NMC
Committed to Nuclear Excellence

Point Beach Nuclear Plant
Operated by Nuclear Management Company, LLC

NRC 2003-0027

10 CFR 50.90

March 27, 2003

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

POINT BEACH NUCLEAR PLANT
DOCKETS 50-266 AND 50-301
LICENSE AMENDMENT REQUEST 231
TECHNICAL SPECIFICATIONS SR 3.1.4.1, ROD GROUP ALIGNMENT LIMITS

In accordance with the provisions of 10 CFR 50.90, Nuclear Management Company, LLC (NMC) is submitting a request for an amendment to the Technical Specifications (TS) for Point Beach Nuclear Plant (PBNP), Units 1 and 2.

The proposed amendment would revise TS Surveillance Requirement (SR) 3.1.4.1, Rod Group Alignment Limits, to change the allowable alignment limits of individual rods in Mode 1 when greater than 85% power. NRC issued Amendments 200/205 for PBNP Units 1 and 2, respectively, on May 8, 2001. These related amendments increased the allowable alignment limits of individual rods for operation at less than or equal to 85% power.

Enclosed with this letter is a copy of WCAP-15432, Revision 2, "Conditional Extension of the Rod Misalignment Technical Specification for Point Beach Units 1 and 2", dated April 2001 (Proprietary) and a copy of WCAP-15442, Revision 1, "Conditional Extension of the Rod Misalignment Technical Specification for Point Beach Units 1 and 2", dated April 2001 (Non-Proprietary).

Also included in the enclosures to this letter are a Westinghouse proprietary authorization letter, CAW-01-1449, accompanying affidavit, Proprietary Information Notice, and Copyright Notice.

As WCAP-15432 contains information proprietary to Westinghouse Electric Company, LLC ("Westinghouse"), it is supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.790 of the Commission's regulations.

Accordingly, it is respectfully requested that the information, which is proprietary to Westinghouse, be withheld from public disclosure in accordance with 10 CFR 2.790. Correspondence regarding the proprietary aspects of the items listed above, or the supporting Westinghouse Affidavit, should reference CAW-01-1449 and be addressed to H. A. Sepp, Manager of Regulatory and Licensing Engineering, Westinghouse Electric Company LLC, P.O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

AP01

NMC requests approval of the proposed License Amendment by December 2003, with the amendment being implemented within 45 days. The approval date was administratively selected to allow for NRC review but the plant does not require this amendment to allow continued safe full power operation. A similar change was previously granted for Indian Point Nuclear Generating Unit 2 on November 7, 2002 (Accession Number ML023160194).

In accordance with 10 CFR 50.91, a copy of this application, with attachments, is being provided to the designated Wisconsin Official.

This letter contains no new commitments and no revision to existing commitments.

I declare under penalty of perjury that the foregoing is true and accurate. Executed on March 27, 2003.

A. J. Cayia
Site Vice President

LAS/kmd

Attachments: 1 - Description of Changes
2 - Proposed Technical Specification Changes
3 - Proposed Technical Specification Bases Changes
4 - Revised Technical Specification Pages

Enclosures

cc (with enclosures):
Project Manager, Point Beach Nuclear Plant, NRR, USNRC

cc (w/o enclosures):
Regional Administrator, Region III, USNRC
NRC Resident Inspector - PBNP
PSCW

DESCRIPTION OF CHANGES

LICENSE AMENDMENT REQUEST 231

TECHNICAL SPECIFICATION SR 3.1.4.1, ROD GROUP ALIGNMENT LIMITS

POINT BEACH NUCLEA R PLANT, UNITS 1 AND 2

1.0 INTRODUCTION

This License Amendment Request (LAR) is made pursuant to 10 CFR 50.90 to modify Technical Specification (TS) Surveillance Requirement (SR) 3.1.4.1, Rod Group Alignment Limits, to change the allowable alignment limits of individual rods in Mode 1 when greater than 85% power. The proposed amendment would expand the limits on allowable rod deviation from demanded position.

2.0 BACKGROUND

The operability (i.e., trippability) of the shutdown and control rods is an initial assumption in all safety analyses that assume rod insertion upon reactor trip. Maximum rod misalignment is an initial assumption in the safety analysis that directly affects core power distributions and assumptions of available shutdown margin (SDM).

The applicable criteria for these reactivity and power distribution design requirements are FSAR Section 3.2, Reactor Design, FSAR Section 1.3.5, Reactivity Control, and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Plants".

Mechanical or electrical failures may cause a control or shutdown rod to become inoperable or to become misaligned from its group. Rod inoperability or misalignment may cause increased power peaking, due to the asymmetric reactivity distribution. There may also be a reduction in the total available rod worth for reactor shutdown. Therefore, rod alignment and operability are related to core operation in design power peaking limits and the core design requirement of a minimum SDM.

Limits on rod alignment have been established, and all rod positions are monitored and controlled during power operation, to ensure that the power distribution and reactivity limits defined by the design power peaking and SDM limits are preserved.

Rod cluster control assemblies (RCCAs), or rods, are moved by their control rod drive mechanisms (CRDMs). Each CRDM moves its RCCA one step (approximately 5/8 inch) at a time, but at varying rates (steps per minute) depending on the signal output from the Rod Control System.

The RCCAs are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously. A bank of RCCAs may consist of one or two groups. When a bank consists of two groups, the groups are moved in a staggered fashion, but always within one step of each other. Control banks A and C and shutdown bank A consist of two groups each while control banks B and D and shutdown bank B consist of a single group.

The shutdown banks are maintained either in the fully inserted or fully withdrawn position. During startup, the control banks are moved in an overlap pattern, using the following withdrawal sequence: When control bank A reaches a predetermined height in the core, control bank B begins to move out with control bank A. Control bank A stops at the position of maximum withdrawal, and control bank B continues to move out. When control bank B reaches a predetermined height, control bank C begins to move out with control bank B. This sequence continues until control banks A, B, and C are at the fully withdrawn position, and control bank D is approximately halfway withdrawn. The insertion sequence is the opposite of the withdrawal sequence. The control rods are arranged in a radially symmetric pattern, so that control bank motion does not introduce radial asymmetries in the core power distributions.

The axial position of shutdown rods and control rods is indicated by two separate and independent systems, which are the Bank Demand Position Indication System (commonly called group step counters) and the Rod Position Indication (RPI) System.

The Bank Demand Position Indication System counts the pulses from the rod control system that moves the rods. There is one step counter for each group of rods. Individual rods in a group all receive the same signal to move and should, therefore, all be at the same position indicated by the group step counter for that group. The Bank Demand Position Indication System is considered highly precise (± 1 step or ± 5/8 inch). If a rod does not move one step for each demand pulse, the step counter will still count the pulse and incorrectly reflect the position of the rod.

The RPI System provides a highly accurate indication of actual rod position, but at a lower precision than the step counters. The RPI is a linear variable differential transformer (LVDT) consisting of primary and secondary coils stacked alternately on a support tube with the control rod drive shaft acting as the core of the transformer. The primary and secondary coils are series connected with the primary coil supplied with AC power from a constant current source. The position of the control rod drive shaft changes the primary to secondary coil magnetic coupling, resulting in a variable secondary voltage that is proportional to the position of the drive shaft (control rod). The RPI channel has an indication accuracy of 5% of span (11.5 steps) therefore, the maximum deviation between actual and demanded indication could be 36 steps (24 steps maximum allowable deviation plus 12 steps indication accuracy).

The specifications ensure that (1) acceptable power distribution limits are maintained; (2) the minimum shutdown margin is maintained; and (3) the potential effects of rod misalignment on associated accident analyses are limited. Operability of the control rod position indicators is required to determine control rod position and thereby ensure compliance with the control rod alignment and insertion limits.

System License Basis

Control rod misalignment accidents are analyzed in the safety analysis. The acceptance criteria for addressing control rod inoperability or misalignment are that:

a. There be no violations of:

   1. Specified acceptable fuel design limits, or
   2. Reactor Coolant System (RCS) pressure boundary integrity; and

b. The core remains subcritical after accident transients.

Two types of misalignment are distinguished. During movement of a control rod group, one rod may stop moving, while the other rods in the group continue. This condition may cause excessive power peaking. The second type of misalignment occurs if one rod fails to insert upon a reactor trip and remains stuck fully withdrawn. This condition requires an evaluation to determine that sufficient reactivity worth is held in the control rods to meet the SDM requirement, with the maximum worth rod stuck fully withdrawn.

Two types of analysis are performed in regard to static rod misalignment. With control banks at their insertion limits, one type of analysis considers the case when any one rod is completely inserted into the core. The second type of analysis considers the case of a completely withdrawn single rod from a bank inserted to its insertion limit. Satisfying limits on departure from nucleate boiling ratio in both of these cases bounds the situation when a rod is misaligned from its group by up to 36 steps.

Another type of misalignment occurs if one RCCA fails to insert upon a reactor trip and remains stuck fully withdrawn. This condition is assumed in the evaluation to determine that the required SDM is met with the maximum worth RCCA also fully withdrawn.

The Required Actions in the rod misalignment LCO ensure that either deviation from the alignment limits will be corrected or that thermal power will be adjusted so that excessive local linear heat rates (LHRs) will not occur, and that the requirements on SDM and ejected rod worth are preserved.

Continued operation of the reactor with a misaligned control rod is allowed if the heat flux hot channel factors $F_Q^C(Z)$ and $F_Q^W(Z)$ and the nuclear enthalpy rise hot channel factor ($F_{\Delta H}^N$) are verified to be within their limits in the COLR and the safety analysis is verified to remain valid. When a control rod is misaligned, the assumptions that are used to determine the rod insertion limits, Axial Flux Difference (AFD) limits, and quadrant power tilt limits are not preserved. Therefore, the limits may not preserve the design peaking factors, and $F_Q^C(Z)$, $F_Q^W(Z)$ and $F_{\Delta H}^N$ must be verified directly by incore mapping. Point Beach Technical Specifications Bases Section 3.2 (Power Distribution Limits) contains more complete discussions of the relation of $F_Q^C(Z)$, $F_Q^W(Z)$, and $F_{\Delta H}^N$ to the operating limits.

Shutdown and control rod operability and alignment are directly related to power distributions and SDM, which are initial conditions assumed in safety analyses.

3.0 PROPOSED CHANGE

The proposed amendment modifies TS SR 3.1.4.1, Rod Group Alignment Limits, to change the allowable alignment limits of individual rods in Mode 1 when greater than 85% power.

Proposed permitted control rod misalignments (as indicated by the RPI System within one hour after control rod motion) are; a) ± 18 steps of the bank demand position (if sufficient peaking factor margin exists, the power level is greater than 85 percent of rated power, and bank D demand is less than 215 steps withdrawn), b) ± 24 steps of the bank demand position (if sufficient peaking factor margin exists, the power level is greater than 85 percent of rated power, and bank D demand is greater than or equal to 215 steps withdrawn), and c) ± 24 steps of the bank demand position (if the power level is less than or equal to 85 percent of rated power). Above 85 percent of rated power, sufficient peaking factor margin is demonstrated by satisfying the requirements of Table 3.1.4-1, e.g., for an 18 step indicated misalignment and rods less than 215 steps withdrawn, the peak measured $F_Q(Z)$ from the latest incore flux map must be at least 5.0% less than the limit and the peak measured $F^N_{\Delta H}$ from the latest incore flux map must be at least 2.0% less than the limiting value. These limits are applicable to all shutdown and control rods (of all banks) over the range of 0 to 230 steps withdrawn inclusive.

Control rods in a single bank move together with no individual rod insertion differing by more than 30 steps from the bank demand position (operation at greater than 85 percent of rated power and demand less than 215 steps), nor more than 36 steps (operation at less than or equal to 85 percent of rated power or operation at greater than 85 percent of rated power and demand position greater than or equal to 215 steps withdrawn). An indicated misalignment limit of 18 steps precludes a rod misalignment of greater than 30 steps with consideration of instrumentation error; 24 steps indicated misalignment corresponds to 36 steps with instrumentation error.

Technical Specification Bases changes are also being made to reflect the proposed Technical Specifications changes.

The proposed change is consistent with the analysis in WCAP-15432, Revision 2.

The magnitude of control rod indicated misalignment is a parameter used to establish the initial conditions for accident evaluation. The proposed limits allow an indicated misalignment based on: limitations in power level, group step counter demand position, and the confirmed presence of margin in measured peaking factors. Analysis have shown that above 85 percent of rated thermal power, peaking factors can be accommodated with rod misalignments up to ±30 steps with rods less than 215 steps withdrawn, or ±36 steps with rods greater than or equal to 215 steps withdrawn. Adherence to the conditions in the proposed Technical Specification will ensure that the plant conditions are consistent with the assumptions and initial conditions used in the safety analysis.

Technical Specification Bases changes are being made to reflect the proposed Technical Specification changes. The discussion on rod misalignment error (B 3.1.4-3) and the conditions for hot channel factor limits to be met (B 3.1.4-5) are being revised to support the proposed changes. The proposed changes are attached.

4.0 TECHNICAL ANALYSIS

The current licensing basis for a misaligned rod is an indicated ±12 step difference between the bank demand position and the individual rod position indicator when reactor power is greater than 85% and ± 24 steps when reactor power is less than or equal to 85%. Point Beach Units 1 & 2 have experienced difficulty maintaining the indicated differences of less than ±12 steps for many control rods due to instability of the IRPI system. It is difficult to calibrate the IRPI for the wide variety of conditions and rod positions that can be experienced during power operation. The proposed amendments will increase the allowable rod misalignment criteria in the Technical Specifications.

Westinghouse has performed an evaluation for increasing the indicated control rod misalignment from the current limits (WCAP-15432, Revision 2). The number and type of rod misalignments were limited by the performance of an evaluation of the Failure Mode and Effects Analysis (FMEA) performed for the rod control system (Reference 1 of WCAP-15432 Rev 2). The evaluation was limited to single failures within the rod control system logic cabinets, power cabinets, and the control rod drive mechanisms. Multiple failures were not considered as reasonable precursors for rod misalignment since there is frequent surveillance of rod position to limit such occurrences. The evaluation concluded that there were six categories of failure mechanisms that warranted investigation. These categories are described in Section 2.0 of WCAP-15432 Rev 2. As a result of these failure mode categories, eight different cases of misalignment were analyzed. These cases involved single and multiple rod misalignments in a single group in either the insertion or withdrawal directions. These misalignments can be asymmetric. Other cases involved all rods in a group misaligned from the group step counter demand position. While this type of misalignment did not result in a rod to rod deviation, either the group did not move in the correct direction or the correct group did not move, which for the purpose of this evaluation was considered a misalignment from the demand position. This type of misalignment is symmetric. The eight cases are described in detail in Section 3.3 of WCAP-15432 Rev 2. Finally, two fuel cycles were evaluated, Unit 1 Cycle 26 and a "future" or "bounding" cycle based on higher enrichments and peaking factors. The cycle characteristics are summarized in Table 3.1 of WCAP-15432 Rev 2.

The Westinghouse evaluation has determined permissible indicated misalignments that depend upon the measured F_Q and its corresponding limit ($F_Q(Z)$), and the measured $F_{\Delta H}$ and its corresponding limit ($F^N_{\Delta H}$). The permissible indicated misalignment is given in proposed Technical Specification tables 3.1.4-1 (for power greater than 85% of rated power and bank demand less than 215 steps) and 3.1.4-2 (for power greater than 85% of rated power and bank demand ≥ 215 steps) as a function of the required margin for F_Q and $F_{\Delta H}$. The margin required is based on the difference between the measured F_Q or $F_{\Delta H}$ and its corresponding limit as a function of power, i.e.,

<u>For OFA and Upgraded OFA Fuel</u>	<u>For 422V+ Fuel</u>
$F_Q(Z) \leq [2.50][K(Z)]/P$ for $P>0.5$	$F_Q(Z) \leq [2.60][K(Z)]/P$ for $P>0.5$
$F_Q(Z) \leq [5.00][K(Z)]$ for $P\leq0.5$	$F_Q(Z) \leq [5.20][K(Z)]$ for $P\leq0.5$
$F^N_{\Delta H} < [1.70][1 + 0.3(1-P)]$	$F^N_{\Delta H} < [1.77][1 + 0.3(1-P)]$

The margin will be determined based on the latest incore flux map performed per the recommended surveillance requirements of TS 3.2.1 and 3.2.2. The margin requirements are 4.0% in $F_{\Delta H}$ and 10.0 % in $F_Q(Z)$ for a maximum control rod misalignment of 24 steps indicated.

For operation at power levels above 85 percent of rated power, the evaluation concludes that the amount of indicated misalignment is a function of the bank D demand position and the peaking factor margin present. The margin is determined by simply comparing the measured F_Q and $F_{\Delta H}$ from the latest incore flux map with their corresponding limits. The amount of margin required for an indicated misalignment greater than ± 12 steps is defined in the proposed Tables 3.1.4-1 and 3.1.4-2. The minimum allowable misalignment will be ± 12 steps.

WCAP-15432 Rev 2, Section 3, identifies the effects of indicated rod misalignments greater than ± 12 steps on the normal operation peaking factors. Section 4 of WCAP-15432 Rev 2 identifies the effects on the safety analyses. In summary, the increase in rod misalignment does not significantly affect the following: moderator or Doppler reactivity coefficients or defects, reactor kinetics data, boron worths or data generated for evaluation of boron dilution or boron system duty. Condition II transients, (rod out of position, dropped rod and single rod withdrawal) assume either all rods out (ARO) or rods at the insertion limit (RIL) as initial conditions. Since the precondition operation with the increased rod misalignment results in an $F_{\Delta H}$ increase of less than 2.0 %, the transient $F_{\Delta H}$ increase due to the misalignment is expected to be bounded by the same margin requirements of Tables 3.1.4-1 and 3.1.4-2.

Safety analyses parameters that are expected to be affected by the increased rod misalignment are the ejected rod F_Q and the ejected rod worth ($\Delta\rho_{EJ}$). As noted in Section 4 of WCAP-15432 Rev 2, to determine the ejected rod effects, preconditioning with the maximum allowed misalignment was assumed for single rods, a group of rods and entire banks. The subsequent effects on F_Q and $\Delta\rho_{EJ}$ for the two cycles were determined. It was noted that increases of 2.8 % in F_Q and 3.0 % in $\Delta\rho_{EJ}$ must be included in the safety analyses to bound the projected effects when a cycle specific analysis is not performed.

Conclusion

WCAP-15432 Rev 2 documents an evaluation of the effects of increasing the allowed control rod misalignment from ± 12 steps indicated to less than or equal to ± 18 steps indicated for operation at power levels greater than 85 percent of rated power with bank D demand position less than 215 steps; or to less than or equal to ± 24 steps indicated for operation at power levels greater than 85 percent of rated power with bank D demand position greater than or equal to 215 steps withdrawn. Based on this evaluation, the proposed changes to Technical Specifications to reflect margin requirements in measured core peaking factors are acceptable.

TS SR 3.1.4.1 should be modified to reflect the following allowances for rod misalignment:

1. Greater than 85 percent of rated power and bank D demand position less than 215 steps withdrawn, indicated misalignments of greater than ±12 steps and less than or equal to ± 18 steps may be permissible in accordance with margins in the proposed Technical Specification Table 3.1.4-1.

2. Greater than 85 percent of rated power and bank D demand position greater than or equal to 215 steps withdrawn, indicated misalignments of greater than ±12 steps and less than or equal to ±24 steps may be permissible in accordance with margins in the proposed Technical Specification Table 3.1.4-2.

Provided that the margin requirements are satisfied, the Westinghouse evaluation concluded that no additional changes to plant procedures were necessary.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Determination

In accordance with the provisions of 10 CFR 50.90, Nuclear Management Company, LLC (NMC) is submitting a request for an amendment to the Technical Specifications (TS) for Point Beach Nuclear Plant, Units 1 and 2. The purpose of the proposed amendment is to modify Technical Specification (TS) Surveillance Requirement (SR) 3.1.4.1, Rod Group Alignment Limits, to change the allowable alignment limits of individual rods in Mode 1 when greater than 85% power.

NMC has evaluated the proposed amendments in accordance with 10 CFR 50.91 against the standards in 10 CFR 50.92 and has determined that the operation of the Point Beach Nuclear Plant in accordance with the proposed amendments presents no significant hazards. Our evaluation against each of the criteria in 10 CFR 50.92 follows.

1. **Operation of the Point Beach Nuclear Plant in accordance with the proposed amendments does not result in a significant increase in the probability or consequences of any accident previously evaluated.**

   This proposed change does not cause an increase in the probabilities of any accidents previously evaluated because the change will not cause an increase in the probability of any initiating events for accidents previously evaluated.

   The consequences of the accidents previously evaluated in the PBNP Final Safety Analysis Report (FSAR) are determined by the results of analyses that are based on initial conditions of the plant, the type of accident, transient response of the plant, and the operation and failure of equipment and systems.

Based on the analyses documented in WCAP-15432, Revision 2, all pertinent licensing-basis acceptance criteria have been met and the margin of safety, as defined in the Technical Specification Bases, is not significantly reduced in any of the Point Beach licensing basis accident analyses due to the subject change. Therefore, the probability of an accident previously evaluated has not significantly increased. Because design limitations continue to be met and the integrity of the reactor coolant system pressure boundary is not challenged, the assumptions employed in the calculation of the offsite radiological doses remain valid. Neither rod position indication nor the limits on allowed rod position deviation is an accident initiator or precursor. Therefore, the consequences of an accident previously evaluated will not be significantly increased.

2. **Operation of the Point Beach Nuclear Plant in accordance with the proposed amendments does not result in a new or different kind of accident from any accident previously evaluated.**

   The changes described in the proposed amendment are supported by the analyses provided in the submittal. The evaluation of the effects of the proposed changes indicates that all design standards and applicable safety criteria limits are met. These changes therefore do not cause the initiation of any new or different accident nor create any new failure mechanisms.

   Equipment important to safety will continue to operate as designed. The proposed change does not result in any event previously deemed incredible being made credible. The change does not result in more adverse conditions or result in any increase in the challenges to safety systems. Therefore, operation of the Point Beach Nuclear Plant in accordance with the proposed amendment will not create the possibility of a new or different type of accident from any accident previously evaluated.

3. **Operation of the Point Beach Nuclear Plant in accordance with the proposed amendments does not result in a significant reduction in a margin of safety.**

   Based on the analyses documented in WCAP-15432, Revision 2, all pertinent licensing-basis acceptance criteria have been met and the margin of safety, as defined in the Technical Specification Bases, is not significantly reduced in any of the Point Beach licensing basis accident analyses based on the subject changes to safety analyses input parameter values. There are no new or significant changes to the initial conditions contributing to accident severity or consequences. Since the analyses in the accompanying submittals demonstrate that all applicable acceptance criteria continue to be met, the subject operating conditions will not involve a significant reduction in a margin of safety at Point Beach.

Conclusion

Operation of the Point Beach Nuclear Plant in accordance with the proposed amendments will not result in a significant increase in the probability or consequences of any accident previously analyzed; will not result in a new or different kind of accident from any accident previously analyzed; and, does not result in more than a minimal reduction in any margin of safety. Therefore, operation of the Point Beach Nuclear Plant in accordance with the proposed amendments will not result in the creation of a significant hazard.

5.2 Applicable Regulatory Requirements

Point Beach was licensed prior to the 1971 publication of Appendix A, "General Design Criteria for Nuclear Power Plants", (GDC) to 10 CFR Part 50. As such, Point Beach is not licensed to the GDC. The Point Beach Final Safety Analysis Report (FSAR), Section 1.3, lists the plant-specific GDC to which the plant was licensed. The Point Beach GDC are similar in content to the draft GDC proposed for public comment in 1967. The Point Beach GDC affecting Rod Group Alignment Limits and reactivity and power distribution design requirements are Point Beach GDC-6, 7, and 27 through 32. The applicable criteria for these reactivity and power distribution design requirements are FSAR Section 3.2, Reactor Design, FSAR Section 1.3.5, Reactivity Control, and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Plants".

Point Beach GDC-6, "Reactor Core Design", and GDC-7, "Suppression of Power Oscillations" require, in part, that reactor core and protection systems shall be designed to function without exceeding acceptable fuel damage limits and that excessive power oscillations can be readily suppressed. Point Beach GDC-27, "Redundancy of Reactivity Control", GDC-28, "Reactivity Hot Shutdown Capability", GDC-29, "Reactivity Shutdown Capability", GDC-30, "Reactivity Hold-down Capability", GDC-31, Reactivity Control Systems Malfunction", and GDC-32, "Maximum Reactivity Worth of Control Rods", require, in part, that two independent reactivity control systems be provided; that the control system be capable of making and holding the reactor subcritical sufficiently fast, and under credible accident conditions, such as to prevent exceeding acceptable fuel damage limits; that shutdown margin assure subcriticality with the most reactive control rod fully withdrawn; that the system be capable of protecting against any single malfunction; and that the maximum control rod reactivity worth and the rates at which reactivity can be increased be limited to preclude rupture of the reactor coolant pressure boundary or reactor vessel internals sufficiently to lose core cooling capability. The technical analysis performed by NMC concludes that the proposed changes to TS SR 3.1.4.1 will continue to maintain acceptable fuel damage limits and the ability to suppress excessive power oscillations. The proposed changes will not affect the other requirements of these criteria.

Surveillance Requirements (SRs), per 10 CFR 50.36(c)(3), are "...to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met." The technical analysis performed by NMC concludes that the proposed changes to TS SR 3.1.4.1 will provide added plant operational flexibility without a corresponding reduction in plant safety margins.

NMC concludes that the proposed changes are in accordance with 10 CFR 50.36(c)(3) with regards to maintaining the necessary quality of systems and components, sustaining facility operation within safety limits, and meeting the limiting conditions for operation. These changes also continue to meet the requirements stated in the PBNP FSAR and the requirements of 10 CFR 50.46. The proposed changes thus continue to be compliant with the above regulatory requirements.

5.3 Commitments

There are no actions committed to by NMC in this document. Any statements in this submittal are provided for information purposes and are not considered to be commitments.

6.0 ENVIRONMENTAL EVALUATION

NMC has determined that the information for the proposed amendment does not involve a significant hazard, authorize a significant change in the types or total amounts of effluent release, or result in any significant increase in individual or cumulative occupational radiation exposure. Therefore, we conclude that the proposed amendment meets the categorical exclusion requirements of 10 CFR 51.22(c)(9) and that an environmental impact appraisal need not be prepared.

PROPOSED TECHNICAL SPECIFICATION CHANGES

LICENSE AMENDMENT REQUEST 231

TECHNICAL SPECIFICATION SR 3.1.4.1, ROD GROUP ALIGNMENT LIMITS

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

(Note: Table 3.1.4-1 and Table 3.1.4-2 are new tables)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.4.1	Verify individual rod positions are within the following alignment limits: a. ± ~~12~~18 steps of demanded position (as allowed by Table 3.1.4-1) in MODE 1 > 85 percent RTP when bank demand position is < 215 steps; ~~and~~ AND b. ± 24 steps of demanded position (as allowed by Table 3.1.4-2) in MODE 1 > 85 percent RTP when bank demand position is ≥ 215 steps; AND c. ± 24 steps of demanded position in MODE 1 ≤ 85 percent RTP or in MODE 2.	12 hours
SR 3.1.4.2	Verify rod freedom of movement (trippability) by moving each rod not fully inserted in the core ≥ 10 steps in either direction.	92 days
SR 3.1.4.3	Verify rod drop time of each rod, from the fully withdrawn position, is ≤ 2.2 seconds from the beginning of decay of stationary gripper coil voltage to dashpot entry, with: a. T_{avg} ≥ 500°F; and b. All reactor coolant pumps operating.	Prior to reactor criticality after each removal of the reactor head

Table 3.1.4-1
Allowable Alignment Limits As A Function Of Measured Peaking Factor Margin ($F_Q(Z)$, $F^N_{\Delta H}$)
At Power Levels > 85% Of Rated Power And Bank D Demand < 215 Steps Withdrawn

ALIGNMENT LIMITS (STEPS)*	REQUIRED MARGIN TO $F^N_{\Delta H}$ LIMIT (%)	REQUIRED MARGIN TO $F_Q(Z)$ LIMIT (%)
12	0.00	0.00
13	0.33	0.83
14	0.67	1.67
15	1.00	2.50
16	1.33	3.33
17	1.67	4.17
18	2.00	5.00

* Between the bank demand position and the RPI System.

Table 3.1.4-2
Allowable Alignment Limits As A Function Of Measured Peaking Factor Margin ($F_Q(Z)$, $F^N_{\Delta H}$)
At Power Levels > 85% Of Rated Power And Bank D Demand ≥ 215 Steps Withdrawn

ALIGNMENT LIMITS (STEPS)*	REQUIRED MARGIN TO $F^N_{\Delta H}$ LIMIT (%)	REQUIRED MARGIN TO $F_Q(Z)$ LIMIT (%)
12	0.00	0.00
13	0.33	0.83
14	0.67	1.67
15	1.00	2.50
16	1.33	3.33
17	1.67	4.17
18	2.00	5.00
19	2.33	5.83
20	2.67	6.67
21	3.00	7.50
22	3.33	8.33
23	3.67	9.17
24	4.00	10.0

* Between the bank demand position and the RPI System.

PROPOSED TECHNICAL SPECIFICATION BASES CHANGES

LICENSE AMENDMENT REQUEST 231

TECHNICAL SPECIFICATION SR 3.1.4.1, ROD GROUP ALIGNMENT LIMITS

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.4 Rod Group Alignment Limits

BASES

BACKGROUND

The OPERABILITY (i.e., trippability) of the shutdown and control rods is an initial assumption in all safety analyses that assume rod insertion upon reactor trip. Maximum rod misalignment is an initial assumption in the safety analysis that directly affects core power distributions and assumptions of available SDM.

The applicable criteria for these reactivity and power distribution design requirements are FSAR Section 3.2, Reactor Design, FSAR Section 1.3.5, Reactivity Control (Ref. 1 and 2), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Plants" (Ref. 3).

Mechanical or electrical failures may cause a control or shutdown rod to become inoperable or to become misaligned from its group. Rod inoperability or misalignment may cause increased power peaking, due to the asymmetric reactivity distribution and a reduction in the total available rod worth for reactor shutdown. Therefore, rod alignment and OPERABILITY are related to core operation in design power peaking limits and the core design requirement of a minimum SDM.

Limits on rod alignment have been established, and all rod positions are monitored and controlled during power operation to ensure that the power distribution and reactivity limits defined by the design power peaking and SDM limits are preserved.

Rod cluster control assemblies (RCCAs), or rods, are moved by their control rod drive mechanisms (CRDMs). Each CRDM moves its RCCA one step (approximately 5/8 inch) at a time, but at varying rates (steps per minute) depending on the signal output from the Rod Control System.

The RCCAs are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously. A bank of RCCAs may consist of one or two groups. When a bank consists of two groups, the groups are moved in a staggered fashion, but always within one step of each other. Control banks A and C and shutdown bank A consist of two groups each while control banks B and D and shutdown bank B consist of a single group.

BASES

BACKGROUND (continued)

The shutdown banks are maintained either in the fully inserted or fully withdrawn position. The control banks are moved in an overlap pattern, using the following withdrawal sequence: When control bank A reaches a predetermined height in the core, control bank B begins to move out with control bank A. Control bank A stops at the position of maximum withdrawal, and control bank B continues to move out. When control bank B reaches a predetermined height, control bank C begins to move out with control bank B. This sequence continues until control banks A, B, and C are at the fully withdrawn position, and control bank D is approximately halfway withdrawn. The insertion sequence is the opposite of the withdrawal sequence. The control rods are arranged in a radially symmetric pattern, so that control bank motion does not introduce radial asymmetries in the core power distributions.

The axial position of shutdown rods and control rods is indicated by two separate and independent systems, which are the Bank Demand Position Indication System (commonly called group step counters) and the Rod Position Indication (RPI) System.

The Bank Demand Position Indication System counts the pulses from the rod control system that moves the rods. There is one step counter for each group of rods. Individual rods in a group all receive the same signal to move and should, therefore, all be at the same position indicated by the group step counter for that group. The Bank Demand Position Indication System is considered highly precise (± 1 step or ± 5/8 inch). If a rod does not move one step for each demand pulse, the step counter will still count the pulse and incorrectly reflect the position of the rod.

The RPI System provides a highly accurate indication of actual rod position, but at a lower precision than the step counters. The RPI is a linear variable differential transformer (LVDT) consisting of primary and secondary coils stacked alternately on a support tube with the control rod drive shaft acting as the core of the transformer. The primary and secondary coils are series connected with the primary coil supplied with AC power from a constant current source. The position of the control rod drive shaft changes the primary to secondary coil magnetic coupling resulting in a variable secondary voltage which is proportional to the position of the drive shaft (control rod). The RPI channel has an indication accuracy of 5% of span (11.5 steps) therefore, the maximum deviation between actual and demanded indication could be ~~24~~36 steps ~~or approximately 15 inches~~ (24 steps maximum allowable deviation plus 12 steps indication accuracy).

BASES

BACKGROUND (continued)

The specifications ensure that (1) acceptable power distribution limits are maintained, (2) the minimum shutdown margin is maintained, and (3) the potential effects of rod misalignment on associated accident analyses are limited. Operability of the control rod position indicators is required to determine control rod position and thereby ensure compliance with the control rod alignment and insertion limits.

Permitted control rod misalignments (as indicated by the RPI System within one hour after control rod motion) are; a) ± ~~12~~ 18 steps of the bank demand position (if sufficient peaking factor margin exists, the power level is greater than 85 percent of rated power, and bank D demand is less than 215 steps withdrawn), b) ± 24 steps of the bank demand position (if sufficient peaking factor margin exists, the power level is greater than 85 percent of rated power, and bank D demand is greater than or equal to 215 steps withdrawn), and c) ± 24 steps of the bank demand position (if the power level is less than or equal to 85 percent of rated power). Above 85 percent of rated power, sufficient peaking factor margin is demonstrated by satisfying the requirements of Table 3.1.4-1, e.g., for an 18 step indicated misalignment and rods less than 215 steps withdrawn, the peak measured $F_Q(Z)$ from the latest incore flux map must be at least 5.0% less than the limit and the peak measured $F^N_{\Delta H}$ from the latest incore flux map must be at least 2.0% less than the limiting value. For power levels less than or equal to 85 percent of rated power, the peaking factor margin does not have to be verified on an explicit basis. This is due to the rate of peaking factor margin increase (due to the peaking factor limit increasing) as the power level decreases being greater than the peaking factor margin loss (due to the increased control rod misalignment). This effect is described in WCAP-15432 Rev. ~~1~~2. These limits are applicable to all shutdown and control rods (of all banks) over the range of 0 to 230 steps withdrawn inclusive.

Control rods in a single bank move together with no individual rod insertion differing by more than ~~24~~ 30 steps from the bank demand position (operation at greater than 85 percent of rated power and demand less than 215 steps), nor more than 36 steps (operation at less than or equal to 85 percent of rated power or operation at greater than 85 percent of rated power and demand position greater than or equal to 215 steps withdrawn). An indicated misalignment limit of ~~12~~ 18 steps precludes a rod misalignment of greater than ~~24~~ 30 steps with consideration of instrumentation error; 24 steps indicated misalignment corresponds to 36 steps with instrumentation error.

BASES

APPLICABLE SAFETY ANALYSES

Control rod misalignment accidents are analyzed in the safety analysis (Ref. 4). The acceptance criteria for addressing control rod inoperability or misalignment are that:

a. There be no violations of:

   1. Specified acceptable fuel design limits, or
   2. Reactor Coolant System (RCS) pressure boundary integrity; and

b. The core remains subcritical after accident transients.

Two types of misalignment are distinguished. During movement of a control rod group, one rod may stop moving, while the other rods in the group continue. This condition may cause excessive power peaking. The second type of misalignment occurs if one rod fails to insert upon a reactor trip and remains stuck fully withdrawn. This condition requires an evaluation to determine that sufficient reactivity worth is held in the control rods to meet the SDM requirement, with the maximum worth rod

BASES

APPLICABLE SAFETY ANALYSES (continued)

stuck fully withdrawn.

Two types of analysis are performed in regard to static rod misalignment (Ref. 4). With control banks at their insertion limits, one type of analysis considers the case when any one rod is completely inserted into the core. The second type of analysis considers the case of a completely withdrawn single rod from a bank inserted to its insertion limit. Satisfying limits on departure from nucleate boiling ratio in both of these cases bounds the situation when a rod is misaligned from its group by ~~12~~ 36 steps.

Another type of misalignment occurs if one RCCA fails to insert upon a reactor trip and remains stuck fully withdrawn. This condition is assumed in the evaluation to determine that the required SDM is met with the maximum worth RCCA also fully withdrawn (Ref. 4).

The Required Actions in this LCO ensure that either deviations from the alignment limits will be corrected or that THERMAL POWER will be adjusted so that excessive local linear heat rates (LHRs) will not occur, and that the requirements on SDM and ejected rod worth are preserved.

Continued operation of the reactor with a misaligned control rod is allowed if the heat flux hot channel factors $F_Q^C(Z)$ and $F_Q^W(Z)$ and the nuclear enthalpy hot channel factor $F_{\Delta H}^N$ are verified to be within their limits in the COLR and the safety analysis is verified to remain valid. When a control rod is misaligned, the assumptions that are used to determine the rod insertion limits, AFD limits, and quadrant power tilt limits are not preserved. Therefore, the limits may not preserve the

BASES

APPLICABLE SAFETY ANALYSES (continued)

design peaking factors, and $F^C_Q(Z)$, $F^W_Q(Z)$ and $F^N_{\Delta H}$ must be verified directly by incore mapping. Bases Section 3.2 (Power Distribution Limits) contains more complete discussions of the relation of $F^C_Q(Z)$, $F^W_Q(Z)$, and $F^N_{\Delta H}$ to the operating limits.

Shutdown and control rod OPERABILITY and alignment are directly related to power distributions and SDM, which are initial conditions assumed in safety analyses. Therefore they satisfy Criterion 2 of the NRC Policy Statement.

LCO

The limits on shutdown or control rod alignments ensure that the assumptions in the safety analysis will remain valid. The requirements on control rod OPERABILITY ensure that upon reactor trip, the assumed reactivity will be available and will be inserted. The control rod OPERABILITY requirement is satisfied provided the control rod will fully insert within the required rod drop time assumed in the safety analysis.

BASES

LCO (continued)

Control rod malfunctions that result in the inability to move a control rod (e.g. lift coil and rod control system logic failures), but do not impact the control rod trippability, do not result in control rod inoperability. The LCO requirements also ensure that the RCCAs and banks maintain the correct power distribution and rod alignment.

The requirement to maintain the rod alignment to within ~~plus or minus 12~~ ± 18 steps (for power operation above 85% and bank demand position less than 215 steps) or within ± 24 steps (for power operation greater than 85% and bank demand position greater than or equal to 215 steps) is conservative. The minimum misalignment assumed in safety analysis is ~~24~~ 36 steps ~~(15 inches)~~, and in some cases a total misalignment from fully withdrawn to fully inserted is assumed. Failure to meet the requirements of this LCO may produce unacceptable power peaking factors and LHRs, or unacceptable SDMs, all of which may constitute initial conditions inconsistent with the safety analysis.

APPLICABILITY

The requirements on RCCA OPERABILITY and alignment are applicable in MODES 1 and 2 because these are the only MODES in which neutron (or fission) power is generated, and the OPERABILITY (i.e., trippability) and alignment of rods have the potential to affect the safety of the plant. In MODES 3, 4, 5, and 6, the alignment limits do not apply because the control rods are bottomed and the reactor is shut down and not producing fission power. In the shutdown MODES, the

APPLICABILITY (continued)

OPERABILITY of the shutdown and control rods has the potential to affect the required SDM, but this effect can be compensated for by an increase in the boron concentration of the RCS. See LCO 3.1.1, "SHUTDOWN MARGIN (SDM)" for SDM in MODE 2 with $k_{eff} < 1.0$, and MODES 3, 4, and 5 and LCO 3.9.1, "Boron Concentration," for boron concentration requirements during refueling.

ACTIONS

The ACTIONS table is modified by a Note indicating that verification of rod operability and the comparison of bank demand position and RPI System may take place at any time up to one hour after rod motion, at any power level. This allows up to one hour of thermal soak time to allow the control rod drive shaft to reach a thermal equilibrium and thus present a consistent position indication. For purposes of invoking this allowance, a substantial rod movement is required. Substantial rod movement is considered to be 10 or more steps in one direction in less than or equal to one hour.

<u>A.1.1 and A.1.2</u>

When one or more rods are inoperable, there is a possibility that the required SDM may be adversely affected. Under these conditions, it is important to determine the SDM, and if it is less than the required value, initiate boration until the required SDM is recovered. The Completion

BASES

ACTIONS (continued)

Time of 1 hour is adequate for determining SDM and, if necessary, for initiating emergency boration and restoring SDM. In this situation, SDM verification must include the worth of the untrippable rod, as well as a rod of maximum worth.

A.2

If the inoperable rod(s) cannot be restored to OPERABLE status, the plant must be brought to a MODE or condition in which the LCO requirements are not applicable. To achieve this status, the unit must be brought to at least MODE 3 within 6 hours.

The allowed Completion Time is reasonable, based on operating experience, for reaching MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

B.1

When a rod becomes misaligned, it can usually be moved and is still trippable. If the rod can be realigned within the Completion Time of 1 hour, local xenon redistribution during this short interval will not be significant, and operation may proceed without further restriction.

An alternative to realigning a single misaligned RCCA to the group average position is to align the remainder of the group to the position of the misaligned RCCA. However, this must be done without violating the bank sequence, overlap, and insertion limits specified in LCO 3.1.5, "Shutdown Bank Insertion Limits," and LCO 3.1.6, "Control Bank Insertion Limits." The Completion Time of 1 hour gives the operator sufficient time to adjust the rod positions in an orderly manner.

B.2.1.1 and B.2.1.2

With a misaligned rod, SDM must be verified to be within limit or boration must be initiated to restore SDM to within limit.

In many cases, realigning the remainder of the group to the misaligned rod may not be desirable. For example, realigning control bank B to a rod that is misaligned 25 steps from the top of the core would require a significant power reduction, since control bank D must be moved fully in and control bank C must be moved in to approximately 100 to 115 steps.

Power operation may continue with one RCCA misaligned, provided that SDM is verified within 1 hour. The Completion Time of 1 hour

BASES

ACTIONS (continued)

represents the time necessary for determining the actual unit SDM and, if necessary, aligning and starting the necessary systems and components to initiate boration.

B.2.2, B.2.3, B.2.4, B.2.5, and B.2.6

For continued operation with a misaligned rod, RTP must be reduced, SDM must periodically be verified within limits, hot channel factors $F_Q^C(Z)$, $F_Q^W(Z)$ and $F_{\Delta H}^N$ must be verified within limits, and the safety analyses must be re-evaluated to confirm continued operation is permissible.

Reduction of power to 75% RTP ensures that local LHR increases due to a misaligned RCCA will not cause the core design criteria to be exceeded (Ref. 4). The Completion Time of 2 hours gives the operator sufficient time to accomplish an orderly power reduction without challenging the Reactor Protection System.

When a rod is known to be misaligned, there is a potential to impact the SDM. Since the core conditions can change with time, periodic verification of SDM is required. A Frequency of 12 hours is sufficient to ensure this requirement continues to be met.

Verifying that $F_Q^C(Z)$, $F_Q^W(Z)$ and $F_{\Delta H}^N$, are within the required limits ensures that current operation at 75% RTP with a rod misaligned is not resulting in power distributions that may invalidate safety analysis assumptions at full power. The Completion Time of 72 hours allows sufficient time to obtain flux maps of the core power distribution using the incore flux mapping system and to calculate $F_Q^C(Z)$, $F_Q^W(Z)$ and $F_{\Delta H}^N$.

Once current conditions have been verified acceptable, time is available to perform evaluations of accident analysis to determine that core limits will not be exceeded during a Design Basis Event for the duration of operation under these conditions. The accident analyses presented in the FSAR Chapter 14 (Ref. 4) that may be adversely affected will be evaluated to ensure that the analysis results remain valid for the duration of continued operation under these conditions. A Completion Time of 5 days is sufficient time to obtain the required input data and to perform the analysis.

C.1

When Required Actions cannot be completed within their Completion Time, the unit must be brought to a MODE or Condition in which the LCO requirements are not applicable. To achieve this status, the unit

BASES

ACTIONS (continued)

must be brought to at least MODE 3 within 6 hours, which obviates concerns about the development of undesirable xenon or power distributions. The allowed Completion Time of 6 hours is reasonable, based on operating experience, for reaching MODE 3 from full power conditions in an orderly manner and without challenging the plant systems.

D.1.1 and D.1.2

More than one control rod becoming misaligned from its group average position is not expected, and has the potential to reduce SDM. Therefore, SDM must be evaluated. One hour allows the operator adequate time to determine SDM. Restoration of the required SDM, if necessary, requires increasing the RCS boron concentration to provide negative reactivity, as described in the Bases of LCO 3.1.1. The required Completion Time of 1 hour for initiating boration is reasonable, based on the time required for potential xenon redistribution, the low probability of an accident occurring, and the steps required to complete the action. This allows the operator sufficient time to align the required valves and start the boric acid pumps. Boration will continue until the required SDM is restored.

D.2

If more than one rod is found to be misaligned or becomes misaligned because of bank movement, the unit conditions fall outside of the accident analysis assumptions. Since automatic bank sequencing would continue to cause misalignment, the unit must be brought to a MODE or Condition in which the LCO requirements are not applicable. To achieve this status, the unit must be brought to at least MODE 3 within 6 hours.

The allowed Completion Time is reasonable, based on operating experience, for reaching MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.1.4.1

Verification that individual rod positions are within alignment limits at a Frequency of 12 hours provides a history that allows the operator to detect a rod that is beginning to deviate from its expected position.

The specified Frequency takes into account other rod position information that is continuously available to the operator in the control

BASES

SURVEILLANCE REQUIREMENTS (continued)

room, so that during actual rod motion, deviations can immediately be detected.

SR 3.1.4.2

Verifying each control rod is OPERABLE would require that each rod be tripped. However, in MODES 1 and 2, tripping each control rod would result in radial or axial power tilts, or oscillations. Exercising each individual control rod every 92 days provides increased confidence that all rods continue to be OPERABLE without exceeding the alignment limit, even if they are not regularly tripped. Moving each control rod by 10 steps will not cause radial or axial power tilts, or oscillations, to occur. The 92 day Frequency takes into consideration other information available to the operator in the control room and SR 3.1.4.1, which is performed more frequently and adds to the determination of OPERABILITY of the rods. Between required performances of SR 3.1.4.2 (determination of control rod OPERABILITY by movement), if a control rod(s) is discovered to be immovable, but remains trippable, the control rod(s) is considered to be OPERABLE. At any time, if a control rod(s) is immovable, a determination of the trippability (OPERABILITY) of the control rod(s) must be made, and appropriate action taken.

SR 3.1.4.3

Verification of rod drop times allows the operator to determine that the maximum rod drop time permitted is consistent with the assumed rod drop time used in the safety analysis. Measuring rod drop times prior to reactor criticality, after reactor vessel head removal, ensures that the reactor internals and rod drive mechanism will not interfere with rod motion or rod drop time, and that no degradation in these systems has occurred that would adversely affect control rod motion or drop time. This testing is performed with all RCPs operating and the average moderator temperature ≥ 500°F to simulate a reactor trip under actual conditions.

This Surveillance is performed during a plant outage, due to the plant conditions needed to perform the SR and the potential for an unplanned plant transient if the Surveillance were performed with the reactor at power.

REFERENCES

1. FSAR, Section 3.2.

2. FSAR, Sections 1.3.5.

BASES

REFERENCES (continued)	3. 10 CFR 50.46. 4. FSAR, Chapter 14.

REVISED TECHNICAL SPECIFICATION PAGES

LICENSE AMENDMENT REQUEST 231

TECHNICAL SPECIFICATION SR 3.1.4.1, ROD GROUP ALIGNMENT LIMITS

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.4.1	Verify individual rod positions are within the following alignment limits: a. ± 18 steps of demanded position (as allowed by Table 3.1.4-1) in MODE 1 > 85 percent RTP when bank demand position is < 215 steps; <u>AND</u> b. ± 24 steps of demanded position (as allowed by Table 3.1.4-2) in MODE 1 > 85 percent RTP when bank demand position is ≥ 215 steps; <u>AND</u> c. ± 24 steps of demanded position in MODE 1 ≤ 85 percent RTP or in MODE 2.	12 hours
SR 3.1.4.2	Verify rod freedom of movement (trippability) by moving each rod not fully inserted in the core ≥ 10 steps in either direction.	92 days
SR 3.1.4.3	Verify rod drop time of each rod, from the fully withdrawn position, is ≤ 2.2 seconds from the beginning of decay of stationary gripper coil voltage to dashpot entry, with: a. T_{avg} ≥ 500°F; and b. All reactor coolant pumps operating.	Prior to reactor criticality after each removal of the reactor head

Table 3.1.4-1
Allowable Alignment Limits As A Function Of Measured Peaking Factor Margin ($F_Q(Z)$, $F^N_{\Delta H}$)
At Power Levels > 85% Of Rated Power And Bank D Demand < 215 Steps Withdrawn

ALIGNMENT LIMITS (STEPS)*	REQUIRED MARGIN TO $F^N_{\Delta H}$ LIMIT (%)	REQUIRED MARGIN TO $F_Q(Z)$ LIMIT (%)
12	0.00	0.00
13	0.33	0.83
14	0.67	1.67
15	1.00	2.50
16	1.33	3.33
17	1.67	4.17
18	2.00	5.00

* Between the bank demand position and the RPI System.

Table 3.1.4-2
Allowable Alignment Limits As A Function Of Measured Peaking Factor Margin ($F_Q(Z)$, $F^N_{\Delta H}$)
At Power Levels > 85% Of Rated Power And Bank D Demand ≥ 215 Steps Withdrawn

ALIGNMENT LIMITS (STEPS)*	REQUIRED MARGIN TO $F^N_{\Delta H}$ LIMIT (%)	REQUIRED MARGIN TO $F_Q(Z)$ LIMIT (%)
12	0.00	0.00
13	0.33	0.83
14	0.67	1.67
15	1.00	2.50
16	1.33	3.33
17	1.67	4.17
18	2.00	5.00
19	2.33	5.83
20	2.67	6.67
21	3.00	7.50
22	3.33	8.33
23	3.67	9.17
24	4.00	10.0

* Between the bank demand position and the RPI System.

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.4 Rod Group Alignment Limits

BASES

BACKGROUND

The OPERABILITY (i.e., trippability) of the shutdown and control rods is an initial assumption in all safety analyses that assume rod insertion upon reactor trip. Maximum rod misalignment is an initial assumption in the safety analysis that directly affects core power distributions and assumptions of available SDM.

The applicable criteria for these reactivity and power distribution design requirements are FSAR Section 3.2, Reactor Design, FSAR Section 1.3.5, Reactivity Control (Ref. 1 and 2), and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Plants" (Ref. 3).

Mechanical or electrical failures may cause a control or shutdown rod to become inoperable or to become misaligned from its group. Rod inoperability or misalignment may cause increased power peaking, due to the asymmetric reactivity distribution and a reduction in the total available rod worth for reactor shutdown. Therefore, rod alignment and OPERABILITY are related to core operation in design power peaking limits and the core design requirement of a minimum SDM.

Limits on rod alignment have been established, and all rod positions are monitored and controlled during power operation to ensure that the power distribution and reactivity limits defined by the design power peaking and SDM limits are preserved.

Rod cluster control assemblies (RCCAs), or rods, are moved by their control rod drive mechanisms (CRDMs). Each CRDM moves its RCCA one step (approximately 5/8 inch) at a time, but at varying rates (steps per minute) depending on the signal output from the Rod Control System.

The RCCAs are divided among control banks and shutdown banks. Each bank may be further subdivided into two groups to provide for precise reactivity control. A group consists of two or more RCCAs that are electrically paralleled to step simultaneously. A bank of RCCAs may consist of one or two groups. When a bank consists of two groups, the groups are moved in a staggered fashion, but always within one step of each other. Control banks A and C and shutdown bank A consist of two groups each while control banks B and D and shutdown bank B consist of a single group.

BASES

BACKGROUND (continued)

The shutdown banks are maintained either in the fully inserted or fully withdrawn position. The control banks are moved in an overlap pattern, using the following withdrawal sequence: When control bank A reaches a predetermined height in the core, control bank B begins to move out with control bank A. Control bank A stops at the position of maximum withdrawal, and control bank B continues to move out. When control bank B reaches a predetermined height, control bank C begins to move out with control bank B. This sequence continues until control banks A, B, and C are at the fully withdrawn position, and control bank D is approximately halfway withdrawn. The insertion sequence is the opposite of the withdrawal sequence. The control rods are arranged in a radially symmetric pattern, so that control bank motion does not introduce radial asymmetries in the core power distributions.

The axial position of shutdown rods and control rods is indicated by two separate and independent systems, which are the Bank Demand Position Indication System (commonly called group step counters) and the Rod Position Indication (RPI) System.

The Bank Demand Position Indication System counts the pulses from the rod control system that moves the rods. There is one step counter for each group of rods. Individual rods in a group all receive the same signal to move and should, therefore, all be at the same position indicated by the group step counter for that group. The Bank Demand Position Indication System is considered highly precise (± 1 step or ± 5/8 inch). If a rod does not move one step for each demand pulse, the step counter will still count the pulse and incorrectly reflect the position of the rod.

The RPI System provides a highly accurate indication of actual rod position, but at a lower precision than the step counters. The RPI is a linear variable differential transformer (LVDT) consisting of primary and secondary coils stacked alternately on a support tube with the control rod drive shaft acting as the core of the transformer. The primary and secondary coils are series connected with the primary coil supplied with AC power from a constant current source. The position of the control rod drive shaft changes the primary to secondary coil magnetic coupling resulting in a variable secondary voltage which is proportional to the position of the drive shaft (control rod). The RPI channel has an indication accuracy of 5% of span (11.5 steps) therefore, the maximum deviation between actual and demanded indication could be 36 steps (24 steps maximum allowable deviation plus 12 steps indication accuracy).

The specifications ensure that (1) acceptable power distribution limits are maintained, (2) the minimum shutdown margin is maintained, and (3) the potential effects of rod misalignment on associated accident

BASES

BACKGROUND (continued)

analyses are limited. Operability of the control rod position indicators is required to determine control rod position and thereby ensure compliance with the control rod alignment and insertion limits.

Permitted control rod misalignments (as indicated by the RPI System within one hour after control rod motion) are; a) ± 18 steps of the bank demand position (if sufficient peaking factor margin exists, the power level is greater than 85 percent of rated power, and bank D demand is less than 215 steps withdrawn), b) ± 24 steps of the bank demand position (if sufficient peaking factor margin exists, the power level is greater than 85 percent of rated power, and bank D demand is greater than 215 steps withdrawn), and c) ± 24 steps of the bank demand position (if the power level is less than or equal to 85 percent of rated power). Above 85 percent of rated power, sufficient peaking factor margin is demonstrated by satisfying the requirements of Table 3.1.4-1, e.g., for an 18 step indicated misalignment and rods less than 215 steps withdrawn, the peak measured $F_Q(Z)$ from the latest incore flux map must be at least 5.0% less than the limit and the peak measured $F^N_{\Delta H}$ from the latest incore flux map must be at least 2.0% less than the limiting value. For power levels less than or equal to 85 percent of rated power, the peaking factor margin does not have to be verified on an explicit basis. This is due to the rate of peaking factor margin increase (due to the peaking factor limit increasing) as the power level decreases being greater than the peaking factor margin loss (due to the increased control rod misalignment). This effect is described in WCAP-15432 Rev. 2. These limits are applicable to all shutdown and control rods (of all banks) over the range of 0 to 230 steps withdrawn inclusive.

Control rods in a single bank move together with no individual rod insertion differing by more than 30 steps from the bank demand position (operation at greater than 85 percent of rated power and demand less than 215 steps), nor more than 36 steps (operation at less than or equal to 85 percent of rated power or operation at greater than 85 percent of rated power and demand position greater than or equal to 215 steps withdrawn). An indicated misalignment limit of 18 steps precludes a rod misalignment of greater than 30 steps with consideration of instrumentation error; 24 steps indicated misalignment corresponds to 36 steps with instrumentation error.

BASES

APPLICABLE SAFETY ANALYSES

Control rod misalignment accidents are analyzed in the safety analysis (Ref. 4). The acceptance criteria for addressing control rod inoperability or misalignment are that:

a. There be no violations of:

    1. specified acceptable fuel design limits, or
    2. Reactor Coolant System (RCS) pressure boundary integrity; and

b. The core remains subcritical after accident transients.

Two types of misalignment are distinguished. During movement of a control rod group, one rod may stop moving, while the other rods in the group continue. This condition may cause excessive power peaking. The second type of misalignment occurs if one rod fails to insert upon a reactor trip and remains stuck fully withdrawn. This condition requires an evaluation to determine that sufficient reactivity worth is held in the control rods to meet the SDM requirement, with the maximum worth rod stuck fully withdrawn.

Two types of analysis are performed in regard to static rod misalignment (Ref. 4). With control banks at their insertion limits, one type of analysis considers the case when any one rod is completely inserted into the core. The second type of analysis considers the case of a completely withdrawn single rod from a bank inserted to its insertion limit. Satisfying limits on departure from nucleate boiling ratio in both of these cases bounds the situation when a rod is misaligned from its group by 36 steps.

Another type of misalignment occurs if one RCCA fails to insert upon a reactor trip and remains stuck fully withdrawn. This condition is assumed in the evaluation to determine that the required SDM is met with the maximum worth RCCA also fully withdrawn (Ref. 4).

The Required Actions in this LCO ensure that either deviations from the alignment limits will be corrected or that THERMAL POWER will be adjusted so that excessive local linear heat rates (LHRs) will not occur, and that the requirements on SDM and ejected rod worth are preserved.

Continued operation of the reactor with a misaligned control rod is allowed if the heat flux hot channel factors $F_Q^C(Z)$ and $F_Q^W(Z)$ and the nuclear enthalpy hot channel factor $F_{\Delta H}^N$ are verified to be within their limits in the COLR and the safety analysis is verified to remain valid. When a control rod is misaligned, the assumptions that are used to determine the rod insertion limits, AFD limits, and quadrant power tilt limits are not preserved. Therefore, the limits may not preserve the design peaking factors, and $F_Q^C(Z)$, $F_Q^W(Z)$ and $F_{\Delta H}^N$ must be verified directly by incore mapping. Bases Section 3.2 (Power Distribution Limits) contains more complete discussions of the relation of $F_Q^C(Z)$, $F_Q^W(Z)$, and $F_{\Delta H}^N$ to the operating limits.

Shutdown and control rod OPERABILITY and alignment are directly related to power distributions and SDM, which are initial conditions assumed in safety analyses. Therefore they satisfy Criterion 2 of the NRC Policy Statement.

BASES

LCO

The limits on shutdown or control rod alignments ensure that the assumptions in the safety analysis will remain valid. The requirements on control rod OPERABILITY ensure that upon reactor trip, the assumed reactivity will be available and will be inserted. The control rod OPERABILITY requirement is satisfied provided the control rod will fully insert within the required rod drop time assumed in the safety analysis. Control rod malfunctions that result in the inability to move a control rod (e.g. lift coil and rod control system logic failures), but do not impact the control rod trippability, do not result in control rod inoperability. The LCO requirements also ensure that the RCCAs and banks maintain the correct power distribution and rod alignment.

The requirement to maintain the rod alignment to within ± 18 steps (for power operation above 85% and bank demand position less than 215 steps) or within ± 24 steps (for power operation greater than 85% and bank demand position greater than or equal to 215 steps) is conservative. The minimum misalignment assumed in safety analysis is 36 steps, and in some cases a total misalignment from fully withdrawn to fully inserted is assumed. Failure to meet the requirements of this LCO may produce unacceptable power peaking factors and LHRs, or unacceptable SDMs, all of which may constitute initial conditions inconsistent with the safety analysis.

APPLICABILITY

The requirements on RCCA OPERABILITY and alignment are applicable in MODES 1 and 2 because these are the only MODES in which neutron (or fission) power is generated, and the OPERABILITY (i.e., trippability) and alignment of rods have the potential to affect the safety of the plant. In MODES 3, 4, 5, and 6, the alignment limits do not apply because the control rods are bottomed and the reactor is shut down and not producing fission power. In the shutdown MODES, the OPERABILITY of the shutdown and control rods has the potential to affect the required SDM, but this effect can be compensated for by an increase in the boron concentration of the RCS. See LCO 3.1.1, "SHUTDOWN MARGIN (SDM)" for SDM in MODE 2 with $k_{eff} < 1.0$, and MODES 3, 4, and 5 and LCO 3.9.1, "Boron Concentration," for boron concentration requirements during refueling.

BASES

ACTIONS

The ACTIONS table is modified by a Note indicating that verification of rod operability and the comparison of bank demand position and RPI System may take place at any time up to one hour after rod motion, at any power level. This allows up to one hour of thermal soak time to allow the control rod drive shaft to reach a thermal equilibrium and thus present a consistent position indication. For purposes of invoking this allowance, a substantial rod movement is required. Substantial rod movement is considered to be 10 or more steps in one direction in less than or equal to one hour.

A.1.1 and A.1.2

When one or more rods are inoperable, there is a possibility that the required SDM may be adversely affected. Under these conditions, it is important to determine the SDM, and if it is less than the required value, initiate boration until the required SDM is recovered. The Completion

Time of 1 hour is adequate for determining SDM and, if necessary, for initiating emergency boration and restoring SDM. In this situation, SDM verification must include the worth of the untrippable rod, as well as a rod of maximum worth.

A.2

If the inoperable rod(s) cannot be restored to OPERABLE status, the plant must be brought to a MODE or condition in which the LCO requirements are not applicable. To achieve this status, the unit must be brought to at least MODE 3 within 6 hours.

The allowed Completion Time is reasonable, based on operating experience, for reaching MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

B.1

When a rod becomes misaligned, it can usually be moved and is still trippable. If the rod can be realigned within the Completion Time of 1 hour, local xenon redistribution during this short interval will not be significant, and operation may proceed without further restriction.

An alternative to realigning a single misaligned RCCA to the group average position is to align the remainder of the group to the position of the misaligned RCCA. However, this must be done without violating the bank sequence, overlap, and insertion limits specified in LCO 3.1.5, "Shutdown Bank Insertion Limits," and LCO 3.1.6, "Control Bank Insertion Limits." The Completion Time of 1 hour gives the operator sufficient time to adjust the rod positions in an orderly manner.

ACTIONS (continued) B.2.1.1 and B.2.1.2

With a misaligned rod, SDM must be verified to be within limit or boration must be initiated to restore SDM to within limit.

In many cases, realigning the remainder of the group to the misaligned rod may not be desirable. For example, realigning control bank B to a rod that is misaligned 25 steps from the top of the core would require a significant power reduction, since control bank D must be moved fully in and control bank C must be moved in to approximately 100 to 115 steps.

Power operation may continue with one RCCA misaligned, provided that SDM is verified within 1 hour. The Completion Time of 1 hour represents the time necessary for determining the actual unit SDM and, if necessary, aligning and starting the necessary systems and components to initiate boration.

B.2.2, B.2.3, B.2.4, B.2.5, and B.2.6

For continued operation with a misaligned rod, RTP must be reduced, SDM must periodically be verified within limits, hot channel factors $F_Q^C(Z)$, $F_Q^W(Z)$ and $F_{\Delta H}^N$ must be verified within limits, and the safety analyses must be re-evaluated to confirm continued operation is permissible.

Reduction of power to 75% RTP ensures that local LHR increases due to a misaligned RCCA will not cause the core design criteria to be exceeded (Ref. 4). The Completion Time of 2 hours gives the operator sufficient time to accomplish an orderly power reduction without challenging the Reactor Protection System.

When a rod is known to be misaligned, there is a potential to impact the SDM. Since the core conditions can change with time, periodic verification of SDM is required. A Frequency of 12 hours is sufficient to ensure this requirement continues to be met.

Verifying that $F_Q^C(Z)$, $F_Q^W(Z)$ and $F_{\Delta H}^N$, are within the required limits ensures that current operation at 75% RTP with a rod misaligned is not resulting in power distributions that may invalidate safety analysis assumptions at full power. The Completion Time of 72 hours allows sufficient time to obtain flux maps of the core power distribution using the incore flux mapping system and to calculate $F_Q^C(Z)$, $F_Q^W(Z)$ and $F_{\Delta H}^N$.

Once current conditions have been verified acceptable, time is available to perform evaluations of accident analysis to determine that core limits will not be exceeded during a Design Basis Event for the duration of operation under these conditions. The accident analyses

BASES

ACTIONS (continued)

presented in the FSAR Chapter 14 (Ref. 4) that may be adversely affected will be evaluated to ensure that the analysis results remain valid for the duration of continued operation under these conditions. A Completion Time of 5 days is sufficient time to obtain the required input data and to perform the analysis.

C.1

When Required Actions cannot be completed within their Completion Time, the unit must be brought to a MODE or Condition in which the LCO requirements are not applicable. To achieve this status, the unit must be brought to at least MODE 3 within 6 hours, which obviates concerns about the development of undesirable xenon or power distributions. The allowed Completion Time of 6 hours is reasonable, based on operating experience, for reaching MODE 3 from full power conditions in an orderly manner and without challenging the plant systems.

D.1.1 and D.1.2

More than one control rod becoming misaligned from its group average position is not expected, and has the potential to reduce SDM. Therefore, SDM must be evaluated. One hour allows the operator adequate time to determine SDM. Restoration of the required SDM, if necessary, requires increasing the RCS boron concentration to provide negative reactivity, as described in the Bases of LCO 3.1.1. The required Completion Time of 1 hour for initiating boration is reasonable, based on the time required for potential xenon redistribution, the low probability of an accident occurring, and the steps required to complete the action. This allows the operator sufficient time to align the required valves and start the boric acid pumps. Boration will continue until the required SDM is restored.

D.2

If more than one rod is found to be misaligned or becomes misaligned because of bank movement, the unit conditions fall outside of the accident analysis assumptions. Since automatic bank sequencing would continue to cause misalignment, the unit must be brought to a MODE or Condition in which the LCO requirements are not applicable. To achieve this status, the unit must be brought to at least MODE 3 within 6 hours.

The allowed Completion Time is reasonable, based on operating experience, for reaching MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.1.4.1

Verification that individual rod positions are within alignment limits at a Frequency of 12 hours provides a history that allows the operator to detect a rod that is beginning to deviate from its expected position.

The specified Frequency takes into account other rod position information that is continuously available to the operator in the control room, so that during actual rod motion, deviations can immediately be detected.

SR 3.1.4.2

Verifying each control rod is OPERABLE would require that each rod be tripped. However, in MODES 1 and 2, tripping each control rod would result in radial or axial power tilts, or oscillations. Exercising each individual control rod every 92 days provides increased confidence that all rods continue to be OPERABLE without exceeding the alignment limit, even if they are not regularly tripped. Moving each control rod by 10 steps will not cause radial or axial power tilts, or oscillations, to occur. The 92 day Frequency takes into consideration other information available to the operator in the control room and SR 3.1.4.1, which is performed more frequently and adds to the determination of OPERABILITY of the rods. Between required performances of SR 3.1.4.2 (determination of control rod OPERABILITY by movement), if a control rod(s) is discovered to be immovable, but remains trippable, the control rod(s) is considered to be OPERABLE. At any time, if a control rod(s) is immovable, a determination of the trippability (OPERABILITY) of the control rod(s) must be made, and appropriate action taken.

SR 3.1.4.3

Verification of rod drop times allows the operator to determine that the maximum rod drop time permitted is consistent with the assumed rod drop time used in the safety analysis. Measuring rod drop times prior to reactor criticality, after reactor vessel head removal, ensures that the reactor internals and rod drive mechanism will not interfere with rod motion or rod drop time, and that no degradation in these systems has occurred that would adversely affect control rod motion or drop time. This testing is performed with all RCPs operating and the average moderator temperature ≥ 500°F to simulate a reactor trip under actual conditions.

This Surveillance is performed during a plant outage, due to the plant conditions needed to perform the SR and the potential for an unplanned plant transient if the Surveillance were performed with the reactor at power.

BASES

REFERENCES

1. FSAR, Section 3.2.
2. FSAR, Sections 1.3.5.
3. 10 CFR 50.46.
4. FSAR, Chapter 14.

ENCLOSURES

to

NRC 2003-0027

WCAP-15432, Revision 2, "Conditional Extension of the Rod Misalignment Technical Specification for Point Beach Units 1 and 2", dated April 2001 (Proprietary)

WCAP-15442, Revision 1, "Conditional Extension of the Rod Misalignment Technical Specification for Point Beach Units 1 and 2", dated April 2001 (Non-Proprietary).

Westinghouse proprietary authorization letter, CAW-01-1449
Affidavit
Proprietary Information Notice
Copyright Notice

Westinghouse Electric Company, LLC

Box 355
Pittsburgh Pennsylvania 15230-0355

April 27, 2001

CAW-01-1449

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

Attention: Mr. Samuel J. Collins

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: WCAP-15432, Revision 2, "Conditional Extension of the Rod Misalignment Technical Specification for Point Beach Units 1 and 2 (Proprietary), April 2001

Dear Mr. Collins:

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-01-1449 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.790 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying Affidavit by Wisconsin Electric Power Company.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-01-1449 and should be addressed to the undersigned.

Very truly yours,

H. A. Sepp, Manager
Regulatory and Licensing Engineering

Enclosures

cc: S. Bloom/NRR/OWFN/DRPW/PDIV2 (Rockville, MD) 1L

P:DATA/DOCUMENTS/0558s

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared Henry A. Sepp, 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 Company LLC ("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:

Henry A. Sepp, Manager
Regulatory and Licensing Engineering

Sworn to and subscribed
before me this 30th day
of April, 2001

PATRICIA L. CROWN COMMONWEALTH OF PENNSYLVANIA NOTARY PUBLIC

Notarial Seal
Patricia L. Crown, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Feb. 7, 2005
Member, Pennsylvania Association of Notaries

Patricia L. Crown

Notary Public

(1) I am Manager, Regulatory and Licensing Engineering, in the Nuclear Services of the Westinghouse Electric Company LLC ("Westinghouse"), 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 and rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10CFR 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 the Westinghouse Electric Company LLC 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.

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 of 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 10CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method 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 WCAP-15432, Revision 2, "Conditional Extension of the Rod Misalignment Technical Specification for Point Beach Units 1 and 2," (Proprietary), April 2001 for Point Beach Units 1 & 2, being transmitted by Wisconsin Electric Power Company letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk, Attention: Mr. Samuel J. Collins. The proprietary information as submitted for use by Wisconsin Electric Power Company for the Point Beach Units 1 & 2 Nuclear Power Plants is expected to be applicable in other licensee submittals in response to certain NRC requirements for justification in minimizing disruptions to normal plant operations due to frequent indications from the Analog Rod Position Indicator (ARPI).

This information is part of that which will enable Westinghouse to:

(a) Modify Technical Specification for bank demand allowable rod misalignment from ± 12 to ± 18 steps indicated.

(b) To minimize disruptions to normal plant operations due to frequent and erroneous indications of rod misalignment.

(c) Assist the customer to obtain NRC approval.

Further this information has substantial commercial value as follows:

(a) Westinghouse's plans to sell the use of similar information to its customers for purposes of meeting NRC requirements for licensing documentation.

(b) The resulting required margins will be determined that they are cycle independent for Point Beach Units 1 and 2 and plant safety will be not be compromised.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar licensing support documentation and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar design programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended for developing testing and analytical methods and performing tests.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.790 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) contained within parentheses located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.790(b)(1).

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WCAP 15442-01

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Conditional Extension of the Rod Misalignment Technical Specification for Point Beach Units 1 and 2

Westinghouse Electric Company LLC

Nuclear Fuel

75

WCAP-15442
Revision 1

Conditional Extension of the Rod Misalignment Technical Specification for Point Beach Units 1 and 2

April, 2001

Author: A. Meliksetian
Core Analysis D

Verified: R. D. Erwin
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Approved: B. R. Beebe, Manager
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Nuclear Fuel
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ABSTRACT

This report proposes modifying the Technical Specification for bank demand allowable rod misalignment from the current ±12 steps indicated above 30 steps and below 215 steps to a value up to a maximum of ±18 steps indicated (±24 steps for power below 85% Rated Thermal Power (RTP), or for bank demand ≥ 215 steps), depending upon the minimum available peaking factor margin. Such a Technical Specifications change is sought to minimize disruptions to normal plant operations due to frequent and erroneous indications of rod misalignment from the Analog Rod Position Indicator (ARPI).

The required margins to the enthalpy rise ($F^N_{\Delta H}$) and heat flux (F_Q) peaking factor limits will be determined by examining the changes in these peaking factors between similar cases with misalignments of ±12 and ±18 steps indicated (±24 steps for bank demand ≥ 215). These resulting required margins will be determined such that they are cycle independent for Point Beach Units 1 and 2. It will also be shown that plant safety will not be compromised by this Technical Specifications change.

The Technical Specifications will utilize the enclosed enthalpy rise and heat flux margin tables to allow an increase in rod misalignment to an amount indicated by the margin available from the latest flux map.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the following individuals for their contributions to the completion of this report: B. R. Beebe, R. Smith, D. Wenzel, R. Erwin, R. J. Fetterman, C. R. Tuley and J. Radawski.

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1.0 INTRODUCTION

The Analog Rod Position Indicator (ARPI) system has an uncertainty of 12 steps, the actual misalignment may be as large as ±24 steps (for indicated misalignment of ±12 steps). In most cases, these indicated misalignments are false readings caused by fluctuations in the temperature of the control rod drive shafts. For example, such fluctuations can occur after Rod Control Cluster Assemblies (RCCAs) are withdrawn from the core during startup. However, when an indication of a misalignment does occur, false or otherwise, the reactor operator must take corrective action per the Technical Specifications.

Increasing the maximum allowed indicated misalignment to the following will provide relief to the aformentioned conditions of false misalignment indications from the ARPI:

- ±18 steps (actual misalignment of ±30 steps) for core power above 85% RTP and bank demand < 215 steps,
- ±24 steps (actual misalignment of ±36 steps) for core power above 85% RTP and bank demand ≥ 215 steps,
- ±24 steps (actual misalignment of ±36 steps) for core power less than 85% RTP .

This maximum allowable misalignment indications are a function of available enthalpy rise and heat flux peaking factors margin as shown in flux maps taken each month. For real misalignments, these misalignment increases generally yield small but acceptable increases in the enthalpy rise and heat flux peaking factors, $F^N_{\Delta H}$ and F_Q. This report will briefly review the feasible single failures of the rod control system that could yield misalignments of single and multiple rods. These feasible single failures will then form the basis for the cases analyzed and documented in this report to support the increase in the misalignment permitted by the Technical Specifications.

2.0 DESCRIPTION OF ROD CONTROL SYSTEM FAILURES

To determine the misalignment cases to be analyzed for this Technical Specification change, an evaluation of the rod control system was performed, drawing from the Failure Mode and Effects Analysis (FMEA) documented in Reference 1. This evaluation considered single failures within the rod control system logic cabinets, power cabinets and the control rod drive mechanisms (CRDMs). This evaluation also considered the impacts of the revised current order timing previously documented in Reference 2.

This evaluation has determined that a single failure of the rod control system can result in six categories of failure mechanisms within the system:

A. [

]^{a,c}.

B. [

]^{a,c}.

C. [

]^{a,c}.

D. [

]^{a,c}.

E. [

]a,c.

F. [

]a,c.

3.0 ANALYSES SUPPORTING NORMAL OPERATION

For the remainder of this report, the failure mechanisms discussed in Section 2 will be referred to by the letter they are listed as; i.e. failures A through F. When analyzing these failure mechanisms for peaking factor impacts, the following cabinet configurations must be considered:

1. 1AC: groups CA1, CC1, SA1
2. 2AC: groups CA2, CC2, SA2
3. 1BD: groups CB, CD, SB

The above configurations are also illustrated in Figure 3.1. The group nomenclature used to describe the power cabinets is defined as follows: the first letter (C or S) refers to a control or shutdown bank; the second letter (A, B, C or D) refers to the bank; the number (1 or 2) refers to the group number. For example, power cabinet 1AC controls group CA1, which is group 1 of control bank A. Power cabinet 2AC controls group SA2, which is group 2 of shutdown bank A.

A key assumption in the analysis of the feasible failures is that the current Westinghouse licensing basis requires the consideration of a single failure only, [

]^{a,c}.

3.1 ANALYSIS METHODOLOGY

The failure mechanism categories described in Section 2 will be analyzed using the USNRC-approved PHOENIX-P/ANC core design system documented in References 3 and 4. For each failure analyzed, calculations are performed for misalignments of up to ±24 steps plus additional misalignments and compared to the corresponding non-misaligned reference case.

The $F_{\Delta H}$ and F_Q for these cases are calculated and compared [

]^{a,c}. Currently, both Point Beach Units operate following the relaxed axial offset power distribution control (RAOC, Reference 5) strategy with operating bands of +9% -8% at greater than 90% RTP. For the current operating cycle, this would translate into a hot full power (HFP) AO range of about 17% over the entire cycle.

3.2 CORE MODELS USED FOR ANALYSIS

To perform the analysis of the possible rod misalignments, one ANC model of Point Beach Unit 1 and one ANC model of Point Beach Unit 2 were utilized. The first model is the currently operating Unit 1 Cycle 26, and represents the current Point Beach Units licensing basis for fuel products and peaking factor limits. The second model used is intended to represent a future cycle (including transition cycle to 422V+ fuel). These two models are summarized in Table 3.1 below:

Table 3.1: Design Models Used in Rod Misalignment Analyses

Design Parameter	Current Cycle	Future Cycle
Cycle Length (End of Full Power Capability, EFPD)	488	[ ]a,c
No. of Feed Assemblies	40	[ ]a,c
No. Feeds Under Lead Bank (No. @ w/o U235)[a]	4 @ 4.0	[ ]a,c
Feed Enrichments (No. @ w/o U235)	16 @ 4.00 24 @ 4.70	[ ]a,c
Axial Blankets (w/o U235)	0.74 2.6	[ ]a,c
Burnable Absorbers (No. / Type / Length)	2320 IFBA, 120" centered;	[ ]a,c
$F^N_{\Delta H}$ Limit	1.70	[ ]a,c (a)
F_Q Limit	2.5	[ ]a,c

a. Analysis has been performed for $F_{\Delta H}$ Limit of 1.8.

3.3 MISALIGNMENT CASES ANALYZED

For the failure mechanism categories listed in Section 2, several distinct subsets of cases are analyzed in ANC. These cases are considered at beginning of cycle life (BOL, 150 MWD/MTU) and end of cycle life (EOL). Some cases are also examined at other cycle burnups, although these cases were found to generally yield less limiting increases in peaking factors from an increase in the rod misalignment. Most of the calculations are performed assuming the reference condition as hot full power (HFP) with rods at the insertion limit (RIL); the Point Beach Units RILs are illustrated in Figure 3.2. Several of these cases are repeated at other reference rod conditions above the RILs, and at part power conditions such as 85% and 50% rated thermal power. The subsets of cases analyzed are summarized below:

1. [

   ][a,c].

2. [

   ][a,c].

3. [

   ][a,c].

4. [

   ][a,c].

5. [

   ][a,c].

6. [

   ][a,c].

7. [

   ][a,c].

8. [

]^{a,c}

The basic analysis approach used in this report proposes dividing the rod misalignment Technical Specification into three modes of surveillance: operation at core powers greater than 85% rated thermal power (RTP) and bank demand less than 215 steps; operation at core powers greater than 85% RTP and bank demand greater than or equal to 215 sreps; operation at core powers less than or equal to 85% RTP.

For the first mode of surveillance, the specific HFP cases analyzed for an additional 6 steps of misalignment are summarized in Table 3.3. The failure mechanisms listed in Table 3.3 are described in Section 2. Several of the limiting 6 step additional misalignment cases were repeated with only 3 steps of additional misalignment (±27 steps total) as listed in Table 3.5. The performance of the 3 step misalignment cases provide completeness and verify the bounding nature of the evaluation process utilized in this report. Results from these two tables are summarized in Table 3.2.

For the second mode of surveillance, the specific HFP cases analyzed for an additional 12 steps of misalignment are summarized in Table 3.6 (these cases are for >85% RTP and bank demand≥ 215). The failure mechanisms listed in Table 3.6 are described in Section 2. Results from these two tables are summarized in Table 3.2.

For the third mode of surveillance, additional cases were performed at part power conditions as listed in Tables 3.4 for additional misalignments of 12 steps (36 steps total). The results of the 12 additional step cases in Table 3.4 are used to determine an acceptable rod misalignment limit for core powers less than or equal to 85% RTP. Results from this table is also summarized in Table 3.2.

3.4 ANALYSIS RESULTS, POWER > 85% RTP

A complete description of all cases analyzed is presented in Tables 3.3 through 3.6. A summary of all cases analyzed and the limiting results to support the rod misalignment Technical Specifications change is given in Table 3.2. This data is presented as the change in the peak $F_{\Delta H}$ and F_Q for an increase in the rod misalignment beyond the current licensing basis of ±12 steps indicated (±24 steps actual).

Note that with the current $F^N_{\Delta H}$ and F_Q Technical Specifications, margins to the limits generally increase as power level decreases:

	For OFA and Upgraded OFA Fuel	For 422V+ Fuel	
$P > 0.5$	$F_Q(Z) \leq (2.50)/P \times K(Z)$	$F_Q(Z) \leq (2.60)/P \times K(Z)$	(1)
$P \leq 0.5$	$F_Q(Z) \leq 5.00 \times K(Z)$	$F_Q(Z) \leq 5.20 \times K(Z)$	
	$F^N_{\Delta H} < 1.70 \times [1 + 0.3\,(1\text{-}P)\,]$	$F^N_{\Delta H} < 1.77 \times [1 + 0.3\,(1\text{-}P)\,]$	(2)

Then, since $F^N_{\Delta H}$ and F_Q margins are usually a minimum at HFP, the amount of margin required to allow the permissible indicated misalignment to be increased from ±12 to ±18 steps for bank demand < 215 (±24 steps for bank demand ≥215 steps) will be determined based on the HFP data for the additional ±6 steps (±12 steps for bank demand ≥ 215 steps) misalignments from Table 3.3 and summarized in Table 3.2.

For all HFP ±6 step misalignment cases, the 95% probibility with 95% confidence level (95/95) increases in $F^N_{\Delta H}$ and F_Q are [ ]^{a,c} and [ ]^{a,c} respectively, and the maximum increases in $F^N_{\Delta H}$ and F_Q are [ ]^{a,c} and [ ]^{a,c} respectively. These results can be conservatively bounded by required $F^N_{\Delta H}$ and F_Q margins of [ ]^{a,c} and [ ]^{a,c}, respectively, for increased rod misalignment of ±6 steps. Note that these required margins are an increase of [ ]^{a,c} and [ ]^{a,c} respectively over the 95/95 values and an increase of [ ]^{a,c} and [ ]^{a,c} respectively over the observed maximum values for all HFP ±6 step cases.

For all HFP ±3 step misalignment cases, the 95/95 increases in $F^N_{\Delta H}$ and F_Q are [ ]^{a,c} and [ ]^{a,c} respectively, and the maximum increases in $F^N_{\Delta H}$ and F_Q are [ ]^{a,c} and [ ]^{a,c} respectively. These results can be conservatively bounded by required $F^N_{\Delta H}$ and F_Q margins of [ ]^{a,c} and [ ]^{a,c}, respectively, for increased rod misalignment of ±3 steps. Note that these required margins are an increase of [ ]^{a,c} and [ ]^{a,c} respectively over the 95/95 values and an increase of [ ]^{a,c} and [ ]^{a,c} respectively over the observed maximum values for all HFP ±3 step cases.

For all HFP ±12step misalignment cases and bank demand ≥ 215 steps, the 95/95 increases in $F_{\Delta H}$ and F_Q are [ ]^{a,c} and [ ]^{a,c} respectively, and the maximum increases in $F^N_{\Delta H}$ and F_Q are [ ]^{a,c} and [ ]^{a,c} respectively. These results can be conservatively bounded by required $F^N_{\Delta H}$ and F_Q margins of [ ]^{a,c} and [ ]^{a,c}, respectively, for increased rod misalignment of ±12 steps. Note that these required margins are an increase of [ ]^{a,c} and [ ]^{a,c} respectively over the 95/95 values and an increase of [ ]^{a,c} and [ ]^{a,c} respectively over the observed maximum values for all HFP ±12 step cases.

Therefore, the proposed $F^N_{\Delta H}$ and F_Q margins for an additional 3 steps of misalignment are half of the limits proposed for an additional 6 steps. Also, the proposed $F^N_{\Delta H}$ and F_Q margins for an additional 12 steps of misalignment are twice the limits proposed for an additional 6 steps.This would suggest that margin required for an increase in the permissible misalignment for core powers greater than 85% RTP can then be specified as a linear function of the available peaking factor margin, with the misalignment increase being determined from the minimum of the available $F^N_{\Delta H}$ or F_Q margin. The proposed rod misalignment limit for core powers greater than 85% RTP are illustrated in Figures 3.3 and 3.4 for bank demands < 215 steps and ≥ 215 steps, respectively.

3.5 ANALYSIS RESULTS, POWER ≤ 85% RTP

The ±12 additional step part-power misalignment case is listed in Table 3.4, and summarized in Table 3.2. At 85% power, the 95/95 increase in the additional ±12 step $F^N_{\Delta H}$ and F_Q are [ ]^{a,c} and [ ]^{a,c}. The ±12 additional step part-power 95/95 $F_{\Delta H}$ and F_Q increases are [ ]^{a,c} and [ ]^{a,c}, respectively, larger than the HFP-only ±12 additional step increases. However, by 85% power, the Technical Specification $F^N_{\Delta H}$ and F_Q limits have increased by 4.5% and 17%, respectively, as defined in Equations 1 and 2. At 50% power, the 95/95 increase in the additional ±12 step $F^N_{\Delta H}$ and F_Q are [ ]^{a,c} and [ ]^{a,c}. The ±12 additional step part-power 95/95 $F^N_{\Delta H}$ and F_Q increases are [ ]^{a,c} and [ ]^{a,c}, respectively, larger than the HFP-only ±12 additional step increases. However, by 50% power, the Technical Specification $F^N_{\Delta H}$ and F_Q limits have increased by 15% and 100%, respectively, as defined in Equations 1 and 2.

Since the peaking factor limits are increasing much faster than the required margins, the proposed rod misalignment Technical Specification limit of ±18 steps indicated for core powers above 85% RTP can be increased for core powers less than or equal to 85% RTP. At 85% RTP, the peaking factor limit increases of 4.5% in $F^N_{\Delta H}$ and 17% in F_Q [

]^{a,c} in F_Q due to the additional ±12 additional steps of rod misalignment. Therefore, the proposed allowable indicated misalignment of ±24 steps for core powers of 85% RTP or less is justified.

3.6 PROPOSED TECHNICAL SPECIFICATION CHANGES

A graphic representation of the proposed Technical Specification for core powers greater than 85% RTP discussed in Section 3.4 is shown in Figures 3.3 and 3.4. The amount of available margin must be determined at least once every effective full power month (30 EFPD) during normal incore flux map surveillance. For Point Beach Units, the amount of F_Q margin will be based on the current F_Q surveillance methodology. The required peaking factors margins for additional misalignments at core powers above 85% RTP and bank demand below 215 steps are summarized below:

Indicated Misalignment (Steps)	Additional Misalignment (Steps)	Required Margin	
		$F^N_{\Delta H}$	F_Q
12	0	0.00	0.00
13	1	0.33	0.83
14	2	0.67	1.67
15	3	1.00	2.50
16	4	1.33	3.33
17	5	1.67	4.17
18	6	2.00	5.00

The required peaking factors margins for additional misalignments at core powers above 85% RTP and bank demand ≥ 215 steps are also summarized below:

Indicated Misalignment (Steps)	Additional Misalignment (Steps)	Required Margin	
		$F^N_{\Delta H}$	F_Q
12	0	0.00	0.00
13	1	0.33	0.83
14	2	0.67	1.67
15	3	1.00	2.50

Indicated Misalignment (Steps)	Additional Misalignment (Steps)	Required Margin	
		$F^N_{\Delta H}$	F_Q
16	4	1.33	3.33
17	5	1.67	4.17
18	6	2.00	5.00
19	7	2.33	5.83
20	8	2.67	6.67
21	9	3.00	7.50
22	10	3.33	8.33
23	11	3.67	9.17
24	12	4.00	10.0

For core powers of 85% RTP or less, as discussed in Section 3.5, the allowable indicated rod misalignment will be ±24 steps. At this amount of misalignment, the increase in the peaking factors relative to the current limit of ±12 steps is [ ][a,c] as defined in Equations 1 and 2 of Section 3.4.

Figure 3.1 Point Beach Units 1 and 2 Control and Shutdown Rod Configuration By Subgroup and Power Cabinet

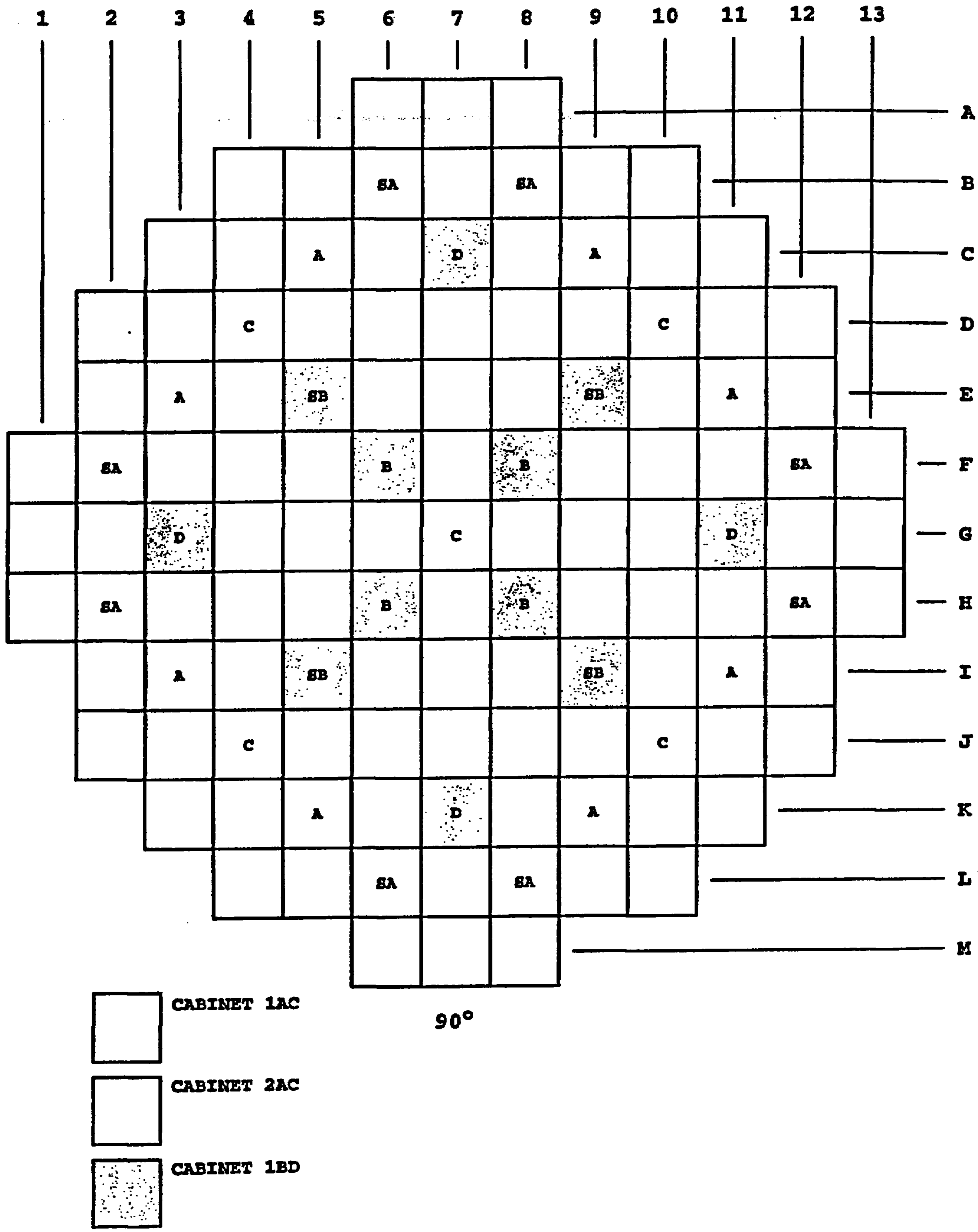

Figure 3.2 Point Beach Units 1 and 2 Control Rod Insertion Limits

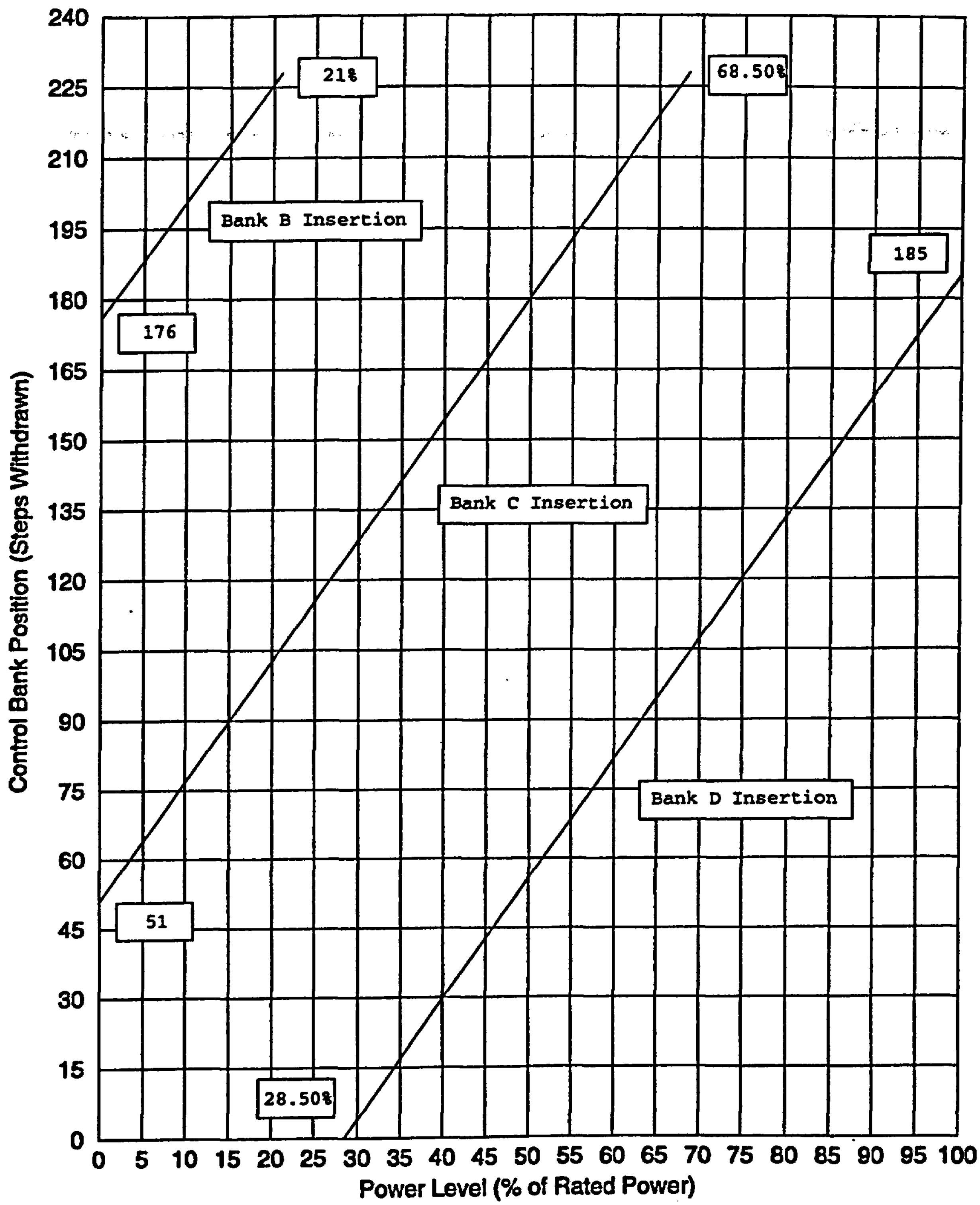

Figure 3.3 Permissible Increase in Rod Misalignment Vs. Available $F^N_{\Delta H}$ and F_Q Margin for >85% RTP and Bank Demand <215 Steps

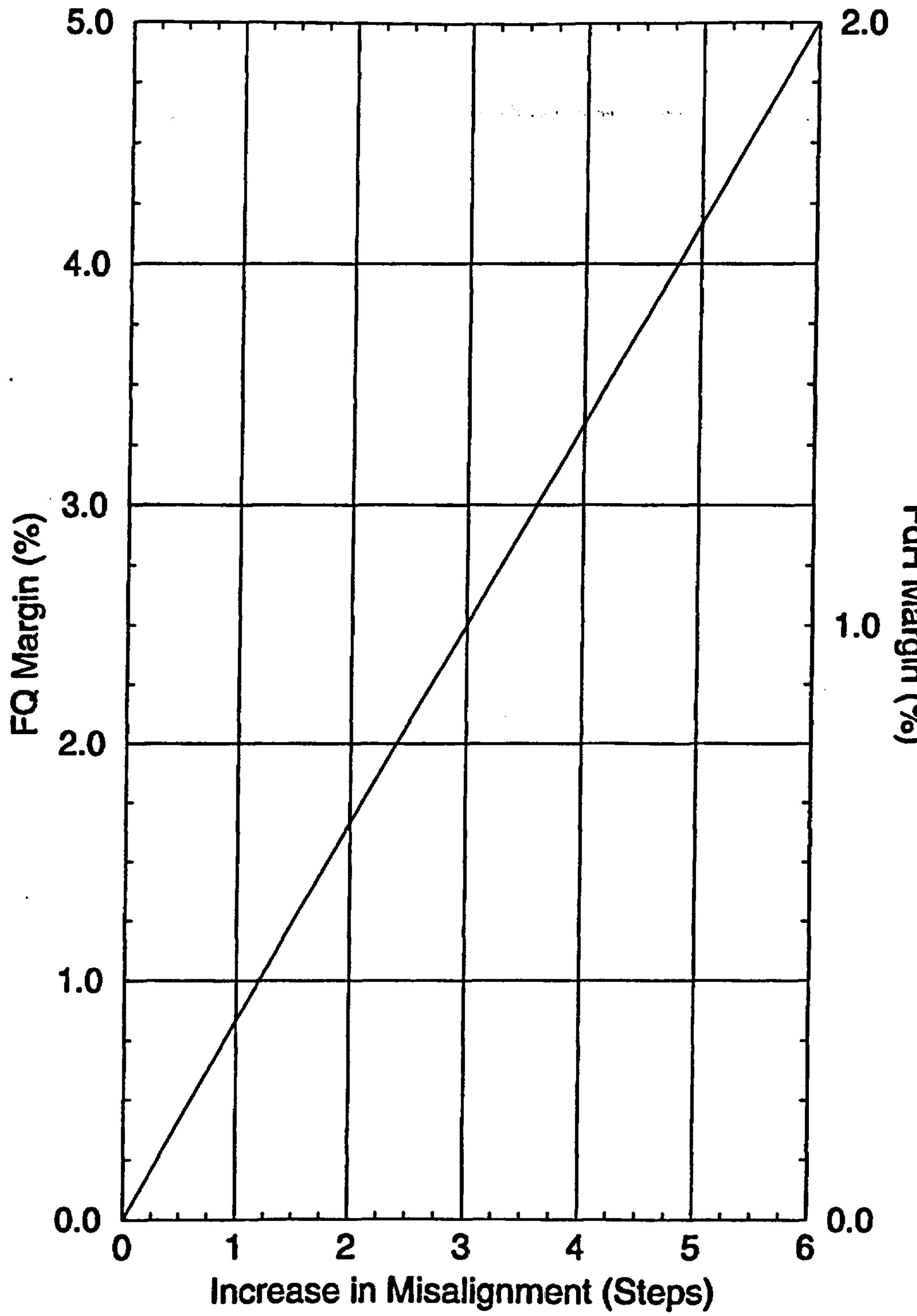

Figure 3.4: Permissible Increase in Rod Misalignment Vs. Available $F^N_{\Delta H}$ and F_Q Margin for >85% RTP and Bank Demand ≥ 215 Steps

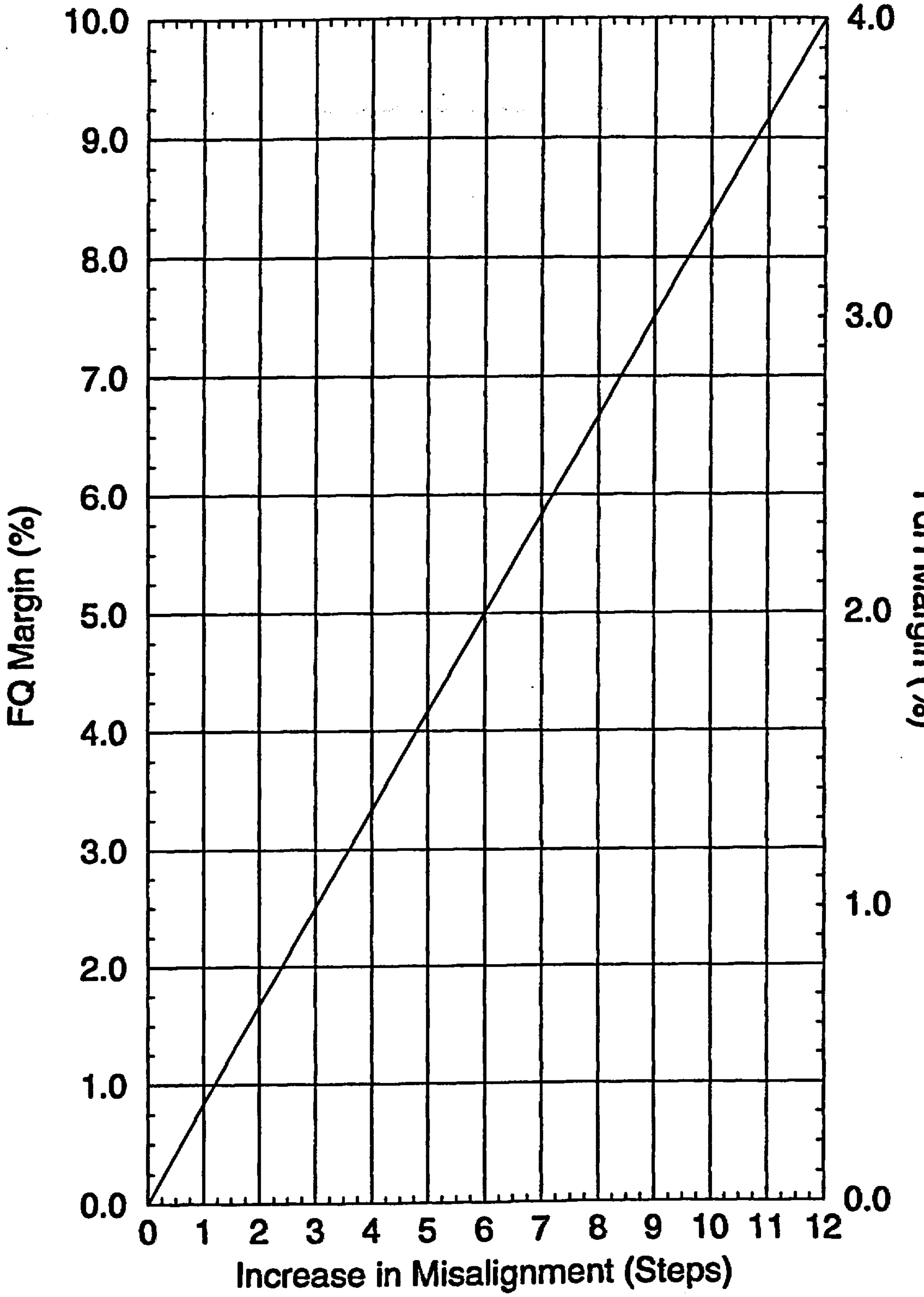

Table 3.2: Summary of Misalignment Cases Analyzed; Change in Peak $F_{\Delta H}$ and F_Q for Increased Misalignment Beyond ±12 Steps Indicated

Power, Indicated Misalignment, No. Points	Peak	Distribution Function	Mean ($\bar{x}$), %	Std. Dev. (σ), %	95/95 Value, %	Max. % (Case No.)
HFP ±18 [ ]^{a,c}	$F_{\Delta H}$	Extreme Value	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}
	F_Q	Extreme Value	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}
Part Power ±24 (85% RTP) [ ]^{a,c}	$F_{\Delta H}$	Beta	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}
	F_Q	Normal	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}
Part Power ±24 (50% RTP) [ ]^{a,c}	$F_{\Delta H}$	Beta	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}
	F_Q	Beta	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}
HFP ±15 [ ]^{a,c}	$F_{\Delta H}$	Normal	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}
	F_Q	Weibull	[ ]^{a,c}	[ ]^{a,c}	[^{a,c}	[ ]^{a,c}
HFP ±24 (≥215 steps) [ ]^{a,c}	$F_{\Delta H}$	Beta	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}
	F_Q	Logistic	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}	[ ]^{a,c}

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 1 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
1	BOL	HFP	Current	A	D at 185			
2	MOL	HFP	Current	A	D at 185			
3	EOL	HFP	Current	A	D at 185			
4	BOL	HFP	Current	D	D at 185			
5	MOL	HFP	Current	D	D at 185			
6	EOL	HFP	Current	D	D at 185			
7	BOL	HFP	Current	A	D at 205			
8	EOL	HFP	Current	A	D at 205			
9	BOL	HFP	Current	A	D at 185			
10	EOL	HFP	Current	A	D at 185			
11	BOL	HFP	Current	D	D at 185			
12	EOL	HFP	Current	D	D at 185			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 2 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
13	BOL	HFP	Current	A	D at 185			a,c
14	EOL	HFP	Current	A	D at 185			
15	BOL	HFP	Current	D	D at 185			
16	EOL	HFP	Current	D	D at 185			
17	BOL	HFP	Current	C	D at 185			
18	EOL	HFP	Current	C	D at 185			
19	BOL	HFP	Current	E/F	D at 200			
20	EOL	HFP	Current	E/F	D at 200			
21	BOL	HFP	Current	E	D at 200			
22	EOL	HFP	Current	E	D at 200			
23	BOL	HFP	Current	E/F	D at 185			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 3 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
24	EOL	HFP	Current	E/F	D at 185			a,c
25	BOL	HFP	Current	E	D at 185			
26	MOL	HFP	Current	E	D at 185			
27	EOL	HFP	Current	E	D at 185			
28	BOL	HFP	Current	A	ARO			
29	EOL	HFP	Current	A	ARO			
30	BOL	HFP	Current	A	ARO			
31	EOL	HFP	Current	A	ARO			
32	BOL	HFP	Current	A	D at 185			
33	EOL	HFP	Current	A	D at 185			
34	BOL	HFP	Current	A	ARO			
35	EOL	HFP	Current	A	ARO			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 4 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
36	BOL	HFP	Current	A	ARO			a,c
37	EOL	HFP	Current	A	ARO			
38	BOL	HFP	Current	A	D at 185			
39	EOL	HFP	Current	A	D at 185			
40	BOL	HFP	Current	A	ARO			
41	EOL	HFP	Current	A	ARO			
42	BOL	HFP	Current	A	ARO			
43	EOL	HFP	Current	A	ARO			
44	BOL	HFP	Current	A	D at 185			
45	EOL	HFP	Current	A	D at 185			
46	BOL	HFP	Current	A	ARO			
47	EOL	HFP	Current	A	ARO			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 5 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
48	BOL	HFP	Current	A	D at 185			a,c
49	EOL	HFP	Current	A	D at 185			
50	BOL	HFP	Current	A	ARO			
51	EOL	HFP	Current	A	ARO			
52	BOL	HFP	Current	A	D at 185			
53	EOL	HFP	Current	A	D at 185			
54	BOL	HFP	Current	A	ARO			
55	MOL	HFP	Current	A	ARO			
56	EOL	HFP	Current	A	ARO			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 6 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
57	BOL	HFP	Current	A	ARO			a,c
58	MOL	HFP	Current	A	ARO			
59	EOL	HFP	Current	A	ARO			
60	BOL	HFP	Current	A	D at 185			
61	EOL	HFP	Current	A	D at 185			
62	EOL	HFP	Current	A	ARO			
63	BOL	HFP	Current	A	ARO			
64	MOL	HFP	Current	A	ARO			
65	EOL	HFP	Current	A	ARO			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 7 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
66	BOL	HFP	Current	A	ARO			a,c
67	EOL	HFP	Current	A	ARO			
68	BOL	HFP	Current	A	D at 185			
69	EOL	HFP	Current	A	D at 185			
70	BOL	HFP	Current	A	ARO			
71	EOL	HFP	Current	A	ARO			
72	BOL	HFP	Current	A	ARO			
73	EOL	HFP	Current	A	ARO			
74	BOL	HFP	Current	A	D at 185			
75	EOL	HFP	Current	A	D at 185			
76	BOL	HFP	Current	A	ARO			
77	EOL	HFP	Current	A	ARO			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 8 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
78	BOL	HFP	Current	A	ARO			a,c
79	MOL	HFP	Current	A	ARO			
80	EOL	HFP	Current	A	ARO			
81	BOL	HFP	Current	A	D at 185			
82	EOL	HFP	Current	A	D at 185			
83	BOL	HFP	Current	A	ARO			
84	MOL	HFP	Current	A	ARO			
85	EOL	HFP	Current	A	ARO			
86	BOL	HFP	Current	A	D at 185			
87	MOL	HFP	Current	A	D at 185			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 9 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
88	EOL	HFP	Current	A	D at 185			
89	BOL	HFP	Current	A	ARO			
90	EOL	HFP	Current	A	ARO			
91	BOL	HFP	Current	A	D at 185			
92	EOL	HFP	Current	A	D at 185			
93	BOL	HFP	Current	A	ARO			
94	MOL	HFP	Current	A	ARO			
95	EOL	HFP	Current	A	ARO			
96	BOL	HFP	Current	A	D at 185			
97	MOL	HFP	Current	A	D at 185			
98	EOL	HFP	Current	A	D at 185			
99	BOL	HFP	Current	A	ARO			

a,c

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 10 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
100	EOL	HFP	Current	A	ARO			a,c
101	BOL	HFP	Current	A	D at 185			
102	EOL	HFP	Current	A	D at 185			
103	BOL	HFP	Current	A	ARO			
104	EOL	HFP	Current	A	ARO			
105	BOL	HFP	Current	A	D at 185			
106	EOL	HFP	Current	A	D at 185			
107	BOL	HFP	Current	A	ARO			
108	EOL	HFP	Current	A	ARO			
109	BOL	HFP	Current	A	D at 185			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 11 of 16)

a,c

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
110	EOL	HFP	Current	A	D at 185			
111	BOL	HFP	Current	A	ARO			
112	MOL	HFP	Current	A	ARO			
113	EOL	HFP	Current	A	ARO			
114	BOL	HFP	Current	A	D at 185			
115	MOL	HFP	Current	A	D at 185			
116	EOL	HFP	Current	A	D at 185			
117	BOL	HFP	Future	A	D at 185			
118	EOL	HFP	Future	D	D at 185			
119	EOL	HFP	Future	E/F	D at 185			
120	EOL	HFP	Future	E	D at 185			
121	EOL	HFP	Future	A	ARO			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 12 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
122	EOL	HFP	Future	A	D at 185			a,c
123	EOL	HFP	Future	A	D at 185			
124	BOL	HFP	Future	A	ARO			
125	EOL	HFP	Future	A	ARO			
126	BOL	HFP	Future	A	D at 185			
127	EOL	HFP	Future	A	D at 185			
128	BOL	HFP	Future	A	ARO			
129	2000	HFP	Future	A	ARO			
130	MOL	HFP	Future	A	ARO			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 13 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
131	EOL	HFP	Future	A	ARO			a,c
132	BOL	HFP	Future	A	ARO			
133	2000	HFP	Future	A	ARO			
134	MOL	HFP	Future	A	ARO			
135	EOL	HFP	Future	A	ARO			
136	BOL	HFP	Future	A	D at 185			
137	EOL	HFP	Future	A	D at 185			
138	EOL	HFP	Future	A	ARO			
139	EOL	HFP	Future	A	ARO			
140	EOL	HFP	Future	A	ARO			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 14 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
141	BOL	HFP	Future	A	ARO			
142	2000	HFP	Future	A	ARO			
143	MOL	HFP	Future	A	ARO			
144	EOL	HFP	Future	A	ARO			
145	EOL	HFP	Future	A	D at 185			
146	EOL	HFP	Future	A	D at 185			
147	BOL	HFP	Future	A	ARO			
148	2000	HFP	Future	A	ARO			
149	MOL	HFP	Future	A	ARO			
150	EOL	HFP	Future	A	ARO			

a,c

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 15 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
151	BOL	HFP	Future	A	D at 185			a,c
152	2000	HFP	Future	A	D at 185			
153	MOL	HFP	Future	A	D at 185			
154	EOL	HFP	Future	A	D at 185			
155	EOL	HFP	Future	A	ARO			
156	EOL	HFP	Future	A	D at 185			
157	BOL	HFP	Future	A	ARO			
158	2000	HFP	Future	A	ARO			
159	MOL	HFP	Future	A	ARO			
160	EOL	HFP	Future	A	ARO			
161	BOL	HFP	Future	A	D at 185			

Table 3.3: Summary of 18 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 16 of 16)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rod(s) Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
162	2000	HFP	Future	A	D at 185	[		
163	MOL	HFP	Future	A	D at 185			
164	EOL	HFP	Future	A	D at 185			]
(*)	Signifies that plots of peaking factors and increases due to additional steps of misalignment are included in the Appendix of this report.							

Table 3.4: Summary of 24 Step Indicated Part-Power Rod Misalignment Cases Analyzed (Sheet 1 of 5)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rods Misaligned	Peaking Factor % Increase for Additional 3 Steps	
							$F^N_{\Delta H}$	F_Q a,c
165	EOL	85%	Current	D	D at 146			
166	EOL	85%	Current	A	D at 146			
167	BOL	85%	Current	C	D at 146			
168	EOL	85%	Current	E/F	D at 146			
169	EOL	85%	Current	A	ARO			
170	EOL	85%	Current	A	ARO			
171	EOL	85%	Current	A	ARO			
172	EOL	85%	Current	A	ARO			
173	EOL	85%	Current	A	ARO			
174	BOL	85%	Current	A	ARO			

Table 3.4: Summary of 24 Step Indicated Part-Power Rod Misalignment Cases Analyzed (Sheet 2 of 5)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rods Misaligned	Peaking Factor % Increase for Additional 3 Steps	
							$F^N_{\Delta H}$	F_Q
175	MOL	85%	Current	A	ARO			a,c
176	EOL	85%	Current	A	ARO			
177	EOL	85%	Current	A	ARO			
178	EOL	85%	Current	A	D at 185			
179	EOL	85%	Current	A	D at 146			
180	EOL	85%	Current	A	ARO			
181	EOL	85%	Current	A	ARO			
182	EOL	85%	Current	A	D at 185			
183	EOL	85%	Current	A	D at 146			

Table 3.4: Summary of 24 Step Indicated Part-Power Rod Misalignment Cases Analyzed (Sheet 3 of 5)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rods Misaligned	Peaking Factor % Increase for Additional 3 Steps	
							$F^N_{\Delta H}$	F_Q
184	2000	85%	Future	A	ARO			a,c
185	EOL	85%	Future	A	ARO			
186	EOL	85%	Future	A	ARO			
187	EOL	85%	Future	A	D at 185			
188	EOL	85%	Future	A	D at 146			
189	EOL	85%	Future	A	ARO			
190	EOL	85%	Future	A	ARO			
191	MOL	85%	Future	A	D at 185			
192	MOL	85%	Future	A	D at 146			
193	EOL	85%	Future	A	ARO			

Table 3.4: Summary of 24 Step Indicated Part-Power Rod Misalignment Cases Analyzed (Sheet 4 of 5)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rods Misaligned	Peaking Factor % Increase for Additional 3 Steps	
							$F^N_{\Delta H}$	F_Q
194	EOL	85%	Future	A	D at 185			
195	EOL	85%	Future	A	D at 146			
196	EOL	85%	Future	A	ARO			
197	MOL	85%	Future	A	ARO			
198	EOL	85%	Future	A	ARO			
199	EOL	85%	Future	A	D at 185			
200	EOL	85%	Future	A	D at 146			
201	EOL	50%	Current	A	ARO			
202	MOL	50%	Current	A	ARO			
203	EOL	50%	Current	A	ARO			

a,c

Table 3.4: Summary of 24 Step Indicated Part-Power Rod Misalignment Cases Analyzed (Sheet 5 of 5)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rods Misaligned	Peaking Factor % Increase for Additional 3 Steps	
							$F^N_{\Delta H}$	F_Q
204	EOL	50%	Current	A	ARO			
205	EOL	50%	Future	A	ARO			
206	EOL	50%	Future	A	D at 185			
207	EOL	50%	Future	A	D at 185			
208	EOL	50%	Future	A	D at 56, C at 180			
209	EOL	50%	Future	A	ARO			
210	EOL	50%	Future	A	D at 56, C at 180			

a,c

Table 3.5: Summary of 15 Step Indicated Rod Misalignment Cases Analyzed (Sheet 1 of 2)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rods Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q a,c
211	BOL	HFP	Current	A	ARO			
212	EOL	HFP	Current	A	ARO			
213	BOL	HFP	Current	A	ARO			
214	EOL	HFP	Current	A	ARO			
215	EOL	HFP	Current	A	ARO			
216	EOL	HFP	Current	A	ARO			
217	EOL	HFP	Current	A	D at 185			
218	EOL	HFP	Current	A	ARO			
219	EOL	HFP	Current	A	D at 185			

Table 3.5: Summary of 15 Step Indicated Rod Misalignment Cases Analyzed (Sheet 2 of 2)

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Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rods Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
220	EOL	HFP	Current	A	ARO			
221	EOL	HFP	Current	A	D at 185			
222	BOL	HFP	Future	A	ARO			
223	EOL	HFP	Future	A	ARO			
224	BOL	HFP	Future	A	ARO			
225	EOL	HFP	Future	A	ARO			
226	EOL	HFP	Future	A	ARO			
227	EOL	HFP	Future	A	ARO			
228	EOL	HFP	Future	A	D at 185			
229	EOL	HFP	Future	A	ARO			
230	EOL	HFP	Future	A	D at 185			

Table 3.6: Summary of 24 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 1 of 3)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rods Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
231	EOL	HFP	Current	A	ARO			
232	BOL	HFP	Current	A	ARO			
233	EOL	HFP	Current	A	ARO			
234	MOL	HFP	Current	A	ARO			
235	EOL	HFP	Current	A	ARO			
236	EOL	HFP	Current	A	ARO			
237	EOL	HFP	Current	A	ARO			
238	BOL	HFP	Future	A	ARO			
239	EOL	HFP	Future	A	ARO			

Table 3.6: Summary of 24 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 2 of 3)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rods Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q a,c
240	EOL	HFP	Future	A	ARO			
241	EOL	HFP	Future	A	ARO			
242	EOL	HFP	Future	A	ARO			
243	EOL	HFP	Current	A	D at 215			
244	BOL	HFP	Current	A	D at 215			
245	EOL	HFP	Current	A	D at 215			
246	MOL	HFP	Current	A	D at 215			
247	EOL	HFP	Current	A	D at 215			
248	EOL	HFP	Current	A	D at 215			

Table 3.6: Summary of 24 Step Indicated Hot Full Power Rod Misalignment Cases Analyzed (Sheet 3 of 3)

Case No.	Burnup	Power	Cycle	Failure Mechanism	Reference Bank Position	Rods Misaligned	Peaking Factor % Increase for Additional 6 Steps	
							$F^N_{\Delta H}$	F_Q
249	EOL	HFP	Current	A	D at 215			
250	BOL	HFP	Future	A	D at 215			
251	EOL	HFP	Future	A	D at 215			
252	EOL	HFP	Future	A	D at 215			
253	EOL	HFP	Future	A	D at 215			
254	EOL	HFP	[a]	A	D at 215			

a. (*) Signifies that plots of peaking factors and increases due to additional steps of misalignment are included in the Appendix of this report

4.0 SAFETY ANALYSIS IMPACTS

Section 3 discussed the effects of increased misalignment on the normal operation peaking factors. This section will address the effects on safety analysis inputs used for the reload safety evaluation (Reference 6).

An increase in rod misalignment does not have a significant impact on any of the moderator or Doppler reactivity coefficients or defects, nor on the reactor kinetics data. An increase in the rod misalignment also will not adversely effect the boron worths or data generated for the evaluation of boron dilution nor the boron system duty.

Many of the Condition II transients, such as rod out of position, dropped rod and single rod withdrawal are based on the motion of a control rod or control bank. These are considered fully misaligned rod transients caused by a single failure of the rod control system. Recall from Section 3.0 that a key assumption of the analysis documented in this report is that rod misalignments resulting from a SINGLE failure only need be considered, consistent with the current Westinghouse and Point Beach licensing basis. Series of [ ]^{a,c} do not need to be considered. Therefore, one does not need to assume a rod misalignment from the [ ]^{a,c} as a precondition to one of the above mentioned Condition II rod misalignment transients; such an assumption would be beyond the current Westinghouse licensing basis and overly conservative. As such, the proposed changes to the rod misalignment Tech Spec do not have an adverse impact on the safety analysis inputs for these accidents, or the DNB analysis results.

Another possible impact of the increase in the rod misalignment is an increase in the rod insertion allowance (RIA), the worth of the rods at their insertion limits or RILs. The RIA has a direct impact on the available trip reactivity and the shutdown margin (SDM) assumed in several transient analyses including steamline break. The maximum increase in the RIA, and hence largest reduction in the trip worth and SDM, would be due to an entire bank being misaligned in deeper than the RIL, consistent with failure category C described in Section 3.3. However, the available trip worth and SDM also assume that the core is subcritical with an N-1 rod configuration, where the highest individual worth rod is stuck out of the core, consistent with failure category D. As stated above, rod misalignments resulting from a SINGLE failure only need be considered, consistent with the current Westinghouse licensing basis. [ ]^{a,c}. Therefore, for the trip reactivity and SDM one does not need to assume an increase in the RIA due to [ ]^{a,c}. In addition, the reduction in available SDM due to the WSR is much greater than the worth that would be lost due to an increase in the RIA. As such, the proposed changes to the rod misalignment Tech Spec do not have an adverse impact on the available trip worth or SDM.

Safety analyses inputs that would be affected by an increase in the allowable misalignment are the rod ejection F_Q, the ejected rod worth $\Delta\rho_{EJ}$, and the available trip worth following a rod ejection accident.

To evaluate the effects of an increased rod misalignment on the rod ejection accident, a cycle depletion with [

]^{a,c}. This is a conservative assumption since Point Beach Units historically do not load follow nor operate with D bank deeply inserted.

The rod ejection parameters can be affected by an increased rod misalignment in two ways: a misalignment of any number of RIL rods during the last 30 effective full power days (EFPD) of the rodded depletion; or a misalignment of the RIL rods at HZP prior to the ejection. For the first scenario, [

]^{a,c}. For both scenarios, misalignments of individual rods, bank groups and entire banks were considered to determine the limiting effects on F_Q and $\Delta\rho_{EJ}$. Calculations were also performed for the limiting cycle, assuming either an additional 6 steps of rod misalignment during the last 30 EFPD of the HFP rodded depletion or an additional 12 steps of rod misalignment at the HZP RIL. Results of these calculations show maximum increases of [ ]^{a,c} in F_Q and [ ]^{a,c} in $\Delta\rho_{EJ}$. Again, recall that the future cycle has a feed assembly under all 4 of the RCCAs in the lead control bank D. As such, the future cycle yields larger non-misaligned values for the ejected rod F_Q and $\Delta\rho_{EJ}$. These values will be increased for conservatism. For application of this Technical Specification change, [

]^{a,c}.

5.0 CONCLUSIONS

An extension of the allowable indicated rod misalignment of ±12 steps to ±18 steps (to ±24 steps for bank demand ≥ 215 steps) may be permitted for core powers above 85% RTP as long as it is demonstrated that sufficient peaking factor margin is available. The amount of required margin is also linearly dependent upon the amount of additional misalignment desired, as shown in Figures 3.3 and 3.4, and summarized below

Power > 85% RTP, Bank Demand < 215 Steps:

Indicated Misalignment (Steps)	Additional Misalignment (Steps)	Required Margin	
		$F^N_{\Delta H}$	F_Q
12	0	0.00	0.00
13	1	0.33	0.83
14	2	0.67	1.67
15	3	1.00	2.50
16	4	1.33	3.33
17	5	1.67	4.17
18	6	2.00	5.00

Power > 85% RTP, Bank Demand ≥ 215 Steps

Indicated Misalignment (Steps)	Additional Misalignment (Steps)	Required Margin	
		$F^N_{\Delta H}$	F_Q
12	0	0.00	0.00
13	1	0.33	0.83
14	2	0.67	1.67
15	3	1.00	2.50

Indicated Misalignment (Steps)	Additional Misalignment (Steps)	Required Margin	
		$F^N_{\Delta H}$	F_Q
16	4	1.33	3.33
17	5	1.67	4.17
18	6	2.00	5.00
19	7	2.33	5.83
20	8	2.67	6.67
21	9	3.00	7.50
22	10	3.33	8.33
23	11	3.67	9.17
24	12	4.00	10.0

Indicated misalignments of up to 24 steps are also permitted for all powers of 85% RTP or less.

The analysis documented in this report has been performed such that the above mentioned excess peaking factor margin required for additional indicated rod misalignment is [ ]^{a,c}.

The analysis documented in this report is conservative and appropriate based on the following assumptions on rod insertion:

- The rod insertion limits (RILs) shown in Figure 3.2 determine the maximum bank demand position as a function of core power;
- The all rods out (ARO) demand position can be as deep as to the top of the active fuel stack for the Point Beach feed fuel assemblies.

The results of this report are also conservative and appropriate for any future change in the RILs that would reduce the maximum allowable rod insertion and for any ARO position above the top of the active fuel stack. Any future change to the RILs that would permit deeper rod insertion would also require an evaluation of the results of this report.

As part of the reload specific safety evaluation, design calculations will include the following additional conservatisms to bound the maximum increases in rod misalignment any time during the cycle:

- [

  ][a,c]
- [

  ][a,c]

6.0 REFERENCES

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2. Baker, T., et. al., *Rod Control System Evaluation Program*, WCAP-13864, Revision 1-A (Non-Proprietary Class 3), November 1994.

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4. Liu, Y. S., et. al., *ANC: A Westinghouse Advanced Nodal Computer Code*, WCAP-10965-P-A (Westinghouse Proprietary), December 1985.

5. Miller, R. W. et. al., *Relaxation of Constant Axial Offset Control - FQ Surveillance Technical Specification*, WCAP-10216-P-A, Revision 1, February 1994.

6. Davison, S. L., et. al., *Westinghouse reload Safety Evaluation Methodology*, WCAP-9272-P-A, , July 1985.

APPENDIX A

This section provides some additional detail to the cases highlighted in Tables 3.3 and 3.6. These cases yielded the limiting increase in $F^N_{\Delta H}$, F_Q or both. The following figures provide the misaligned peaking factors compared to the reference non-misaligned case, and the percent differences relative to 24 steps of total misalignment (±12 steps indicated). Data in these figures are provided as a function of axial offset, covering the maximum expected range for the Point Beach Units. The data summarized in Tables 3.3 through 3.6 represents the maximum points from these figures.

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Figure A.1

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Figure A.2

Figure A.3

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Figure A.4

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Figure A.5

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Figure A.7

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Figure A.8

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Figure A.9

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Figure A.10

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Figure A.11

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Figure A.12

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Figure A.13

a,c

Figure A.14

a,c

Figure A.15

a,c

Figure A.16

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