WESTINGHOUSE PROPRIETARY CLASS 3

WCAP-10217-A
Revision 1A

RELAXATION OF CONSTANT AXIAL OFFSET CONTROL

F_Q SURVEILLANCE TECHNICAL SPECIFICATION

REVISED VERSION: OCTOBER 1993
APPROVED VERSION: FEBRUARY 1994

APPROVED: F. W. Kramer, Manager
Engineering Manufacturing Technology
Nuclear Manufacturing Divisions

APPROVED: A. L. Casadei, Manager
Core Engineering
Nuclear Manufacturing Divisions

WESTINGHOUSE ELECTRIC CORPORATION
Nuclear Manufacturing Divisions
P. O. Box 355
Pittsburgh, PA 15230

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SECTION A

UNITED STATES
LEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 26, 1993

DEC 16 1993

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R REFERENCING OF REVISED VERSION OF LICENSING TOPICAL
0216-P, REV. 1, "RELAXATION OF CONSTANT AXIAL OFFSET
SURVEILLANCE TECHNICAL SPECIFICATION" (TAC NO. M88206)

the topical report submitted by Westinghouse Electric
r of October 29, 1993. The report is acceptable for
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the enclosed report and U.S. Nuclear Regulatory
aluation. The evaluation defines the basis for acceptance

repeat its review of the matters described in the report
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accordance with procedures established in NUREG-0390, the
Westinghouse Electric Corporation publish accepted versions
rietary and non-proprietary, within 3 months of receipt of
accepted versions shall incorporate this letter and the
on between the title page and the abstract and an -A
ted) following the report identification symbol.

iteria or regulations change so that its conclusion that the
ble is invalidated, Westinghouse Electric Corporation and/or
erencing the topical report will be expected to revise and
spective documentation, or submit justification for the
ability of the topical report without revision of the
entation.

Sincerely,

Ashok C. Thadani, Director
Division of Systems Safety and Analysis

Enclosure:
WCAP-10216-P, Rev. 1 Evaluation

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 26, 1993

DEC 16 1993

Mr. Nicholas J. Liparulo, Manager
Nuclear Safety and Regulatory Activities
Westinghouse Electric Corporation
P.O. Box 355
Pittsburgh, PA 15230-0355

Dear Mr. Liparulo:

SUBJECT: ACCEPTANCE FOR REFERENCING OF REVISED VERSION OF LICENSING TOPICAL REPORT WCAP-10216-P, REV. 1, "RELAXATION OF CONSTANT AXIAL OFFSET CONTROL-F_Q SURVEILLANCE TECHNICAL SPECIFICATION" (TAC NO. M88206)

The staff has reviewed the topical report submitted by Westinghouse Electric Corporation by letter of October 29, 1993. The report is acceptable for referencing in license applications to the extent specified and under the limitations stated in the enclosed report and U.S. Nuclear Regulatory Commission (NRC) evaluation. The evaluation defines the basis for acceptance of the report.

The staff will not repeat its review of the matters described in the report and found acceptable when the report appears as a reference in license applications, except to assure that the material presented applies to the specific plant involved. NRC acceptance applies only to the matters described in the report. In accordance with procedures established in NUREG-0390, the NRC requests that Westinghouse Electric Corporation publish accepted versions of the report, proprietary and non-proprietary, within 3 months of receipt of this letter. The accepted versions shall incorporate this letter and the enclosed evaluation between the title page and the abstract and an -A (designating accepted) following the report identification symbol.

If the NRC's criteria or regulations change so that its conclusion that the report is acceptable is invalidated, Westinghouse Electric Corporation and/or the applicant referencing the topical report will be expected to revise and resubmit its respective documentation, or submit justification for the continued applicability of the topical report without revision of the respective documentation.

Sincerely,

Ashok C. Thadani, Director
Division of Systems Safety and Analysis

Enclosure:
WCAP-10216-P, Rev. 1 Evaluation

SECTION B

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATING TO TOPICAL REPORT WCAP-10216-P, REV. 1
"RELAXATION OF CONSTANT AXIAL OFFSET CONTROL - F_Q SURVEILLANCE TECH SPEC"
WESTINGHOUSE ELECTRIC CORPORATION

1. INTRODUCTION

In a letter of October 29, 1993, from N. J. Liparulo to U.S. Nuclear Regulatory Commission (NRC), Westinghouse Electric Corporation submitted a revision to topical report WCAP-10216-P, "Relaxation of Constant Axial Offset Control - F_Q Surveillance Technical Specification," for NRC review. The report describes an NRC-approved methodology developed by Westinghouse for performing power distribution control in Westinghouse-type pressurized-water reactors. The proposed revision accounts for F_Q increases greater than 2 percent between measurements to enhance the existing surveillance methodology.

2. EVALUATION

The heat flux hot channel factor, $F_Q(z)$, is the maximum local heat flux on the surface of a fuel rod at core elevation z, divided by the average fuel rod heat flux. For those plants using Constant Axial Offset Control (CAOC) or Relaxed Axial Offset Control (RAOC) during normal operation, $F_Q(z)$ is shown to be within its limits by performing periodic measurements. Since $F_Q(z)$ surveillance is only required when power has been increased by 20 percent of rated power from the previous surveillance, or at least every 31 effective full power days (EFPD), the technical specifications (TS) take into account the possibility that $F_Q(z)$ may increase between surveillances. The TS require that when performing the surveillance, the resulting maximum $F_Q(z)$ value must be compared to the maximum $F_Q(z)$ determined from the previous measurement. If the maximum $F_Q(z)$ has increased since the previous determination of $F_Q(z)$, the TS allow two options: either the current $F_Q(z)$ must be increased by an additional 2.0 percent to account for further increases in $F_Q(z)$ before the next surveillance, or the surveillance period must be reduced to every seven EFPD.

The $F_Q(z)$ penalty of 2.0 percent was based on the Westinghouse assumption that F_Q would change by no more than 2.0 percent between monthly flux maps. This assumption was based on calculations for previous (pre-1983) core designs which pre-date the low leakage loading patterns, high amounts of burnable poisons, and 18-month cycles typical of recent cores. Recently, some Westinghouse-designed cores have experienced increases in the measured $F_Q(z)$ as high as 5 to 6 percent between monthly flux maps over certain burnup ranges. Therefore, for those cores which are predicted to have larger increases in $F_Q(z)$ over certain burnup ranges, a larger penalty will be provided on a cycle-specific basis. The penalties will be calculated using

NRC-approved methods.

The larger penalty will be included in the plant Peaking Factor Limit Report (PFLR) or in the Core Operating Limit Report (COLR) as a replacement for the current 2 percent standard value. Alternatively, the additional penalty in excess of 2 percent may be factored into the W(z) function, which is a cycle-dependent function that accounts for power distribution transients encountered during normal operation. The W(z) function is also provided in the PFLR or the COLR. When the $F_Q(z)$ increase penalty is provided on a cycle-specific basis, TS Surveillance 4.2.2.2.e.1 must be modified to reflect inclusion of this parameter in the PFLR or the COLR.

The staff finds either of these methods for incorporating a larger $F_Q(z)$ penalty acceptable.

3. CONCLUSION

The proposed revisions to the F_Q Surveillance Technical Specification in those reactors using CAOC or RAOC for power distribution control are acceptable. These revisions would allow the incorporation of a larger penalty to account for $F_Q(z)$ increases greater than 2 percent between measurements. These penalties may be incorporated in either the plant PFLR or COLR, as described above, and will be calculated with NRC-approved methods. The approved version of WCAP-10216-P, Rev. 1 must be included in the Administrative Reporting Requirements Section of the TS for those plants incorporating the penalty factor in the COLR. Also, TS Surveillance 4.2.2.2.e.1 must be modified to reflect inclusion of this parameter in the PFLR or COLR.

SECTION C

Westinghouse Electric Corporation

Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

November 12, 1993
ET-NRC-93-4009

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Attention: R. C. Jones, Chief
Reactor Systems Branch
Division of System Technology

Subject: Transmittal of Revised Version of Topical, WCAP-10217-A, "Relaxation of Constant Axial Offset Control - F_Q Surveillance Technical Specification," October 1993 [Non-Proprietary]

Reference: (1) ET-NRC-93-3987, Transmittal of Revised Version of Topical, WCAP-10216-P, "Relaxation of Constant Axial Offset Control-F_Q Surveillance Technical Specification," October 29, 1993 [Proprietary]

Dear Mr. Jones:

Your staff, as directed by the Office of General Counsel, informed Westinghouse that a Non-Proprietary version must accompany the recent Reference (1) Proprietary submittal.

Enclosed are twelve (12) copies of WCAP-10217-A, Revision 1 "Relaxation of Constant Axial Offset control-F_Q Surveillance Technical Specification," October 1993 [Non-Proprietary] to meet this requirement.

Very truly yours,

Nicholas J. Liparulo, Manager
Nuclear Safety and Regulatory Activities

cc: L. W. Barnett, NRR/MIPA
L. Kopp, NRR/SRXB

SECTION D

WESTINGHOUSE CLASS 3

WCAP-10217-A
Revision 1

RELAXATION OF CONSTANT AXIAL OFFSET CONTROL

F_Q SURVEILLANCE TECHNICAL SPECIFICATION

ORIGINAL VERSION: AUGUST 1982

AUTHORS: R. W. Miller
N. A. Pogorzelski
J. A. Vestovich

APPROVED VERSION: JUNE 1983

PREPARED BY: S. L. Davidson
J. A. Iorii

REVISED VERSION: OCTOBER 1993

APPROVED: [signature]
F. W. Kramer, Manager
Engineering Manufacturing Technology
Nuclear Manufacturing Divisions

APPROVED: [signature]
A. L. Casadei, Manager
Core Engineering
Nuclear Manufacturing Divisions

WESTINGHOUSE ELECTRIC CORPORATION
Nuclear Manufacturing Divisions
P.O. Box 355
Pittsburgh, PA 15230

The F_Q SURVEILLANCE TECHNICAL SPECIFICATION

(Part B of NS-EPR-2649)

R. W. Miller

N. A. Pogorzelski

J. A. Vestovich

September 1982

REVISED: OCTOBER 1993

WESTINGHOUSE ELECTRIC CORPORATION
P.O. Box 355
Pittsburgh, Pennsylvania 15230

PROPRIETARY NOTICE

This document contains material that is proprietary to the Westinghouse Electric Corporation. The basis for making the information proprietary and the basis on which the information may be withheld from public disclosure is set forth in the affidavit of R. A. Wiesemann. Pursuant to the provisions of Section 2.790 of the Commission's regulations, this affidavit is attached to the application for withholding from public disclosure which accompanied this document.

This information is for your internal use only and should not be released to any persons or organizations outside the Office of Nuclear Reactor Regulation and the ACRS without the prior approval of Westinghouse Electric Corporation. Should it become necessary to obtain such approval, please contact R. A. Wiesemann, Assistant to the Manager of Nuclear Safety, Westinghouse Electric Corporation, P.O. Box 355, Pittsburgh, Pennsylvania 15230.

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

FEB 28 1983

Mr. E. P. Rahe, Manager
Nuclear Safety Department
P. O. Box 355
Pittsburgh, Pennsylvania 15230

Dear Mr. Rahe:

Subject: Acceptance for Referencing of Licensing Topical Report
WCAP 10216(P) - (NS-EPR-2649)

The Nuclear Regulatory Commission (NRC) has completed its review of the two enclosures, Part A and Part B, submitted by Westinghouse Electric Corporation (W) letter Number NS-EPR-2649, dated August 31, 1982. Part A, entitled "Relaxation of Constant Axial Offset Control," proposes a revised method for power distribution control in Westinghouse designed pressurized water reactors. Part B, entitled "The F_Q Surveillance Technical Specification," describes an alternative to the present technique for performing surveillance on the value of the total power peaking factor (F_Q) in the core. It is understood that the accepted versions of these submittals will be consolidated in a single report under the report identification symbols WCAP-10216(P), proprietary version, and WCAP-10217(NP), nonproprietary version. Our separate evaluations of Parts A and B are enclosed.

Based on our review, we conclude that the Axial Offset Control procedure described in Part A is an acceptable method for power distribution control in Westinghouse designed pressurized water reactors and the proposed power peaking factor (F_Q) surveillance technical specification described in Part B is an acceptable means of meeting the requirements for surveillance of this parameter.

As a result of our review, we find the enclosures to Westinghouse's letter NS-EPR-2649 Part A "Relaxation of the Constant Axial Offset Control" dated August 1982, and Part B, "The F_Q Surveillance Technical Specification," dated September 1982, are acceptable for referencing in license applications for Westinghouse designed pressurized water reactors to the extent specified and under the limitations delineated in the reports and their associated evaluations enclosed.

We do not intend to repeat the review of the safety features described in the reports and found acceptable when they appear as references in a license application except to assure that the material presented is applicable to the specific plant involved. Our acceptance applies only to the features described in the reports.

In accordance with established procedures (NUREG-0390), it is requested that Westinghouse publish accepted versions of these reports, proprietary and nonproprietary, within three months of receipt of this letter. The revisions are to incorporate this letter and the enclosed evaluations following title page, and thus just in front of the abstract. It is understood that the accepted versions are to have a report identification symbol (RI SYM) WCAP-10216(P) and WCAP-10217(NP). The RI SYM must include a -A suffix.

Should Nuclear Regulatory Commission criteria or regulations change such that our conclusions as to the acceptability of the report are invalidated, Westinghouse Electric Corporation and/or the applicants referencing the topical report will be expected to revise and resubmit their respective documentation or submit justification for the continued effective applicability of the topical report without revision of their respective documentation.

Sincerely,

Cecil O. Thomas

Cecil O. Thomas, Chief
Standardization & Special
Projects Branch
Division of Licensing

Enclosures:
As stated

EVALUATION OF PART A
OF WESTINGHOUSE PROPRIETARY DOCUMENT NS-EPR-2649,
"RELAXATION OF CONSTANT AXIAL OFFSET CONTROL"
(TACS 48817)

By letter dated August 31, 1982 Westinghouse Electric Corporation submitted document NS-EPR-2649 for review. The Reactor Physics Section of the Core Performance Branch has reviewed Part A of this document entitled "Relaxation of Constant Axial Offset Control" and prepared the following evaluation. The evaluation of Part B of the document will be presented separately.

1. Description of Report

Axial power distribution control in Westinghouse reactors is currently achieved by following the Constant Axial Offset Control (CAOC) procedure. This procedure requires that the axial offset be kept within a narrow band (typically ± 5 percent) about a target value during normal plant operation-including power change maneuvers - in order to ensure that unallowed power shapes do not occur. For some plants for which the LOCA analysis yields high values of permitted peaking factors significant margin exists between these values and those produced by the CAOC operating procedure. Some plants have employed wider operating bands within the CAOC procedure but still must follow the procedure. NS-EPR-2649 proposes to replace the CAOC with the Relaxed Axial Offset Control (RAOC) procedure.

The presence of margin to limits with the CAOC procedure implies that the allowed value of ΔI, the axial flux difference (difference between the upper and lower excore detector readings) may be increased, particularly at lower power. The result of the RAOC procedure is a curve of allowed ΔI as a function of power. The report provides the details of the manner in which the curve is constructed.

The procedure begins by constructing a xenon distribution library. Selected xenon transients are calculated and the resulting axial xenon distributions are characterized by certain parameters. These parameters are stored and the xenon distribution reconstructed from them when required. The allowed xenon distributions are limited to those for which the core ΔI values remain within tentatively chosen limits which are wider than the expected LOCA limits. Xenon libraries are prepared for BOL, MOL, and EOL burnup.

The next step in the procedure is the normal operation analysis. The only constraints employed are the rod insertion limits and the tentative ΔI limits. One dimensional calculations are performed at BOL, MOL, and EOL for a number of power levels and for xenon distributions throughout the range of the xenon library. The axial power distribution is recorded for each case. Each power shape generated is examined to see if LOCA limits are met or exceeded. The standard Westinghouse synthesis method is used. The result of this examination is a ΔI range as a function of power which meets the LOCA limits. The power shapes within this range are then examined to ascertain whether they meet the thermal-hydraulic constraints imposed by the loss of flow accident (LOFA) and the limits are revised accordingly.

The effect of the widened ΔI band on the consequences of anticipated transients is next investigated. The cool down event, control rod withdrawal event and boration/dilution event are investigated for each reload. Sensitivity studies for other events have shown that reanalysis is not required. The analyses consist of choosing initial power distributions from the allowed power-ΔI domain, being careful to include the entire domain and performing the transient calculation with each distribution. The axial power shapes are preserved from each "snapshot" in the event, and core peaking factors are synthesized by the standard procedure. The results are examined for violations of peak power and DNB limits. If required the overtemperature-delta temperature (OTΔT) or overpower-delta temperature (OPΔT) trips may be altered to provide protection by changing the F(ΔI) penalty function in the trips. Alternatively the ΔI operating band may be further restricted to limit the initial conditions.

Application of the RAOC to a particular reactor requires alteration of its Technical Specifications. Sample revised Technical Specifications are presented in the report. All reference to the CAOC is removed from the specifications and replaced by a single curve, Figure 3.2-1, of Axial Flux Difference (ΔI) as a function of power. Specification 3.2.1 requires that ΔI be maintained within the allowed operations space on the Figure. Surveillance requirements are similar to those for other alarmed limits.

2. Summary of Evaluation

The following discussion summarizes the evaluation of report NS-EPR-2649, Part A.

The xenon distribution reconstruction model makes use of standard procedures for such applications. The procedure has been verified by comparison of reconstructed distributions to the original and shown to be within acceptable limits. In particular the axial offset and axial peaking factors are reproduced to within one percent or less. We conclude that the reconstruction model adequately represents the xenon axial distributions used in the analysis.

The xenon distributions used in the analyses are obtained from xenon transient calculations which are chosen to bound any that might occur in reactor operation. The transients are initiated by step changes in power which tend to exacerbate the resulting power swings. We conclude that an adequate library of xenon distribution shapes is created.

The procedure used to obtain the ΔI band limits for the normal operation limited events (LOCA and LOFA) is straightforward and acceptable. A sufficiently large sample of power shapes is examined to assure, with high probability, that limiting shapes have been sampled. The synthesis method used to determine whether LOCA constraints are met or exceeded is the standard Westinghouse procedure and is acceptable. The thermal-hydraulic methods used to perform the DNB comparisons for the loss of flow accident are similar to those used for the same analysis in the CAOC methodology and are acceptable.

The procedures employed in the determination of whether the allowed power shapes obtained from the normal operation analysis lead to acceptable consequences for Condition II events is straightforward and acceptable. We conclude that a sufficient set of events and starting conditions are analyzed to provide a high degree of confidence that the consequences of Condition II events are acceptable after alteration of the permitted ΔI band or the DNB trip algorithms.

The rather involved CAOC Technical Specification is replaced by a specification that merely requires that the axial flux difference (ΔI) be maintained with the acceptable band as a function of power. Upon discovery that the band limits have been exceeded (a computer alarm is provided) the operator must restore ΔI to within limits within fifteen minutes or reduce power to less than 50 percent of full power. This is an acceptable specification. The surveillance requirement discusses the frequency of verification of ΔI as a function of the status of the alarm. This is typical of such specifications and is acceptable.

3. Evaluation Procedure

The evaluation of report NS-EPR-2649, Part A has been performed under guidelines for methods and procedures provided in Section 4.3 of the Standard Review Plan. Enough information is provided to permit a knowledgeable person to conclude that the procedure described is adequate to accomplish its purposes and that the analyses performed to implement and verify its suitability are state-of-art and are acceptable.

4. Regulatory Position

Based on its review, which is described above, the staff concludes that the Relaxed Axial Offset Control procedure is an acceptable method for power distribution control in Westinghouse designed pressurized water reactors. The staff further concludes that report NS-EPR-2649, Part A may be used as a reference to describe the method and suppert its use.

EVALUATION OF PART B OF
WESTINGHOUSE PROPRIETARY REPORT NS-EPR-2649,
"THE F_Q SURVEILLANCE TECHNICAL SPECIFICATION"
(TACS 48818)

By le… …ed August 31, 1982 Westinghouse Electric Corporation submitted Document NS-EPR-2649 for review. The Reactor Physics Section of the Core Performance Branch has reviewed Part B of this document entitled "The F_Q Surveillance Technical Specification" and prepared the following evaluati… The evaluation of Part A of this document will be presented separat…

1. Description of Document

This document describes an alternative to the present technique for performing surveillance on the value of the total power peaking factor F_Q in the core.

Currently periodic plant surveillance on the height dependent radial peaking factor, $F_{xy}(Z)$, is required as partial verification that operation will not cause the $F_Q(Z)$ limit to be exceeded. The remaining verification is provided by operation within the CAOC procedures and rod insertion limits. The proposed procedure replaces the $F_{xy}(Z)$ surveillance with a measurement of steady state $F_Q(Z)$ and multiplication of the measured value by a factor, W(Z), which accounts for plant maneuvers within the restriction on axial flux difference and rod insertion permitted by the Technical Specifications. The product of the measured $F_Q^M(Z)$ and the analytically determined W(Z) is then compared to the $F_Q(Z)$ limit. Before forming the product a measurement uncertainty is added to $F_Q^M(Z)$.

The procedure may be applied to plants which use either constant axial offset control or relaxed axial offset control. In either case the W(Z) factor is developed from the series of calculations used to establish the flux imbalance limits. W(Z) is defined as

$$W(Z) = \frac{(F_Q(Z) \times P) \text{ maximum, simulated transient}}{(F_Q(Z) \times P) \text{ equilibrium}}$$

Where P is core power.

Changes in the core power distribution caused by control rod insertion, power level changes, and axial and radial xenon transients are all included in W(Z). For plants using CAOC operation the W(Z) function is determined by analyzing a full range of power shapes occurring from simulation of typical load follow operations. For a plant with RAOC operation the power shapes used in the normal operation analysis are used.

2. Summary of Evaluation

The following discussion summarizes our evaluation of the proposed F_Q surveillance Technical Specification.

The revised procedure accomplishes the same purpose as the procedure it replaces. The calculational component of the new procedure is less than that of the old since only the change in axial shape is included as compared to the previous entire axial shape. The measurement uncertainty employed is the previously accepted value for F_Q measurements.

A sufficient number of calculations is performed to permit the conclusion that there is a high probability that the W(Z) function will be bounding.

The proposal to submit the W(Z) curve in a Peaking Factor Limit Report is consistent with present practice with respect to the F_{xy} surveillance and is acceptable.

The procedures used to account for possible increases in $F_Q(Z)$ between measurements are similar to those currently used and are acceptable.

3. Evaluation Procedure

The evaluation of report NS-EPR-2649, Part B has been performed within the guidelines provided in the Standard Review Plan, Section 4.3 for methods and procedures. Enough information is provided to permit a knowledgeable person to conclude that the surveillance procedure described in the report is adequate to accomplish its purpose and that the analyses performed to implement the procedure provide a high degree of confidence that the $F_Q(Z)$ limit will not be exceeded during normal plant operation.

4. Regulatory Position

Based on its review, which is described above, the staff concludes that the proposed F_Q surveillance Technical Specification is an acceptable means of meeting the requirements for surveillance of this parameter. Further, report NS-EPR-2649, Part B may be used as a reference to support its use.

Westinghouse Electric Corporation
Water Reactor Divisions

Nuclear Technology Division
Box 355
Pittsburgh Pennsylvania 15230

NS-EPR-2649

August 31, 1982

Mr. C. H. Berlinger, Chief
Core Performance Branch
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: Mr. D. Fieno

Dear Mr. Berlinger:

Enclosed are:

1) Twenty-five (25) copies of a Westinghouse document titled, "Relaxation of Constant Axial Offset Control" (Proprietary).

2) Fifteen (15) copies of a Westinghouse document titled, "Relaxation of Constant Axial Offset Control" (Non-Proprietary).

3) Twenty-five (25) copies of a Westinghouse document titled, "The F_Q Surveillance Technical Specifications" (Proprietary).

4) Fifteen (15) copies of a Westinghouse document titled, "The F_Q Surveillance Technical Specifications" (Non-Proprietary).

Also enclosed are:

A) One (1) copy of Application for Withholding, AW-82-53 (Non-Proprietary).

B) One (1) copy of original Affidavit (Non-Proprietary).

The first enclosure, titled "Relaxation of Constant Axial Offset Control", is information supplied for your review regarding an improved Westinghouse methodology for power distribution control. The major operational differences between this new methodology (RAOC) and Constant Axial Offset Control (CAOC) are: a) elimination of the target band (typically $\pm$ 5% ΔI) and b) the widening and extension to 100% power of the administrative limits. These differences result in increased operational flexibility and should eliminate those few instances where power escalation is limited due to operator inability to maintain the indicated ΔI within the target band. The information provided is generic in scope with examples provided for a typical case.

Your review of the enclosed and subsequent approval of the approach and methodology is requested. Plant specific calculations noting the plant specific administrative limits will be provided on the individual plant dockets.

The second enclosure, titled "The F_Q Surveillance Technical Specifications", is information supplied for your review regarding an improved Westinghouse methodology for the surveillance of F_Q. The information provided is similar to that discussed with Mr. M. Dunenfeld of your staff in a meeting on February 25, 1981, and notes two types of Technical Specifications, a) for RAOC and b) for CAOC. Please note that only the RAOC version of the Technical Specifications has been provided as part of this enclosure. The CAOC version of the Technical Specifications will be provided as an addendum when utilized for the first time. Your review of this enclosure and subsequent approval of the approach and methodology in the generic sense for both RAOC and CAOC is requested.

This submittal contains proprietary information of Westinghouse Electric Corporation. In conformance with the requirements of 10CFR Section 2.790, as amended, of the Commission's regulations, we are enclosing with this submittal an application for withholding from public disclosure by the Commission.

Correspondence with respect to the affidavit or application for withholding should reference AW-82-53 and should be addressed to R. A. Wiesemann, Manager, Regulatory and Legislative Affairs, Westinghouse Electric Corporation, P.O. Box 355, Pittsburgh, Pennsylvania 15230.

Very truly yours,

for E. P. Rahe, Jr., Manager
Nuclear Safety Department

CRT/kk
Enclosures

Westinghouse Electric Corporation
Water Reactor Divisions
Box 355
Pittsburgh Pennsylvania 15230

August 31, 1982
AW-82-53

Mr. C. H. Berlinger, Chief
Core Performance Branch
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

SUBJECT: "Relaxation of Constant Axial Offset Control" and "The Fq Surveillance Technical Specifications," August 1982

REF: Westinghouse Letter, Rahe to Berlinger, NS-EPR-2649, August 31, 1982

Dear Mr. Berlinger:

This application for withholding is submitted by Westinghouse Electric Corporation pursuant to the provisions of paragraph (b)(1) of Section 2.790 of the Commission's regulations. Withholding from public disclosure is requested with respect to the subject information.

The proprietary material for which withholding is being requested is of the same technical type as that proprietary material submitted by Westinghouse previously in application for withholding AW-76-8, and was accompanied by an affidavit signed by the owner of the proprietary information, Westinghouse Electric Corporation.

Further, the affidavit AW-76-8 submitted to justify the previous material was approved by the Commission on November 9, 1977, and is equally applicable to the subject material.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse and which is further identified in the affidavit be withheld from public disclosure in accordance with 10CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference AW-82-53 and should be addressed to the undersigned.

Very truly yours,

Robert A. Wiesemann

Robert A. Wiesemann, Manager
Regulatory & Legislative Affairs

/bek
Attachment

cc: E. C. Shomaker, Esq.
Office of the Executive Legal Director, NRC

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared Robert A. Wiesemann, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Corporation ("Westinghouse") and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

Robert A. Wiesemann, Manager
Licensing Programs

Sworn to and subscribed
before me this 11th day
of August 1976.

Notary Public

(1) I am Manager, Licensing Programs, in the Pressurized Water Reactor Systems Division, of Westinghouse Electric Corporation and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing or rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Water Reactor Divisions.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse Nuclear Energy Systems in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(g) It is not the property of Westinghouse, but must be treated as proprietary by Westinghouse according to agreements with the owner.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition in those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information is not available in public sources to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in the attachment to Westinghouse letter number NS-CE-1139, Eicheldinger to Stolz, dated July 19, 1976, concerning supplemental information for use in the Augmented Startup and Cycle 1 Physics Program. The letter and attachment are being submitted as part of the above mentioned program in response to concerns of the Advisory Committee on Reactor Safeguards with the new Westinghouse PWR's, which are rated at higher power densities than currently operating Westinghouse reactors.

This information enables Westinghouse to:

(a) Justify the Westinghouse design correlations.

(b) Assist its customers to obtain licenses.

(c) Provide greater flexibility to customers assuring them of safe reliable operation.

(d) Optimize performance while maintaining a high level of fuel integrity.

(e) Justify operation at a reduced peaking factor with a wider target band than normal.

(f) Justify full power operation and meet warranties.

Further, the information gained from the Augmented Startup and Cycle 1 Physics Program is of commercial value and is sold for considerable sums of money as follows:

(a) Westinghouse uses the information to perform and justify analyses which are sold to customers.

(b) Westinghouse uses the information to sell to its customers for the purpose of meeting NRC requirements for full power licensing.

(c) Westinghouse could sell testing services based on the experience gained and the analytical methods developed using this information.

Public disclosure of this information concerning the Augmented Startup program is likely to cause substantial harm to the competitive position of Westinghouse by allowing its competitors to develop similar analysis methods and models at a much reduced cost.

The analyses performed, their methods and evaluation represent a considerable amount of highly qualified development effort, which has been underway for many years. If a competitor were able to use the results of the analyses in the attached document, to normalize or verify their own methods or models, the development effort and monetary expenditure required to achieve an equivalent capability would be significantly reduced. In total, a substantial amount of money and effort has been expended by Westinghouse which could only be duplicated by a competitor if he were to invest similar sums of money and provided he had the appropriate talent available.

Further the deponent sayeth not.

WESTINGHOUSE CLASS 3

Relaxation of Constant Axial Offset Control

(Part A of NS-EPR-2649)

R. W. Miller

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August 1982

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I. RAOC -- AN EXTENSION OF CAOC

A. REVIEW OF CONSTANT AXIAL OFFSET CONTROL (CAOC)

WCAP-8385 (Proprietary) and WCAP-8403 (non-Proprietary), "Power Distribution Control and Load Following Procedures," developed the methodology and described the procedure needed for plant operation to insure peaking factors below accident analysis limits. The Constant Axial Offset Control (CAOC) strategy developed in this topical report insures peaking factor and DNB limits are satisfied by maintaining the axial power distribution within a $\pm 5\%$ ΔI band around a measured target value. By controlling the axial power distribution, the possible skewing of the axial xenon distribution is limited, thus minimizing xenon oscillations and their effects on the power distribution.

This topical report described two modes of operation: operation with part length (PL) rods (Mode B) and operation without PL rods (Mode A). It was demonstrated generically that a LOCA peaking factor of 2.32 could be met at all times, and plant specific analyses were required only if the F_Q limit was less than this generic value or generic radial peaking factor limits were not met. A typical ΔI band is shown in Figure I-1.

B. ΔI BAND WIDENING STUDIES

Plants have varying degrees margin to Design Bases Limits which can be converted into operating flexibility in the form of a wider ΔI band. Several "standard" widened ΔI bands are available with the two common being +6, -9% and +3, -12%. A typical widened ΔI band is shown in Figure I-2 with respect to the standard ΔI band.

C. RELAXED AXIAL OFFSET CONTROL (RAOC)

Typically in plants with relatively high LOCA F_Q limits, some margin to the LOCA limit still remains even after one of the standard band widening studies is performed. This is evidenced in Figures I-3 and

I-4. Figure I-3 is the $F_Q \cdot P$ vs. core height plot from a reload cycle using the standard ±5% ΔI band. Figure I-4 is a similar plot using a +6, -9% ΔI band. While the +6, -9% ΔI band increases peaking factors relative to the ±5% ΔI band, margin still exists to the LOCA limit. This indicates that the ΔI band could be widened by some additional amount. The RAOC methodology eliminates the iterative process of searching for this wider band by determining the allowed band directly.

The allowed ΔI band can additionally be widened further at reduced power levels. This is evidenced by two pieces of data. First, current Standard Technical Specifications allow ΔI to be outside the allowed band for up to one hour in 24 between 50 and 90% power and two hours in 24 below 50% power. In fact, the current Technical Specifications do not require CAOC operation below 50% at all as long as power is not increased above 50% until CAOC requirements are met. Secondly, all the limiting F_Q values calculated using the current analysis (such as those shown in Figure I-3 and I-4) are a result of full power operation. Since the limit is based on $F_Q \cdot P$ this indicates that power decreases faster than F_Q increases during CAOC operation and therefore indicates that larger axial peaking factors, and hence wider ΔI limits, are permissible at reduced power levels. The RAOC methodology also determines this permissable part power relaxation directly. A typical RAOC limit is shown in Figure I-5 with respect to the standard and widened CAOC ΔI bands.

Because relaxation of the CAOC Technical Specifications is much sought after by utilities, the RAOC methodology has been developed. This methodology makes it possible to obtain the necessary and sufficient requirements to satisfy the safety limits under all operating conditions. The advantages of RAOC operation are to:

a) Allow the operator to minimize and/or smooth the boron system duty relative to CAOC operation,

b) Increase spinning reserve capacity during Mode A operation,

c) Reduce rod motion corrections and hence operator action required to maintain conformance with power distribution control Technical Specifications,

d) Increase greatly the ability to return to power after a plant trip.

In actual plant operation, the surveillance requirements to verify RAOC conformance to the F_Q limits can take two forms. First, $F_{xy}(z)$ can be measured, as in the current Standard Technical Specifications, to verify the values used in the analysis. Second, $F_Q(z)$ can be measured directly and an allowance for normal operation transients, W(z), applied before $F_Q(z)$ is compared to the limit, as in the F_Q Surveillance Technical Specification.

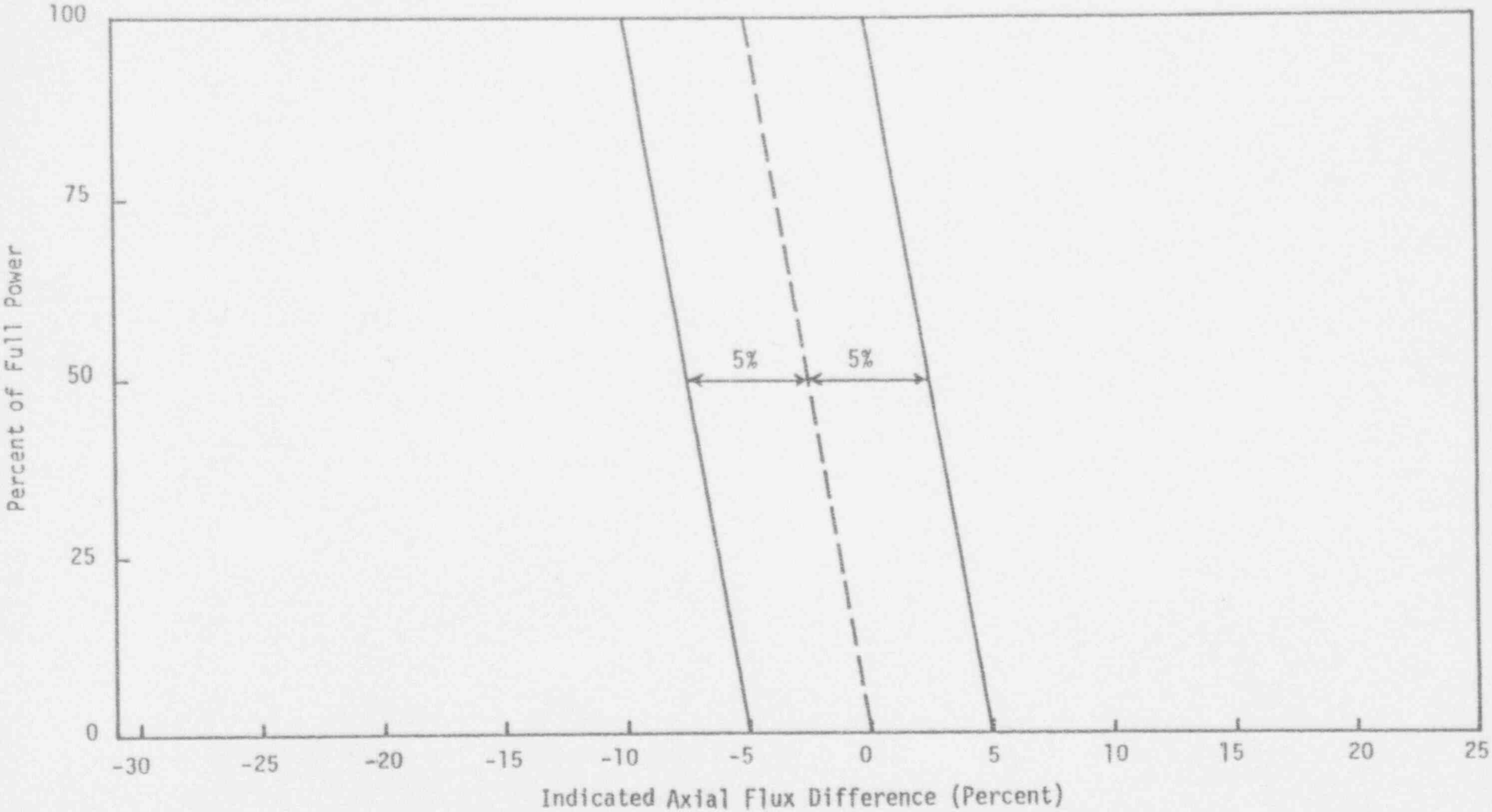


FIGURE I-1

EXAMPLE OF CAOC ± 5% ΔI BAND

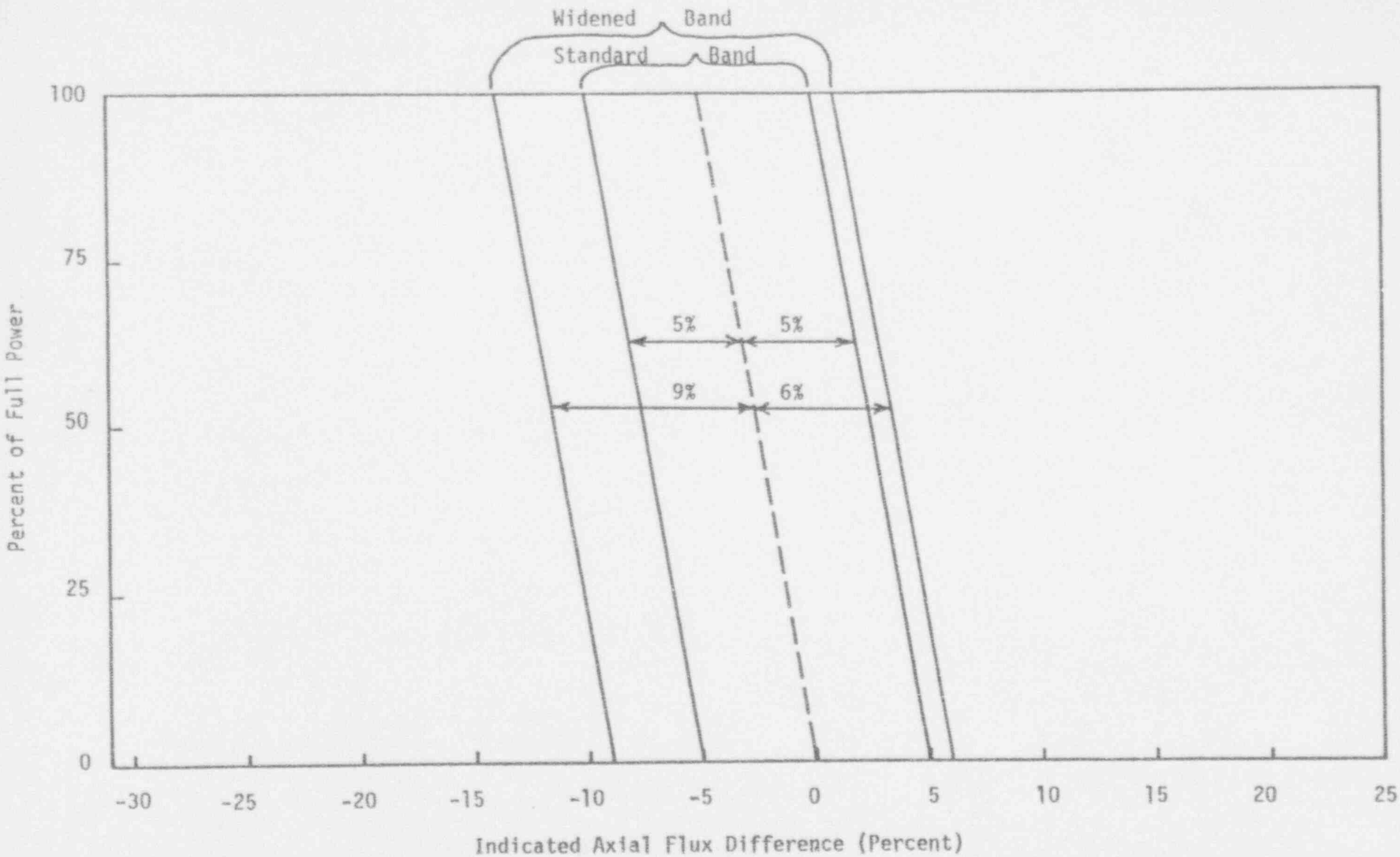


FIGURE I-2

Example of CAOC +6, -9% ΔI Band

FIGURE I-3

EXAMPLE OF MAXIMUM [$F_Q^T \cdot P_{Rel}$] VERSUS AXIAL CORE HEIGHT

DURING NORMAL OPERATION ±5% ΔI BAND

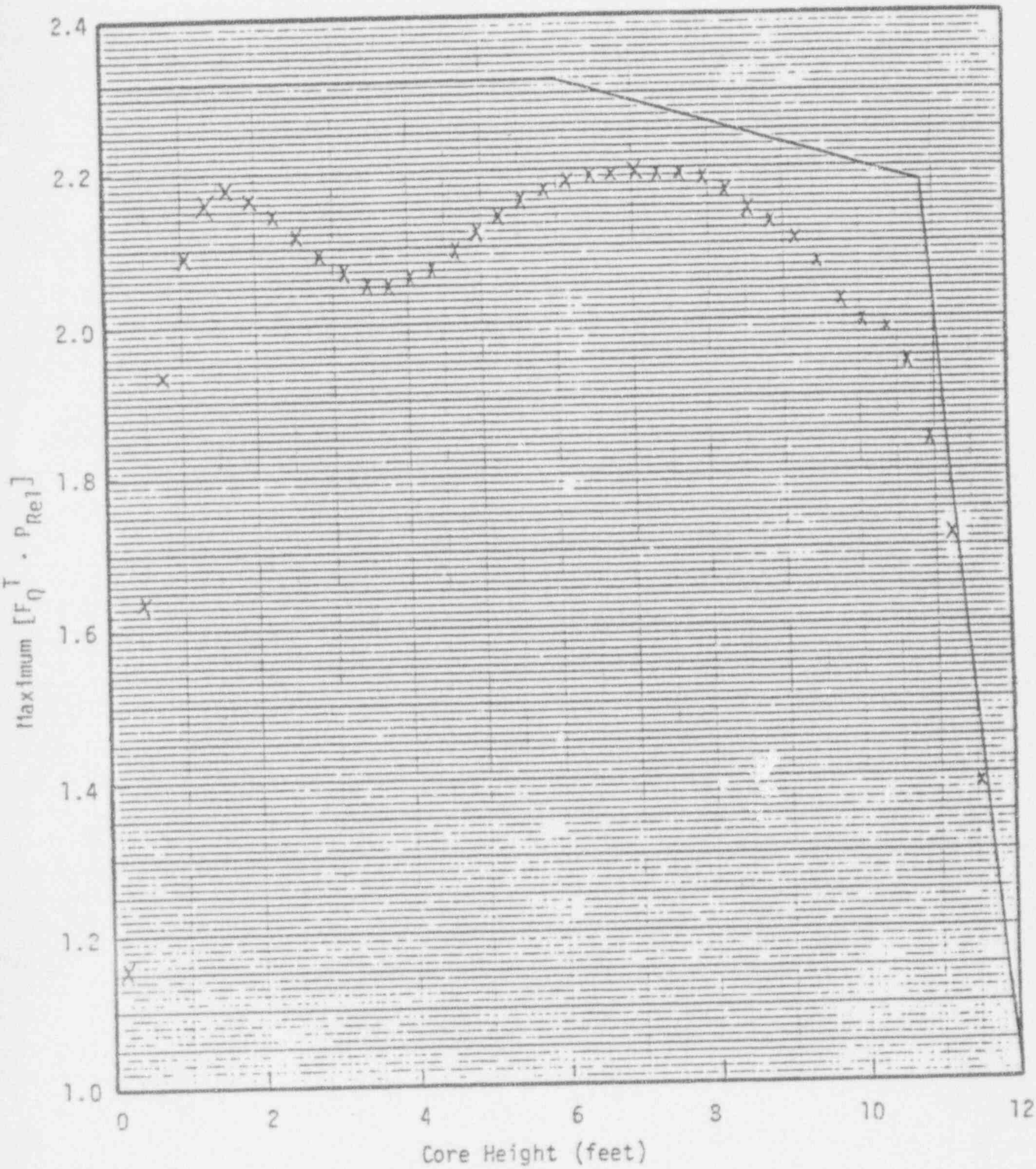
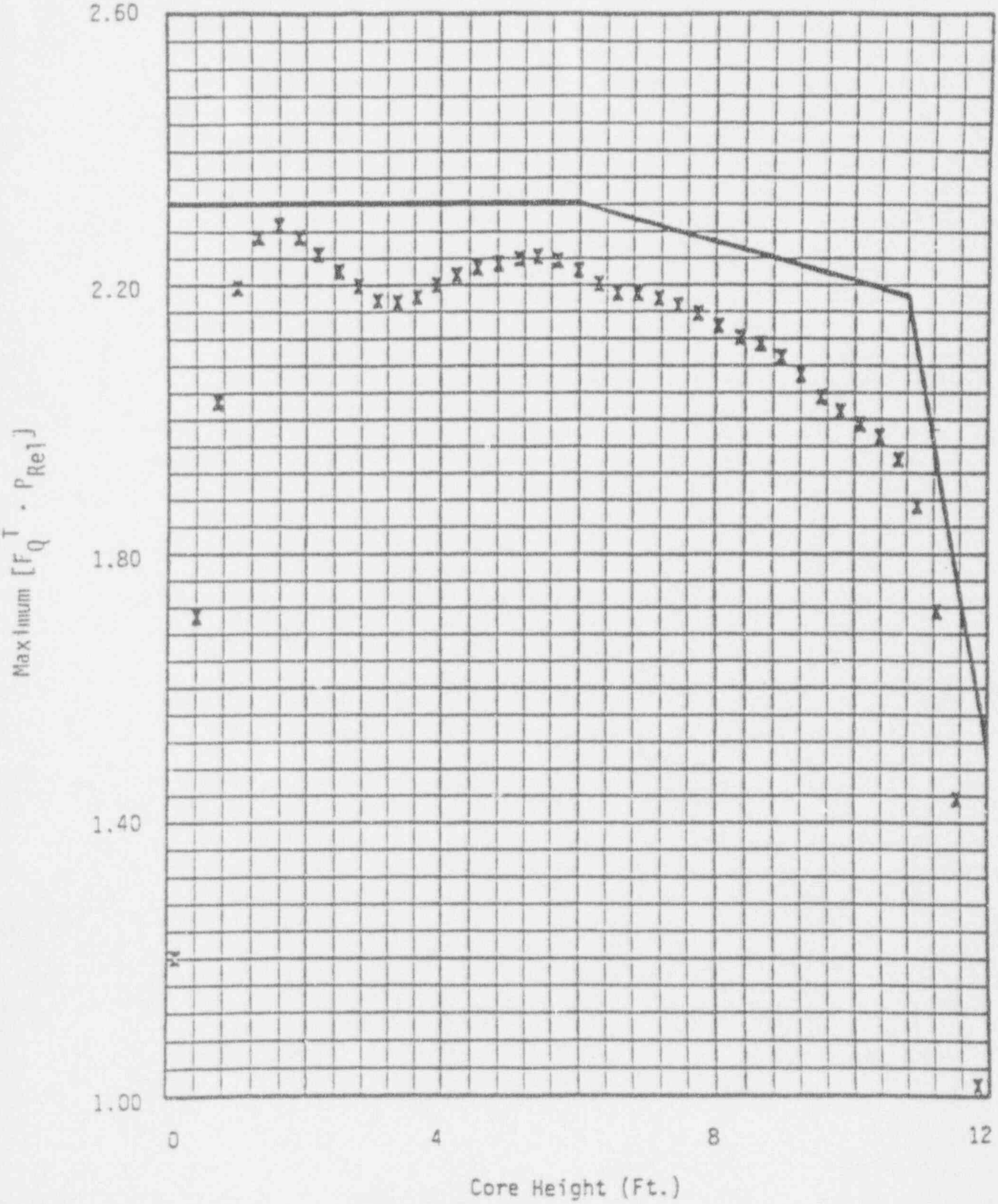


FIGURE I-4

EXAMPLE OF MAXIMUM [$F_Q^T \cdot P_{Rel}$] VERSUS AXIAL CORE HEIGHT

DURING NORMAL OPERATION +6, -9% ΔI BAND



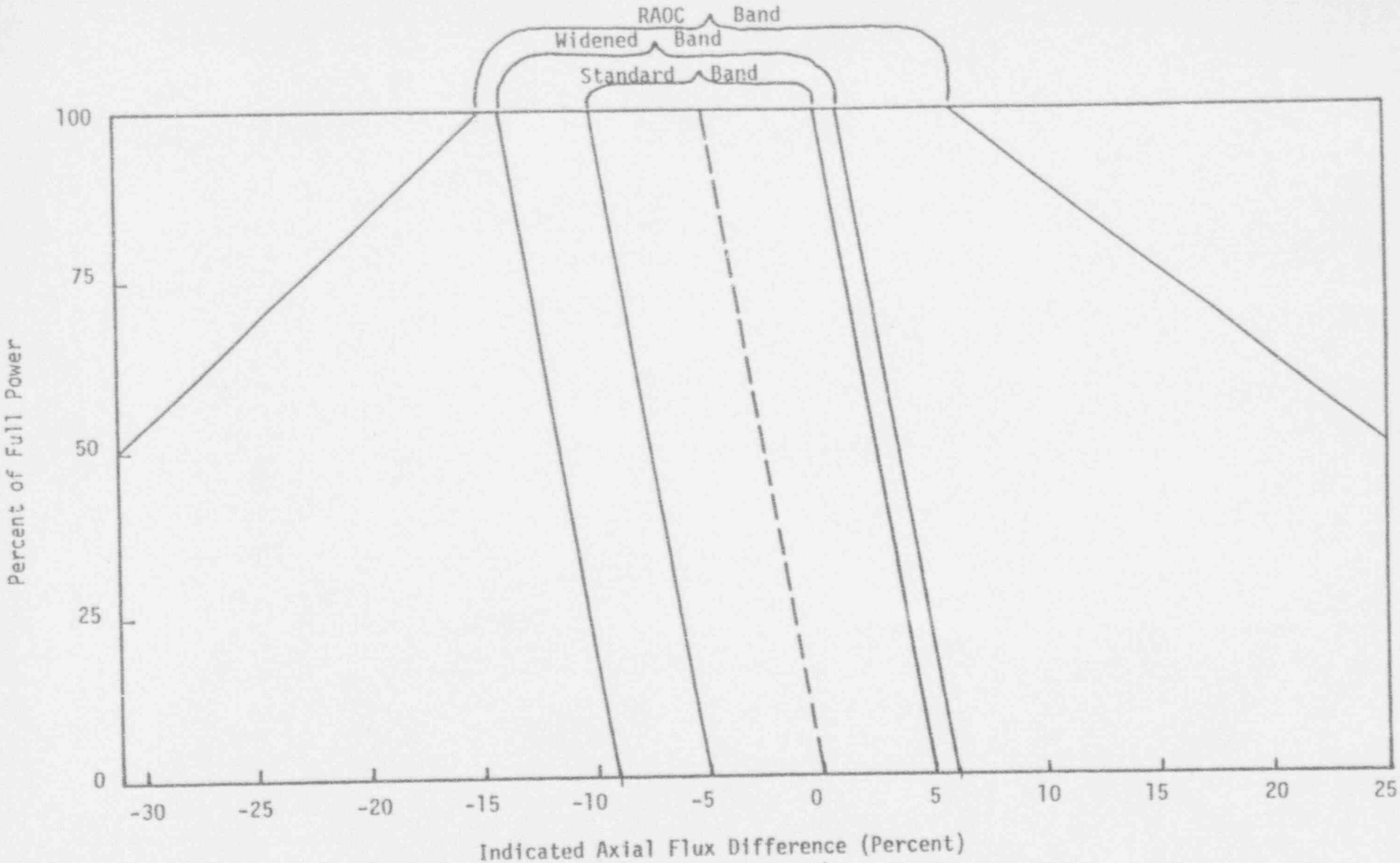


FIGURE I-5

EXAMPLE OF BANDWIDENING POSSIBLE WITH RAOC

II. CALCULATIONAL PROCEDURE

A. XENON RECONSTRUCTION

In the normal CAOC 18 case analysis, load follow simulations, which generate power distributions covering the allowed CAOC operating space, are performed to generate a typical range of allowed axial xenon distributions which in turn are used to calculate axial power distributions in both normal operation and Condition II accident conditions. Because of the much larger allowed operating space during RAOC operation, load follow simulations are not a practical method for generating power distributions covering this wider ΔI-Power operating space. Therefore, for RAOC analyses, axial xenon distributions are created by a reconstruction model. +(a,c)

+(a,c)

[ ] +(a,c)

The accuracy of the reconstruction model has been verified by two methods. They are:

a) Comparison of reconstructed Xe(z) values with those of the diffusion theory created distributions having the same xenon parameters,

b) Comparison of axial offset and F_z differences obtained with the actual and reconstructed xenon models.

Figure II-1 shows a typical envelope of pointwise Xe(z) differences. These differences over most of the core are [ ] Near the top and bottom of the core differences are larger, but do not impact RAOC limit analysis. Figure II-2 shows histograms of A.O. and F_z differences. In general, AO's agree within [ ] and F_z's agree within [ ] Because of the wide range of xenon distributions examined in the RAOC analysis, the accuracy of the reconstruction model to reproduce any individual xenon distribution, and its associated power distributions, is not important. The accuracy in AO and F_z is quite sufficient for the enveloping studies for which the reconstruction model is used. +(a,c) +(a,c)

B. XENON LIBRARY

The xenon reconstruction model makes it possible to accurately recreate an axial xenon distribution from the xenon parameters. Therefore, pointwise xenon distributions need not be stored since they can be recreated from their characteristic parameters. In addition, the reconstruction model eliminates the need to simulate a large number of xenon transients to generate the allowed range of xenon distribution. Instead, a few selected xenon transients can be analyzed to determine the allowed range of xenon parameters. These parameters then constitute the xenon parameter library. The remainder of this section describes the generation of the xenon library.

[ ] +(a,c)

The first step in determining the range of the xenon parameters is to select a tentative ΔI-Power operating space. The tentative operating space should be at least as wide or wider than the expected LOCA/LOFA limits. This will insure that the xenon parameter ranges are conservative. However, the tentative space should not be so large as to result in overly conservative parameter ranges. A poor selection will result in a time consuming iterative process to arrive at the final allowed operating space. A reasonable initial operating space is the widest space allowed at any time during the cycle by the administrative runback line and CAOC operation. This is illustrated in Figure II-3.

Xenon transient calculations are executed with ΔI maintained within the tentative ΔI-Power space. The sequence of these calculations is as follows:

[ ] +(a,c)

+(a,c)

In all the above steps the control rods must meet rod insertion limit constraints.

The recommended burnup steps and power levels are listed in Table II-1. A typical plot of ΔXe vs. XEMID (Step k) is shown in Figure II-4. This result indicates the allowed ΔXe and XEMID range for that burnup step.

The results of the above transient calculations for a typical Westinghouse reload core are shown in Figures II-5, II-6, and II-7 at BOL, MOL, and EOL respectively.

TABLE II-1

Burnups	Powers (P1-P2)

+(a,c)

$^{+}$(a,c)

C. NORMAL OPERATION ANALYSIS

1. POWER SHAPE GENERATION

In the standard CAOC analysis the generation of normal operation power distributions is constrained by the rod insertion limits (RIL) and ΔI band limits. The purpose of RAOC is to find the widest permissible ΔI-Power operating space by analyzing a wide range of ΔI. Therefore the generation of normal operation power distributions is constrained only by the RIL. The sequence for generating the power distributions is then:

$^{+}$(a,c)

]+(a,c)

The results of the above process is a large set of power distributions covering a large area of ΔI-Power space. A brief representation of this space is shown in Figure II-8. This data is used as input to the LOCA and LOFA analysis.

2. F_Q ANALYSIS

Each power shape generated in Section C.1, above, is analyzed to determine if LOCA constraints are met or exceeded. The total peaking factor, F_Q^T, is determined using standard synthesis methods as described in WCAP-8385. For each power level, the results of this analysis will indicate a range of ΔI in which there are no violations of the LOCA limits. This range is plotted for all the power levels analyzed and a bounding limit is determined. This is illustrated in Figure II-9. This bounding limit becomes the tentative allowed ΔI-power operating space for the plant, pending the results of the Loss of Flow Accident (LOFA) and Condition II Accident Analyses.

The LOCA limited ΔI-Power operations space for a typical Westinghouse reload core is shown in Figure II-10.

3. LOFA Analysis

The thermal-hydraulic methods used to analyze axial power distributions generated by the RAOC methodology is similar to those used in the CAOC methodology. Normal operation power distributions are evaluated relative to the assumed limiting normal operation power distribution, typically the 1.55 cosine, used in the accident analysis. Limits on allowable operating axial flux imbalance as a function of power level from these considerations are compared to those resulting from LOCA F_Q considerations, (Figure II-10), and the most restrictive limits determined.

D. CONDITION II ANALYSIS

The objectives of Condition II simulation (Accident Simulation) are to:

(a) Evaluate whether the consequence of the specified accident satisfy the design basis of safety related items, i.e., the maximum power density and design basis axial power shape used in DNBR evaluations.

(b) Provide, if necessary, information to obtain appropriate setpoints for core protection systems which assure the validity of the design basis. This will be accomplished by such means as redefining the f(ΔI) penalty function in the Overtemperature ΔT setpoint equation (OTΔT).

Pre-accident conditions have to satisfy the normal operating conditions, i.e.:

(a) Control rods are above their insertion limit.

(b) The flux difference, ΔI, has to be within the ΔI-Power space determined in the Normal Operation Analysis.

Axial xenon distributions are generated by the xenon reconstruction model for the range of ΔXe, XEMID and XEAVG's allowed during normal operation (ie, within the ΔI-Power Operating space determined in the normal analysis). Starting from a normal operating condition, the following accidents are simulated.

Cooldown Accident (Manual Rod Control Mode)

This accident assumes reduction of the inlet temperature of the primary coolant due to a sudden excessive load increase, steam dump valve opening, excessive feed water flow or a turbine valve opening. The control rods are assumed to stay at their original insertion. The reactor power increases as a result of this accident. The maximum amount of temperature reduction is limited to $30^{\circ}F$. The cooldown will be terminated if the reactor power reaches the high flux trip point even if the amount of temperature reduction is less than $30^{\circ}F$.

Control Rod Withdrawal

This accident assumes uncontrolled full length control rod withdrawal either by system malfunction or operator error. The boron concentration is fixed. The control rod is withdrawn every 10% of core height up to the fully withdrawn position. A reactor trip occurs if the reactor power reaches the high flux trip point. This analysis also simulates excessive (uncontrolled) load increase with automatic control rod operation.

Boration/Dilution (Automatic Rod Control Mode)

An uncontrolled boration/dilution accident is the result of a system malfunction or operator error, and is simulated as follows. The reactor power is maintained at a constant level. The reactivity change associated with the boration/dilution is compensated by automatic control rod motion. The boration is terminated when all rods are out of the core. The dilution is terminated 15 minutes after the rods pass the rod insertion limits.

1) Power Shape Generation

The first step in the Condition II analysis is the determination of the allowable normal operation preconditions. This is accomplished by selecting a set of xenon distribution parameters and searching for the control rod insertions at a given power (constrained by the rod insertion limits) that are permissible within the ΔI-Power operating space determined in the normal operation analysis. This is illustrated in Figure II-11. For that xenon distribution and power level, any rod insertion between these limits is a valid normal operation precondition for the accident analysis. The process for the accident analysis is then

[ ]+(a,c)

The power distributions generated in this sequence are then analyzed for peak power density (Kw/ft) and DNB concerns.

2) Peak Power Density

Core peaking factors can be obtained by the standard synthesis procedures using 1-D calculated axial power shapes and power levels obtained from the accident simulations and input F_{xy}'s. The results are summarized in flyspeck format as shown in Figure II-12. Usually peak power density will exceed the design basis limit only in very large axial offset (or ΔI) regions. These regions are easily protected by operator action and/or an operationally non-restrictive OPΔT f(ΔI) penalty function. (Current 17x17 plants with CAOC control operate based on an analysis without an OPΔT f(ΔI) penalty function since the OTΔT f(ΔI) penalty function is more restrictive. If the need for an OPΔT f(ΔI) penalty function is indicated by the RAOC analysis, the OTΔT f(ΔI) function would be changed such that it would be more restrictive.)

3) DNB and Setpoint Analysis

The Condition II analyses are evaluated relative to the axial power distribution assumptions used to generate DNB core limits and resultant OTΔT setpoints (including the f(ΔI) function) to determine if the setpoints are adequate for the RAOC generated conditions.

E. FINAL DETERMINATION OF RAOC LIMIT

Once the normal operation and accident analysis described in the previous sections has been completed, the final determination of the RAOC allowed ΔI-Power operating space can be made. This is accomplished by first comparing the LOCA allowed ΔI-Power operating space to that of the LOFA and selecting the most limiting operating space allowed by these normal operation limited accidents. This result is then compared to the trip setpoints that result from the OPΔT and OTΔT f(ΔI) penalty functions to insure that the trip setpoints are non-restrictive.

The resulting ΔI-Power space from this determination for a typical Westinghouse reload core is shown in Figure II-13.

F. SENSITIVITY STUDIES FOR VARIOUS F_Q LIMITS

The sensitivity of ΔI-Power operations space to changes in F_Q were analyzed through a wide range of F_Q's. The method of analysis is identical to the F_Q analysis described in Section C.2, with F_Q varied for each sensitivity case. The results indicate that a 1% change in F_Q will cause less than a 1% change in ΔI. As ΔI is under the control of the operator, F_Q can be conservatively reduced by a 1% reduction in ΔI for each 1% F_Q is to be decreased.

This conservative relationship of 1% ΔI per 1% F_Q is used in the Technical Specifications incorporating F_Q Surveillance to reduce the allowed ΔI-Power operating space in the event a measured F_Q indicates insufficient margin to the F_Q limit to allow use of the full ΔI-Power operating space.

G. IMPACT ON REMAINING SAFETY ANALYSIS

The impact of the wider ΔI-Power space allowed by RAOC on safety parameters other than those discussed in the previous section has been evaluated. No change in the methods of determining these safety parameters is required as a result of RAOC for the following reasons.

a) The current methodology as described in WCAP-9272, "Westinghouse Reload Safety Evaluation Methodology," is sufficiently conservative to bound RAOC operation. This is a result of the conservative methods used to bound the power distribution skewing allowed by CAOC.

b) Although the allowed ΔI-Power operating space is larger for RAOC than it is for CAOC, the plant is physically able to operate at the extremes of the allowed space for only brief periods of time. The plant will always tend toward the equilibrium value of ΔI, i.e. the CAOC target value, as any xenon oscillation decays. As a result the most probable power distribution occuring during normal operation of the plant will be within the CAOC ΔI-Power allowed operations space.

+(a,c)

Percent Difference

Bottom Core Height Top

FIGURE II-1

XENON RECONSTRUCTION MODEL ENVELOPE OF LOCAL XENON CONCENTRATION DIFFERENCES

+(a,c)

Relative Frequency

F_Z Differences (%)

+(a,c)

Relative Frequency

AO Differences

FIGURE II-2

XENON RECONSTRUCTION MODEL

HISTOGRAMS OF F_Z AND AO DIFFERENCES

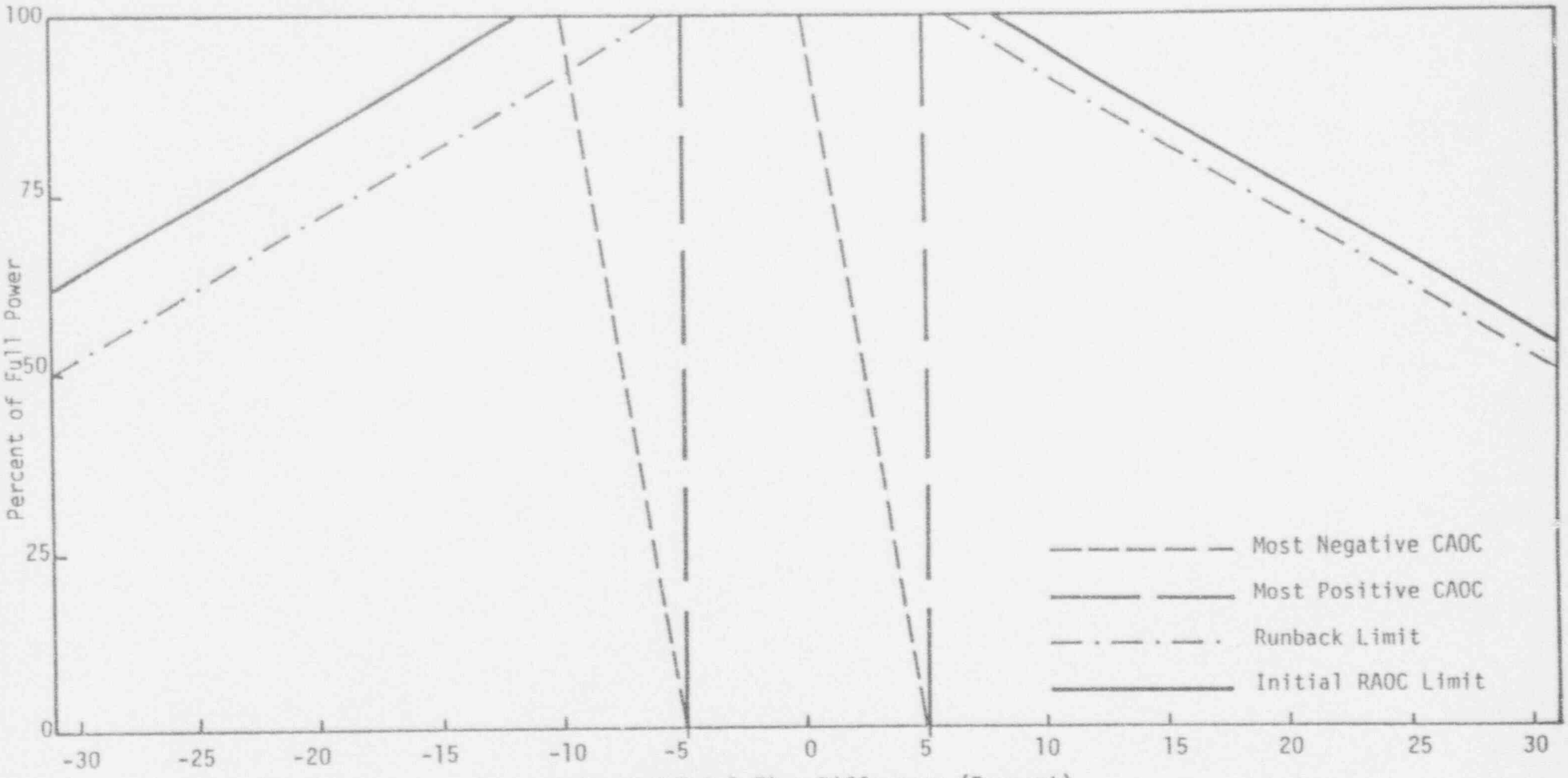


FIGURE II-3

EXAMPLE OF SELECTING PRELIMINARY RAOC LIMITS

+(a,c)

DEL-XE

XE-MID

FIGURE II-4

SAMPLE PLOT OF XENON PARAMETERS FROM TRANSIENT CALCULATION

+(a,c)

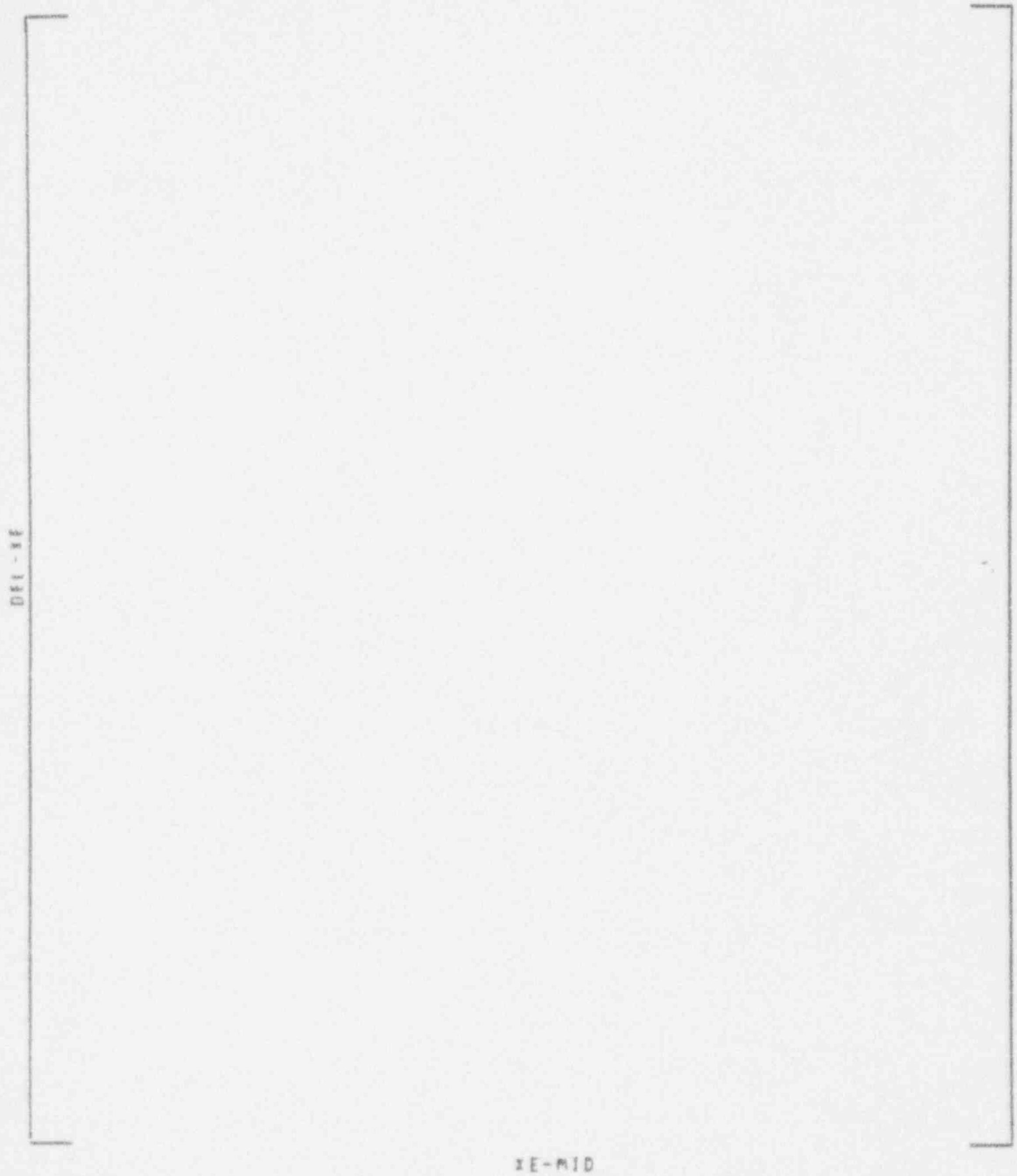


FIGURE II-5

TYPICAL WESTINGHOUSE RELOAD CORE

RESULTS OF XENON TRANSIENTS AT BOL

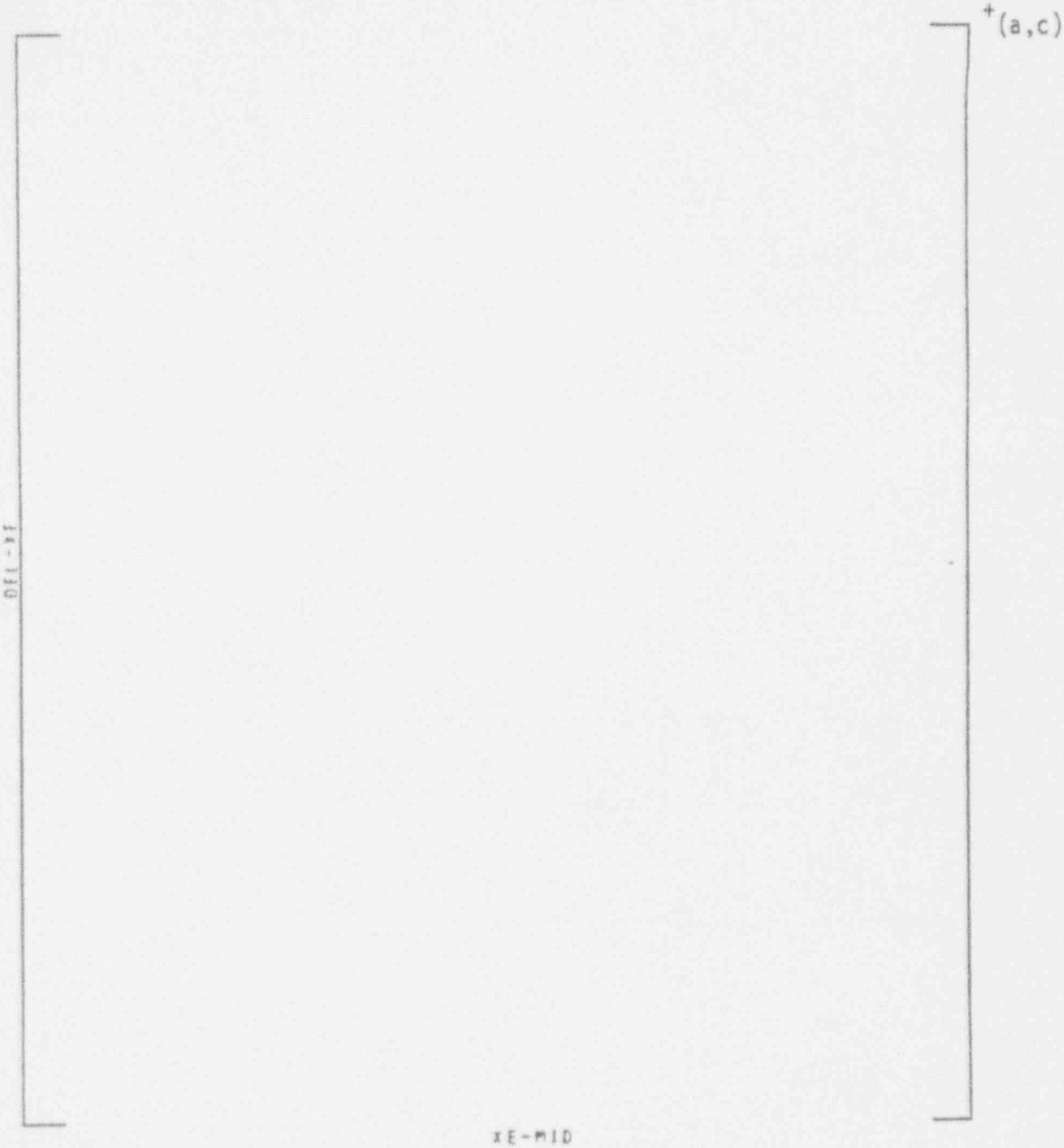


FIGURE II-6

TYPICAL WESTINGHOUSE RELOAD CORE

RESULTS OF XENON TRANSIENTS AT MOL

+(a,c)

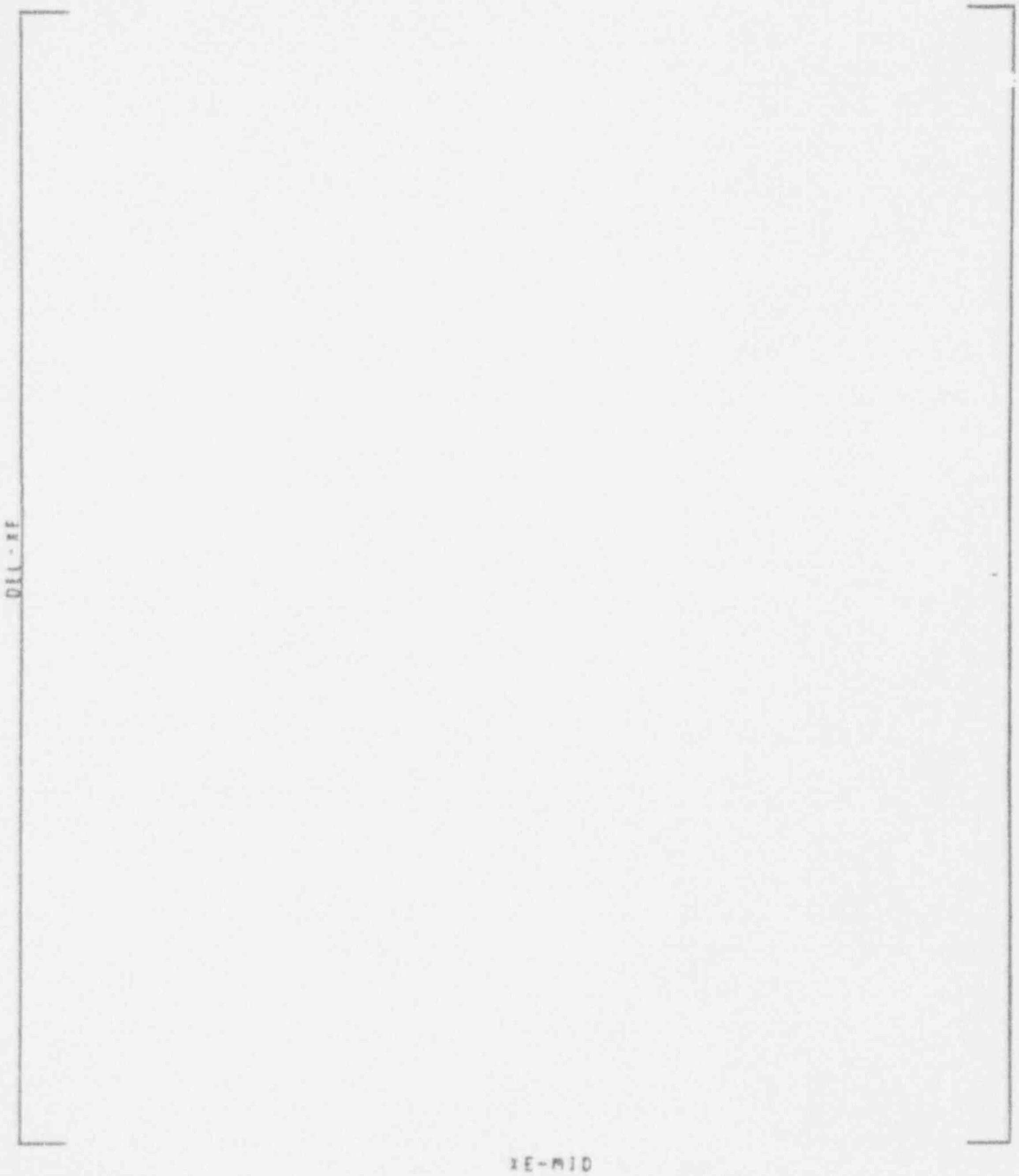


FIGURE II-7

TYPICAL WESTINGHOUSE RELOAD CORE

RESULTS OF XENON TRANSIENTS AT EOL

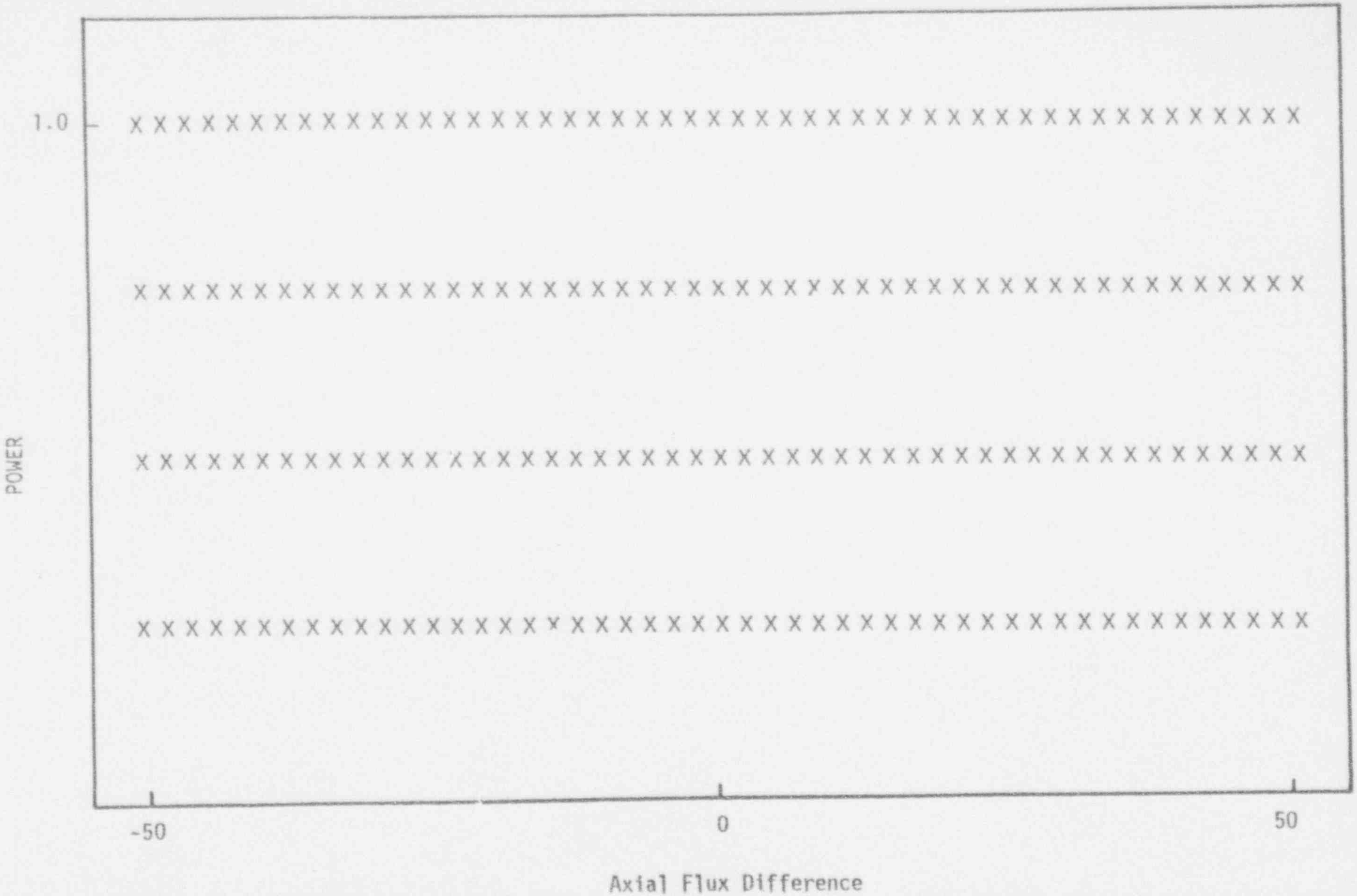


FIGURE II-8

EXAMPLE OF RANGE OF ΔI-POWER SPACE COVERED DURING NORMAL OPERATION ANALYSIS

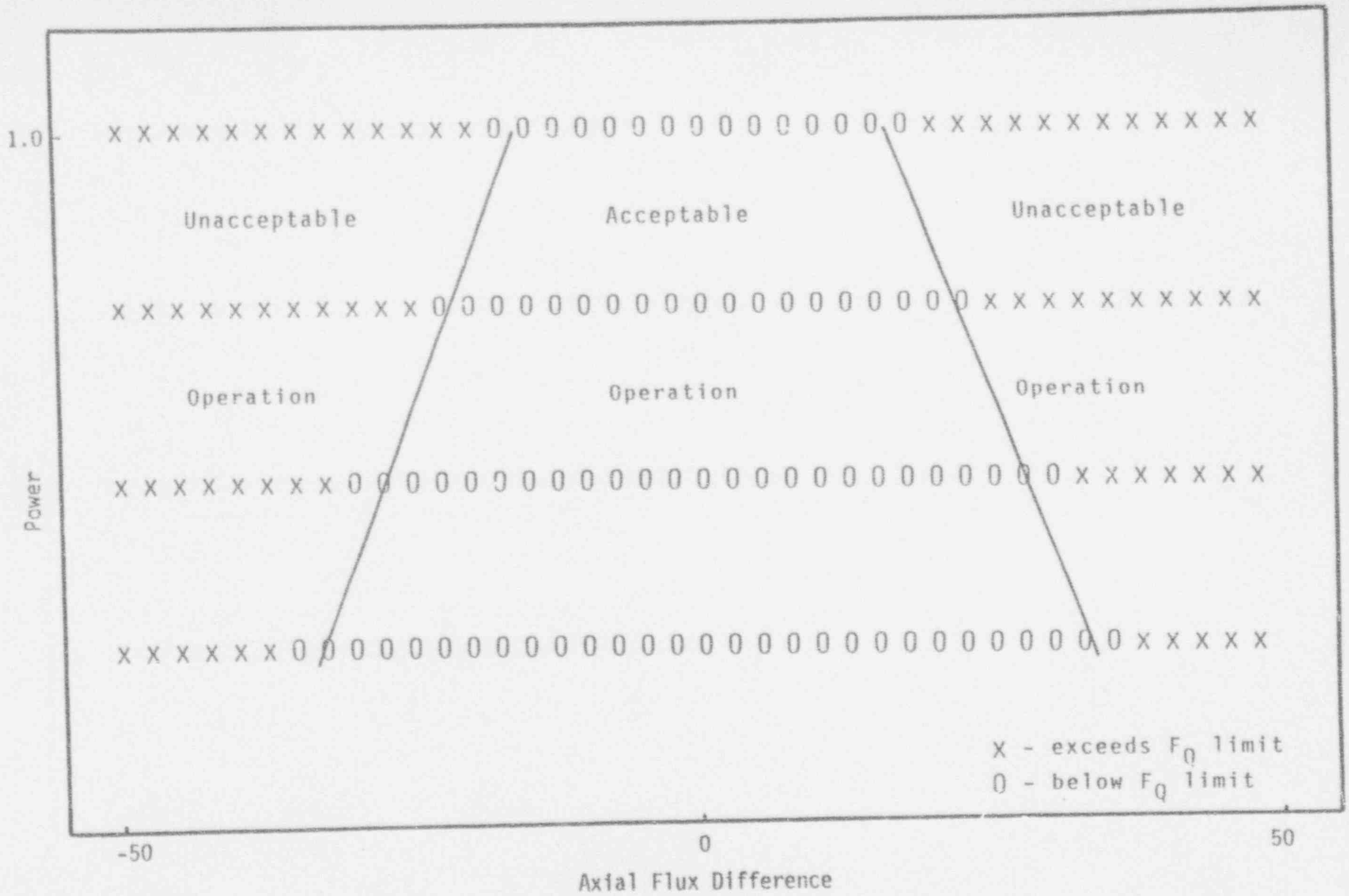


FIGURE II-9

EXAMPLE OF LIMITING ΔI-POWER SPACE BASED ON LOCA CONCERNS

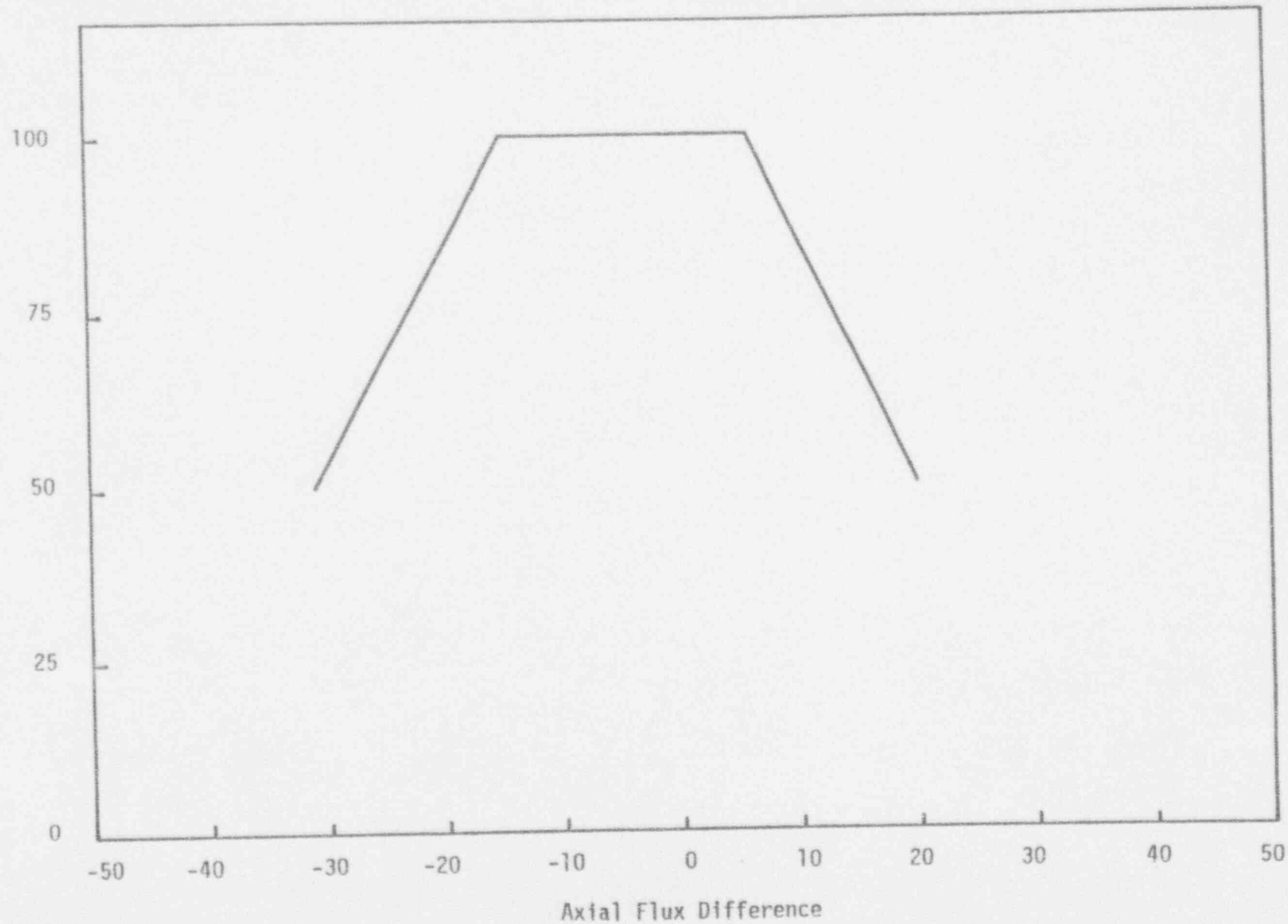


FIGURE II-10

LOCA BASED ΔI-POWER SPACE FOR A TYPICAL WESTINGHOUSE RELOAD CORE

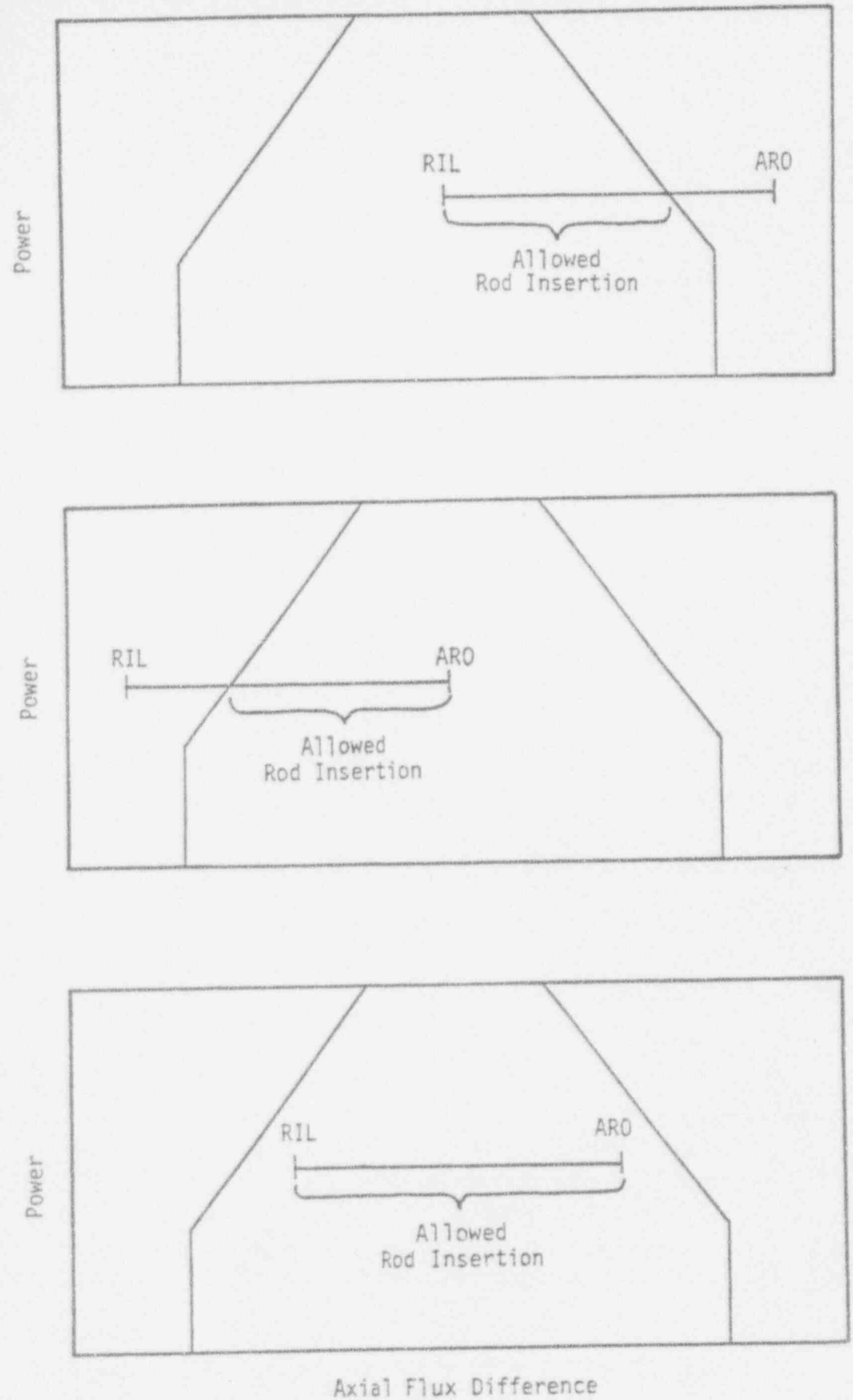


FIGURE II-11

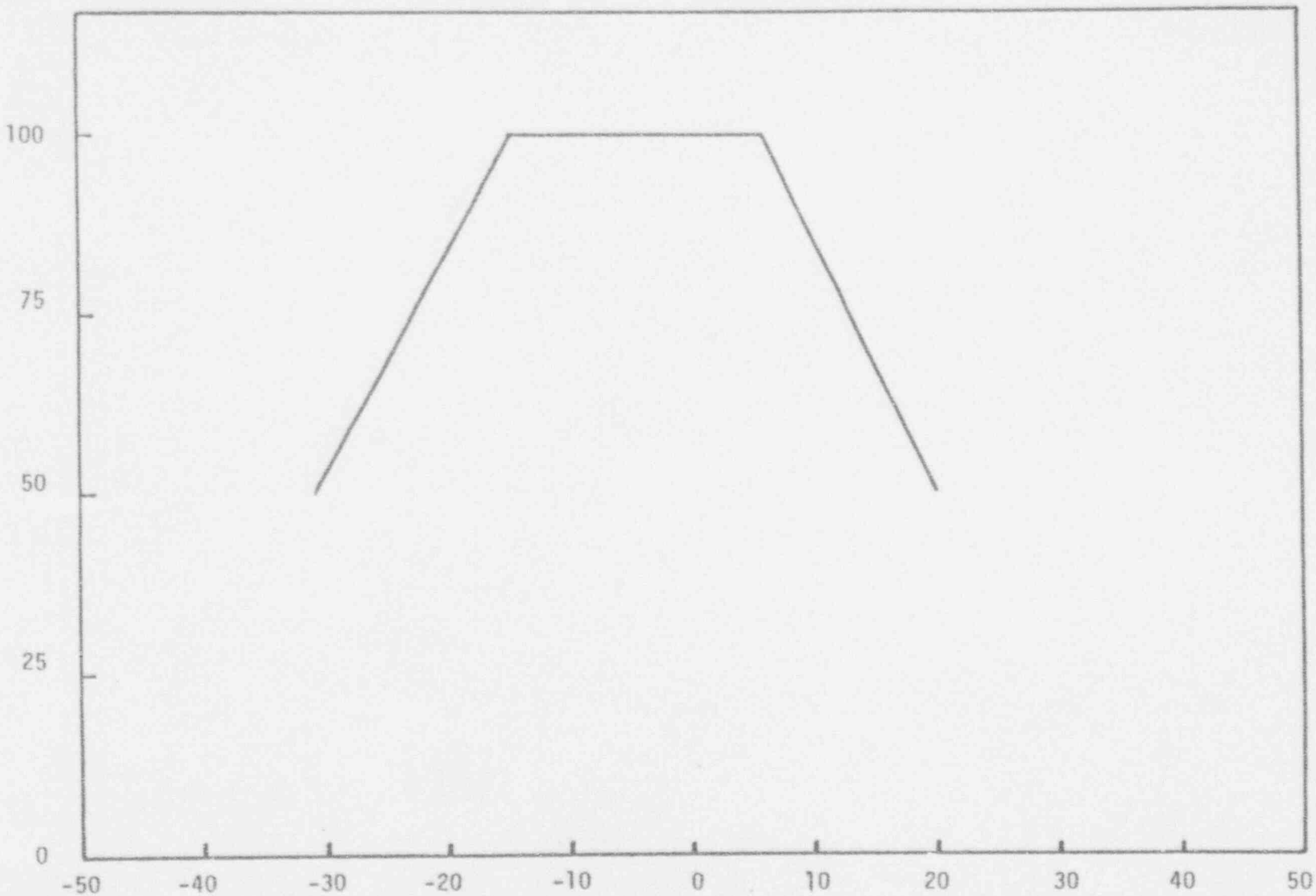
DETERMINATION OF ALLOWED RANGE OF CONTROL ROD INSERTION FOR NORMAL OPERATION

+(a,c)

DELTA I

FIGURE II-12

PEAK POWER DENSITY (Kw/ft) DURING
CONDITION II TRANSIENTS
(TYPICAL EXAMPLE)



Axial Flux Difference

FIGURE II-13

FINAL ΔI-POWER OPERATING SPACE FOR A TYPICAL WESTINGHOUSE RELOAD CORE

III. TECHNICAL SPECIFICATIONS

A. MODIFICATIONS TO 3/4.2.1

In a plant incorporating RAOC operation the Technical Specifications are modified to remove all references to CAOC in Section 3/4.2.1 and the corresponding bases. The allowed ΔI-Power operating space determined in the previous section becomes Figure 3.2-1 of the Technical Specification and operation within these limits is required. If these limits are exceeded, ΔI must be returned within the limits within a short grace period or power must be reduced. An example of the modifications to 3/4.2.1 is Section 1 of the attachment. An example of the modifications to the BASES of 3/4.2.1 is Section 2 of the attachment.

B. OTHER POTENTIAL TECHNICAL SPECIFICATION CHANGES

As a result of the OTΔT and OPΔT analysis of the Condition II transients, changes may be required to the f(ΔI) penalty functions in Table 2.2-1 of the Technical Specifications. This may be required on plants with high F_Q limits where wider ΔI limits are possible.

IV. SUMMARY AND CONCLUSIONS

The RAOC methodology has been developed for relaxing the current contraints on axial power distribution control. This methodology widens the allowed ΔI-Power operating space relative to CAOC operation particularly at reduced power levels while ensuring that safety considerations are satisfied. This is achieved by examination of a wide range of possible xenon distributions and the possible range of axial power distributions associated with each xenon distribution in both normal operation and accident conditions. This methodology has been applied to the safety analysis of a typical Westinghouse reload core. With the Technical Specification changes described in this report, the plant can operate both safely and with enhanced flexibility during this cycle.

ATTACHMENT

TECHNICAL SPECIFICATION CHANGES

A.1. MODIFICATIONS TO 3/4.2.1

AXIAL FLUX DIFFERENCE LIMITS

3/4.2 POWER DISTRIBUTION LIMITS

3/4.2.1 AXIAL FLUX DIFFERENCE (AFD)

LIMITING CONDITION FOR OPERATION

3.2.1 The indicated AXIAL FLUX DIFFERENCE (AFD) shall be maintained within the allowed operational space defined by Figure 3.2-1.

APPLICABILITY: MODE 1 ABOVE 50 PERCENT RATED THERMAL POWER

ACTION:

a. With the indicated AXIAL FLUX DIFFERENCE outside of the Figure 3.2-1 limits,

   1.) Either restore the indicated AFD to within the Figure 3.2-1 limits within 15 minutes, or

   2.) Reduce THERMAL POWER to less than 50% of RATED THERMAL POWER within 30 minutes and reduce the Power Range Neutron Flux - High Trip setpoints to less than or equal to 55 percent of RATED THERMAL POWER within the next 4 hours.

b. THERMAL POWER shall not be increased above 50% of RATED THERMAL POWER unless the indicated AFD is within the Figure 3.2-1 limits.

SURVEILLANCE REQUIREMENTS

4.2.1.1 The indicated AXIAL FLUX DIFFERENCE shall be determined to be within its limits during POWER OPERATION above 50 percent of RATED THERMAL POWER by:

a. Monitoring the indicated AFD for each OPERABLE excore channel:

   1. At least once per 7 days when the AFD Monitor Alarm is OPERABLE, and

   2. At least once per hour for the first 24 hours after restoring the AFD Monitor Alarm to OPERABLE status.

b. Monitoring and logging the indicated AXIAL FLUX DIFFERENCE for each OPERABLE excore channel at least once per hour for the first 24 hours and at least once per 30 minutes thereafter, when the AXIAL FLUX DIFFERENCE Monitor Alarm is inoperable. The logged values of the indicated AXIAL FLUX DIFFERENCE shall be assumed to exist during the interval preceding each logging.

4.2.1.2 The indicated AFD shall be considered outside of its limits when at least 2 OPERABLE excore channels are indicating the AFD to be outside the limits.

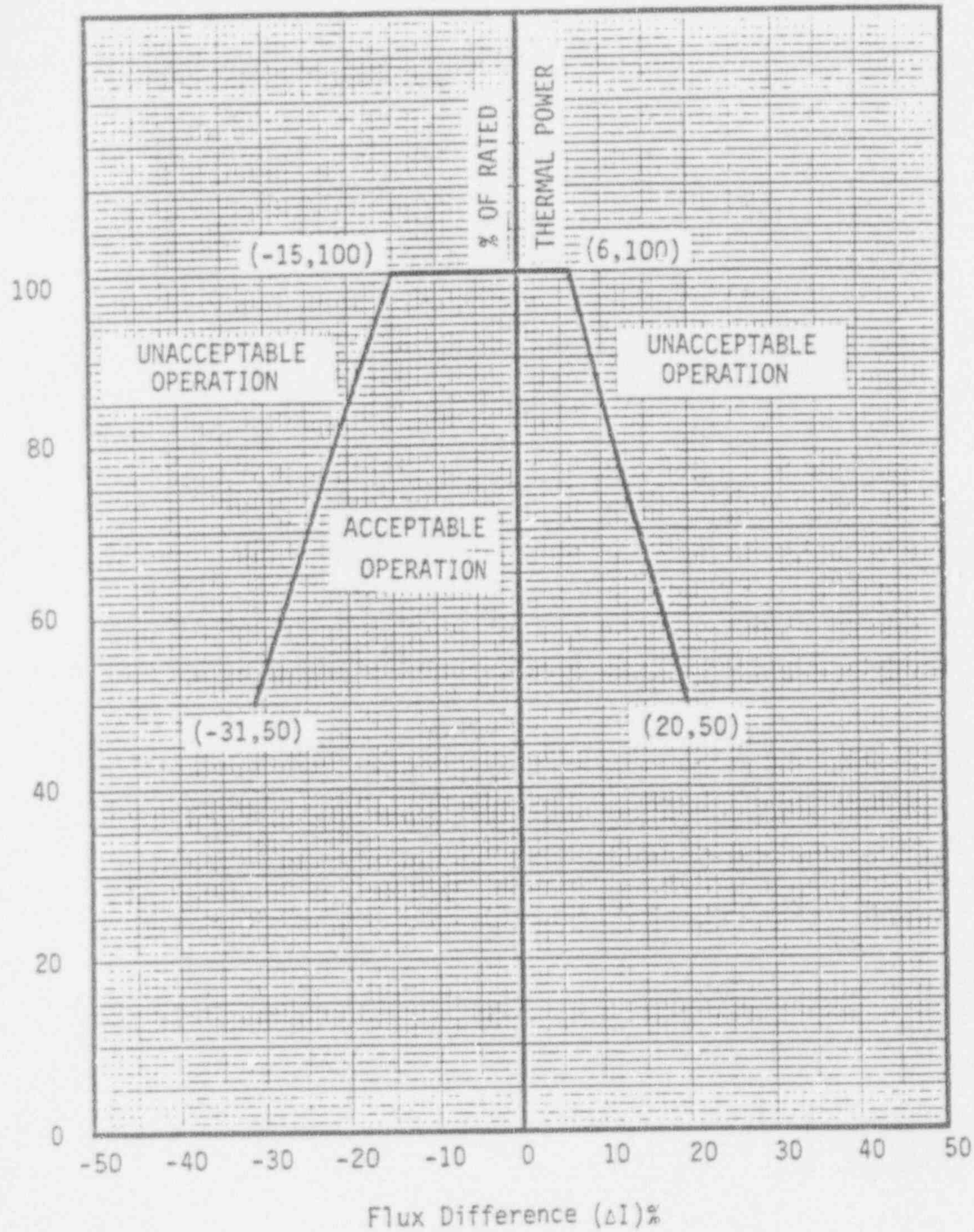


FIGURE 3.2-1

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER
(TYPICAL EXAMPLE)

A.2. MODIFICATIONS TO B 3/4.2.1

BASES FOR AXIAL FLUX DIFFERENCE LIMITS

3/4.2.1 AXIAL FLUX DIFFERENCE (AFD)

The limits on AXIAL FLUX DIFFERENCE assure that the $F_Q(Z)$ upper bound envelope of F_Q^{limit} times the normalized axial peaking factor is not exceeded during either normal operation or in the event of xenon redistribution following power changes.

Provisions for monitoring the AFD on an automatic basis are derived from the plant process computer through the AFD Monitor Alarm. The computer determines the one minute average of each of the OPERABLE excore detector outputs and provides an alarm message immediately if the AFD for at least 2 of 4 or 2 of 3 OPERABLE excore channels are outside the AFD limits and the THERMAL POWER is greater than 50 percent of RATED THERMAL POWER.

THIS FIGURE DELETED

Figure B 3/4 2-1 TYPICAL INDICATED AXIAL FLUX DIFFERENCE VERSUS THERMAL POWER

The F_Q SURVEILLANCE TECHNICAL SPECIFICATION

(Part B of NS-EPR-2649)

R. W. Miller

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J. A. Vestovich

September 1982

REVISED: OCTOBER 1993

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3050e.wpf:50/101493

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ATTACHMENT

TECHNICAL SPECIFICATION CHANGES

I. INTRODUCTION

Plant operation below the heat flux hot channel factor ($F_Q(z)$) limit assures that peak clad temperature above the 2200^{o}F ECCS acceptance limits is not exceeded during a LOCA event. Currently, periodic plant surveillance on the height dependent radial peaking factor, $F_{xy}(z)$, is required as partial verification that operation will not cause the $F_Q(z)$ limit to be exceeded. In the F_Q Surveillance Technical Specifiction, $F_{xy}(z)$ surveillance has been replaced by $F_Q(z)$ surveillance. Monitoring $F_Q(z)$ and increasing the value for expected plant maneuvers provides a more convenient form of assuring plant operation below the F_Q (z) limit while retaining the intent of using a measured parameter to verify operation below Technical Specification limits.

II. REFORMULATION TO F_Q(Z) SURVEILLANCE

$F_Q(z)$ surveillance is accomplished in the following manner. A full core flux map is taken under equilibrium conditions to determine $F_Q(z)$. This measured $F_Q(z)$ is increased by appropriate uncertainties to account for manufacturing tolerances and measurement uncertainty. The resulting $F_Q(z)$ including uncertainties is called $F_Q^M(z)$. Since $F_Q^M(z)$ was measured under equilibrium conditions, potential increases in $F_Q(z)$ that might arise from changes in the equilibrium power distribution caused by power level changes and control rod movement must also be accounted for. A W(z) function that represents the maximum likely increase in the equilibrium measured $F_Q(z)$ that might arise during power distribution transients will account for nonequilibrium operation.

$F_Q(z)$ surveillance is then accomplished by comparing the product of the measured $F_Q^M(z)$ and the analytically determined W(z) to the $F_Q(z)$ limit.

$$F_Q^M(z) \times W(z) \leq \frac{F_Q^{limit} \times K(z)}{P} \text{ for } P > 0.50$$

$$F_Q^M(z) \times W(z) \leq \frac{F_Q^{limit} \times K(z)}{0.5} \text{ for } P \leq 0.50$$

where K(z) is the normalized $F_Q(z)$ limit and P is the fraction of rated thermal power.

In a plant using CAOC operation, an Allowed Power Level (APL) can then be defined. APL represents the highest percentage of rated thermal power at which the plant can operate and still be assured that $F_Q(z)$ will be maintained below Technical Specifiction limits. APL is determined by taking the $F_Q(z)$ limit and dividing by the product of $F_Q^M(z)$ and W(z).

$$APL = \underset{\text{over } z}{\text{minimum}} \left(\frac{F_Q^{limit} \times K(z)}{F_Q^M(z) \times W(z)} \right) \times 100\%$$

While it is possible for the APL to be defined here as a number greater than 100%, other Technical specifications prevent plant operation above 100% of RATED THERMAL POWER. If APL is less than 100%, operation above APL is allowed to the extent that APDMS surveillance demonstrates or plant operation restrictions insure that the F_Q limit is met.

If the plant is using RAOC operation and $F_Q^M(z) \times W(z)$ exceeds its limit, the allowed ΔI-Power operating space must be reduced to insure operation below the F_Q limit. No allowance for widening the ΔI-Power space over that of Figure 3.2-1 if $F_Q^M(z) \times W(z)$ is below its limit is permited.

III. REVISIONS TO THE TECHNICAL SPECIFICATIONS

A. Surveillance Requirements - Section 4.2.2.2

During normal operation $F_Q(z)$ is shown to be within its limit by comparing the result of a measured $F_Q(z)$ multiplied by a $W(z)$ transient function to the $F_Q(z)$ limit. Periodically a full core flux map is taken under equilibrium conditions to determine a measured $F_Q(z)$. This $F_Q(z)$ is then increased by 3% to account for manufacturing tolerances and further increased by 5% to account for measurement uncertainties. The resulting equilibrium measured $F_Q(z)$ including uncertainties is called $F_Q^M(z)$. To verify operation below the Tech Spec $F_Q(z)$ limit, $F_Q^M(z)$ must be shown to be less than or equal to the $F_Q(z)$ limit divided by the $W(z)$ transient function

$$F_Q^M(z) \leq \frac{F_Q^{limit} \times K(z)}{P \times W(z)} \quad \text{for } P > 0.5$$

$$F_Q^M(z) \leq \frac{F_Q^{limit} \times K(z)}{W(z) \times 0.5} \quad \text{for } P \geq 0.5$$

where $K(z)$ is the normalized $F_Q(z)$ limit, P is the fraction of rated thermal power and everything else is as defined previously. $F_Q(z)$ surveillance must be performed when power has been increased by 10% of rated thermal power over the thermal power that $F_Q^M(z)$ was last determined or at least once every 31 effective full power days, whichever occurs first. When verifying that $F_Q^M(z)$ is within its limits, the top and bottom 15% of the core are excluded from consideration due to the difficulty in making a precise measurement for this region and the low probability that this region would be more limiting than the central 70% of the active core.

B. Surveillance Requirements - Section 4.2.2.2.e

Because $F_Q(z)$ surveillance is only required every 31 effective full power days, the Technical Specification takes into account the possibility that $F_Q(z)$ may increase between surveillances. Typically, because of natural feedback effects, $F_Q(z)$ decreases with increasing core burnup. Locations of peak power output in the core are also locations of peak fuel depletion rate in the core. However, cores using large numbers of burnable poison rods or non-standard fuel management techniques may show some small increase In $F_Q(z)$ with core burnup. The Technical Specification requires that when performing $F_Q(z)$ surveillance the resulting $F_Q(z)$ value must be compared to $F_Q(z)$ determined from the previous flux map. If the margin to the $F_Q(z)$ limit has decreased, since the previous determination of $F_Q(z)$, then additional action must be taken. The Technical Specification allows two options. If the margin to the $F_Q(z)$ limit has decreased since the previous map, then either the new $F_Q(z)$ must be increased by an appropriate penalty to account for further increases in $F_Q(z)$ before the next surveillance, or surveillance must be performed every seven full power days. A 2% value was chosen as the standard penalty, since it bounds the maximum increase in $F_Q(z)$ for typical cores. For those cores which are predicted to have larger increases over certain burnup ranges, a larger penalty will be provided on a cycle-specific basis or the additional penalty in excess of 2% will be factored into the cycle-specific W(z) function. The additional penalty or more frequent mapping requirements can be discontinued when two successive flux maps indicate that the margin to the $F_Q(z)$ limit is no longer decreasing.

An example of the modifications to 3/4.2.2 required to Incorporate F_Q surveillance for RAOC operation is Section 1 of the attachment. When the $F_Q(z)$ increase penalty is provided on a cycle-specific basis, Specification 4.2.2.2.e.1 must be modified to reflect inclusion of this parameter in the Peaking Factor Limit Report (PFLR) or Core Operating Limit Report (COLR).

C. PEAKING FACTOR LIMIT REPORT-SECTION 6.9.1.14 OR COLR

The W(z) function is a plant and cycle dependent function. The W(z) function for a given cycle will be formally reported to the utility and the NRC in the PFLR or in the COLR. If appropriate, the W(z) function may include the excess $F_Q(z)$ increase penalty above 2% or alternatively, a larger burnup-dependent penalty factor may be provided in the PFLR (or COLR) as a replacement for the standard 2% value.

The Peaking Factor Limit Report will be supplied at least 60 days prior to cycle initial criticality or 60 days prior to the date the values would become effective unless otherwise exempted by the NRC. Section 2 of the attachment is the changes to the Reporting Requirements section (6.9) of the Technical Specifications requiring a Peaking Factor Limit Report. Section 3 is a sample report for RAOC operation.

D. AXIAL POWER DISTRIBUTION - SECTION 3.2.6 (CAOC PLANTS ONLY)

In conjunction with the measurement of $F_Q^M(z)$, an Allowed Power Level (APL) is determined. APL is defined as the ratio of the $F_Q(z)$ limit to the product of $F_Q^M(z)$ and $W(z)$.

$$APL = \text{minimum over } z \left(\frac{F_Q^{Limit} \times K(z)}{F_Q^M(z) \times W(z)} \right) \times 100\%$$

The top and the bottom 15% of the core are also excluded from the calculations of APL. Operation at power levels above APL requires the use of the APDMS or operational restrictions (such as Base Load Operation) on the plant.

IV. METHODOLOGY FOR $F_Q(z)$ AND $W(z)$ ANALYSIS

A. W(z) METHODOLOGY

The $W(z)$ factor represents the largest expected increase in an equilibrium $F_Q(z)$ that can result from changes in ΔI and power level which are allowed in plant operation.

W(z) is defined as:

$$W(z) = \frac{(F_Q(z) \times P)^{\text{maximum, simulated transient}}}{(F_Q(z) \times P)^{\text{equilibrium}}}$$

Changes in the core power distribution caused by control rod insertion, power level changes, axial xenon transients, and radial xenon transients are all included in W(z). If appropriate, the W(z) function may also include the excess $F_Q(z)$ increase penalty above the standard 2% for cores which are predicted to show larger increases over certain monthly burnup intervals. In most reload cores, operating flexibility can be maximized by making the W(z) function burnup dependent.

For a plant incorporating CAOC operation, the W(z) function is determined by analyzing a full range of power shapes occurring from simulation of typical load follow operation. Plant maneuvers covering the full range of power levels, core burnups, and operator control strategies are simulated while maintaining the appropriate ΔI band. The specific cases analyzed are those used in the standard Westinghouse $F_Q(z)$ analysis[1,2]. Alternatively, other standard F_Q analyses[3,4] could be employed to compute W(z).

For a plant with a RAOC Technical Specification, W(z) is determined based on the transient $F_Q(z)$ resulting from the normal operation analysis of the final ΔI-Power operating space. The methodology for determining the ΔI-Power operating space is discussed in "Relaxation of Constant Axial Offset Control" (Part A of NS-EPR-2649).

---

(1) "F_Q Envelope Calculations", C.E. Eicheldinger letter NS-CE-687; 6/27/74 (Prop.)
(2) F.M. Bordelon, et. al. "Westinghouse Reload Safety Methodology," WCAP-9272, March 1978 (Prop.)
(3) Letter from C. Eicheldinger (Westinghouse), NS-CE-1749 to John F. Stolz (NRC); April 6, 1978 (Prop.)
(4) Letter from T.M. Anderson (Westinghouse), NS-TMA-2198, to K. Kniel (NRC); January 31, 1980 (Prop.)

B. Radial Xenon Methodology

The insertion or withdrawal of control rods while changing power level can cause radial xenon redistribution as well as axial xenon redistribution. Since $F_Q(z)$ increases caused by radial xenon redistribution cannot be modeled in the axial model used to evaluate F_Q, this factor must be taken into account with separate calculations. $F_Q(z)$ increases due to radial xenon transients are explicitly included in W(z) through a height dependent radial xenon factor, Xe(z). Three-dimensional calculations are used to evaluate increases in elevation dependent radial peaking factors in a conservative manner by inducing a radial xenon oscillation. An equilibrium xenon case is perturbed by reducing power level and inserting control rods deeply enough to force the axial flux difference to the most negative allowed valve. The xenon distribution is allowed to change for sereral hours in this configuration, then the control rods are withdrawn and power is increased. The resulting xenon transient is followed in short time steps. The maximum value of F_{xy} at each elevation occuring during the transient is used to determine

Xe(z), where

$$Xe(z) = \frac{F_{xy}(z,t)^{\text{maximum, transient}}}{F_{xy}(z)_{\text{equilibrium}}}$$

The final form of Xe(z) is determined by conservatively bounding the results of the transient calculation.

A.1. MODIFICATIONS TO 3/4.2.2
HEAT FLUX HOT CHANNEL FACTOR LIMITS

POWER DISTRIBUTION LIMITS

HEAT FLUX HOT CHANNEL FACTOR-FQ(Z)

LIMITING CONDITION FOR OPERATION

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

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

$$F_Q(z) \leq \left[\frac{F_Q^{Limit}}{0.5}\right] [K(Z)] \text{ for } P \leq 0.5$$

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

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:

1. Reduce THERMAL POWER at least 1 percent for each 1 percent $F_Q(z)$ 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 ΔT Trip Setpoints (value of K_4) have been reduced at least 1 percent (in ΔT span) for each 1 percent $F_Q(z)$ exceeds the limit.

b. Identify and correct the cause of the out of limit condition prior to increasing THERMAL POWER; THERMAL POWER may then be increased provided $F_Q(z)$ is demonstrated through incore mapping to be within its limit.

SURVEILLANCE REQUIREMENTS

4.2.2.1 The provisions of Specification 4.0.4 are not applicable.

4.2.2.2 $F_Q(z)$ shall be evaluated to determine if $F_Q(z)$ is within its limit by:

a. Using the moveable incore detectors to obtain a power distribution map at any THERMAL POWER greater than 5 percent of RATED THERMAL POWER.

b. Increasing the measured $F_Q(z)$ component of the power distribution map by 3 percent to account for manufacturing tolerances and further increasing the value by 5 percent to account for measurement uncertainties.

c. Satisfying the following relationship:

$$F_Q^M(z) \le \frac{F_Q^{Limit}}{P \times W(z)} \times K(z) \text{ for } P > 0.5$$

$$F_Q^M(z) \le \frac{F_Q^{limit}}{W(z) \times 0.5} \times K(z) \text{ for } P \le 0.5$$

where $F_Q^M(z)$ is the measured $F_Q(z)$ increased by the allowances for manufacturing tolerances and measurement uncertainty, F_Q^{limit} is the F_Q limit, $K(z)$ is given in Figure 3.2-2, P is the relative THERMAL POWER, and $W(z)$ is the cycle dependent function that accounts for power distribution transients encountered during normal operation. This function is given in the Peaking Factor Limit Report as per Specification 6.9.1.14.

d. Measuring $F_Q^M(z)$ according to the following schedule:

1. Upon achieving equilibrium conditions after exceeding by 10 percent or more of RATED THERMAL POWER, the THERMAL POWER at which $F_Q(z)$ was last determined,* or

2. At least once per 31 effective full power days, whichever occurs first.

---

*During power escalation at the beginning of each cycle, power level may be increased until a power level for extended operation has been achieved and a power distribution map obtained.

SURVEILLANCE REQUIREMENTS (Cont)

e. With measurements indicating

$$\underset{\text{over } z}{\text{maximum}} \left(\frac{F_Q^M(z)}{K(z)} \right)$$

has increased since the previous determination of $F_Q{}^M(z)$ either of the following actions shall be taken:

1. $F_Q{}^M(z)$ shall be increased by 2 percent over that specified in 4.2.2.2.c, or

2. $F_Q{}^M(z)$ shall be measured at least once per 7 effective full power days until 2 successive maps indicate that

$$\underset{\text{over } z}{\text{maximum}} \left(\frac{F_Q^M(z)}{K(z)} \right) \text{is not increasing.}$$

f. With the relationships specified in 4.2.2.2.c above not being satisfied:

1. Calculate the percent $F_Q(z)$ exceeds its limit by the following expression:

$$\left\{ \left(\underset{\text{over } z}{\text{maximum}} \left[\frac{F_Q{}^M(z) \times W(z)}{\frac{F_Q^{\text{limit}}}{P} \times K(z)} \right] \right) -1 \right\} \times 100 \quad \text{for } P \geq 0.5$$

$$\left\{ \left(\underset{\text{over } z}{\text{maximum}} \left[\frac{F_Q{}^M(z) \times W(z)}{\frac{F_Q^{\text{limit}}}{0.5} \times K(z)} \right] \right) -1 \right\} \times 100 \quad \text{for } P < 0.5$$

2. Either of the following actions shall be taken:

   a. Place the core in an equilibrium condition where the limit in 4.2.2.2.c is satisfied. Power level may then be increased provided the AFD limits of Figure 3.2-1 are reduced 1% AFD for each percent $F_Q(z)$ exceeded its limit, or

   b. Comply with the requirements of Specification 3.2.2 for $F_Q(z)$ exceeding its limit by the percent calculated above

g. The limits specified in 4.2.2.2.c, 4.2.2.2.e, and 4.2.2.2.f above are not applicable in the following core plane regions:

   1. Lower core region 0 to 15 percent inclusive.

   2. Upper core region 85 to 100 percent inclusive.

4.2.2.3 When $F_Q(z)$ is measured for reasons other than meeting the requirements of Specification 4.2.2.2 an overall measured $F_Q(z)$ shall be obtained from a power distribution map and increased by 3 percent to account for manufacturing tolerances and further increased by 5 percent to account for measurement uncertainty.

3/4.2 POWER DISTRIBUTION LIMITS

BASES

The specifications of this section provide assurance of fuel integrity during Condition I (Normal Operation) and II (Incidents of Moderate Frequency) events by: (a) maintaining the calculated DNBR in the core at or above design during normal operation and in short term transients, and (b) limiting the fission gas release, fuel pellet temperature and cladding mechanical properties to within assumed design criteria. In addition, limiting the peak linear power density during Condition I events provides assurance that the initial conditions assumed for the LOCA analyses are met and the ECCS acceptance criteria limit of 2200°F is not exceeded.

The definitions of certain hot channel and peaking factors as used in these specifications are as follows:

$F_Q(z)$ Heat flux Hot Channel Factor, is defined as the maximum local heat flux on the surface of a fuel rod at core elevation Z divided by the average fuel rod heat flux, allowing for manufacturing tolerances on fuel pellets and rods.

$F^N_{\Delta H}$ Nuclear Enthalpy Rise Hot Channel Factor is defined as the ratio of the integral of linear power along the rod with the highest integrated power to the average rod power.

3/4.2.1 AXIAL FLUX DIFFERENCE (AFD)

The limits on AXIAL FLUX DIFFERENCE assure that the $F_Q(z)$ upper bound envelope of F_Q^{limit} times the normalized axial peaking factor is not exceeded during either normal operation or in the event of xenon redistribution following power changes.

Provisions for monitoring the AFD on an automatic basis are derived from the plant process computer through the AFD Monitor Alarm. The computer determines the one minute average of each of the OPERABLE excore detector outputs and provides an alarm message immediately if the AFD for at least 2 of 4 or 2 of 3 OPERABLE excore channels are outside the allowed ΔI-Power operating space and the THERMAL POWER is greater than 50 percent of RATED THERMAL POWER.

3/4.2.2 and 3/4.2.3 HEAT FLUX HOT CHANNEL FACTOR, RCS FLOWRATE AND NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR

The limits on heat flux hot channel factor, RCS flowrate, and nuclear enthalpy rise hot channel factor 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.

BASES (Cont)

Each of these is 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 limits are maintained provided:

a. Control rods in a single group move together with no individual rod insertion differing by more than $\pm$ 13 steps from the group demand position.

b. Control rod groups are sequenced with overlapping groups as described in Specifiction 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.

$F^N_{\Delta H}$ will be maintained within its limits provided conditions a. through d. above are maintained. As noted on Figures 3.2-3 and 3.2-4, RCS flow and $F^N_{\Delta H}$ may be "traded off" against one another to ensure that the calculated DNBR will not be below the design DNBR value. The relaxation of $F^N_{\Delta H}$ as a function of THERMAL POWER allows changes in the radial power shape for all permissible rod insertion limits.

When RCS flow rate and $F^N_{\Delta H}$ are measured, no additional allowances are necessary prior to comparison with the limits of Figures 3.2-3 and 3.2-4. Measurement errors of 3.5 percent for RCS total flow rate and 4 percent for $F^N_{\Delta H}$ have been allowed for in determination of the design DNBR value.

When an F_Q measurement is taken, both experimental error and manufacturing tolerances must be allowed for. 5 percent is the appropriate allowance for a full core map taken with the incore detector flux mapping system and 3 percent is the appropriate allowance for manufacturing tolerance.

The hot channel factor $F_Q{}^M(z)$ is measured periodically and increased by a cycle and height dependent power factor, W(z), to provide assurance that the limit on the hot channel factor, $F_Q(z)$, is met. W(z) accounts for the effects of normal operation transients and was determined from expected power control maneuvers over the full range of burnup conditions in the core. The W(z) function for normal operation is provided in the Peaking Factor Limit Report per Specification 6.9.1.14.

BASES (Cont)

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 startup testing and periodically during power operation.

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 of F_Q is reinstated by reducing the power by 3 percent from RATED THERMAL POWER for each percent of tilt in excess of 1.0.

3/4.2.5 DNB PARAMETERS

The limits on the DNB related parameters assure that each of the parameters are maintained within the normal steady state envelope of operation assumed in the transient and accident analyses. The limits are consistent with the intial FSAR assumptions and have been analytically demonstrated adequate to maintain a minimum DNBR of 1.3 throughout each analyzed transient.

The 12 hour periodic surveillance of these parameters through instrument readout is sufficient to ensure that the parameters are restored within their limits following load changes and other expected transient operation.

THIS FIGURE DELETED

Figure B 3/4 2-1 TYPICAL INDICATED AXIAL FLUX DIFFERENCE VERSUS THERMAL POWER

A.2. ADDITIONS TO 6.0

ADMINISTRATIVE CONTROLS

PEAKING FACTOR LIMIT REPORT

6.9.1.14 The W(z) function for normal operation shall be provided to the Director, Nuclear Reactor Regulations, Attention Chief of the Core Performance Branch, U. S. Nuclear Regulatory Commission, Washington, D.C. 20555 at least 60 days prior to cycle initial criticality. In the event that these values would be submitted at some other time during core life, it will be submitted 60 days prior to the date the values would become effective unless otherwise exempted by the Commission.

Any information needed to support W(z) will be by request from the NRC and need not be included in this report.

A.3. SAMPLE PEAKING FACTOR LIMIT REPORT

APPENDIX A

PEAKING FACTOR LIMIT REPORT

This Peaking Factor Limit Report is provided in accordance with Paragraph 6.9.1.14 of the Plant A Technical Specifications.

The Cycle N W(z) function for RAOC operation is shown in Figure 1. W(z) was calculated using the method described in Reference 1.

This W(z) function is used to confirm that the heat flux hot channel factor, $F_Q(z)$, will be limited to the Technical Specifications values of:

$$F_Q(z) \leq \frac{F_Q^{Limit}}{P} [K(z)] \text{ for } P > 0.5 \text{ and}$$

$$F_Q(z) \leq \frac{F_Q^{Limit}}{0.5} [K(z)] \text{ for } P \leq 0.5$$

This W(z) function, when applied to a powe distribution measured under equilibrium conditions, demonstrate that the initial conditions assumed in the LOCA are met, along with the ECCS acceptance criteria of 10CFR50.46.

(1) NS-EPR-2649, Letter from E.P. Rahe (Westinghouse) to C.H. Burlinger (NRC), August 31, 1982

+(a,c)

MAX W(Z)

CORE HEIGHT (FEET)

HEIGHT (FEET)	MAX W(Z)

+(a,c)

* Top and bottom 15% excluded as per Technical Specification 4.2.2.2.g

FIGURE 1

TYPICAL WESTINGHOUSE RELOAD CORE

RAOC W(Z)

SECTION E

WCAP-10217-A

RELAXATION OF CONSTANT AXIAL OFFSET CONTROL

F_Q SURVEILLANCE TECHNICAL SPECIFICATION

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FEB 28 1983

Mr. E. P. Rahe, Manager
Nuclear Safety Department
P. O. Box 355
Pittsburgh, Pennsylvania 15230

Dear Mr. Rahe:

Subject: Acceptance for Referencing of Licensing Topical Report
WCAP 10216(P) - (NS-EPR-2649)

The Nuclear Regulatory Commission (NRC) has completed its review of the two enclosures, Part A and Part B, submitted by Westinghouse Electric Corporation (W) letter Number NS-EPR-2649, dated August 31, 1982. Part A, entitled "Relaxation of Constant Axial Offset Control," proposes a revised method for power distribution control in Westinghouse designed pressurized water reactors. Part B, entitled "The F_Q Surveillance Technical Specification," describes an alternative to the present technique for performing surveillance on the value of the total power peaking factor (F_Q) in the core. It is understood that the accepted versions of these submittals will be consolidated in a single report under the report identification symbols WCAP-10216(P), proprietary version, and WCAP-10217(NP), nonproprietary version. Our separate evaluations of Parts A and B are enclosed.

Based on our review, we conclude that the Axial Offset Control procedure described in Part A is an acceptable method for power distribution control in Westinghouse designed pressurized water reactors and the proposed power peaking factor (F_Q) surveillance technical specification described in Part B is an acceptable means of meeting the requirements for surveillance of this parameter.

As a result of our review, we find the enclosures to Westinghouse's letter NS-EPR-2649 Part A "Relaxation of the Constant Axial Offset Control" dated August 1982, and Part B, "The F_Q Surveillance Technical Specification," dated September 1982, are acceptable for referencing in license applications for Westinghouse designed pressurized water reactors to the extent specified and under the limitations delineated in the reports and their associated evaluations enclosed.

We do not intend to repeat the review of the safety features described in the reports and found acceptable when they appear as references in a license application except to assure that the material presented is applicable to the specific plant involved. Our acceptance applies only to the features described in the reports.

In accordance with established procedures (NUREG-0390), it is requested that Westinghouse publish accepted versions of these reports, proprietary and nonproprietary, within three months of receipt of this letter. The revisions are to incorporate this letter and the enclosed evaluations following title page, and thus just in front of the abstract. It is understood that the accepted versions are to have a report identification symbol (RI SYM) WCAP-10216(P) and WCAP-10217(NP). The RI SYM must include a -A suffix.

Should Nuclear Regulatory Commission criteria or regulations change such that our conclusions as to the acceptability of the report are invalidated, Westinghouse Electric Corporation and/or the applicants referencing the topical report will be expected to revise and resubmit their respective documentation or submit justification for the continued effective applicability of the topical report without revision of their respective documentation.

Sincerely,

Cecil O. Thomas

Cecil O. Thomas, Chief
Standardization & Special
Projects Branch
Division of Licensing

Enclosures:
As stated

EVALUATION OF PART A
OF WESTINGHOUSE PROPRIETARY DOCUMENT NS-EPR-2649,
"RELAXATION OF CONSTANT AXIAL OFFSET CONTROL"
(TACS 48817)

By letter dated August 31, 1982 Westinghouse Electric Corporation submitted document NS-EPR-2649 for review. The Reactor Physics Section of the Core Performance Branch has reviewed Part A of this document entitled "Relaxation of Constant Axial Offset Control" and prepared the following evaluation. The evaluation of Part B of the document will be presented separately.

1. Description of Report

Axial power distribution control in Westinghouse reactors is currently achieved by following the Constant Axial Offset Control (CAOC) procedure. This procedure requires that the axial offset be kept within a narrow band (typically ± 5 percent) about a target value during normal plant operation-including power change maneuvers - in order to ensure that unallowed power shapes do not occur. For some plants for which the LOCA analysis yields high values of permitted peaking factors significant margin exists between these values and those produced by the CAOC operating procedure. Some plants have employed wider operating bands within the CAOC procedure but still must follow the procedure. NS-EPR-2649 proposes to replace the CAOC with the Relaxed Axial Offset Control (RAOC) procedure.

The presence of margin to limits with the CAOC procedure implies that the allowed value of ΔI, the axial flux difference (difference between the upper and lower excore detector readings) may be increased, particularly at lower power. The result of the RAOC procedure is a curve of allowed ΔI as a function of power. The report provides the details of the manner in which the curve is constructed.

The procedure begins by constructing a xenon distribution library. Selected xenon transients are calculated and the resulting axial xenon distributions are characterized by certain parameters. These parameters are stored and the xenon distribution reconstructed from them when required. The allowed xenon distributions are limited to those for which the core ΔI values remain within tentatively chosen limits which are wider than the expected LOCA limits. Xenon libraries are prepared for BOL, MOL, and EOL burnup.

The next step in the procedure is the normal operation analysis. The only constraints employed are the rod insertion limits and the tentative ΔI limits. One dimensional calculations are performed at BOL, MOL, and EOL for a number of power levels and for xenon distributions throughout the range of the xenon library. The axial power distribution is recorded for each case. Each power shape generated is examined to see if LOCA limits are met or exceeded. The standard Westinghouse synthesis method is used. The result of this examination is a ΔI range as a function of power which meets the LOCA limits. The power shapes within this range are then examined to ascertain whether they meet the thermal-hydraulic constraints imposed by the loss of flow accident (LOFA) and the limits are revised accordingly.

The effect of the widened ΔI band on the consequences of anticipated transients is next investigated. The cool down event, control rod withdrawal event and boration/dilution event are investigated for each reload. Sensitivity studies for other events have shown that reanalysis is not required. The analyses consist of choosing initial power distributions from the allowed power-ΔI domain, being careful to include the entire domain and performing the transient calculation with each distribution. The axial power shapes are preserved from each "snapshot" in the event, and core peaking factors are synthesized by the standard procedure. The results are examined for violations of peak power and DNB limits. If required the overtemperature-delta temperature (OTΔT) or overpower-delta temperature (OPΔT) trips may be altered to provide protection by changing the F(ΔI) penalty function in the trips. Alternatively the ΔI operating band may be further restricted to limit the initial conditions.

Application of the RAOC to a particular reactor requires alteration of its Technical Specifications. Sample revised Technical Specifications are presented in the report. All reference to the CAOC is removed from the specifications and replaced by a single curve, Figure 3.2-1, of Axial Flux Difference (ΔI) as a function of power. Specification 3.2.1 requires that ΔI be maintained within the allowed operations space on the Figure. Surveillance requirements are similar to those for other alarmed limits.

2. Summary of Evaluation

The following discussion summarizes the evaluation of report NS-EPR-2649, Part A.

The xenon distribution reconstruction model makes use of standard procedures for such applications. The procedure has been verified by comparison of reconstructed distributions to the original and shown to be within acceptable limits. In particular the axial offset and axial peaking factors are reproduced to within one percent or less. We conclude that the reconstruction model adequately represents the xenon axial distributions used in the analysis.

The xenon distributions used in the analyses are obtained from xenon transient calculations which are chosen to bound any that might occur in reactor operation. The transients are initiated by step changes in power which tend to exacerbate the resulting power swings. We conclude that an adequate library of xenon distribution shapes is created.

The procedure used to obtain the ΔI band limits for the normal operation limited events (LOCA and LOFA) is straightforward and acceptable. A sufficiently large sample of power shapes is examined to assure, with high probability, that limiting shapes have been sampled. The synthesis method used to determine whether LOCA constraints are met or exceeded is the standard Westinghouse procedure and is acceptable. The thermal-hydraulic methods used to perform the DNB comparisons for the loss of flow accident are similar to those used for the same analysis in the CAOC methodology and are acceptable.

The procedures employed in the determination of whether the allowed power shapes obtained from the normal operation analysis lead to acceptable consequences for Condition II events is straightforward and acceptable. We conclude that a sufficient set of events and starting conditions are analyzed to provide a high degree of confidence that the consequences of Condition II events are acceptable after alteration of the permitted ΔI band or the DNB trip algorithms.

The rather involved CAOC Technical Specification is replaced by a specification that merely requires that the axial flux difference (ΔI) be maintained with the acceptable band as a function of power. Upon discovery that the band limits have been exceeded (a computer alarm is provided) the operator must restore ΔI to within limits within fifteen minutes or reduce power to less than 50 percent of full power. This is an acceptable specification. The surveillance requirement discusses the frequency of verification of ΔI as a function of the status of the alarm. This is typical of such specifications and is acceptable.

3. Evaluation Procedure

The evaluation of report NS-EPR-2649, Part A has been performed under guidelines for methods and procedures provided in Section 4.3 of the Standard Review Plan. Enough information is provided to permit a knowledgeable person to conclude that the procedure described is adequate to accomplish its purposes and that the analyses performed to implement and verify its suitability are state-of-art and are acceptable.

4. Regulatory Position

Based on its review, which is described above, the staff concludes that the Relaxed Axial Offset Control procedure is an acceptable method for power distribution control in Westinghouse designed pressurized water reactors. The staff further concludes that report NS-EPR-2649, Part A may be used as a reference to describe the method and support its use.

EVALUATION OF PART B OF
WESTINGHOUSE PROPRIETARY REPORT NS-EPR-2649,
"THE F_Q SURVEILLANCE TECHNICAL SPECIFICATION"
(TACS 48818)

By letter dated August 31, 1982 Westinghouse Electric Corporation submitted Document NS-EPR-2649 for review. The Reactor Physics Section of the Core Performance Branch has reviewed Part B of this document entitled "The F_Q Surveillance Technical Specification" and prepared the following evaluation. The evaluation of Part A of this document will be presented separately.

1. Description of Document

This document describes an alternative to the present technique for performing surveillance on the value of the total power peaking factor F_Q in the core.

Currently periodic plant surveillance on the height dependent radial peaking factor, $F_{xy}(Z)$, is required as partial verification that operation will not cause the $F_Q(Z)$ limit to be exceeded. The remaining verification is provided by operation within the CAOC procedures and rod insertion limits. The proposed procedure replaces the $F_{xy}(Z)$ surveillance with a measurement of steady state $F_Q(Z)$ and multiplication of the measured value by a factor, W(Z), which accounts for plant maneuvers within the restriction on axial flux difference and rod insertion permitted by the Technical Specifications. The product of the measured $F_Q^M(Z)$ and the analytically determined W(Z) is then compared to the $F_Q(Z)$ limit. Before forming the product a measurement uncertainty is added to $F_Q^M(Z)$.

The procedure may be applied to plants which use either constant axial offset control or relaxed axial offset control. In either case the W(Z) factor is developed from the series of calculations used to establish the flux imbalance limits. W(Z) is defined as

$$W(Z) = \frac{(F_Q(Z) \times P) \text{ maximum, simulated transient}}{(F_Q(Z) \times P) \text{ equilibrium}}$$

Where P is core power.

Changes in the core power distribution caused by control rod insertion, power level changes, and axial and radial xenon transients are all included in W(Z). For plants using CAOC operation the W(Z) function is determined by analyzing a full range of power shapes occurring from simulation of typical load follow operations. For a plant with RAOC operation the power shapes used in the normal operation analysis are used.

2. Summary of Evaluation

The following discussion summarizes our evaluation of the proposed F_Q surveillance Technical Specification.

The revised procedure accomplishes the same purpose as the procedure it replaces. The calculational component of the new procedure is less than that of the old since only the change in axial shape is included as compared to the previous entire axial shape. The measurement uncertainty employed is the previously accepted value for F_Q measurements.

A sufficient number of calculations is performed to permit the conclusion that there is a high probability that the W(Z) function will be bounding.

The proposal to submit the W(Z) curve in a Peaking Factor Limit Report is consistent with present practice with respect to the F_{xy} surveillance and is acceptable.

The procedures used to account for possible increases in $F_Q(Z)$ between measurements are similar to those currently used and are acceptable.

3. Evaluation Procedure

The evaluation of report NS-EPR-2649, Part B has been performed within the guidelines providad in the Standard Review Plan, Section 4.3 for methods and procedures. Enough information is provided to permit a knowledgeable person to conclude that the surveillance procedure described in the report is adequate to accomplish its purpose and that the analyses performed to implement the procedure provide a high degree of confidence that the $F_Q(Z)$ limit will not be exceeded during normal plant operation.

4. Regulatory Position

Based on its review, which is described above, the staff concludes that the proposed F_Q surveillance Technical Specification is an acceptable means of meeting the requirements for surveillance of this parameter. Further, report NS-EPR-2649, Part B may be used as a reference to support its use.

Westinghouse Electric Corporation

Water Reactor Divisions

Nuclear Technology Division

Box 355
Pittsburgh Pennsylvania 15230

NS-EPR-2649

August 31, 1982

Mr. C. H. Berlinger, Chief
Core Performance Branch
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: Mr. D. Fieno

Dear Mr. Berlinger:

Enclosed are:

1) Twenty-five (25) copies of a Westinghouse document titled, "Relaxation of Constant Axial Offset Control" (Proprietary).

2) Fifteen (15) copies of a Westinghouse document titled, "Relaxation of Constant Axial Offset Control" (Non-Proprietary).

3) Twenty-five (25) copies of a Westinghouse document titled, "The F_Q Surveillance Technical Specifications" (Proprietary).

4) Fifteen (15) copies of a Westinghouse document titled, "The F_Q Surveillance Technical Specifications" (Non-Proprietary).

Also enclosed are:

A) One (1) copy of Application for Withholding, AW-82-53 (Non-Proprietary).

B) One (1) copy of original Affidavit (Non-Proprietary).

The first enclosure, titled "Relaxation of Constant Axial Offset Control", is information supplied for your review regarding an improved Westinghouse methodology for power distribution control. The major operational differences between this new methodology (RAOC) and Constant Axial Offset Control (CAOC) are: a) elimination of the target band (typically $\pm$ 5% ΔI) and b) the widening and extension to 100% power of the administrative limits. These differences result in increased operational flexibility and should eliminate those few instances where power escalation is limited due to operator inability to maintain the indicated ΔI within the target band. The information provided is generic in scope with examples provided for a typical case.

Your review of the enclosed and subsequent approval of the approach and methodology is requested. Plant specific calculations noting the plant specific administrative limits will be provided on the individual plant dockets.

The second enclosure, titled "The F_Q Surveillance Technical Specifications", is information supplied for your review regarding an improved Westinghouse methodology for the surveillance of F_Q. The information provided is similar to that discussed with Mr. M. Dunenfeld of your staff in a meeting on February 25, 1981, and notes two types of Technical Specifications, a) for RAOC and b) for CAOC. Please note that only the RAOC version of the Technical Specifications has been provided as part of this enclosure. The CAOC version of the Technical Specifications will be provided as an addendum when utilized for the first time. Your review of this enclosure and subsequent approval of the approach and methodology in the generic sense for both RAOC and CAOC is requested.

This submittal contains proprietary information of Westinghouse Electric Corporation. In conformance with the requirements of 10CFR Section 2.790, as amended, of the Commission's regulations, we are enclosing with this submittal an application for withholding from public disclosure by the Commission.

Correspondence with respect to the affidavit or application for withholding should reference AW-82-53 and should be addressed to R. A. Wiesemann, Manager, Regulatory and Legislative Affairs, Westinghouse Electric Corporation, P.O. Box 355, Pittsburgh, Pennsylvania 15230.

Very truly yours,

for E. P. Rahe, Jr., Manager
Nuclear Safety Department

CRT/kk
Enclosures

Westinghouse Electric Corporation
Water Reactor Divisions
Box 355
Pittsburgh Pennsylvania 15230

August 31, 1982
AW-82-53

Mr. C. H. Berlinger, Chief
Core Performance Branch
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

SUBJECT: "Relaxation of Constant Axial Offset Control" and "The Fq Surveillance Technical Specifications," August 1982

REF: Westinghouse Letter, Rahe to Berlinger, NS-EPR-2649, August 31, 1982

Dear Mr. Berlinger:

This application for withholding is submitted by Westinghouse Electric Corporation pursuant to the provisions of paragraph (b)(1) of Section 2.790 of the Commission's regulations. Withholding from public disclosure is requested with respect to the subject information.

The proprietary material for which withholding is being requested is of the same technical type as that proprietary material submitted by Westinghouse previously in application for withholding AW-76-8, and was accompanied by an affidavit signed by the owner of the proprietary information, Westinghouse Electric Corporation.

Further, the affidavit AW-76-8 submitted to justify the previous material was approved by the Commission on November 9, 1977, and is equally applicable to the subject material.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse and which is further identified in the affidavit be withheld from public disclosure in accordance with 10CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference AW-82-53 and should be addressed to the undersigned.

Very truly yours,

Robert A. Wiesemann

Robert A. Wiesemann, Manager
Regulatory & Legislative Affairs

/bek
Attachment

cc: E. C. Shomaker, Esq.
Office of the Executive Legal Director, NRC

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared Robert A. Wiesemann, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Corporation ("Westinghouse") and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

Robert A. Wiesemann

Robert A. Wiesemann, Manager
Licensing Programs

Sworn to and subscribed before me this 11th day of August 1976.

Notary Public

(1) I am Manager, Licensing Programs, in the Pressurized Water Reactor Systems Division, of Westinghouse Electric Corporation and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing or rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Water Reactor Divisions.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse Nuclear Energy Systems in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(g) It is not the property of Westinghouse, but must be treated as proprietary by Westinghouse according to agreements with the owner.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition in those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information is not available in public sources to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in the attachment to Westinghouse letter number NS-CE-1139, Eicheldinger to Stolz, dated July 19, 1976, concerning supplemental information for use in the Augmented Startup and Cycle 1 Physics Program. The letter and attachment are being submitted as part of the above mentioned program in response to concerns of the Advisory Committee on Reactor Safeguards with the new Westinghouse PWR's, which are rated at higher power densities than currently operating Westinghouse reactors.

This information enables Westinghouse to:

(a) Justify the Westinghouse design correlations.

(b) Assist its customers to obtain licenses.

(c) Provide greater flexibility to customers assuring them of safe reliable operation.

(d) Optimize performance while maintaining a high level of fuel integrity.

(e) Justify operation at a reduced peaking factor with a wider target band than normal.

(f) Justify full power operation and meet warranties.

Further, the information gained from the Augmented Startup and Cycle 1 Physics Program is of commercial value and is sold for considerable sums of money as follows:

(a) Westinghouse uses the information to perform and justify analyses which are sold to customers.

(b) Westinghouse uses the information to sell to its customers for the purpose of meeting NRC requirements for full power licensing.

(c) Westinghouse could sell testing services based on the experience gained and the analytical methods developed using this information.

Public disclosure of this information concerning the Augmented Startup program is likely to cause substantial harm to the competitive position of Westinghouse by allowing its competitors to develop similar analysis methods and models at a much reduced cost.

The analyses performed, their methods and evaluation represent a considerable amount of highly qualified development effort, which has been underway for many years. If a competitor were able to use the results of the analyses in the attached document, to normalize or verify their own methods or models, the development effort and monetary expenditure required to achieve an equivalent capability would be significantly reduced. In total, a substantial amount of money and effort has been expended by Westinghouse which could only be duplicated by a competitor if he were to invest similar sums of money and provided he had the appropriate talent available.

Further the deponent sayeth not.

B. Surveillance Requirements - Section 4.2.2.2.e

Because $F_Q(z)$ surveillance is only required every 31 effective full power days, the Technical Specification takes into account the possibility that $F_Q(z)$ may increase between surveillances. Typically, because of natural feedback effects, $F_Q(z)$ decreases with increasing core burnup. Locations of peak power output in the core are also locations of peak fuel depletion rate in the core. However, cores using large numbers of burnable poison rods or non-standard fuel management techniques may show some small increase in $F_Q(z)$ with core burnup. The Technical Specification requires that when performing $F_Q(z)$ surveillance the resulting $F_Q(z)$ value must be compared to $F_Q(z)$ determined from the previous flux map. If the margin to the $F_Q(z)$ limit has decreased since the previous determination of $F_Q(z)$ then additional action must be taken. The Technical Specification allows two options. If the margin to the $F_Q(z)$ limit has decreased since the previous map, then either the new $F_Q(z)$ must be increased by an additional 2% to account for further increases in $F_Q(z)$ before the next surveillance, or surveillance must be performed every seven full power days. Analysis of both flux maps and predicted $F_Q(z)$ values indicate that $F_Q(z)$ will not increase by more than 1% per month. 2% was chosen as a conservative bound for the maximum possible decrease in margin to the $F_Q(z)$ limit between monthly flux maps that might be encountered during plant operation. The additional 2% penalty or more frequent mapping requirements can be discontinued when two successive flux maps indicate that the margin to the $F_Q(z)$ limit is no longer decreasing.

An example of the modifications to 3/4.2.2 required to incorporate F_Q surveillance for RAOC operation is Section 1 of the attachment.

C. PEAKING FACTOR LIMIT REPORT-SECTION 6.9.1.14

The W(z) function is a plant and cycle dependent function. The W(z) function for a given cycle will be formally reported to the utility and the NRC in the Peaking Factor Limit Report. The Peaking Factor Limit

Changes in the core power distribution caused by control rod insertion, power level changes, axial xenon transients, and radial xenon transients are all included in W(z). In some reload cores, operating flexibility can be maximized by making the W(z) function burnup dependent.

For a plant incorporating CAOC operation, the W(z) function is determined by analyzing a full range of power shapes occurring from simulation of typical load follow operation. Plant maneuvers covering the full range of power levels, core burnups, and operator control strategies are simulated while maintaining the appropriate ΔI band. The specific cases analyzed are those used in the standard Westinghouse $F_Q(z)$ analysis[1,2]. Alternatively, other standard F_Q analyses[3,4] could be employed to compute W(z).

For a plant with a RAOC Technical Specification, W(z) is determined based on the transient $F_Q(z)$ resulting from the normal operation analysis of the final ΔI-Power operating space. The methodology for determining the ΔI-Power operating space is discussed in "Relaxation of Constant Axial Offset Control" (Part A of NS-EPR-2649).

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(1) "F_Q Envelope Calculations", C.E. Eicheldinger letter NS-CE-687; 6/27/74 (Prop.)

(2) F.M. Bordelon, et. al. "Westinghouse Reload Safety Methodology", WCAP-9272. March 1978. (Prop.)

(3) Letter from C. Eicheldinger (Westinghouse), NS-CE-1749 to John F. Stolz (NRC); April 6,, 1978 (Proprietary).

(4) Letter from T.M. Anderson (Westinghouse), NS-TMA-2198, to K. Kniel (NRC); January 31, 1980 (Proprietary).

Westinghouse
Commercial Nuclear Fuel Division
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