GENE-637-044-0295
DRF A00-04021
Class III

APPLICATION OF THE "REGIONAL EXCLUSION WITH FLOW-BIASED APRM NEUTRON FLUX SCRAM" STABILITY SOLUTION (OPTION I-D) TO THE JAMES A. FITZPATRICK NUCLEAR POWER PLANT

Licensing Topical Report

February 1995

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ABSTRACT

This report demonstrates the application of the "Regional Exclusion with Flow-Biased APRM Neutron Flux Scram" Stability Solution (Option I-D) of the "BWR Owners' Group Stability Long-term Solutions Licensing Methodology" to Cycle 10 of the James A. Fitzpatrick Nuclear Power Plant. Compliance with General Design Criterion 12 is met and protection of the fuel Safety Limit Minimum Critical Power Ratio is demonstrated for both Core-wide Mode and Regional Mode oscillations with the Flow-biased APRM Neutron Flux Scram System. An Exclusion Region is presented for the plant which identifies plant conditions that may lead to an instability and it is shown that the large single-phase pressure drops induced by the relatively small inlet orifices of Fitzpatrick will create a preference for Core-wide Mode oscillations should the plant maneuver into the conditions susceptible to oscillations. Although the analysis concludes that Regional Mode oscillations are not anticipated to occur for Fitzpatrick, the Flow-biased APRM Neutron Flux Scram provides protection for this mode.

1 INTRODUCTION

This report demonstrates the application of the "Regional Exclusion with Flow-Biased APRM Neutron Flux Scram" Stability Solution (Option I-D) to the James A. Fitzpatrick Nuclear Power Plant as prescribed by the "BWR Owners' Group Long-term Stability Solutions Licensing Methodology" [1]. The protection of the Safety Limit Minimum Critical Power Ratio (SLMCPR) afforded by the Flow-biased Average Power Range Monitor (APRM) Neutron Flux Scram is demonstrated for the preferred mode of coupled thermal-hydraulic/neutronic oscillations for Fitzpatrick, i.e., Core-wide Mode. For Regional Mode oscillations, protection of the SLMCPR is calculated commensurate with expected frequency of occurrence of such oscillations. This solution creates an "Exclusion Region" in the plant operating map wherein oscillatory power behavior is conservatively predicted and which is avoided during plant operations.

1.1 Historical Perspective

Protection against power oscillations that might lead to fuel damage has always been required by General Design Criterion 12 [2], which requires that such oscillations either not be possible or be reliably detected and suppressed. In the past, this requirement was met by showing that oscillations are not possible by calculating Core and Channel Decay Ratios as a part of reload licensing analyses. Such results notwithstanding, guidance was provided to BWR operators as early as 1982 in the form of a GE Service Information Letter [3] on the detection and suppression of hypothetical power oscillations at low-flow and high-power conditions.

With the advent of 8X8 fuel designs and more aggressive operating strategies to improve operational flexibility and fuel utilization (e.g., extended load lines, feedwater heaters out-of-service, etc.), stability margins decreased such that instabilities could no longer be demonstrated to be impossible; therefore, in 1982 and after, protection against power oscillations was ensured by providing plant operators with guidance on detecting and suppressing such oscillations [3,4]. In addition, analysis was performed to demonstrate that the occurrence of such oscillations did not challenge fuel thermal-mechanical limits [5,6]

Additional concerns about BWR stability were raised by the March 9, 1988, oscillation event at the LaSalle-2 plant, when investigations revealed that power oscillations could occur more rapidly than had been thought probable. Furthermore, new analyses predicted less margin to the MCPR limit than was previously shown [7]. This event led NRC to issue Bulletin 88-07 [8], which requires BWR owners to indicate how they would guard against such events in the future.

1.2 BWR Owners' Group Response

In response to NRC Bulletin 88-07, the BWR Owners' Group, in conjunction with GE, implemented a program to develop a long-term solution to the whole stability issue. The BWROG approach, as well as interim protective guidelines, was accepted by the NRC in Supplement 1 to the aforementioned Bulletin [9]. The BWROG efforts have culminated in the generation of the "BWR Owners' Group Long-term Stability Solutions Licensing Methodology," which outlines several solution options. Some of these involve the introduction of a new Reactor Protection System (RPS) trip function and may be applied to all BWR's, while others demonstrate the adequacy of existing hardware but are applicable to only a limited set of plants.

1.3 Option I-D Solution

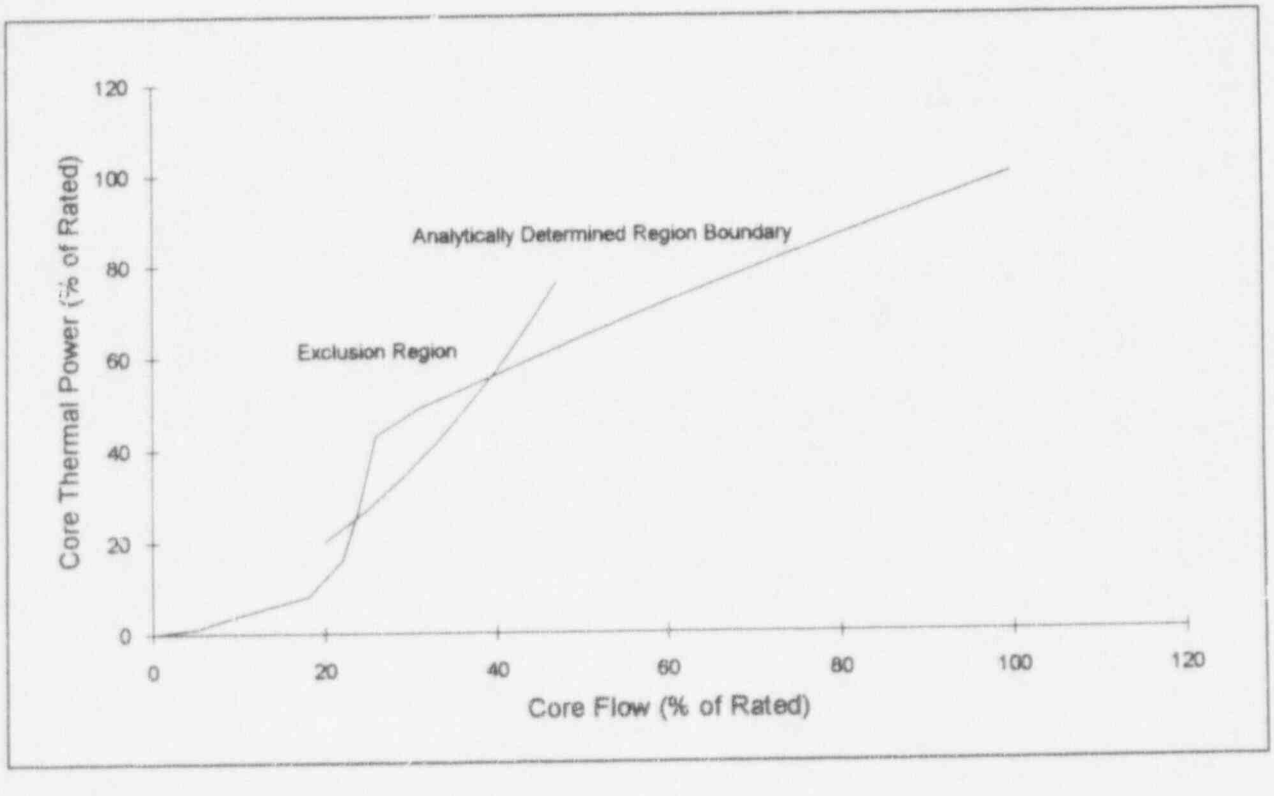
One of the solutions which demonstrates the adequacy of existing hardware is Option I-D, entitled, "Regional Exclusion with Flow-Biased APRM Neutron Flux Scram." This solution consists of two parts. The first is the creation of an Exclusion Region in the operating map for the plant (Figure 1-1). This is a region where conservative Decay Ratio calculations indicate that power oscillations are possible. If the plant should enter this region due to an operational transient, such as a Recirculation Pump trip, a Recirculation Pump runback, or, the Loss of Feedwater Heating or Inadvertent Control Rod Withdrawal at low flow, the operators are instructed to leave the region promptly or provide manual scram if oscillations occur. As a part of the generation of the Exclusion Region, the margin to Regional Mode oscillations is quantified using the methodology identified in Supplement 1 to NEDO-31960 [1].

The second part of this solution is a demonstration that, even in the unlikely event of a power oscillation, an APRM Flow-Biased Flux Trip will detect and suppress the most probable mode power oscillations (Core-wide Mode) before the MCPR limit is reached. This demonstration uses the statistical methodology described in NEDO-31960 [1] (Section 6.0). It is conservatively applied for Core-wide Mode oscillations both in terms of the inputs and confidence levels used in the statistical methodology. In addition, a similar demonstration is made for Regional Mode oscillations, but with best estimate nominal values selected as inputs to the analysis and nominal confidence levels, even though such oscillations are not predicted to occur (Figure 4-2).

While the Exclusion Region and MCPR analysis are the most prominent parts of the Option I-D solution, they should not be regarded, in and of themselves, as the complete solution. Rather, they are part of a hierarchy of barriers that provide a high degree of assurance that fuel thermal limits cannot be approached. The barriers that must be scaled before fuel limits can be approached may be summarized as:

- Occurrence of a transient that brings the plant into the Exclusion Region (e.g., pump trip, pump runback, Inadvertent Control Rod withdrawal or Loss of Feedwater Heating during startup)
- Failure to leave the Exclusion Region either by increasing flow or decreasing power (It has been observed that an appreciable time lapse occurs before the system stabilizes at the new operating point and that oscillations require some time to evolve. There is adequate time for the operators to maneuver the plant out of the Exclusion Region or to scram the plant upon recognition of an oscillation.)
- Development of oscillatory power behavior for which a RPS trip does not occur before fuel thermal limits are exceeded

Figure 1-1
Typical Exclusion Region in Operating Map



1.4 Applicability of Option I-D to Fitzpatrick

Integral to the Option I-D approach is the assertion that Regional Mode oscillations have a low probability of occurrence. One feature of Fitzpatrick that assists in protecting against the occurrence of Regional Mode oscillations is that there are large single-phase channel pressure losses when compared to other BWR's. Such losses, in the absence of other changes in core hydraulic characteristics, are known to be stabilizing. When comparing various plant designs, differences in single phase pressure losses are mostly attributable to the fuel inlet orifices; thus, plants, such as Fitzpatrick, which have relatively small inlet orifice diameters, are expected to be more stable than those with large inlet orifice diameters (the inlet orifice diameter for Fitzpatrick is 2.09 inches as compared to 2.43 inches for most other BWR 4's and 5's).

Option I-D has been characterized as applying to plants where the core is relatively "small." Since the phenomenon underlying the neutronic portion of Regional Mode oscillations is the excitation of the higher harmonics modes of the fundamental (i.e., critical) flux shape, the occurrence of Regional Mode oscillations requires the insertion of sufficient reactivity to overcome the inherent sub-critical multiplication of those modes (i.e., "eigenvalue separation"). The eigenvalue separation has been found to be strongly dependent on the size of the core, with smaller cores (e.g., 368 bundles) having markedly greater separation than larger cores (e.g., 764 bundles). In general, the Core-wide Mode will be excited before the Regional Mode for smaller core sizes, and the APRM Flow Biased Flux Scram will suppress the oscillations before a thermal limit is reached (the MCPR limit is the most sensitive thermal limit for oscillations). However, the current analysis conservatively neglects eigenvalue separation and relies wholly on the larger hydraulic losses of the inlet orifices to demonstrate a preference for the Core-wide Mode of oscillation.

While Fitzpatrick can be characterized as having a "mid-size" core (it has 560 bundles), it is demonstrated that the hydraulic losses caused by its orifices are of sufficient importance to force a preference for a Core-wide Mode of oscillation (it has the smallest orifice size of those used in GE BWR 3-6 design).

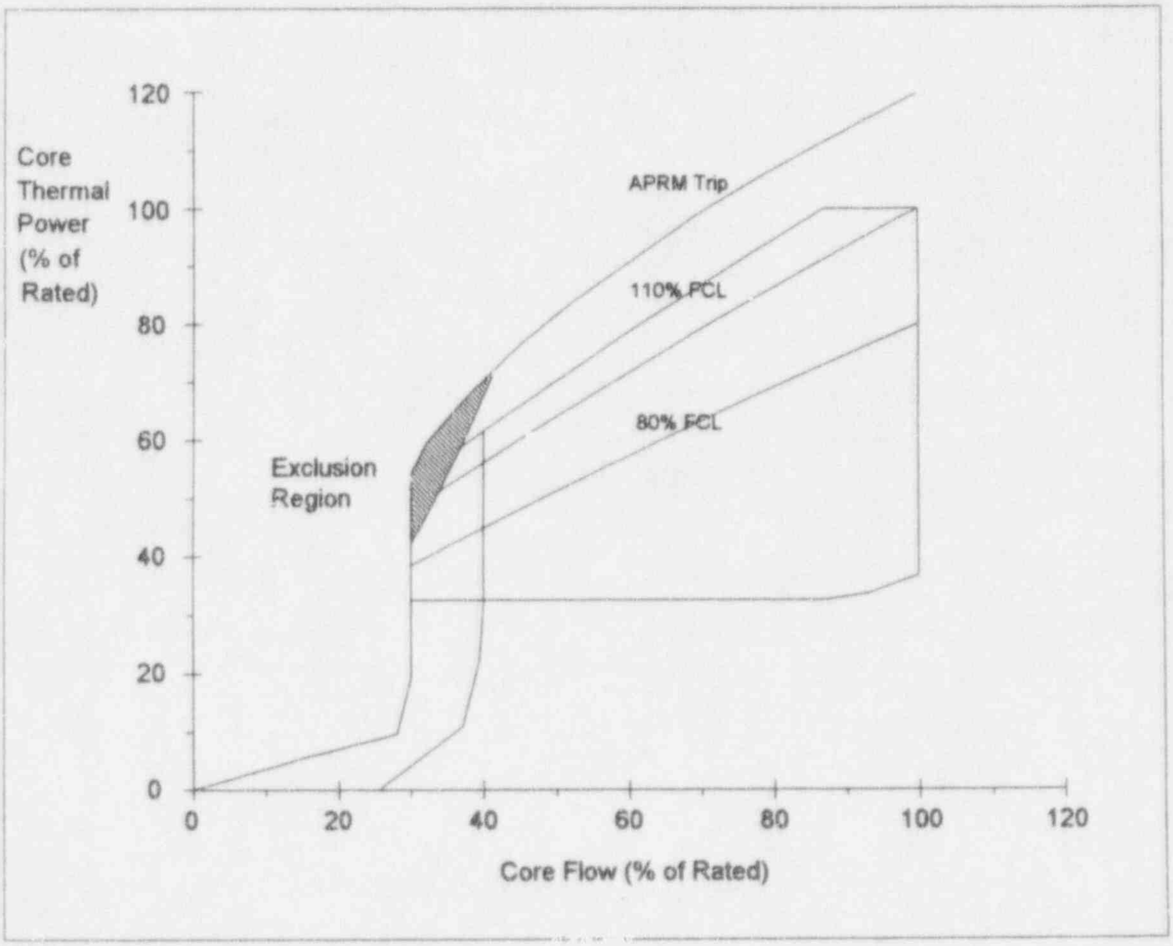
To adopt this solution Fitzpatrick must alter its Simulated Thermal-Power Monitor (STPM) logic to eliminate the APRM signal filtering intended to approximate the fuel thermal response rather than the neutron flux. If the STPM were left in place, the ~.45 Hz frequency characteristic of oscillations would effectively be eliminated by the ~6 second time constant of the STPM.

2 SUMMARY AND CONCLUSIONS

Compliance with General Design Criterion 12 is met with the Regional Exclusion with Flow-biased APRM Neutron Flux Scram Stability Solution (Option I-D) for Cycle 10 of the James A. Fitzpatrick Nuclear Power Plant.

The Exclusion Region for Cycle 10 of Fitzpatrick is shown in Figure 2-1. The analysis shows that Core-wide Mode oscillations are the preferred mode for Fitzpatrick primarily due to the relatively small fuel inlet orifices.

Figure 2-1
Fitzpatrick Exclusion Region (Cycle 10)



Protection for Core-wide Mode oscillations is provided by the Flow-biased APRM Neutron Flux Scram with large margin to the Safety Limit Minimum Critical Power Ratio (SLMCPR). Using normal statistical confidence levels, protection of the SLMCPR is assured for Regional Mode oscillations even though there is large margin to the occurrence of Regional Mode oscillations throughout the Exclusion Region.

The analysis uses conservative inputs and assumptions so as to provide assurance that the results of this demonstration for Cycle 10 are conservative with respect to future reload cycles.

3 APPLICATION OF BWROG STABILITY LONG-TERM SOLUTION REGIONAL EXCLUSION METHODOLOGY

Section 3 describes the application of the BWROG Regional Exclusion Methodology for Fitzpatrick. This application is intended to define the power flow conditions to be avoided during normal operation. Also, the results of this analysis conservatively indicate that the Core-wide Mode is the preferred mode for Fitzpatrick. The analysis inputs described below for the demonstration application were developed for Cycle 10. Future operating cycle reload analyses will confirm the applicability of the power flow map Exclusion Region and preference for Core-wide Mode oscillations to the particular characteristics of the new fuel cycle.

The algorithm used to define the Exclusion Region is based on the FABLE/BYPSS methodology and the inputs to it are as described in Section 5.2 of the BWROG methodology report [1]. Input parameters that are dependent upon cycle specific parameters, such as fuel loading, are from Cycle 10 for Fitzpatrick. As such, the Exclusion Region is specific to Cycle 10 and its validity must be confirmed for each subsequent fuel reload.

3.1 Void Coefficient

The most negative point model void-feedback parameters (nuclear void coefficient and delayed neutron data) for Cycle 10 are used. Since this coefficient is the most negative value for the cycle, it does not correspond to the other inputs to the methodology (e.g., axial power distribution) but is conservative.

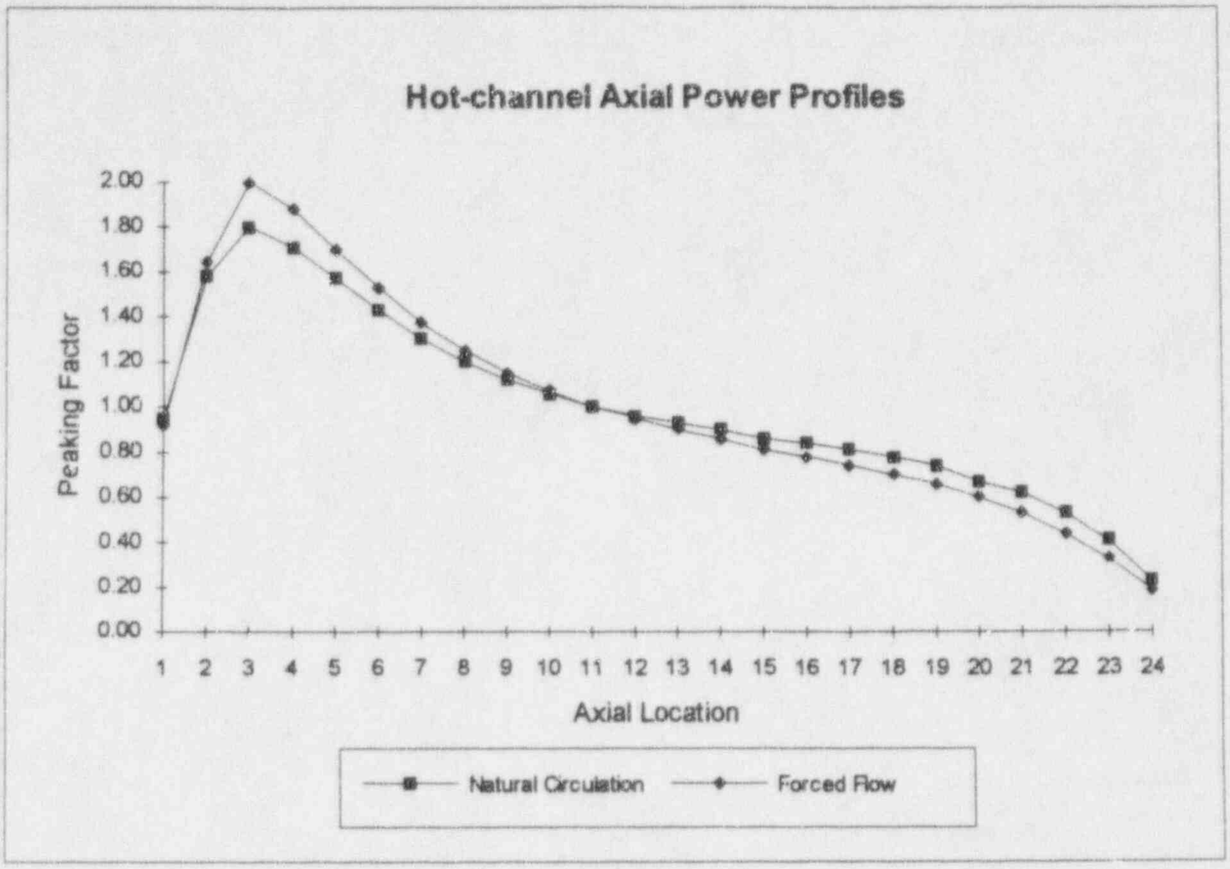
3.2 Thermal-hydraulic Data

Standard design values for Fitzpatrick, consistent with the FABLE/BYPSS qualification bases, are used in the analysis.

3.3 Hot-Channel Axial Power Distribution

Channel hydraulic stability is known to be strongly affected by the channel's axial power distribution. For the hot channels, the axial power distribution is fixed by the procedure to be peaked near the bottom of the channel, a distribution that is known to be less stable. These axial power distributions for both forced flow and natural circulation are shown in Figure 3-1. These axial profiles are consistent with those shown in Figure 5-5 of the BWROG Methods report [1]. Hot channels are identified for each hydraulic channel design in the Fitzpatrick core.

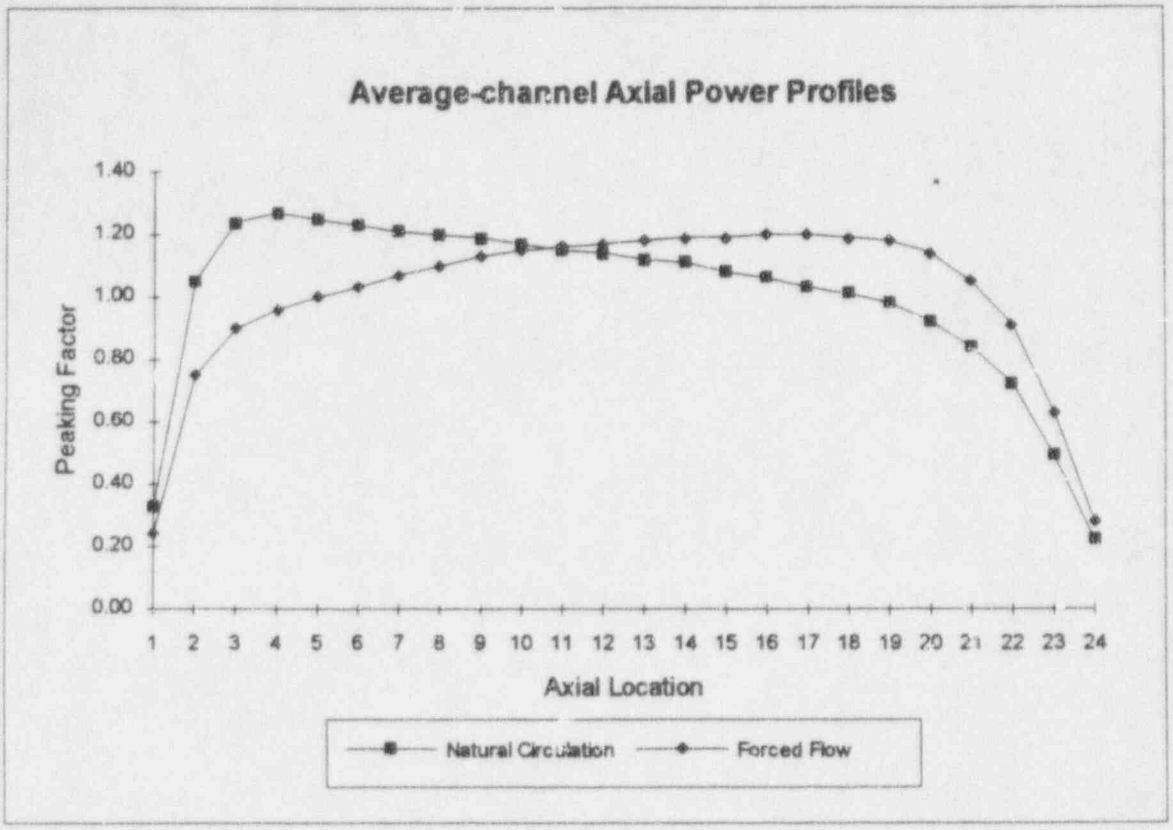
Figure 3-1



3.4 Average-Channel Axial Power Distribution

Core stability is known to be affected by the axial power distribution of the bulk of the channels in the core (all those other than the "hot channels"). In the absence of other changes, a relatively "flat" axial power distribution will be less stable than top-peaked or bottom-peaked distributions; therefore, for forced circulation conditions, the Haling End-of-Cycle 10 (EOC-10) full power and flow core-average axial power distribution is used (see Figure 3-2). For natural circulation conditions the power distribution moves strongly to the bottom of the core and use of a Haling profile characteristic of full power and flow would be too conservative; therefore, a core-average axial power distribution characteristic of Natural Circulation flow at the Haling EOC-10 exposure point is used. The axial power profile at the intersection of the rated Flow-control Line (FCL) and the Natural Circulation flow line is shown in Figure 3-2.

Figure 3-2



Average-channel Axial Power Profiles

3.5 Radial Power Distribution

The radial peaking factors for the channel grouping used in the FABLE/BYPSS analyses are based on those obtained from the GE 3D BWR Simulator Code [10]. The values chosen are from the EOC-10 Haling exposure point.

3.6 Pellet-Clad Gap Conductance

Core average pellet-clad gap conductances were determined for each fuel design using the approved fuel licensing model consistent with the FABLE/BYPSS qualification bases.

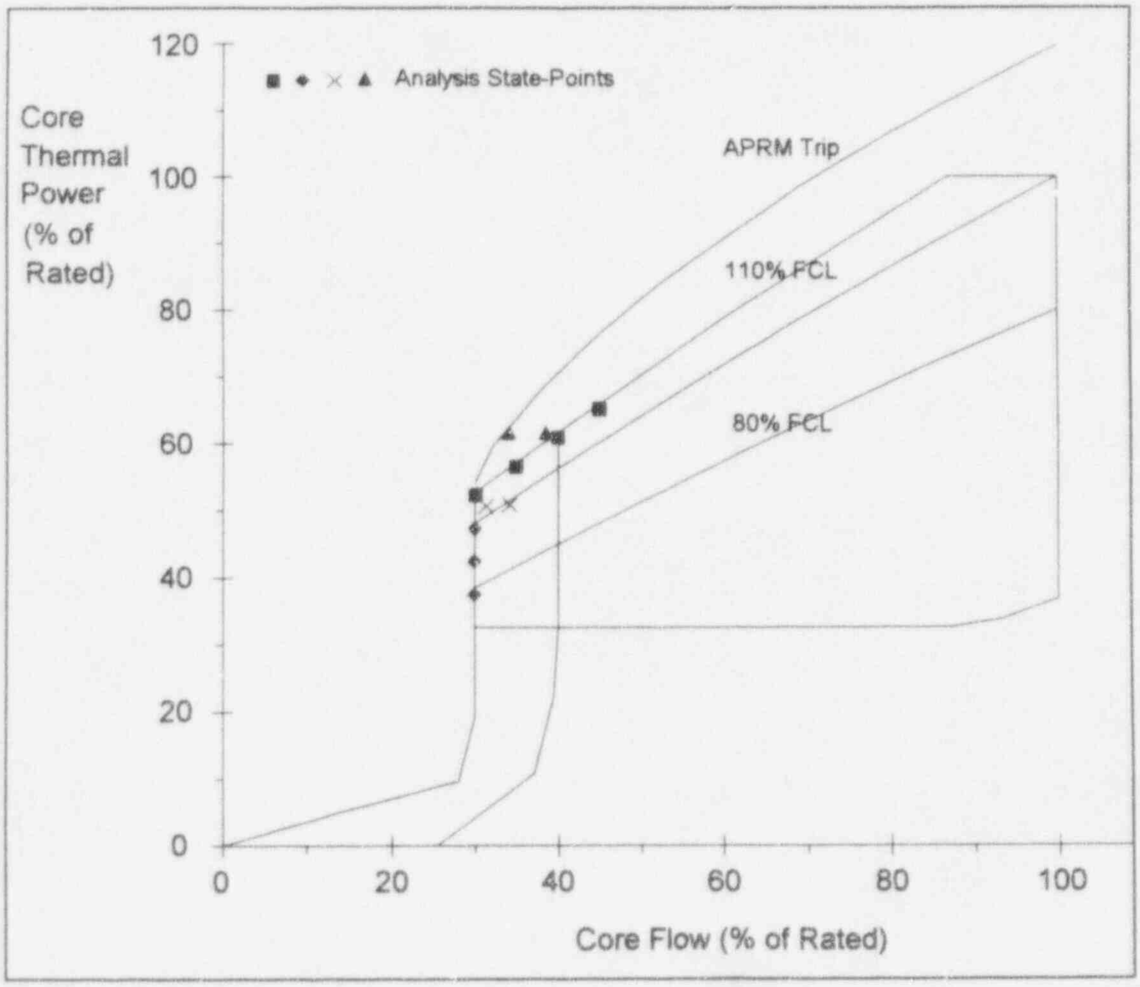
3.7 Miscellaneous Input Values

Other input values to the FABLE/BYPSS analyses, such as heat balance data, recirculation loop resistance, fuel physical parameters and material properties are standard design values for the Fitzpatrick plant. It is assumed that the nominal heat balance assumptions, such as the operation of all Feedwater Heaters, are valid for this model.

4 REGIONAL EXCLUSION RESULTS

Core and Channel Decay Ratios were calculated for several power flow combinations on the operating map (see Figure 4-1) using the inputs described in Section 3. The purpose of analyzing these combinations is to determine the Exclusion Region boundary on the power flow map and, using the generic BWROG Stability Criterion Map, establish the preferred mode of oscillation and the margin to the occurrence of Regional Mode oscillations for Fitzpatrick.

Figure 4-1
Probe Points on Operating Map



The points calculated are provided in Table 4-1. Points 1 through 4 are along the 110% Flow-control Line; Point 4 is at the intersection of the 110% FCL and the natural circulation line; Points 4 through 7 are along the natural circulation line; Points 8 and 9 are to bracket the expected location of the Exclusion Region at 50.9 power; Points 10 and 11 are to bracket the expected location of the Exclusion Region at 61.2 power. The core and channel decay ratio results of the analyzed points are tabulated in Table 4-1.

Table 4-1
Probe Points on Operating Map

Point Number	Power (%)	Flow (%)	Channel Hydraulic Decay Ratio	Core Decay Ratio	Symbol on Figure 4-2
1	64.7	45.0	0.20	0.54	■
2	60.6	40.0	0.24	0.66	■
3	56.6	35.0	0.31	0.84	■
4	52.4	30.0	0.40	1.22	■
5	47.4	30.0	0.33	1.00	◆
6	42.4	30.0	0.27	0.80	◆
7	37.4	30.0	0.23	0.65	◆
8	50.9	31.0	0.35	1.02	×
9	50.9	33.8	0.28	0.80	×
10	61.2	33.8	0.39	1.09	▲
11	61.2	38.8	0.27	0.72	▲

The points shown in Figure 4-1 and provided in Table 4-1 are plotted on the Stability Criterion Map in Figure 4-2. The plotting symbols have been provided in Table 4-1 for clarification. The lines which connect the appropriate state points in Figure 4-2 are used to determine the power and flow conditions at which the stability map criterion are exactly met. The coordinates of the intersections with the stability map criterion lines are given in Table 4-2.

Figure 4-2
Coordinates of Probe Points on Stability Criterion Map

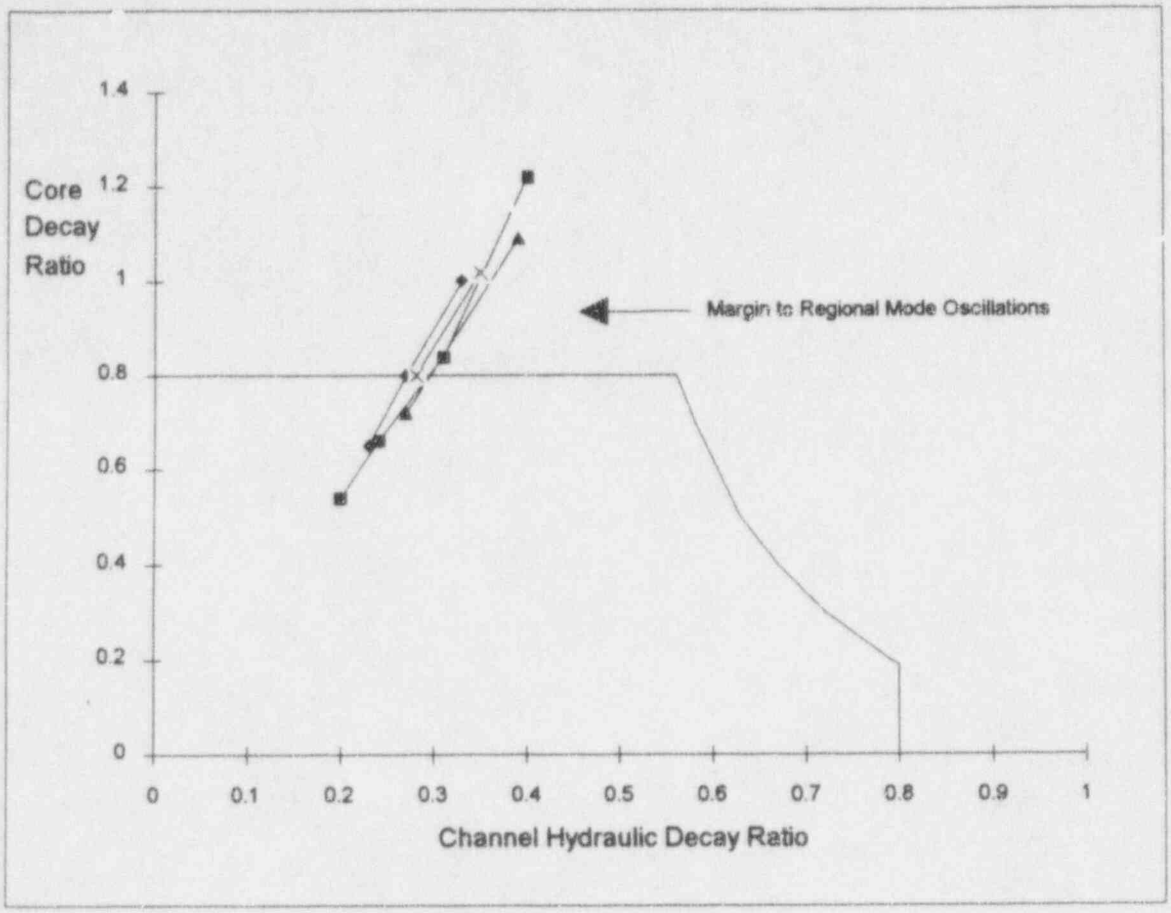


Table 4-2
Coordinates of Exclusion Region Boundary

Flow (%)	Power (%)
30.00	42.45
33.75	50.90
36.21	57.65
37.71	61.20

The coordinates of the probe points on the Stability Criterion Map, Figure 4-2, provide further evidence that Regional Mode oscillations are not probable for Fitzpatrick. It was shown in the stability solutions licensing methodology report [1] that the probability of Regional Mode oscillations becomes progressively smaller as Channel Hydraulic Decay Ratio is decreased, and Regional Mode oscillations have not been observed for Channel Hydraulic Decay Ratios less than 0.6. The largest Channel Hydraulic Decay Ratio conservatively predicted by the methodology for Fitzpatrick is 0.40 and occurs at the intersection of the natural circulation flow line and the extended operating domain flow control line: at the high-power/low-flow corner of the Exclusion Region (point 4). This portion of the power/flow map is in very close proximity to the existing APRM Flow Biased Flux Trip line; therefore, even if a Regional Mode oscillation were to occur, it could not grow very large without causing an APRM trip to occur. However, because of the relatively low Channel Hydraulic Decay Ratios, Regional Mode oscillations are not anticipated to occur anywhere on the operating map for Fitzpatrick.

The points identified in Table 4-2 were then used to determine the location of the Exclusion Region boundary, which is shown in Figure 4-3. The actual Exclusion Region boundary for Fitzpatrick is specified as a least-squares fit to the values tabulated in Table 4-2. The equation for the boundary is as follows:

$$\text{Power} = 9.020327 + 3.762876\text{E-}2\ (\text{Flow}) + 3.565181\text{E-}2\ (\text{Flow})^2$$

where,

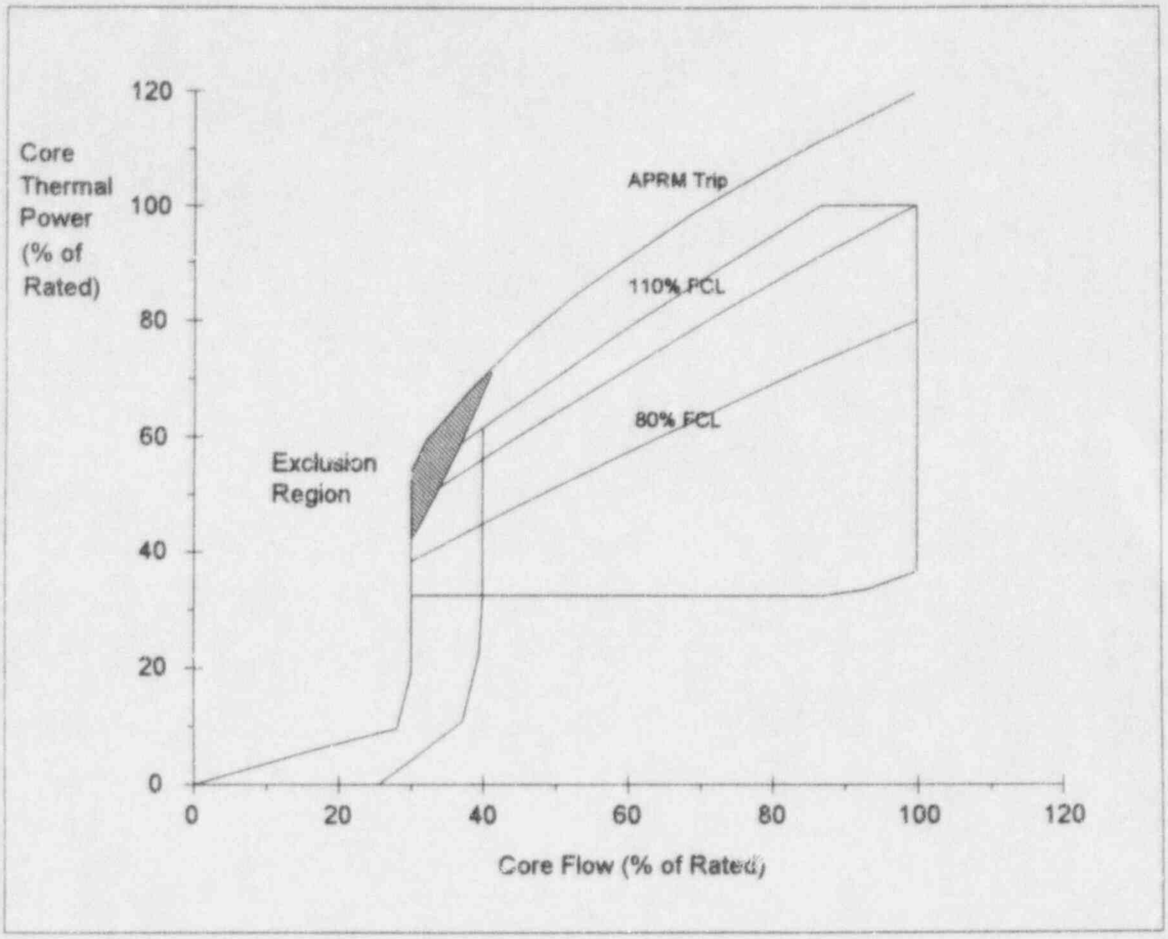
Flow = core flow as percent of rated
Power = core thermal power as percent of rated

and the range of validity of the fit is:

$$30.0 < \text{Flow} < 37.7$$

Figure 4-3

Fitzpatrick Exclusion Region (Cycle 10)



5 APPLICATION OF BWROG STABILITY LONG-TERM SOLUTION DETECTION AND SUPPRESSION METHODOLOGY

Section 5 describes the application of the BWROG Detection and Suppression Methodology for Fitzpatrick. This application is intended to demonstrate the protection for the SLMCPR provided by the Flow-Biased APRM Neutron Flux Scram System to Core-wide and Regional Mode oscillations.

The algorithm used to determine the margin to the SLMCPR is that described in Section 6.2 of the BWROG methodology report [1]. The analysis inputs described below for the demonstration application were developed for Cycle 10. Future operating cycle reload analysis will confirm the applicability of the Detection and Suppression results to the particular characteristics of the new fuel cycle.

Inputs to the methodology are different depending on the mode of oscillation. Because of this, the specific input for both Core-wide Mode and Regional Mode oscillations will be reviewed.

5.1 Core-Wide Mode Oscillations

Inputs to the Detection and Suppression methodology identified in Reference 1, for Core-wide Mode oscillations are chosen to reflect the assumption that this is the expected mode of oscillation for Fitzpatrick. Correspondingly, statistical results at a high confidence level are reported.

5.1.1 Initial Conditions

Consistent with the BWROG generic methodology, 95% of the initiating transients are assumed to start at full-power conditions, while the remaining five percent start at minimum forced flow along the rated Flow-control Line. For both starting points, the MCPR is assumed to be on the limits specified in the Cycle 10 Core Operating Limits Report (COLR). The limiting MCPR at full power conditions is 1.26 and at minimum forced flow is 1.45.

5.1.2 Oscillation Contours

The oscillation contour is the relative distribution of oscillation magnitudes within the core and is used in the methodology in the simulation of the LPRM signals that are used to confirm the detect/suppress system setpoints. The oscillation contour for Core-wide Mode oscillations is assumed to be the Fundamental Mode power shape and representative values for a 560 bundle core are used.

5.1.3 Oscillation Growth Rate

These paragraphs contain proprietary information and are not for public disclosure. This is intentionally left blank.

Table 5-1
67B Design Basis Scram Times

Insertion Fraction	Average Scram Time (seconds)
0.00	0.200
0.05	0.375
0.20	0.900
0.50	2.000
0.90	3.500

5.1.4 Trip System Definition

A trip system definition consistent with the Fitzpatrick Flow-biased APRM Neutron Flux Trip System was used for this analysis. Consistent with the probability of this mode of oscillation, the failure of the highest reading APRM channel is assumed in the analysis for Core-wide Mode oscillations. The trip equation is defined as:

$$\text{Power}(\%) = 0.66 * \text{Flow}(\%) + 54(\%)$$

5.1.5 LPRM Failures

A random distribution of failed and bypassed LPRM's was assumed for this analysis. These values are shown in Table 5-2. They are consistent with those obtained for all BWRs.

Table 5-2
LPRM Failure Statistics

Point in Cycle	Failure Fraction (%)
BOC	6
MOC	8
EOC	9

5.1.6 Change in MCPR with Flow Reduction

This term is used to compute the change in MCPR due to the initiating event (flow reduction) and prior to the inception of oscillations. The statistics used to evaluate the increase in MCPR with flow reduction are shown in Table 5-3. These values are different from those shown in Table 6-5 of the BWROG Methodology report [1] and represent a more comprehensive survey of all BWRs.

Table 5-3
MCPR Increase with Flow Reduction Statistics

Parameter	**Value**
Mean (ΔMCPR)	0.0041
Standard Deviation	0.0013
Number of Samples	40

5.1.7 CPR Performance

The change in the Minimum Critical Power Ratio (MCPR) with oscillation magnitude is a "fixed" curve based on detailed analyses of coupled thermal-hydraulic/neutronic oscillations [1]. Since the expected mode of oscillations for Fitzpatrick is Core Wide, a "fixed" curve is selected that shows large margin to the majority of the existing fully coupled results (see Figure 5-1). This selection is consistent with the objective of obtaining a statistically high-confidence result.

Figure 5-1
CPR Performance Curve for Core-wide Mode Oscillations

This figure contains proprietary information and is not for public disclosure. This figure is intentionally blank.

5.2 Regional Mode Oscillations

Inputs to the Detection and Suppression Methodology for Regional Mode oscillations are chosen to reflect the unlikely potential for this mode to occur for Fitzpatrick as shown by the results of the Regional Exclusion analysis in Section 4. The relatively small fuel inlet orifice diameter creates a preference for Core-wide Mode oscillations over the entire operating map as discussed in Section 4. Correspondingly, statistical results at an expected confidence level are reported for Regional Mode oscillations.

5.2.1 Initial Conditions

In accordance with the BWROG generic methodology, 95% of the initiating transients are assumed to start at full power conditions, while the remaining five percent start at minimum forced flow along the rated Flow-control Line. Initial MCPR values are chosen that are representative of those obtained during actual operation. The representative MCPR at full power conditions is 1.58 and at minimum forced flow is 2.20.

5.2.2 Oscillation Contours

The oscillation contours for Regional Mode oscillations are assumed to be the First Azimuthal Mode power shape and representative values for a 560 bundle core are used. The contours are computed with the GE 3D BWR Simulator and are consistent with plant data for this oscillation mode.

5.2.3 Oscillation Growth Rate

Since this mode of oscillation is not anticipated, its occurrence would result in slowly growing, low-magnitude limit cycle oscillations that would exhibit essentially no power overshoot after the trip signal is obtained, therefore a zero growth rate is assumed.

5.2.4 Trip System Definition

A trip system definition consistent with the Fitzpatrick Flow-biased APRM Neutron Flux Trip System is used for this analysis. No channel failures are assumed. The trip equation is given in Section 5.1.4.

5.2.5 LPRM Failures

A random distribution of failed and bypassed LPRM's was assumed for this analysis that is the same as that used for Core-wide Mode oscillations (see Table 5-2).

5.2.6 Change in MCPR with Flow Reduction

The MCPR change statistics with flow reduction are the same as those used for Core-wide Mode oscillations (Table 5-3).

5.2.7 CPR Performance

The change in the Minimum Critical Power Ratio (MCPR) with oscillation magnitude is a "fixed" curve based on detailed analyses of coupled thermal-hydraulic/neutronic oscillations [1]. Since this mode of oscillation is not expected, a "fixed" curve is selected that is representative of the more challenging fully coupled results (see Figure 5-2).

Figure 5-2
CPR Performance Curve for Regional Mode Oscillations

This figure contains proprietary information and is not for public disclosure. This figure is intentionally blank.

6 DETECTION AND SUPPRESSION RESULTS

The Detection and Suppression Methodology application to Fitzpatrick described in Section 5, herein, was used to calculate the Oscillation-induced, Final MCPR (FMCPR) values for both Core-wide Mode and Regional Mode oscillations. Both were analyzed for initiating transients that result in oscillations starting at equilibrated conditions at the intersection of the rated Flow-Control Line and Natural Circulation Line. The initiating transient in the methodology is a dual Recirculation Pump trip. The FMCPR values resulting from both modes of oscillation are shown in Table 6-1.

Table 6-1
FMCPR Values for Both Modes of Oscillation

Mode of Oscillation	FMCPR
Core Wide (high confidence)	1.19
Regional (nominal confidence)	1.29

For both modes of oscillation, large margin is available to the SLMCPR of 1.07. Therefore, the Flow-Biased APRM Neutron Flux Scram provides adequate protection of the fuel SLMCPR against oscillations without impacting plant operating limits for Cycle 10. In addition, note that raising the Operating Limit MCPR (OLMCPR) also raises the FMCPR.

7 REFERENCES

1. "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," NEDO-31960, June 1991, and NEDO-31960 Supplement 1, March 1992.

2. 10 CFR 50, Appendix A.

3. GE Service Information Letter, SIL-380, Revision 0, August 11, 1982.

4. GE Service Information Letter, SIL-380, Revision 1, February 10, 1984.

5. NEDE-22277-P, "Compliance of the General Electric Boiling Water Reactor Fuel Designs to Stability Licensing Criteria," December, 1982.

6. NEDE-22277-P-1, "Compliance of the General Electric Boiling Water Reactor Fuel Designs to Stability Licensing Criteria," October, 1984.

7. NEDO-31708, "Fuel Thermal Margin during Core Thermal Hydraulic Oscillations in a Boiling Water Reactor," June, 1989.

8. NRC Bulletin No. 88-07, "Power Oscillations in Boiling Water Reactors," June 15, 1988.

9. NRC Bulletin No. 88-07, Supplement 1, "Power Oscillations in Boiling Water Reactors," December 30, 1988.

10. NEDO-30130-A, "Steady State Nuclear Methods," April, 1985.

11. NEDE-31917P, "GE11 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR II)," April, 1991.

ATTACHMENT IV to JPN-95-032

Summary of Commitments

Number	Commitment	Due Date
JPN-95-032-01	Submit a description of the on-line stability monitor, and its application, to the NRC.	March 31, 1996
JPN-95-032-02	Submit proposed changes to Technical Specifications to support implementation of the Option 1-D solution.	March 31, 1996