Section	Title	Page
3.5	Instrumentation Systems	3.5-1
3.6	Containment System	3.6-1
3.6.A	Containment Integrity	3.6-1
3.6.B	Internal Pressure	3.6-1
3.6.C	Containment Temperature	3.6-2
3.6.D	Containment Vent and Purge System	3.6-2
3.7	Auxiliary Electrical Systems	3.7-1
3.8	Refueling, Fuel Handling and Storage	3.8-1
3.9	Radioactive Materials Management	3.9-1
3.10	Control Rod and Power Distribution Limits	3.10-1
3.10.1	Shutdown Reactivity	3.10-1
3.10.2	Power Distribution Limits	3.10-1
3.10.3	Quadrant Power Tilt Limits	3.10-4
3.10.4	Rod Insertion Limits	3.10-5
3.10.5	Rod Misalignment Limitations	3.10-6
3.10.6	Inoperable Rod Position Indicator Channels	3.10-7
3.10.7	Inoperable Rod Limitations	3.10-7
3.10.8	Rod Drop Time	3.10-7
3.10.9	Rod Position Monitor	3.10-8
3.10.10	Reactivity Balance	3.10-8
3.10.11	Notification	3.10-8
3.11	Movable Incore Instrumentation	3.11-1
3.12	River Level	3.12-1
3.13	Safety-Related Shock Suppressors (Snubbers)	3.13-1
3.14	Fire Protection and Detection Systems	3.14-1
3.14.A	High Pressure Water Fire Protection System	3.14-1
3.14.B	Fire Protection Spray and/or Sprinkler Systems	3.14-2
3.14.C	Penetration Fire Barriers	3.14-2
3.14.D	Fire Detection Systems	3.14-4
3.14.E	Fire Hose Stations	3.14-4
3.14.F	Yard Fire Hydrants and Hydrant Hose Houses	3.14-6
3.14.G	CO_2 Fire Protection System	3.14-6
4	Surveillance Requirements	4.1-1
4.1	Operational Safety Review	4.1-1
4.2	Inservice Inspection	4.2-1
4.2.1	Weld and Support Program	4.2-1

Amendment No. 89, 116, 122,

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LIST OF TABLES

Table No.	Title
3.4-1	Maximum Allowable Power Range Neutron Flux High Setpoint with Inoperable Steam Line Safety Valves
3.5-1	Engineered Safety Features Initiation Instrument Setting Limits
3.5-2	Reactor Trip Instrumentation Limiting Operating Conditions
3.5-3	Instrumentation Operating Condition for Engineered Safety Features
3.5-4	Instrument Operating Conditions for Isolation Functions
3.5-5	Table of Indicators and/or Recorders Available to the Operator
3.6-1	Non-Automatic Containment Isolation Valves Open Continuously or Intermittently for Plant Operation
3.10-1	Acceptable Indicated Control Rod Misalignment As a Function Of Measured Peaking Factor Margin (F_Q (Z), $F_{\Delta H}^N$) At Power Levels >85% Of Rated Thermal Power
3.10-2	Accident Analyses Requiring Reevaluation in the Event of an Inoperable Full Length Rod
3.14-1	Fire Detection Instruments
3.14-2	Fire Hose Stations
3.14-3	Yard Fire Hydrant and Associated Hydrant Hose Houses
4.1-1	Minimum Frequencies for Checks, Calibrations and Tests of Instrument Channels
4.1-2	Frequencies for Sampling Tests
4.1-3	Frequencies for Equipment Tests
4.4-1	Containment Isolation Valves
4.9-1	Steam Generator Tube Inspection
4.10-1	Seismic Monitoring Instrumentation
4.10-2	Seismic Monitoring Instrumentation Surveillance Requirements
6.2-1	Minimum Shift Crew Composition

Amendment No. 116,

LIST OF FIGURES

Title	Figure No.
Core Limits - Four Loop Operation	2.1-1
Maximum Permissible T_{cold} for First RCP Start (OPS Operable, Hottest SG Temp. > T_{cold})	3.1.A-1
Maximum Permissible RCS Pressure for RCP Start(s) with OPS Inoperable (SG Temp. > T_{cold} for additional pump starts, SG Temp. < T_{cold} for all pump starts)	3.1.A-2
RCS Pressure Limits for Low Temperature Operation	3.1.A-3
Maximum Pressurizer Level for OPS Inoperable and First RCP Start (SG Temp. > T_{cold})	3.1.A-4
Maximum Pressurizer Level with OPS Inoperable and One (1) Charging Pump Energized	3.1.A-5
Maximum Pressurizer Level with OPS Inoperable and One (1) Safety Injection Pump and/or Three (3) Charging Pumps Energized	3.1.A-6
Reactor Coolant System Heatup Limitations	3.1-1
Reactor Coolant System Cooldown Limitations	3.1-2
Primary Coolant Specific Activity Limit vs. Percent of Rated Thermal Power	3.1-3
Gross Electrical Output - 1" HG Backpressure	3.4-1
Gross Electrical Output - 1.5" HG Backpressure	3.4-2
Minimum Burnup for Storage of Fuel in Maximum Density Spent Fuel Pit Racks	3.8-2
Maximum Density Spent Fuel Pit Racks - Regions and Indexing	3.8-3
Permissible Rod Misalignment vs. Step Counter Demand Position, >85% Of Rated Thermal Power	3.10-1
Pressure/Temperature Limitations for Hydrostatic Leak Test	4.3-1

3.10.5 Rod Misalignment Limitations

3.10.5.1 At least once per shift(allowing one hour for thermal soak after rod motion) the position of each control or shutdown rod shall be determined:

a. For operation less than or equal to 85% of rated thermal power, the indicated misalignment between the group step counter demand position and the analog rod position indicator shall be less than or equal to 24 steps. A control or shutdown rod indicating a misalignment greater than 24 steps shall be realigned within one hour or the core peaking factors shall be determined within two hours and the requirements of Specification 3.10.2 applied.

b. For operation greater than 85% of rated thermal power, the indicated misalignment between the group step counter demand position and the analog rod position indicator shall be within the requirements of Figure 3.10-1. A control or shutdown rod indicating a misalignment greater than that allowed by Figure 3.10-1 shall be realigned within one hour or the core peaking factors shall be determined within two hours and the requirements of Specification 3.10.2 applied.

c. For operation greater than 85% of rated thermal power, the indicated misalignment between the group step counter demand position and the analog rod position indicator may be increased by up to 6 additional steps (indicated on Table 3.10-1) as a function of peaking factor margin on $F_Q(Z)$ and $F_{\Delta H}^N$.

3.10.5.2 If the requirements of Specification 3.10.3 are determined not to apply and the core peaking factors have not been determined within two hours and the rod remains misaligned, the high reactor flux setpoint shall be reduced to 85% of its rated value.

3.10.5.3 If the misaligned control rod is not realigned within 8 hours, the rod shall be declared inoperable.

3.10.6 Inoperable Rod Position Indicator Channels

3.10.6.1 If a rod position indicator channel is out of service, then:

a. For operation between 50 percent and 100 percent of rating, the position of the control rod shall be checked indirectly by core instrumentation (excore detectors and/or movable incore detectors) every shift, or subsequent to rod motion exceeding 24 steps, whichever occurs first.

b. During operation below 50 percent of rating, no special monitoring is required.

3.10.6.2 Not more than one rod position indicator channel per group nor two rod position indicator channels per bank shall be permitted to be inoperable at any time.

3.10.6.3 If a control rod having a rod position indicator channel out of service is found to be misaligned from 3.10.6.1a above, then Specification 3.10.5 will be applied.

3.10.7 Inoperable Rod Limitations

3.10.7.1 An inoperable rod is a rod which does not trip or which is declared inoperable under Specification 3.10.5 or fails to meet the requirements of 3.10.8.

3.10.7.2 Not more than one inoperable control rod shall be allowed any time the reactor is critical except during physics tests requiring intentional rod misalignment. Otherwise, the plant shall be brought to the hot shutdown condition.

3.10.7.3 If any rod has been declared inoperable, then the potential ejected rod worth, associated transient power distribution peaking factors and the accidents listed in Table 3.10-2 shall be analyzed within 5 days, or the reactor brought to the hot shutdown condition using normal operating procedures. The analysis shall include due allowance for non-uniform fuel depletion in the neighborhood of the inoperable rod. If the analysis results in a more limiting hypothetical transient than the cases reported in the safety analysis, the plant power level shall be reduced to an analytically determined part power level which is consistent with the safety analysis.

3.10.8 Rod Drop Time

At operating temperature and full flow, the drop time to each control rod shall be no greater than 1.8 seconds from loss of stationary gripper coil voltage to dashpot entry.

(e.g. rod misalignment) affect $F_{\Delta H}^N$, in most cases without necessarily affecting F_Q, (b) the operator has a direct influence on F_Q through movement of rods, and can limit it to the desired value, he has no direct control over $F_{\Delta H}^N$ and (c) an error in the predictions for radial power shape, which may be detected during startup physics tests, can be compensated for in F_Q by tighter axial control, but compensation for $F_{\Delta H}^N$ is less readily available. When a measurement of $F_{\Delta H}^N$ is taken, no additional allowances are necessary prior to comparison with the limit of section 3.10.2. A measurement uncertainty of 4% has been allowed for in determination of the design DNBR value.

Measurements of the hot channel factors are required as part of startup physics tests, at least each effective full power month of operation, and whenever abnormal power distribution conditions require a reduction of core power to a level based on measured hot channel factors. The incore map taken following initial loading provides confirmation of the basic nuclear design basis including proper fuel loading patterns. The periodic monthly incore mapping provides additional assurance that the nuclear design bases remain inviolate and identify operational anomalies which would, otherwise, affect these bases.

For normal operation, it is not necessary to measure these quantities. Instead it has been determined that, provided certain conditions are observed, the hot channel factor limits will be met; these conditions are as follows:

1. Control rods in a single bank move together with no individual rod insertion differing by more than 15 inches from the group step counter demand position (operating at greater than 85% of rated thermal power with no accounting for peaking factor margin), 18.75 inches (operating at greater than 85% of rated thermal power with accounting for peaking factor margin) or 22.5 inches (operating at less than or equal to 85% of rated thermal power). An indicated misalignment limit of 12 steps precludes a rod misalignment no greater than 15 inches with consideration of instrumentation error, 18 steps indicated misalignment corresponds to 18.75 inches with instrumentation error and 24 steps indicated misalignment corresponds to 22.5 inches with instrumentation error.

2. Control Rod banks are sequenced with overlapping banks as described in Technical Specification 3.10.4.

3. The control rod bank insertion limits are not violated.

If tilt ratio greater than 1.09 occurs which is not due to a misaligned rod, the reactor shall be brought to a hot shutdown condition for investigation. However, if the tilt condition can be identified as due to rod misalignment, operation can continue at a reduced power (3% for each one percent the tilt ratio exceeds 1.0) for two hours to correct the rod misalignment.

A sufficient shutdown margin insures that: 1) the reactor can be made subcritical from all operating conditions, 2) the reactivity transients associated with postulated accident conditions are controllable within acceptable limits, and 3) the reactor will be maintained sufficiently subcritical to preclude inadvertent criticality in the shutdown condition.

Shutdown margin requirements vary throughout core life as a function of fuel depletion, RCS boron concentration, and RCS T_{avg}. The most restrictive condition occurs at end of life (EOL), with T_{avg} at no load operating temperature, and is associated with a postulated steam line break accident resulting in uncontrolled RCS cooldown. In the analysis of this accident, a minimum shutdown margin of 1.3 % $\Delta k/k$ is required to control the reactivity transient. Accordingly, the shutdown margin requirement is based upon this limiting condition and is consistent with FSAR safety analysis assumptions.

The action to be taken when shutdown margin is out of limit is to borate using the best available source. In the determination of the required combination of boration flow rate and boron concentration, there is no unique Design Basis Event which must be satisfied. It is imperative to raise the boron concentration of the Reactor Coolant System as soon as possible. Therefore, the operator should begin boration with the best possible source available for the plant condition.

Rod insertion limits are used to assure adequate trip reactivity, to assure meeting power distribution limits, and to limit the consequence of a hypothetical rod ejection accident. The available control rod reactivity, or excess beyond needs, decreases with decreasing boron concentration because the negative reactivity required to reduce the core power level from full power to zero is largest when the boron concentration is low.

The intent of the test to measure control rod worth and shutdown margin (Specification 3.10.4) is to measure the worth of all rods less the worth of the worst case for an assumed stuck rod, that is, the most reactive rod. The measurement would be anticipated as part of the initial startup program and infrequently over the life of the plant, to be associated primarily with determinations of special interest such as end of life cooldown, or startup of fuel cycles which deviate from normal equilibrium conditions in terms of fuel loading patterns and anticipated control bank worth. These measurements will augment the normal fuel cycle design calculations and place the knowledge of shutdown capability on a firm experimental as well as analytical basis.

The specifications of Section 3.10.5 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 analog rod position indicators within one hour after control rod motion) fall into four separate categories, which are:

a) ±18 steps of the group step counter demand position (if sufficient peaking factor margin exists and the power level is greater than 85% of rated thermal power);

b) to within +17, -12 steps ramping to ±17 steps of the group step counter demand position (depending on the group step counter demand position greater than

212 steps withdrawn and the power level is greater than 85% of rated thermal power);

c) to within ±12 steps of the group step counter demand position (if sufficient peaking factor margin does not exist, group step counter demand position is less than or equal to 212 steps withdrawn and the power level is greater than 85% of rated thermal power);

d) ±24 steps of the group step counter demand position (if the power level is less than or equal to 85% of rated thermal power).

Items a) through d) are reconciled into a single analog rod position indicator deviation specification by defining a basic deviation limit versus group step counter demand position (Figure 3.10-1) and augmenting that limit for allowable peaking factor margin (Table 3.10-1). The allowable deviation varies as a function of bank demand position allowing for the top of active fuel at a control rod position of approximately 225 steps. Also above 85% of rated thermal power, if sufficient peaking factor margin is demonstrated by satisfying the requirements of Table 3.10-1, the acceptable deviation is increased by up to an additional 6 steps depending upon peaking factor margin,(e.g.for an allowable increase of 6 additional steps from indicated misalignment, the peak measured $F_Q(Z)$ from the latest incore flux map must be at least 3.0% less than the limit AND the peak measured $F_{\Delta H}^N$ 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% of rated thermal 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 (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-14668. These limits are applicable to all control rods (of all banks) over the range of 0 to 230 steps withdrawn inclusive.

For group step counter demand positions greater than 212 steps withdrawn, it is acceptable for the analog rod position indicator to indicate misalignment greater than +12 steps (as indicated on Figure 3.10-1) without accounting for peaking factor margin. This is due to the top of active fuel stack being at approximately 225 steps withdrawn. Indicated misalignment in the more withdrawn direction should result in the actual rod position being no lower than 201 steps withdrawn (which is within the analyzed limits). Actual control rod positions above the top of active fuel will not result in increased peaking factors for increased misalignments. Similarly, allowable negative deviation limits may increase by 1 step for every step of group step counter demand position over the top of active fuel.

The comparison of group step counter demand position and analog rod position indicator may take place at any time up to one hour after rod motion. 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. A similar time period (up to one hour after rod motion) is allowed for comparison of the bank insertion limits and the analog rod position indicators. This comparison is sufficient to verify that the control rods are above the insertion limits and thus assures the presence of sufficient shutdown margin to satisfy the assumptions of the safety analyses. Rod position can also be confirmed via a digital voltage meter applied to the rod position control racks, in which case the operators will continue to monitor the rod position indicators on the main control board (and on the plant computer, if available and in agreement with the digital voltage meter reading) to check for deviation.

The action statements which permit limited variation from the basic requirements are accompanied by additional restrictions which ensure that the original criteria are met. Misalignment of a rod requires measurement of peaking factors (to confirm acceptability) or a restriction in thermal power; either of these restrictions provides assurance of fuel rod integrity during continued operation.

The reactivity worth of a misaligned rod is limited for the remainder of the fuel cycle to prevent exceeding the assumption used in the accident analysis.

One inoperable control rod is acceptable provided that the power distribution limits are met, trip shutdown capability is available, and provided the potential hypothetical ejection of the inoperable rod is not worse than the cases analyzed in the safety analysis report. The rod ejection accident for an isolated fully inserted rod will be worse if the residence time of the rod is long enough to cause significant non-uniform fuel depletion. The 5 day period is short compared with the time interval required to achieve a significant, non-uniform fuel depletion.

The assumed control rod drop time in the safety analysis is 2.40 seconds, consisting of 1.80 seconds for normal rod drop time plus a plant specific allowance of 0.60 seconds for a seismic event. The required control rod drop time in Section 3.10.8 is therefore consistent with that assumed in the safety analysis.

REFERENCE

1. WCAP-8576, "Augmented Startup and Cycle 1 Physics Program," August 1975

2. FSAR Appendix 14C

3. Letter from J.P. Bayne to S.A. Varga dated April 23, 1985, entitled "Proposed Technical Specifications Regarding the Cycle 4/5 Refueling."

4. WCAP-14668, "Conditional Extension of the Rod Misalignment Technical Specification for Indian Point Unit 3," October 1996.

TABLE 3.10-1

ACCEPTABLE INDICATED CONTROL ROD MISALIGNMENT
AS A FUNCTION OF MEASURED PEAKING FACTOR MARGIN ($F_Q(Z)$, $F_{\Delta H}^N$)
AT POWER LEVELS)85% OF RATED THERMAL POWER

(Margins To Be Determined From Most Recent Full-Power Flux Maps)
Note: The tabulated margins shown below represent the minimum margins that must Both be satisfied in order to increase the allowable misalignment by the corresponding number of steps shown in the first column.

Increase In Allowable Indicated Position Misalignment*	Required Margin to $F_Q(Z)$ Limit	Required Margin to $F_{\Delta H}^N$ Limit
0	0%	0%
1	0.5%	0.33%
2	1.0%	0.67%
3	1.5%	1.0%
4	2.0%	1.33%
5	2.5%	1.67%
6	3.0%	2.0%

Increase in allowable indicated position misalignment is above and beyond the allowable deviations of Figure 3.10-1 in both positive and negative directions.

*Between the group step counter demand position and the analog rod position indicator.

Amendment No.

TABLE 3.10-2

ACCIDENT ANALYSES REQUIRING REEVALUATION
IN THE EVENT OF AN INOPERABLE FULL
LENGTH ROD

Rod Cluster Control Assembly Insertion Characteristics

Rod Cluster Control Assembly Misalignment

Loss of Reactor Coolant From Small Ruptured Pipes Or From Cracks In Large Pipes Which Actuates The Emergency Core Cooling System

Single Rod Cluster Control Assembly Withdrawal At Full Power

Major Reactor Coolant System Pipe Ruptures (Loss of Coolant Accident)

Major Secondary System Pipe Rupture

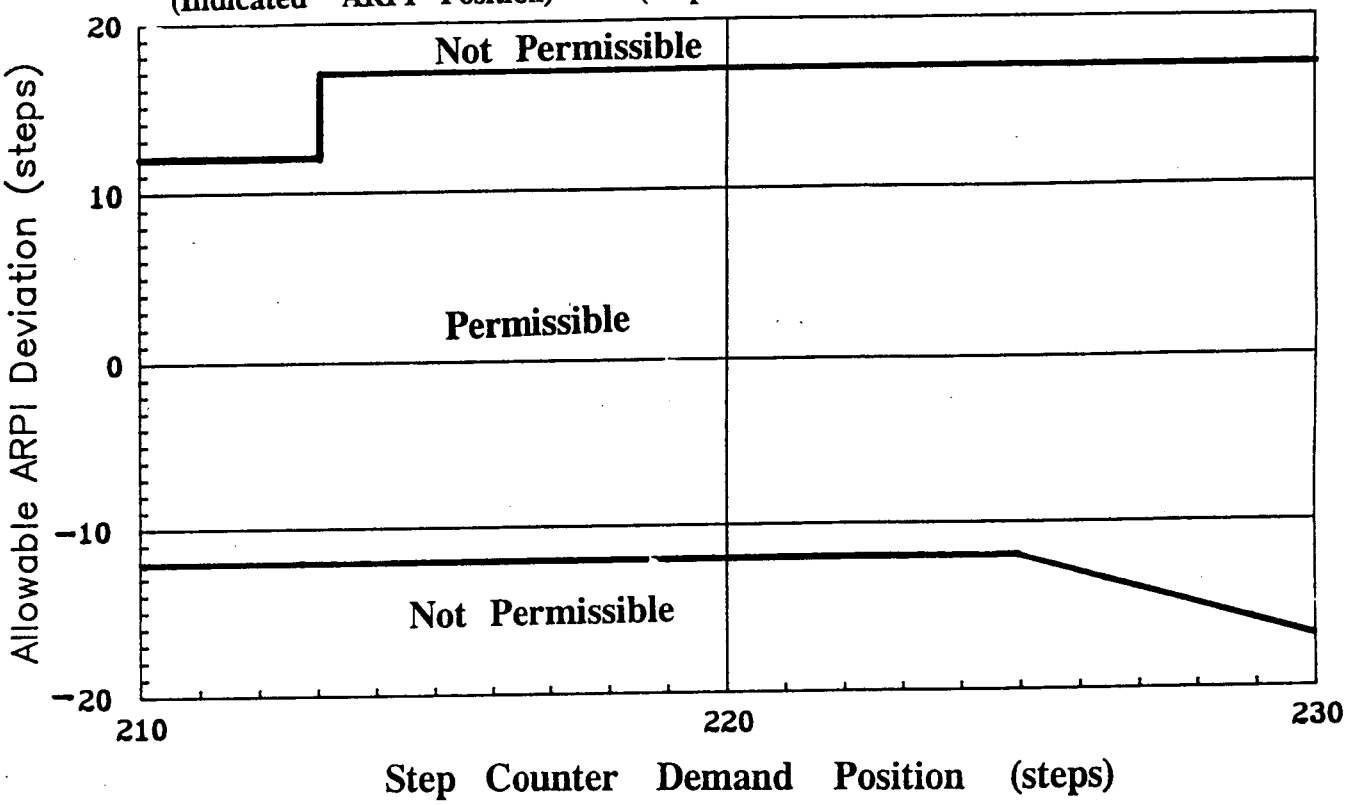
Rupture of a Control Rod Drive Mechanism Housing (Rod Cluster Control Assembly Ejection)

Amendment No. 29, 34, 103,

Figure 3.10-1

Permissible Rod Misalignment vs. Step Counter Demand Position, >85% of Rated Thermal Power

Note: In this Figure, ARPI Deviation is defined as:
(Indicated ARPI Position) - (Step Counter Demand Position)



Step Counter Demand Position	Maximum Deviation (ARPIs reading ABOVE Step Counter Demand Pos)	Maximum Deviation (ARPIs Reading BELOW Step Counter Demand Pos)
≤212	+12	-12
213	+17	-12
214	+17	-12
215	+17	-12
216	+17	-12
217	+17	-12
218 - 225	+17	-12
226	+17	-13
227	+17	-14
228	+17	-15
229	+17	-16
230	+17	-17

ATTACHMENT II TO IPN-97-010

SAFETY EVALUATION FOR

PROPOSED TECHNICAL SPECIFICATION CHANGES

REGARDING CONTROL ROD MISALIGNMENT

AND ROD POSITION INDICATION

NEW YORK POWER AUTHORITY
INDIAN POINT 3 NUCLEAR POWER PLANT
DOCKET NO. 50-286
DPR-64

SAFETY EVALUATION OF TECHNICAL SPECIFICATION CHANGES REGARDING CONTROL ROD MISALIGNMENT AND ROD POSITION INDICATION

This application for amendment to the Indian Point 3 Technical Specifications proposes to amend Sections 3.10.5 and 3.10.7, and the Bases of Appendix A of the Operating License. The proposed amendment would permit increasing the indicated control rod misalignment from the current limit of ±12 steps to an indicated misalignment of ±24 steps when the core power is less than or equal to 85% of rated thermal power (RTP) and ±12 steps above 85% of RTP with the following considerations: when the group step counter (GSC) demand position exceeds the top of active fuel (TAF) at about 225 steps, the acceptable deviation on the negative side (i.e. when analog rod position indicator is below GSC demand position) may increase by 1 step for every additional step of GSC demand position; when the GSC demand position is below the TAF by no more than 12 steps, the acceptable deviation on the positive side may extend to the all-rods-out (ARO) position; the acceptable deviation may be further increased by up to 6 steps as a function of measured peaking factor margin. The proposed change is based on an evaluation performed by Westinghouse in WCAP-14668 (Attachment III).

SECTION I- Description Of Change

The proposed changes are:

Revise "Table Of Contents" page iii to change page 3.10-6 to 3.10-7 for Section 3.10.6. Revise "List Of Tables" page vii to add Table No. 3.10-1 and change current Table No. 3.10-1 to 3.10-2. Revise "List Of Figures" page viii to add Figure No. 3.10-1.

Correct typographical errors.

Revise Section 3.10.5.1 to read as follows:

3.10.5.1 3.10.5.1 At least once per shift (allowing one hour for thermal soak after rod motion) the position of each control or shutdown rod shall be determined:

a. For operation less than or equal to 85% of rated thermal power, the indicated misalignment between the group step counter demand position and the analog rod position indicator shall be less than or equal to 24 steps. A control or shutdown rod indicating a misalignment greater than 24 steps shall be realigned within one hour or the core peaking factors shall be determined within two hours and the requirements of Specification 3.10.2 applied.

b. For operation greater than 85% of rated thermal power, the indicated misalignment between the group step counter demand position and the analog rod position indicator shall be within the requirements of

Figure 3.10-1. A control or shutdown rod indicating a misalignment greater than that allowed by Figure 3.10-1 shall be realigned within one hour or the core peaking factors shall be determined within two hours and the requirements of Specification 3.10.2 applied.

c. For operation greater than 85% of rated thermal power, the indicated misalignment between the group step counter demand position and the analog rod position indicator may be increased by up to 6 additional steps (indicated on Table 3.10-1) as a function of peaking factor margin on $F_Q(Z)$ and $F_{\Delta H}^N$.

3.10.7.3 In Specification 3.10.7.3 change Table 3.10-1 to Table 3.10-2.

In the Bases Section, revise the following items to read:

Page 3.10-10 1. Control rods in a single bank move together with no individual rod insertion differing by more than 15 inches from the group step counter demand position (operating at greater than 85% of rated thermal power with no accounting for peaking factor margin), 18.75 inches (operating at greater than 85% of rated thermal power with accounting for peaking factor margin) or 22.5 inches (operating at less than or equal to 85% of rated thermal power). An indicated misalignment limit of 12 steps precludes a rod misalignment no greater than 15 inches with consideration of instrumentation error, 18 steps indicated misalignment corresponds to 18.75 inches with instrumentation error and 24 steps indicated misalignment corresponds to 22.5 inches with instrumentation error.

Page 3.10-15 The specifications of Section 3.10.5 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 analog rod position indicators within one hour after control rod motion) fall into four separate categories, which are:
a) ±18 steps of the group step counter demand position (if sufficient peaking factor margin exists and the power level is greater than 85% of rated thermal power);
b) to within +17, -12 steps ramping to ±17 steps of the group step counter demand position (depending on the group step counter demand position greater than 212 steps withdrawn and the power level is greater than 85% of rated thermal power);
c) to within ±12 steps of the group step counter demand position (if

sufficient peaking factor margin does not exist, group step counter demand position is less than or equal to 212 steps withdrawn and the power level is greater than 85% of rated thermal power);
d) ±24 steps of the group step counter demand position (if the power level is less than or equal to 85% of rated thermal power).

Items a) through d) are reconciled into a single analog rod position indicator deviation specification by defining a basic deviation limit versus group step counter demand position (Figure 3.10-1) and augmenting that limit for allowable peaking factor margin (Table 3.10-1). The allowable deviation varies as a function of bank demand position allowing for the top of active fuel at a control rod position of approximately 225 steps. Also above 85% of rated thermal power, if sufficient peaking factor margin is demonstrated by satisfying the requirements of Table 3.10-1, the acceptable deviation is increased by up to an additional 6 steps depending upon peaking factor margin,(e.g.for an allowable increase of 6 additional steps from indicated misalignment, the peak measured $F_Q(Z)$ from the latest incore flux map must be at least 3.0% less than the limit AND the peak measured $F_{\Delta H}^N$ 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% of rated thermal 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 (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-14668. These limits are applicable to all control rods (of all banks) over the range of 0 to 230 steps withdrawn inclusive.

For group step counter demand positions greater than 212 steps withdrawn, it is acceptable for the analog rod position indicator to indicate misalignment greater than +12 steps (as indicated on Figure 3.10-1) without accounting for peaking factor margin. This is due to the top of active fuel stack being at approximately 225 steps withdrawn. Indicated misalignment in the more withdrawn direction should result in the actual rod position being no lower than 201 steps withdrawn (which is within the analyzed limits). Actual control rod positions above the top of active fuel will not result in increased peaking factors for increased misalignments. Similarly, allowable negative deviation limits may increase by 1 step for every step of group step counter demand position

over the top of active fuel.

The comparison of group step counter demand position and analog rod position indicator may take place at any time up to one hour after rod motion. 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. A similar time period (up to one hour after rod motion) is allowed for comparison of the bank insertion limits and the analog rod position indicators. This comparison is sufficient to verify that the control rods are above the insertion limits and thus assures the presence of sufficient shutdown margin to satisfy the assumptions of the safety analyses. Rod position can also be confirmed via a digital voltage meter applied to the rod position control racks, in which case the operators will continue to monitor the rod position indicators on the main control board (and on the plant computer, if available and in agreement with the digital voltage meter reading) to check for deviation.

The action statements which permit limited variation from the basic requirements are accompanied by additional restrictions which ensure that the original criteria are met. Misalignment of a rod requires measurement of peaking factors (to confirm acceptability) or a restriction in thermal power; either of these restrictions provides assurance of fuel rod integrity during continued operation. The reactivity worth of a misaligned rod is limited for the remainder of the fuel cycle to prevent exceeding the assumption used in the accident analysis.

Page 3.10-17 — Add new page number 3.10-17 and add Reference 4, WCAP-14668, "Conditional Extension of the Rod Misalignment Technical Specification for Indian Point Unit 3," October 1996.

Add Page 3.10-18, Table 3.10-1, Acceptable Indicated Control Rod Misalignment as a Function of Measured Peaking Factor Margin ($F_Q(z)$, $F_{\Delta H}^N$) at Power Levels 〉85% of Rated Thermal Power.

Add Page 3.10-19, and change Table 3.10-1 to Table 3.10-2.

Add Figure 3.10-1, Permissible Rod Misalignment vs. Step Counter Demand Position, ≥85% Of Rated Thermal Power

SECTION II- Evaluation of Changes

Westinghouse performed an evaluation of the effects of increasing the allowed control rod indicated misalignment from ±12 steps to an indicated misalignment of ±24 steps when the core power is less than or equal to 85% of RTP and ±12 steps above 85% of RTP with the following considerations: when the group step counter demand position exceeds the top of

active fuel (TAF), the acceptable deviation on the negative side may increase by 1 step for every additional step of group step counter demand position; when the group step counter demand position is below the TAF by no more than 12 steps, the acceptable deviation on the positive side may extend to the all-rods-out (ARO) position; the acceptable deviation may be further increased by up to 6 steps as a function of measured peaking factor margin. The results of this evaluation are reported in Westinghouse document WCAP-14668 and are summarized here. The number and type of rod misalignments were limited by the performance of an evaluation of the Failure Mode and Effects Analysis performed for the rod control system (Reference 1 of WCAP-14668). The evaluation was limited to single failures within the rod control system logic cabinets, power cabinets and the control rod drive mechanisms themselves. Multiple failures were not considered as reasonable precursors of 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-14668. 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-14668.

The evaluation concluded that below 85% of RTP, indicated rod misalignments of up to ± 24 steps between the group step counter demand position and analog rod position indicator (ARPI) may be allowed based on the magnitude of peaking factor margin that is introduced by the reduction in the power level.

The margin increases are provided by the equations of Specification 3.10.2.1, noted below for clarity:

$$F_Q(Z) \leq \frac{[F_Q^{RTP}][K(Z)]}{P} \quad \text{for } P > 0.5$$

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

$$F_{\Delta H}^N \leq [F_{\Delta H}^{RTP}]\,[1.0+(PF_{\Delta H})(1-P)]$$

The margin requirements are 3.5% in $F_{\Delta H}$ and 6.3% in $F_Q(Z)$ for a maximum control rod misalignment of 24 steps indicated. The increases in the limits for F_Q and $F_{\Delta H}$ exceed these values prior to operation at or below 85% of RTP (for P = 85%, the quantity [1.0 + 0.3(1-P)] equals 1.045 or an increase of 4.5% in $F_{\Delta H}$ and 1/P equals 1.176 or an increase of 17.6% in F_Q). Therefore, the increase in allowed indicated misalignment is considered reasonable and acceptable.

For operation at power levels above 85% of RTP, the evaluation concludes that the degree of indicated misalignment is a function of the peaking factor margin present. The margin is determined by simply comparing the measured F_Q (Z)and $F_{\Delta H}^N$ from the latest incore flux map with their corresponding limits. The degree of margin required for an indicated misalignment greater than that allowed by Figure 3.10-1 is defined in Table 3.10-1.

TS 3.10.5.1 has been modified to allow up to one hour after control rod motion to verify control rod position. This time period is based on the time deemed necessary to allow the control rod drive shaft to reach thermal equilibrium. Due to changes in the magnetic permeability of the drive shaft as a function of temperature, the indicated position is expected to change with time as the drive shaft cools on withdrawal. The one hour time period is consistent with NRC approved time extensions at other plants, specifically Salem Units 1 and 2 and Turkey Point Units 3 and 4, and allows for the position indication to stabilize prior to taking any action.

For group step counter demand positions greater than 212 steps withdrawn, it is acceptable for the ARPI to indicate misalignment greater than +12 steps (as indicated on Figure 3.10-1) without accounting for peaking factor margin. This is due to the TAF stack being at approximately 225 steps withdrawn. Actual control rod positions above the TAF will not result in increased peaking factors for increased misalignments. Similarly, allowable negative deviation limits may increase by 1 step for every step of group step counter demand position over the TAF.

WCAP-14668 Section 3 identifies the effects of indicated rod misalignments greater than ±12 steps on the normal operation peaking factors. Section 4 of WCAP-14668 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 worth 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 magnitude.

Safety analyses parameters that are expected to be affected by the increased rod misalignment are the rod insertion allowance (RIA), the ejected rod F_Q (Z) and the ejected rod worth ($\Delta\rho_{EJ}$). As noted in Section 4 of WCAP-14668, the maximum effect on the RIA will occur upon misalignment of all rods at the RIL in the inserted direction. Evaluation of this misalignment was performed at full power, zero power and part-power conditions for both of the cycles evaluated for Indian Point Unit 3. The evaluation concluded that the RIA increased as a result of the misalignment and that the calculated RIA for the reload safety evaluation should be increased to 160 pcm to conservatively bound this effect. To determine the ejected rod effects, preconditioning with the maximum allowed misalignment was assumed for single

rod, a group of rods and entire banks. The subsequent effects on $F_Q(Z)$ and $\Delta\rho_{EJ}$ for the two cycles were determined. It was noted that increases of 1.5% $F_Q(Z)$ and 3.0% $\Delta\rho_{EJ}$ must be included in the safety analyses to bound the projected effects when a cycle specific analysis is not performed.

The number and type of rod misalignments were limited by the performance of an evaluation of the Failure Mode and Effects Analysis performed for the rod control system (Reference 1 of WCAP-14668). The evaluation was limited to single failures within the control system logic cabinets, power cabinets and the control rod drive mechanisms themselves. Multiple failures were not considered as reasonable precursors for rod misalignment since there is frequent surveillance of rod position to limit such occurrences. These categories are described in Section 2.0 of WCAP-14668.

Section III - No Significant Hazards Evaluation

Consistent with the criteria of 10 CFR 50.92, the enclosed application is judged to involve no significant hazards based on the following information:

(1) Does the proposed license amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response:

No. Based on the Westinghouse evaluation in WCAP-14668, the Authority has determined that all pertinent licensing basis acceptance criteria have been met, and the margin of safety as defined in the TS Bases is not reduced in any of the IP3 licensing basis accident analysis. Increasing the magnitude of allowed control rod indicated misalignment is not a contributor to the mechanistic cause of an accident evaluated in the FSAR. Neither the rod control system nor the rod position indicator function is being altered. 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. Therefore, the consequences of an accident previously evaluated will not be significantly increased.

(2) Does the proposed license amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response:

No. Based on the Westinghouse evaluation in WCAP-14668, the Authority has determined that all pertinent licensing basis acceptance criteria have been met, and the margin of safety as defined in the TS is not reduced in any of the IP3 licensing basis accident analysis. Increasing the magnitude of allowed control rod indicated

misalignment is not a contributor to the mechanistic cause of any accident. Neither the rod control system nor the rod position indicator function is being altered. Therefore, an accident which is new or different than any previously evaluated will not be created.

3) Does the proposed amendment involve a significant reduction in a margin of safety?

Response:

No. Based on the Westinghouse evaluation in WCAP-14668, the Authority has determined that all pertinent licensing basis acceptance criteria have been met, and the margin of safety as defined in the TS Bases is not reduced in any of the IP3 licensing basis accident analysis based on the changes to safety analyses input parameter values as discussed in WCAP-14668. Since the evaluations in Section 3.0 of WCAP-14668 demonstrate that all applicable acceptance criteria continue to be met, the proposed change will not involve a significant reduction in margin of safety.

Section IV - Impact of Changes

These changes will not adversely affect the following:
ALARA Program
Security and Fire Protection Programs
Emergency Plan
FSAR or SER Conclusions
Overall Plant Operations and the Environment

Section V - Conclusions

The incorporation of this change: a) will not significantly increase the probability nor the consequences of an accident or malfunction of equipment important to safety as previously evaluated in the Safety Analysis Report; b) will not create the possibility of a new or different kind of accident than any evaluated previously in the Safety Analysis Report; c) will not significantly reduce the margin of safety as defined in the bases for any technical specification; and d) involves no significant hazards considerations as defined in 10 CFR 50.92.

Section VI - References

a) IP3 FSAR
b) IP3 SER
c) WCAP-14668, "Conditional Extension of the Rod Misalignment Technical Specification for Indian Point Unit 3," October 1996 (Proprietary).