO is verified within its limit at least once per hour for 12 hours or until verified as 95% or greater RATED THERMAL POWER.

### SURVEILLANCE REQUIREMENTS

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- 4.2.4.1 The QUADRANT POWER TILT RATIO shall be determined to be within the limit above 50% of RATED THERMAL POWER by:
  - a. Calculating the ratio at least once per 7 days when the alarm is OPERABLE.
  - b. Calculating the ratio at least once per 12 hours during steady state operation when the alarm is inoperable.
- 4.2.4.2 The QUADRANT POWER TILT RATIO shall be determined to be within the limit when above 75 percent of RATED THERMAL POWER with one Power Range Channel inoperable by using the movable incore detectors to confirm that the normalized symmetric power distribution, obtained from 2 sets of 4 symmetric thimble locations or a full-core flux map (see Specification 3.3.3.2.1) is consistent with the indicated QUADRANT POWER TILT RATIO at least once per 12 hours.

## INSTRUMENTATION

### MOVABLE INCORE DETECTORS (AT LEAST 38 DETECTOR THIMBLES)

#### LIMITING CONDITION FOR OPERATION

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3.3.3.2.1 The movable incore detection system shall be OPERABLE with:

- a. At least 75% of the detector thimbles,
- b. A minimum of 2 detector thimbles per core quadrant, and
- c. Sufficient movable detectors, drives, and readout equipment to map these thimbles.

#### APPLICABILITY:

When the movable incore detection system is used for:

- a. Recalibration of the excore neutron flux detection system,
- b. Monitoring the QUADRANT POWER TILT RATIO, or
- c. Measurement of  $F_{\Delta H}^N$ ,  $F_Q(Z)$  and  $F_{xy}(Z)$

#### ACTION:

With the movable incore detection system inoperable, do not use the system for the above applicable monitoring or calibration functions. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

#### SURVEILLANCE REQUIREMENTS

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4.3.3.2.1 The movable incore detection system shall be demonstrated OPERABLE, at least once per 24 hours, by normalizing each detector output to be used during its use when required for:

- a. Recalibration of the excore neutron flux detection system, or
- b. Monitoring the QUADRANT POWER TILT RATIO, or
- c. Measurement of  $F_{\Delta H}^N$ ,  $F_Q(Z)$  and  $F_{xy}(Z)$

## INSTRUMENTATION

### MOVABLE INCORE DETECTORS (AT LEAST 26 BUT LESS THAN 38 DETECTOR THIMBLES)

#### LIMITING CONDITION FOR OPERATION

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3.3.3.2.2 The movable incore detection system shall be OPERABLE with:

- a. At least 52% of the detector thimbles (26 thimbles),
- b. A minimum of 4 detector thimbles per core quadrant, and
- c. Sufficient movable detectors, drives, and readout equipment to map these thimbles.

#### APPLICABILITY:

When all full length (shutdown and control) rods are OPERABLE and positioned within  $\pm 12$  steps (indicated position) of their group step counter demand position and less than 38 thimbles are operable, the movable incore detection system can be used to satisfy the routine surveillance requirements for:

- a. Recalibration of the excore neutron flux detection system,
- b. Monitoring the QUADRANT POWER TILT RATIO, or
- c. Measurement of  $F_{\Delta H}^N$ ,  $F_Q(Z)$  and  $F_{xy}(Z)$

#### ACTION:

With the movable incore detection system inoperable, do not use the system for the above applicable monitoring or calibration functions. The provisions of Specifications 3.0.3 and 3.0.4 are not applicable.

#### SURVEILLANCE REQUIREMENTS

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4.3.3.2.2 The movable incore detection system shall be demonstrated OPERABLE, at least once per 24 hours, by normalizing each detector output to be used during its use when required for:

- a. Recalibration of the excore neutron flux detection system, or
- b. Monitoring the QUADRANT POWER TILT RATIO, or
- c. Measurement of  $F_{\Delta H}^N$ ,  $F_Q(Z)$  and  $F_{xy}(Z)$

## POWER DISTRIBUTION LIMITS

### BASES

#### 3/4.2.2 and 3/4.2.3 HEAT FLUX AND NUCLEAR ENTHALPY HOT CHANNEL FACTORS - $F_Q(Z)$ and $F_{\Delta H}^N$

The limits on heat flux and nuclear enthalpy hot channel factors 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 hot channel factors are 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 hot channel factor 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 3.1.3.6.
- c. The control rod insertion limits of Specifications 3.1.3.5 and 3.1.3.6 are maintained.
- d. The axial power distribution, expressed in terms of AXIAL FLUX DIFFERENCE, is maintained within the limits.

The relaxation in  $F_{\Delta H}^N$  as a function of THERMAL POWER allows changes in the radial power shape for all permissible rod insertion limits.  $F_{\Delta H}^N$  will be maintained within its limits provided conditions a thru d above, are maintained.

When an  $F_Q$  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 of at least 38 thimbles taken with the incore detector flux mapping system and a 3% allowance is appropriate for manufacturing tolerance. 7% is the appropriate allowance for a core map of less than 38 thimbles, but with at least 26 thimbles, taken with the incore detector flux mapping system and a 3% allowance is appropriate for manufacturing tolerance.

## POWER DISTRIBUTION LIMITS

### BASES

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When  $F_{\Delta H}^N$  is measured with at least 38 thimbles, 4% is the appropriate experimental error allowance for a full core map of at least 38 thimbles taken with the incore detection system. When  $F_{\Delta H}^N$  is measured with less than 38 thimbles but with at least 26 thimbles, experimental error must be allowed for and 5% is the appropriate allowance for a core map of at least 26 thimbles taken with the incore detector system. The specified limit for  $F_{\Delta H}^N$  also contains an 8% allowance for uncertainties which mean that normal operation will result in  $F_{\Delta H}^N$  less than or equal to 1.55/1.08. The 8% allowance is based on the following consideration:

- a. abnormal perturbations in the radial power shape, such as from rod misalignment, effect  $F_{\Delta H}^N$  more directly than  $F_Q$ ,
- b. although rod movement has a direct influence upon limiting  $F_Q$  to within its limit, such control is not readily available to limit  $F_{\Delta H}^N$ , and
- c. errors in prediction for control power shape detected during startup physics tests can be compensated for in  $F_Q$  by restricting axial flux distributions. This compensation for  $F_{\Delta H}^N$  is less readily available.

### 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 start-up testing and periodically during power operation.

The limit of 1.02 at which corrective action is required provides DNB and linear heat generation rate protection with x-y plane power tilts.

The two hour time allowance for operation with a tilt condition greater than 1.02 but less than 1.09 is provided to allow identification and correction of a dropped or misaligned rod. In the event such action does not correct the tilt, the margin for uncertainty on  $F_Q$  is reinstated by reducing the power by 3 percent for each percent of tilt in excess of 1.0.

For purposes of monitoring QUADRANT POWER TILT RATIO when one excore detector is inoperable, the moveable incore detectors are used to confirm that the normalized symmetric power distribution is consistent with the QUADRANT POWER TILT RATIO. The incore detector monitoring is done with a full incore flux map of at least 38 thimbles or two sets of 4 symmetric thimbles. The two sets of 4 symmetric thimbles is a unique set of 8 detector locations. These locations are C-8, E-5, E-11, H-3, H-13, L-5, L-11, and N-8.

## INSTRUMENTATION

### BASES

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#### 3/4.3.3.2 MOVABLE INCORE DETECTORS

The OPERABILITY of the movable incore detectors with the specified minimum complement of equipment ensures that the measurements obtained from use of this system accurately represent the spatial neutron flux distribution of the reactor core. The OPERABILITY of this system is demonstrated by irradiating each detector used and normalizing its respective output.

For the purpose of the monthly surveillance measuring of  $F_Q(Z)$  or  $F_{\Delta H}^N$ , an incore map of at least 26 detector thimbles but less than 38 thimbles or a map of at least 38 thimbles may be used, as specified in sections 3.3.3.2.1 and 3.3.3.2.2. When  $F_Q(Z)$  or  $F_{\Delta H}^N$  have exceeded their limits, measuring of  $F_Q(Z)$  or  $F_{\Delta H}^N$  must be made with a full incore map of at least 38 thimbles. Quarter-core flux maps, as defined in WCAP-8648, June 1976, may be used in recalibration of the excore neutron flux detection system, and full incore flux maps of at least 38 thimbles or symmetric incore thimbles may be used for monitoring the QUADRANT POWER TILT RATIO when one Power Range Channel is inoperable.

#### 3/4.3.3.3 SEISMIC INSTRUMENTATION

Not Applicable.

#### 3/4.3.3.4 METEOROLOGICAL INSTRUMENTATION

Not Applicable.

#### 3/4.3.3.5 AUXILIARY SHUTDOWN PANEL MONITORING INSTRUMENTATION

The OPERABILITY of the remote shutdown instrumentation ensures that sufficient capability is available to permit shutdown and maintenance of HOT STANDBY of the facility from locations outside of the control room. This capability is required in the event control room habitability is lost and is consistent with General Design Criterion 19 of 10 CFR 50.

#### 3/4.3.3.6 ACCIDENT MONITORING INSTRUMENTATION

The OPERABILITY of the accident monitoring instrumentation ensures that sufficient information is available on selected plant parameters to monitor and assess these variables following an accident.

ATTACHMENT 3

## SAFETY EVALUATION

The North Anna Technical Specifications currently require a full core map to consist of a minimum of 75% of the monitored detector thimbles (38 thimbles). However, if a full core map is necessary, and a malfunction of the flux mapping system hardware results in a condition where less than 38 thimbles are accessible, valid hot channel peaking factor measurements can still be made.

Based on a study of the effects of reduced number of thimbles on hot channel peaking factor measurements<sup>1</sup>, uncertainty values, which must be applied in addition to the current measurement and manufacturing uncertainty values, were derived. They are an additional 1% for  $F_{\Delta H}^N$ , 2% for  $F_Q$ , and 1% for  $F_{xy}$ . These uncertainty values are valid if there is a minimum of 26 monitored thimbles with at least four thimbles per core quadrant (two thimbles per core quadrant are required for a minimum of 38 thimbles). Furthermore, only monthly hot channel factor measurements will be performed using less than 38 thimbles (each monthly surveillance interval is 31 effective full power days). If less than 26 detector thimbles are accessible, the incore detection system will not be used for hot channel peaking factor ( $F_Q$ ,  $F_{\Delta H}^N$ , and  $F_{xy}$ ) verification.

This proposed change does not pose an unreviewed safety question or a significant hazard consideration. The probability of occurrence or the consequences of a malfunction of equipment important to safety and previously evaluated in the UFSAR is not increased, and the possibility of a different type of accident or malfunction than was previously evaluated in the UFSAR has not been created because this proposed change only modifies a surveillance hardware requirement without reducing the capability of the hardware to perform

<sup>1</sup> A Study of the Effects of a Reduced Number of Thimbles On the Results of Incore Flux Map Analysis, VEP-NOS-8, D. L. Reid, October, 1983. (Attached)

its intended function. The margin of safety as described in the Bases section of any part of the Technical Specifications is not reduced since the additional uncertainty values which will be applied to the measured hot channel peaking factors yield a result that is equivalent to or conservative with respect to flux map analyses results obtained in accordance with the requirements of the current Technical Specifications.

ATTACHMENT 4